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The eleventh year report on a cooperative research project between the Pennsylvania Department of Transportation, Bureau of Maintenance and Operations; and the Pennsylvania State University, College of Agricultural Sciences; including:
Brush control research evaluating basal bark, dormant stem, and low volume foliar herbicide applications.
Herbaceous weed control research evaluating the effect of herbicides on the control of Canada thistle in various groundcovers.
Evaluation of plant growth regulator treatments for the possibility of reducing the number of mowings required along the roadsides.
Low maintenance grass establishment including comparing various mulch products and evaluating the conversion of a mechanically brushed area into a desirable groundcover.
Evaluating application methods and chemicals for use in various aspects of roadside vegetation management.
Comparing various herbicides for total vegetation control under guiderails and agricultural sites.
Wildflower research evaluating the establishment of annual flowers into turfgrass suppressed with herbicides and also the evaluation of herbicides for weed control within wildflower plantings.

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Thomas L. Watschke	Professor of Turfgrass Science

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INTRODUCTION

In October, 1985, personnel at The Pennsylvania State University began a cooperative research project with the Pennsylvania Department of Transportation to investigate several aspects of roadside vegetation management. An annual report has been submitted each year which describes the research activities and presents the data. The previous reports can be obtained from The National Technical Information Service, Springfield, VA, and are listed below:

Report # PA86-018 + 85-08 - Roadside Vegetation Management Research Report

Report # PA87-021 + 85-08 - Roadside Vegetation Management Research Report
- Second Year Report

Report # PA89-005 + 85-08 - Roadside Vegetation Management Research Report
- Third Year Report

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Use of Statistics in This Report

Many of the individual reports in this document make use of statistics, particularly techniques involved in the analysis of variance. The use of these techniques allows for the establishment of a criteria for significance, or, when the differences between numbers are most likely due to the different treatments, rather than due to chance. We have relied almost exclusively on the commonly used probability level of 0.05, however a level of 0.10 is utilized in some circumstances. When a treatment effect is significant at the 0.05 level, this indicates that there is only a five percent chance that the differences are due to chance alone; or we are 95 percent sure that the differences are due to the treatments. At the bottom of the results tables where analysis of variance has been employed, there is a value for significance level and least significant difference (LSD). The significance level is the probability that the variation between the different treatments is due to chance. Therefore, the lower the significance level, or p-value, the less likely the differences are due to chance. When the p-value is equal or less than 0.05 (or 0.10), Fisher's LSD means separation test is used. When the difference between two treatment means is equal or greater than the LSD value, these two values are significantly different.

When the p-value is greater than 0.05 (or 0.10), the LSD procedure is not used. What is being demanded with this criteria is that the variation due to the treatments be significant before we determine significant differences between individual treatments. Using the p-value as a criteria for the LSD test is called a 'Protected LSD test'. This provides a more conservative estimate of the LSD, as there are often significant differences within a large set of treatments, regardless of the p-value.

This report includes information from studies relating to roadside brush control, herbaceous weed control, plant growth regulator studies, roadside vegetation management demonstrations, total vegetation control under guiderails, and wildflower evaluation.

Herbicides are referred to as product names for ease of reading. The herbicides used in each research area are listed on the following page by product name, active ingredients, formulation, and manufacturer.

Product name, active ingredients, formulation, and manufacturer information for products referred to in this report. Numbers in parentheses after formulations indicate amount of active ingredients in combination products in same order listed in 'Active Ingredients' column.

Trade Name	Active Ingredients	Formulation	Manufacturer
Access	picloram, triclopyr	3 OS (1+2)	DowElanco
Accord	glyphosate	4 S	Monsanto
Arborchem Basal Oil	diluent	- - -	Arborchem Products, Inc.
Arsenal	imazapyr	2 S	American Cyanamid Co.
Clean Cut	adjuvant	- - -	Arborchem Products, Inc.
Dyne-Amic	adjuvant	- - -	Setre Chemical Company
EH 1094	experimental	- - -	PBI / Gordon Corp.
Embark LITE	mefluidide	0.2 S	PBI / Gordon Corp.
Endurance	prodiamine	65 WG	Sandoz Agro, Inc.
Escort	metsulfuron methyl	60 DF	E.I. DuPont de Nemours & Co.
Ethrel	ethephon	2 LB	Rhone-Poulenc
FeRROMEC	liquid iron supplement	- - -	PBI / Gordon Corp.
Finale	glufosinate-ammonium	1 S	AgrEvo USA Company
Formula 358	drift retardent	- - -	Exacto Chemical Company
Garlon 3A	triclopyr	3 S	DowElanco
Garlon 4	triclopyr	4 EC	DowElanco
HyGrade Basal Oil	diluent	- - -	CWC Chemical Company
JLB Oil Plus	diluent	- - -	Brewer International
Karmex	diuron	80 DF	E.I. DuPont de Nemours & Co.
Krenite S	fosamine ammonium	4 S	E.I. DuPont de Nemours & Co.
MON 59120	experimental	- - -	Monsanto
NAF-6	triclopyr, picloram	RTU	DowElanco
Oust	sulfometuron methyl	75 DF	E.I. DuPont de Nemours & Co.
Pathfinder II	triclopyr	RTU	DowElanco
Penevator 9	adjuvant	- - -	Exacto Chemical Company
Penevator Basal Oil	diluent	- - -	Exacto Chemical Company
Penevator Veg. Oil	diluent	- - -	Exacto Chemical Company
Plateau	imazameth	2 S	American Cyanamid Co.
Polytex A1001	drift retardent	- - -	Exacto Chemical Company
Predict	norflurazon	80 DF	Sandoz Agro, Inc.
Primo	trinexapac-ethyl	1 EC	Ciba-Geigy Corporation
QwikWet 357	adjuvant	- - -	Exacto Chemical Company
R-6447	experimental	80 DF	E.I. DuPont de Nemours & Co.
Roundup (Pro)	glyphosate	4 S	Monsanto
Scythe	pelargonic acid	57% L	Mycogen Corp.
SAN 1269H	experimental	70 WG	Sandoz Agro, Inc.
Stalker	imazapyr	2 EC	American Cyanamid Co.
Sun-it II	MSO surfactant	- - -	American Cyanamid Co.
Thinvert (RTU)	invert emulsion	- - -	Waldrum Specialties, Inc.
Transline	clopyralid	3 S	DowElanco
Turf Hi-Dep	2,4-D	3.8S	PBI / Gordon Corp.
Vanquish	dicamba-glycolamine	4 S	Sandoz Agro, Inc.

EFFECT OF HERBICIDE DILUENT ON CONTROL OF GREEN ASH, BLACK BIRCH, AND PIN CHERRY WITH BASAL BARK APPLICATIONS - SECOND YEAR RESULTS

INTRODUCTION

A trial was established near Port Matilda, PA, to compare the effect of diluents on the control of green ash (*Fraxinus pennsylvanica* Marsh.), black birch (*Betula lenta* L.), and pin cherry (*Prunus pensylvanica* L.) treated with basal bark herbicide applications. These diluents, utilized as the carrier in basal bark applications, assist the chemical in penetrating the bark of the tree. In some instances, more than one growing season is required to gain full control of the treated stem. The intent of the rating taken in 1996 was to establish second season results and to determine if treatment effects differed from first year results.

MATERIALS AND METHODS

The six diluents evaluated included three petroleum-based products; Arborchem Basal Oil, HyGrade I Basal Oil, and Penevator Basal Oil; two vegetable-based products, JLB Oil Plus and Penevator Vegetable Oil; and Dyne-Amic, an organosilicone/methylated seed oil blend. Dyne-Amic is not currently labeled for basal bark applications, but it has proven to be an effective spray adjuvant on turf applications. Stems of birch and ash were treated February 14 and 20, 1995, respectively, with a solution containing 95 percent diluent and 5 percent Garlon 4 (v/v). Pin cherry was treated February 13, 1995, with a solution containing 95 percent diluent and 5 percent Access (v/v). The concentration of Garlon 4 and Access applied were below label rates, but were used to isolate any differences in control provided by the various diluents. Each treatment was applied to ten stems of each species at a rate of 1.0 mL/inch of stem circumference at a height of six inches, using a syringe and 14 gauge pipetting needle. The diameters for all three species ranged from 0.75 inches to 4 inches, with an average of 2 inches. The experimental layout for each species was a completely randomized design, with each stem being an experimental unit. Ratings of percent canopy reduction were taken August 9, 1995; in which '0' indicates full leaf canopy and '100' indicates no leaves remaining. Canopy reduction values for the checks were reported 'as seen' in 1995, rather than given zero values. Ratings of tree injury were taken for green ash on August 9, 1996, and for black birch and pin cherry on September 6, 1996; where '1' indicates no injury, '5' indicates moderate injury including the terminal, and '10' indicates total control of the treated stem. Tree injury ratings in 1996 were based upon the checks, which received a rating of '1'. The data were subjected to an analysis of variance. Analysis of covariance was used to adjust canopy reduction and tree injury according to stem caliper in birch.

RESULTS

Table 1 includes T-Grouping for all values. Treatment means followed by the same letter within a given column are not significantly different according to Fisher's LSD test. A single LSD value is not reported for black birch due to the effect of the analysis of covariance performed.

Compared to the untreated check, all treatments provided significant canopy reduction or tree injury on all species, except Dyne-Amic on black birch in 1995 (Table 1).

Arborchem Basal Oil, HyGrade I Basal Oil, Penevator Basal Oil, and Penevator Vegetable Oil treatments provided canopy reduction values from 88 to 95 percent on green ash in 1995 and tree injury ratings from 9.6 to 10.0 in 1996. The treatments including these diluents provided complete control of the pin cherry stems in both 1995 and 1996. Black birch did not express immediate control symptoms in 1995, with adjusted canopy reduction ratings for these four diluents ranging from 41 to 54 percent. However, by 1996, tree injury ratings increased and ranged from 9.0 to 10.0 for these diluents.

JLB Oil Plus was statistically similar to Arborchem Basal Oil, HyGrade I Basal Oil, Penevator Basal Oil, and Penevator Vegetable Oil on green ash and pin cherry, but did not provide as much control on black birch.

In 1995, Dyne-Amic provided the lowest canopy reduction ratings of all the diluents on all three species. However in 1996, it provided the lowest rating only on pin cherry and was similar to all diluents on green ash and to JLB Oil Plus on black birch. It showed a significant injury increase in 1996, especially in black birch.

During the ratings there were no visible signs of resprouting on the cherry stems. Also, the untreated checks for both green ash and pin cherry had canopy reduction values of 24 and 31 percent, respectively, in 1995. These canopy reduction values for the checks were due to the high stem density and full canopy, which shaded the lower branches and reduced their foliage density.

CONCLUSIONS

Arborchem Basal Oil, HyGrade I Basal Oil, Penevator Basal Oil, and Penevator Vegetable Oil all worked equally well on all species tested. JLB Oil Plus did provide similar results to these diluents on ash and cherry, but did not provide as much control on birch. These five diluents are similarly priced, therefore a purchase decision is a matter of personal preference and product availability. Dyne-Amic however has three disadvantages for use as a basal bark diluent. It is not currently labeled for basal applications, did not perform well overall, and is expensive when applied in an undiluted form. It has been suggested to use Dyne-Amic in a diluted form for basal bark applications tested in the future. By diluting the product, its pricing will be more competitive with the other diluents evaluated in this study.

The first and second year results of this study again showed that two or more growing seasons are required to gain full control or an increase in control of the treated stems when the herbicides are applied at the low rates used in this study.

TABLE 1: Treatments of 5 percent Garlon 4 and 95 percent (v/v) diluent were applied to black birch and green ash stems on February 14 and 20, 1995, respectively. Treatments of 5 percent Access and 95 percent (v/v) diluent were applied to pin cherry stems February 13, 1995. Ratings of percent canopy reduction were taken August 9, 1995; a rating of '0' indicates full leaf canopy and '100' indicates no leaves remaining. Tree injury ratings were taken for green ash on August 9, 1996, and for black birch and pin cherry on September 6, 1996; a rating of '1' indicates no injury, '5' indicates moderate injury including the terminal, and '10' indicates complete control of the treated stem. Treatment means followed by the same letter within a given column are not significantly different according to Fisher's LSD test (p=0.05). Each value is the mean of ten replications.

	Canopy Reduction or Tree Injury					
	Green Ash		*Pin Cherry*		*Black Birch*[1/]	
Diluent	1995	1996	1995	1996	1995	1996
	(%)	(1-10)	(%)	(1-10)	(%)	(1-10)
Arborchem Basal Oil	95 a	10.0 a	100 a	10.0 a	41 ab	9.1 a
HyGrade I Basal Oil	91 ab	9.6 a	100 a	10.0 a	54 a	9.8 a
JLB Oil Plus	83 ab	9.7 a	94 a	10.0 a	23 bc	7.0 b
Penevator Basal Oil	88 ab	10.0 a	100 a	10.0 a	49 a	10.0 a
Penevator Vegetable Oil	94 a	10.0 a	100 a	10.0 a	49 a	9.0 a
Dyne-Amic	72 b	9.6 a	81 b	8.6 b	12 c	7.2 b
Untreated Check	24 c	1.0 b	31 c	1.0 c	5 c	1.0 c

[1/] Means adjusted by analysis of covariance according to stem caliper, therefore no LSD value is reported.

EVALUATION OF BRUSH CONTROL PROVIDED BY BASAL BARK APPLICATIONS OF ACCORD, GARLON 4, AND KRENITE S

INTRODUCTION

Studies were established in Centre, Cambria, and Mifflin counties to evaluate the control of green ash (*Fraxinus pennsylvanica* Marsh.), red maple (*Acer rubrum* L.), and tree-of-heaven or ailanthus (*Ailanthus altissima* Mill.) treated with basal bark applications of Accord, Garlon 4, and Krenite S; and three diluents.

MATERIALS AND METHODS

Treatments included an untreated check, Accord in MON 59120 and water; Accord in Thinvert R; Garlon 4 in Penevator Basal Oil; and a combination of either Accord or Krenite S with Stalker in MON 59120 and water. Treatments were applied to three separate colonies, or replications, of ailanthus divided into equal portions on April 12 and 15, 1996, near Lewistown, PA. Treatments were applied to ten stems each of green ash near Port Matilda, PA, on April 10; and red maple on April 5 near Ebensburg, PA. The experimental design for ailanthus was a randomized complete block design with three replications; and the design for ash and maple was completely randomized, with each stem being an experimental unit. Treatments of Accord in combination with only MON 59120 and water or with Thinvert R were applied to cover the lower 24 inches of the base of each stem. All other treatments were applied to the lower 12 inches. Application equipment included a CO_2-powered hand held sprayer equipped with a Spraying Systems #5500 adjustable conejet nozzle with a Y2 tip, operating at 25 psi. Stem diameters ranged from 0.25 to 5 inches for ailanthus, 1 to 6.25 inches for ash, and 1 to 5.5 inches for maple, with an overall average of 2.5 inches. Ratings of tree injury were taken August 9 and 13 for ash and maple, respectively; while tree injury and percent groundcover of resprouts was rated for ailanthus on September 16, 1996. Injury was rated on a scale of 1 to 10; in which '1' indicates no injury, '5' indicates moderate defoliation including the terminal, and '10' indicates complete control of the treated stem. The data was subjected to an analysis of variance. Analysis of covariance was used to adjust tree injury values according to stem caliper in ash.

RESULTS

Table 1 includes T-Grouping for certain values, in which treatment means followed by the same letter within a given column are not significantly different according to Fisher's LSD test. A single LSD value is not reported due to the effect of the analysis of covariance performed.

Garlon 4 and Krenite S plus Stalker were the only treatments that provided excellent control of all three species (Table 1). They also allowed little resprouting of ailanthus. Accord plus Stalker provided good control of all three species and ailanthus resprouting.

Accord plus Thinvert R provided no control of maple and poor to moderate control of ash and ailanthus. Accord in MON 59120 and water provided good control of green ash at all rates of application. It provided good control of red maple only at the highest rate. Control of ailanthus was confusing, as the highest level of control was observed at the medium rate of application.

CONCLUSIONS

Garlon 4 is still the standard by which other basal bark treatments must be judged. Krenite S plus Stalker and Accord plus Stalker provided moderate to excellent control, but at higher cost and risk to adjacent desirable vegetation. MON 59120 is a much better diluent to use with basal bark applications of Accord than Thinvert R.

TABLE 1: Tree injury provided by various basal bark treatments applied to green ash plots April 10, red maple April 5, and ailanthus April 12 and 15, 1996. Treatments were rated August 9 and 13, 1996, for ash and maple, respectively; and September 16 for ailanthus. Average injury was visually rated on a scale of 1 to 10, in which '1' indicates no injury, '5' indicates moderate defoliation including the terminal, and '10' indicates complete control of the treated stem. Each value is the mean of three replications for ailanthus and ten replications for green ash and red maple.

Herbicide	Application Rate	Average Tree Injury Rating: Green Ash[1/]	Red Maple	Ailanthus	Groundcover of Ailanthus Resprouts
	(% v/v)	(----------------average injury rating----------------)			(%)
Untreated Check	- -	1.7 d	1.0	1.3	5
Accord	10	8.8 a	2.7	5.7	47
MON 59120	45				
Water	45				
Accord	25	8.9 a	5.3	9.3	68
MON 59120	37.5				
Water	37.5				
Accord	50	9.1 a	9.0	4.7	37
MON 59120	25				
Water	25				
Accord	10	4.4 c	1.0	7.0	70
Thinvert R	90				
Accord	25	5.5 bc	1.4	6.0	66
Thinvert R	75				
Accord	50	6.6 b	1.2	6.7	43
Thinvert R	50				
Garlon 4	20	9.9 a	10.0	10.0	9
Penevator Basal Oil	80				
Accord	50	10.0 a	6.0	6.7	2
Stalker	5				
MON 59120	22.5				
Water	22.5				
Krenite S	50	9.2 a	7.9	8.3	3
Stalker	5				
MON 59120	22.5				
Water	22.5				
Significance Level (p)		0.0001	0.0001	0.003	0.02
LSD (p=0.05)		- -	1.8	3.4	47

[1/] Means adjusted by analysis of covariance according to stem caliper. The values are reported using a T-Grouping to determine which treatments are statistically different.

AN EVALUATION OF DORMANT STEM APPLICATIONS TO CONTROL BRUSH USING ACCORD, GARLON 4, OR STALKER IN WATER OR THINVERT R

INTRODUCTION

A demonstration was established to evaluate Accord, Garlon 4, and Stalker and different carriers for their effect on brush control provided by dormant stem applications. Accord is a formulation of glyphosate that contains no surfactant. To obtain satisfactory control of vegetation with Accord, a surfactant must be added to the spray solution. In this study the effectiveness of an experimental surfactant, MON 59120, was evaluated. Thinvert R was also evaluated as a carrier for the Accord in place of the water:surfactant combination. Two treatments using low rates of Garlon 4 were included in the study for comparative purposes. Stalker was also included with treatments of Garlon 4 or Accord to determine its potential use in controlling species for which Garlon 4 or Accord provide poor control.

MATERIALS AND METHODS

Nine treatments were applied to a stand of second year resprouts at the interchange of SR 219 and SR 22, near Ebensburg, PA, on April 5, 1996. The treatments were applied with a CO_2-powered, hand-held sprayer equipped with a Spraying Systems #5500 Adjustable ConeJet nozzle, with a Y-2 tip. The herbicide solution was applied to provide complete coverage of the lower 24 to 36 inches of each primary stem in a sprout cluster. Six treatments included Accord alone; mixed at 10, 25, and 50 percent (v/v) of product. These concentrations of Accord were mixed with either water plus the surfactant MON 59120; or Thinvert R, a ready-to-use invert emulsion carrier. Garlon 4 was mixed at 5 percent (v/v) product with 2 percent (v/v) Clean Cut (crop oil concentrate) in water; alone, or with 0.5 percent (v/v) Stalker. Additionally, Accord at 10% plus Stalker at 1 percent product (v/v), were mixed with MON 59120 and water. The predominant brush species were green ash (*Fraxinus pennsylvanica* Marsh.), black cherry (*Prunus serotina* Ehrh.), red maple (*Acer rubrum* L.), sugar maple (*Acer saccharum* Marsh.), and red oak (*Quercus rubra* L.). There were stems of black birch (*Betula lenta* L.) present within two of the treated plots. Plant heights ranged from 3 to 10 ft, with an average height of 6 to 8 ft. Each treated sprout cluster was rated September 14, 1996, using an injury scale of 1 to 10, in which '1' is no injury, and '10' indicates complete control of the treated plant.

RESULTS

Injury results by individual species and total average injury ratings for each treatment are listed in Table 1. Black birch was only present in two plots, thus the results are not reported.

This evaluation was conducted as a demonstration with no replication and therefore no statistical analysis was performed. All observations are based upon the mean or average injury value determined from the multiple stems treated within each plot.

When mixed with MON 59120 and water, Accord alone produced average injury ratings ranging from 8.9 to 9.6. When mixed with Thinvert R the average injury ratings ranged from only 4.4 to 7.6. Injury to red maple was somewhat less than on other species at the lowest Accord rates. Scattered stems of black birch averaged an injury rating of only 3.0 when treated with the 25% (v/v) rate of Accord in MON 59120. The high rate Accord mixture did not spray as easily as the two lower rates when mixed with MON 59120. The Accord formulation did not mix well with the Thinvert R, as constant agitation during application was necessary to prevent separation, particularly at the high Accord rate. Garlon 4 alone had an average injury rating of 5.2, and Garlon 4 plus Stalker averaged 6.1, with most of the increased injury seen on ash. The Accord plus Stalker combination in MON 59120 and water had a lower average injury rating than the same rate of Accord alone. This difference was mostly due to the lower control ratings for the red oak and sugar maple in the plot, which had injury ratings of only 5.7 and 7.4, respectively.

CONCLUSIONS

Further investigations need to be conducted to determine the range of species effectively controlled by dormant applications of Accord, the effect of time of year on injury, as well as whether full circumference coverage of the treated stems is necessary on the smaller stems typical of this trial.

Accord plus MON 59120 and water provided good to excellent control of the species treated in this study. Accord and Thinvert R did not mix well at the concentrations used in this study. Under these conditions the Accord/Thinvert R combinations did not provide satisfactory control of the black cherry, red oak, or red maple. Garlon 4 in water and Clean Cut did not provide satisfactory control of any of the species treated. The addition of Stalker to the mix resulted in good control of the green ash only. Adding Stalker to the Accord did not improve the performance of the Accord alone.

Table 1: Visual injury ratings taken September 14, 1996, on plants treated April 5, 1996. Injury was rated on a scale of 1 to 10, where '1' indicates no injury, and '10' indicates the plant was dead. Numbers in parentheses indicate the number of stems treated.

Treatment	Product mixture (% v/v)	Green Ash		Black Cherry		Red Oak		Red Maple		Sugar Maple		Average	
		(----------Injury (treated stems)----------)											
Accord MON 59120 water	10 45 45	8.8	(32)	8.8	(12)	- -	- -	8.1	(20)	9.2	(39)	8.9	(116)
Accord MON 59120 water	25 37.5 37.5	9.3	(61)	9.8	(8)	- -	- -	8.7	(14)	9.4	(18)	8.9	(110)
Accord MON 59120 water	50 25 25	9.4	(56)	10.0	(21)	- -	- -	10.0	(4)	10.0	(3)	9.6	(84)
Accord Thinvert R	10 90	7.9	(8)	3.7	(18)	- -	- -	2.3	(11)	10.0	(1)	4.4	(40)
Accord Thinvert R	25 75	10.0	(4)	4.9	(9)	- -	- -	6.3	(16)	6.0	(1)	6.3	(30)
Accord Thinvert R	50 50	10.0	(6)	7.7	(13)	6.0	(12)	7.8	(11)	10.0	(1)	7.6	(43)
Garlon 4 Clean Cut water	5 2 93	6.8	(4)	4.9	(8)	- -	- -	4.9	(8)	5.0	(1)	5.2	(21)
Garlon 4 Stalker Clean Cut water	5 0.5 2 92.5	8.9	(14)	3.4	(9)	2.0	(1)	4.4	(7)	5.8	(6)	6.1	(37)
Accord Stalker MON 59120 water	10 1 44.5 44.5	- -	- -	9.3	(20)	5.7	(15)	8.3	(23)	7.4	(14)	7.9	(76)

BRUSH CONTROL PROVIDED BY LOW VOLUME FOLIAR APPLICATIONS

INTRODUCTION

A study evaluating brush control provided by low volume foliar applications of Vanquish alone and in combination with other herbicides was established along SR 219 near Ebensburg, PA.

MATERIALS AND METHODS

Vanquish was applied alone at rates of 48 and 64 oz/ac; in combination with Garlon 3A , Arsenal, and RoundUp; and compared to RoundUp, and Krenite S plus Arsenal (Table 1). Thinvert RTU, a ready-to-use invert emulsion, was used in three of the treatments as a carrier instead of water. Treatments were applied on September 1, 1995, to approximately 20 by 50 ft plots which were arranged in a randomized complete block design with three replications. A CO_2-powered backpack sprayer equipped with a handgun and a Spraying Systems #5500 Adjustable ConeJet with an X-6 tip, operating at 20 psi was used to approximate an application volume of 20 gal/ac for the aqueous (water carrier) treatments. The Thinvert RTU treatments were applied with the same apparatus except for a change to a Thinvert 71031 tip. All aqueous treatments included 0.125% (v/v) QwikWet 357 surfactant and 0.25% (v/v) Formula 358 drift control agent. Each plot contained several tree species in the 3 to 10 ft height range with a few up to 15 ft. The predominant species were red maple (*Acer rubrum* L.), black cherry (*Prunus serotina* Ehrh.), quaking aspen (*Populus tremuloides* Michx.), white oak (*Quercus alba* L.), red oak (*Quercus rubra* L.), green ash (*Fraxinus pennsylvanica* Marsh.), and staghorn sumac (*Rhus typhina* L.). Visual ratings of foliar necrosis, or 'brown-out', were taken September 15, 1995, 14 days after treatment (DAT). Visual ratings of tree injury were taken August 13, 1996 (347 DAT). Average tree injury results are reported in Table 1.

RESULTS

Green ash, staghorn sumac and a few less notable species are not included on Table 1 due to lack of space. The average total tree injury rating on the far right side of the table includes these tree species in the statistical analysis, however. Table 1 includes a T-Grouping for determining which treatments are statistically different. LSD values could not be presented because of the unequal replication among the species.

Foliar necrosis data is not reported; however, the treatments including RoundUp caused the most foliar necrosis 14 DAT. The treatments providing the highest average tree injury ratings 347 DAT were 64 oz/ac Vanquish plus 16 oz/ac Arsenal, 48 oz/ac Vanquish plus 24 oz/ac Arsenal in Thinvert, 64 oz/ac RoundUp, 96 oz/ac Krenite S plus 9.6 oz/ac Arsenal, and Vanquish at the 64 oz/ac rate in combination with RoundUp at 48 oz/ac. Vanquish alone injured the brush, but not to an acceptable level. Two of the three treatments using Thinvert provided no better control than those in aqueous solutions.

CONCLUSIONS

Roundup alone at 64 oz/ac provided very good brush control in this study. The use of Roundup for brush control has several advantages and disadvantages. Its major advantages are the broad spectrum control provided and the fact that it has no residual activity in the soil. Its disadvantages are the 'brownout' it causes after application and the potential groundcover damage. Krenite plus Arsenal in the aqueous solution provided excellent control with no brownout. It is the standard treatment currently being used by PennDOT. Its only disadvantage is the injury to some understory plants following application.

Two of the three Vanquish plus Arsenal combinations evaluated in this trial provided satisfactory first year injury ratings, but used high rates of Arsenal. Due to the soil activity of Arsenal, combinations with Vanquish using lower rates of Arsenal need to be evaluated to most efficiently use this combination on rights-of-way.

The Thinvert provided no advantage over aqueous solutions.

TABLE 1: Average injury rating and number of stems, by species, for foliar herbicide treatments applied September 1, 1995. Injury was rated August 16, 1996, on a scale of 1 to 5, where '1'=no injury, '2'=slight defoliation, '3'=moderate defoliation including terminal , '4'=severe defoliation and epinasty, '5'=complete control of the tree. Treatment means followed by the same letter within a given column are not significantly different according to Fisher's LSD. A single LSD value is not reported due to unequal replication. Several species are not included on Table 1 due to lack of space. However, the average total rating includes these species in the statistical analysis.

		Average Tree Injury Rating														
Herbicide	Application Rate	Maple			Cherry			Populus			Oak			Average Total		
	(oz/ac)	(-------average injury rating (number of stems)T-Grouping-------)														
untreated	- - -	1.0	(40)	f	1.1	(37)	f	1.0	(63)	j	1.0	(28)	h	1.0	(283)	i
Vanquish	48	2.7	(13)	e	4.4	(10)	bc	4.2	(120)	cdf	2.9	(22)	ef	3.9	(166)	f
Vanquish	64	3.4	(53)	cd	3.9	(39)	d	3.8	(80)	hi	1.7	(11)	g	3.6	(188)	g
Vanquish Garlon 3A	64 32	4.5	(6)	ab	4.5	(80)	c	3.8	(110)	ghi	2.0	(2)	fgh	4.1	(213)	e
Vanquish Arsenal	48 24	4.9	(11)	a	5.0	(48)	a	4.2	(207)	def	4.9	(7)	ab	4.4	(309)	cd
Vanquish Arsenal	64 16	5.0	(20)	a	4.9	(44)	a	4.6	(122)	ab	4.8	(46)	a	4.7	(235)	a
Vanquish RoundUp	48 48	3.8	(5)	bc	4.9	(90)	a	4.1	(169)	efg	3.0	(12)	ef	4.3	(325)	de
Vanquish RoundUp	64 48	4.3	(22)	b	5.0	(40)	a	4.4	(111)	bcd	2.2	(9)	fg	4.5	(259)	bc
RoundUp	64	3.0	(8)	de	5.0	(42)	a	4.7	(160)	a	3.5	(6)	de	4.6	(240)	ab
Krenite S Arsenal	96 9.6	5.0	(6)	a	4.8	(42)	ab	4.5	(78)	abc	4.1	(22)	bcd	4.6	(149)	abc[1/]
Krenite S Arsenal Thinvert	96 9.6 -	5.0	(6)	a	5.0	(37)	a	4.0	(182)	efgh	5.0	(14)	a	4.3	(247)	de
Vanquish Thinvert	64 -	3.3	(8)	cde	3.1	(19)	e	3.6	(94)	i	2.2	(9)	fg	3.4	(135)	h
Vanquish Arsenal Thinvert	48 24 -	4.9	(59)	a	4.9	(35)	a	4.4	(34)	abcdf	4.5	(30)	ac	4.7	(158)	a

[1/] Due to rounded off values, treatments may have identical ratings but different T-Grouping results.

EVALUATION OF BRUSH CONTROL PROVIDED BY VANQUISH WITH LOW VOLUME APPLICATIONS - SECOND YEAR RESULTS

INTRODUCTION

A study was established near State College, PA, to evaluate brush control provided by a low volume foliar application of the herbicide Vanquish (diglycol amine salt of dicamba), alone or in combination with other herbicides.

MATERIALS AND METHODS

Treatments were applied on September 8, 1994, to an area that had recently been clear cut. Vanquish was applied alone at rates of 1.0, 1.25, 1.5, and 2.0 qts/ac; in combination with Garlon 3A, Arsenal, or RoundUp; and compared to RoundUp plus Arsenal and Krenite S plus Arsenal. The plots were 20 by 100 ft, arranged in a randomized complete block design with two replications. Applications were made with a CO_2-powered backpack sprayer operating at 20 psi and equipped with a handgun containing a Spraying Systems #5500 adjustable conejet nozzle with a Y-2 tip. An application volume of approximately 15 gal/ac was targeted. All spray treatments included a surfactant, QwikWet 357, and a drift control agent, Formula 358, at 0.125 and 0.5 percent v/v, respectively. Each plot contained several tree species ranging from 3 to 10 ft in height. The predominant species were red maple (*Acer rubrum* L.), black cherry (*Prunus serotina* Ehrh.), quaking aspen (*Populus tremuloides* Michx.), mockernut hickory (*Carya tomentosa* L.), white oak (*Quercus alba* L.), red oak (*Quercus rubra* L.), and green ash (*Fraxinus pennsylvanica* Marsh.). Ratings of percent canopy reduction were taken August 24, 1995, 1 year after treatment (YAT), with '0' indicating full leaf canopy and '100' indicating no leaves remaining, or complete control. Tree injury ratings were taken September 12, 1996, 2 YAT, with '1' denoting no injury, '5' indicating moderate defoliation including the terminal, and '10' indicating complete control of the tree.

RESULTS

The three treatments that provided the best canopy reduction 1 YAT (Table 1) all included Arsenal. The average canopy reduction of trees in areas treated with RoundUp plus Arsenal or 1.5 qts/ac Vanquish plus 0.75 qts/ac Arsenal, was 97 percent reduction. For trees treated with 2 qts/ac Vanquish plus 0.5 qts/ac Arsenal, it was 89 percent reduction. Krenite S plus Arsenal, a commonly utilized combination, provided an average of only 79 percent canopy reduction, due primarily to poor control of populus or quaking aspen. Vanquish alone did not provide satisfactory results at any rate. Canopy reduction values were reported for the checks 'as seen', rather than given zero values.

Tree injury ratings taken 2 YAT (Table 2) provided similar results to the ratings conducted the prior year. This table includes a T-Grouping which provides an assessment of which treatments are statistically different. RoundUp plus Arsenal and 1.5 qts/ac Vanquish plus 0.75 qts/ac Arsenal, both provided ratings of 9.0 or greater. Vanquish at 2 qts/ac plus 0.5 qts/ac Arsenal still provided a total average tree injury rating of 7.6. Vanquish alone continued to provide unsatisfactory results.

CONCLUSIONS

Two years after treatment, at the rates evaluated in this trial, Vanquish alone did not provide satisfactory control of the brush species treated. Vanquish at 1.5 qts/ac plus 0.75 qts/ac Arsenal provided control similar to RoundUp at 3 qts/ac plus Arsenal at 0.3 qts/ac. Because of the long residual activity of Arsenal, and the risk of injury to trees growing next to treated areas, applicators would prefer using a combination with lower rates of Arsenal. Reducing the rate of Arsenal and increasing the rate of Vanquish may not produce the desired results. The combination of Vanquish at 2 qts/ac plus Arsenal at 0.5 qts/ac provided only fair control of the brush species treated.

TABLE 1: Treatments were applied September 8, 1994. All treatments contained 0.125% (v/v) QwikWet 357 and 0.5% (v/v) Formula 358 drift control agent. Ratings of percent canopy reduction were taken August 23 and 24, 1995, with '0' indicating full canopy and no discoloration of leaves and '100' indicating no leaves remaining on the tree. Each rating value is the mean of two replications and the number in parentheses indicates the total treated stems evaluated for both replications. A '- -' indicates the species was not present in the treatment area.

	Application	Canopy Reduction Ratings							
Treatment	Rate	Maple	Cherry	Populus	Hickory	Oak	Ash	Other	Total
	(qts/ac)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Vanquish	2	86 (9)	39 (17)	40 (5)	- -	40 (2)	52 (16)	- -	53 (49)
Vanquish	1.5	30 (4)	13 (9)	49 (29)	8 (2)	76(10)	72 (11)	5 (1)	36 (66)
Vanquish	1.25	63(16)	44 (8)	39 (21)	5 (2)	63(17)	55 (13)	10(1)	41 (78)
Vanquish	1	49 (9)	33 (8)	46 (6)	25 (2)	72 (9)	44 (20)	5 (1)	42 (55)
Vanquish Garlon 3A	2 1	83 (7)	57 (17)	50 (19)	38 (5)	100(4)	89 (12)	- -	68 (64)
Vanquish Arsenal	2 0.5	100(10)	89 (12)	71 (19)	60 (2)	98 (3)	97 (31)	100(1)	89 (78)
Vanquish Arsenal	1.5 0.75	100(6)	94 (16)	94 (12)	100 (1)	100(1)	97 (24)	- -	97 (60)
Vanquish RoundUp	2 1.5	57(10)	88 (11)	72 (9)	90 (2)	83 (3)	70 (21)	- -	75 (56)
Vanquish RoundUp	1.5 1.5	82 (5)	100 (8)	85 (39)	- -	78 (2)	66 (16)	- -	82 (70)
Krenite S Arsenal	3 0.3	100(10)	71 (19)	47 (20)	- -	- -	100 (33)	- -	79 (82)
RoundUp Arsenal	3 0.3	100(8)	100 (7)	100 (37)	98 (2)	87 (4)	98 (20)	- -	97 (78)
Untreated	- - -	23(16)	6 (22)	7 (24)	6 (4)	5 (10)	15 (33)	- -	11(109)
Significance Level (p)		0.003	0.0008	0.0003	0.0009	0.001	0.0005	- -	0.0001
LSD (p=0.05)		34	37	25	18	30	25	- -	12

TABLE 2: Visual ratings of tree injury taken September 12, 1996, with '1' indicating no injury, '5' indicating moderate defoliation including the terminal, and '10' indicating complete control of the stem. Treatments were applied September 8, 1994. Each rating value is the mean of two replications and the number in parentheses indicates the total treated stems evaluated for both replications.. A '- -' indicates the species was not present in the treatment area.

Treatment	Application Rate	Average Tree Injury							
		Maple	Cherry	Populus	Hickory	Oak	Ash	Other	Total
	(qts/ac)	(----------------------- average injury rating (number of stems) T-Grouping--------------------)							
Vanquish	2	2.6(9)	2.9 (14)	4.0 (3)	- -	- -	1.0 (8)	- -	2.5(34) f
Vanquish	1.5	1.5(4)	1.3 (6)	2.6 (19)	1.0 (2)	1.1(7)	3.8 (4)	- -	2.1(42) f
Vanquish	1.25	1.3(14)	3.6 (8)	1.1 (16)	1.0 (2)	2.0(16)	2.1 (11)	- -	1.8(67) f
Vanquish	1	1.9(9)	1.6 (8)	1.3 (6)	1.0 (2)	3.3(8)	1.6 (17)	1.0(1)	1.8(51) f
Vanquish Garlon 3A	2 1	5.7(7)	3.7 (17)	4.2 (18)	1.8 (4)	7.3(3)	4.9 (11)	- -	4.4(60) e
Vanquish Arsenal	2 0.5	9.8(9)	7.6 (10)	4.5 (12)	- -	6.7(3)	8.9 (29)	8.0(1)	7.6(64) b
Vanquish Arsenal	1.5 0.75	10.0(4)	8.8 (16)	8.9 (11)	10.0 (1)	10.0(1)	9.0 (22)	- -	9.0(55) a
Vanquish RoundUp	2 1.5	2.7(9)	6.8 (10)	4.8 (5)	2.5 (2)	3.0(3)	6.2 (18)	- -	5.2(47) d
Vanquish RoundUp	1.5 1.5	6.8(5)	9.1 (7)	6.1 (22)	- -	5.5(2)	4.2 (13)	- -	6.1(49) c
Krenite S Arsenal	3 0.3	10.0(9)	4.7 (15)	3.8 (19)	- -	- -	9.6 (28)	- -	7.1(71) b
RoundUp Arsenal	3 0.3	9.4(8)	10.0 (7)	9.9 (24)	10.0 (2)	7.0(3)	9.5 (20)	- -	9.6(64) a
Untreated	- - -	1.0(16)	1.0 (22)	1.0 (24)	1.0 (4)	1.0(10)	1.0 (33)	- -	1.0(109) g
Significance Level (p)		0.0001	0.0001	0.0001	0.0001	0.0006	0.0001	- -	0.0001

BRUSH CONTROL DEMONSTRATION - DISTRICT 8-0

INTRODUCTION

Tree-of-heaven (*Ailanthus altissima* Mill.) or ailanthus is a tree species that is becoming more common along Pennsylvania's roadsides. Its stems and root-suckers grow vigorously and it is a weak-wooded species, which makes this tree a hazard to motorists. Due to its aggressive growth habit and prolific root-suckering, it is extremely difficult to totally control established colonies, especially with typical maintenance practices of cutting or fixed patterns of herbicide applications. Excellent control of treated stems has been accomplished using backpack sprayers. However, single applications have not provided control of the entire colony.

A demonstration area was established to evaluate a basal bark application for initial control of the ailanthus trees, followed by low volume foliar treatments to control resprouts. This area was established in 1994 along SR 322 near Newport, PA, to evaluate the long-term effectiveness of these selective brush control techniques.

MATERIALS AND METHODS

On April 27, 1994, a basal bark application was made to a two mile stretch of median between Newport and Millerstown along SR 322 plus the Newport entrance and exit ramps. The primary target species was ailanthus, but stems of red maple (*Acer rubrum* L.), black locust (*Robinia pseudoacacia* L.), and staghorn sumac (*Rhus typhina* L.) were also treated. A total of 10 gallons of solution was applied over the area. Of this total, 6 gallons were a tank mix of 15% (v/v) Garlon 4 and 85% (v/v) Penevator Basal Oil; 2 gallons of 15% (v/v) Garlon 4 and 85% (v/v) Arborchem Basal Oil; and 2 gallons of 0.37% (v/v) Arsenal, 15% (v/v) Garlon 4, and 84.63% (v/v) Arborchem Basal Oil. The application was made in a total of 15 man hours by personnel equipped with backpack sprayers containing Spraying Systems #5500 adjustable conejets with Y-2 tips.

On August 19 and 23, 1994, a low volume foliar treatment was made to this same site to control all resprouts and uncontrolled stems from the basal bark application in April. A total of 25.5 gallons of spray solution was applied to the entire area. Of this total, 19.5 gallons was 5% (v/v) Krenite S, 0.5% (v/v) Arsenal, 0.25% (v/v) QwikWet 357 surfactant, and 0.5% (v/v) Formula 358 drift control. Another 3 gallons each of 2% (v/v) Garlon 4 or 1% (v/v) Arsenal were applied in combination with 0.25% (v/v) QwikWet and 0.25% (v/v) Formula 358 to compare their effectiveness. The total application was made in 23 man hours by personnel utilizing the same equipment as that used for the basal bark application.

In addition, approximately two miles of the eastbound shoulder of SR 322 was treated with the low volume foliar technique prior to the Newport exit. It was treated with 3.5 gallons of the Krenite plus Arsenal mix in a total of 6 hours.

Another low volume foliar application was made to the median area on October 1, 1996, to control any root sprouts or uncontrolled stems from the previous applications made in 1994. The eastbound shoulder area treated in August 1994 was not retreated. A total of approximately 18 gallons of spray solution was applied to the area. Of this total, 13 gallons were 5% (v/v) Krenite S, 0.5% (v/v) Arsenal, 0.125% (v/v) QwikWet 357, and 0.25% (v/v) Polytex A1001 drift control. Another 5 gallons of 4% (v/v) Garlon 4, 1% (v/v) Roundup PRO, and 0.25% (v/v) Polytex A1001 drift control was also applied. The application was made in a total of 18 man hours by personnel equipped with backpack sprayers containing Spraying Systems #5500 adjustable conejets with Y-2 tips.

Observations of the area were taken August 19 and September 2, 1994; and May 23 and October 3, 1995.

Table 1 summarizes the solution used and man hours required to treat the median portion of the demonstration area.

RESULTS

Basal bark applications require access to the lower 12 to 18 inches of the stem and are normally conducted during the dormant season from November to March. However, a continuous snow and ice cover from mid-December 1993 through March 1994 delayed all of the basal bark applications until April 1994. At the time of this basal bark application, the ailanthus and other target tree species were in the late stages of bud break. By August 19, the ailanthus and sumac stems treated were controlled; however, vigorous resprouting occurred from both species; therefore, the need for the follow-up foliar treatment.

This follow-up low volume foliar treatment was applied to resprouts and uncontrolled stems in August 1994. On September 2 (two weeks after treatment), the Garlon 4 treatment caused necrosis of the treated plants and showed a fair amount of understory damage. The foliage in the areas treated with Arsenal or the Krenite/Arsenal combination was beginning to discolor and curl.

At the rating on May 23, 1995, most of the stems treated with any herbicide combination were controlled. Many of those which were not totally controlled were often found in the middle of large clusters of plants where coverage may not have been adequate. Some understory damage was evident, but it was difficult to determine how much groundcover was present prior to treatment due to the shading effect of the dense stand of plants.

By October 3, 1995, excellent control of the treated stems was obtained by all three foliar treatments. However, areas treated with Garlon 4 or Arsenal showed approximately 25% ailanthus resprouting while the area treated with Krenite/Arsenal had only 10% resprouting. The groundcover was recovering and beginning to fill in to an acceptable level.

A reduction in the amount of ailanthus present at the site between 1994 and 1996 was evident as the solution used for the 1996 low volume foliar application was reduced by 7.5 gallons and required 5 less man hours to complete.

CONCLUSIONS

The basal bark application in April 1994 was followed by significant resprouting of ailanthus. Previous studies have indicated that Garlon 4 does not translocate into the root system of the plants with this type of application, but rather controls the stem above the treatment band by a girdling affect. The question arose as to whether the later than normal application timing caused the significant resprouting. Several basal bark studies on ailanthus have been established since this treatment, and the resprouting has been variable with Garlon 4 despite the timing of application. Based on the results of these studies, it appears a small application window may exist in early spring in which resprouting can be minimal. However, further testing needs to be conducted.

The basal bark and low volume foliar applications have been successful in controlling the growth and spread of the ailanthus in the treatment area. However, resprouting has occurred and because the area is completely surrounded by other thriving ailanthus colonies, seeds will continually be blown onto the site. Therefore, continued treatment will likely be required to manage this species within the test area.

Observations will continue to be made in the upcoming years and the site will be maintained with any necessary treatments. It is expected that the amount of solution, man hours required, and the frequency of follow-up treatments required will continue to decline.

Table 1: Summary of amounts of solution used and man hours required for the treatment of the median area near Newport, PA.

Application	Solution Used (gallons)	Man hours
Basal Bark (1994)	10	15
Low Volume Foliar (1994)	25.5	23
Low Volume Foliar (1996)	18	18

EVALUATION OF HERBICIDES FOR CONTROL OF CANADA THISTLE IN FINE FESCUE

INTRODUCTION

Because it has been almost impossible to selectively remove Canada thistle from crownvetch, a system has been developed in which both are eradicated with non-selective, non-residual herbicides, and low maintenance fine fescues are seeded into the treated area. Selective herbicides can then be used to remove surviving Canada thistle plants from the grass.

A study was established at Penn State's Landscape Management Research Center to evaluate several herbicides for selective control of Canada thistle (*Cirsium arvense* L.) within a stand of fine fescue.

MATERIALS AND METHODS

Treatments included an untreated check, 24 oz/ac Vanquish, 8 oz/ac SAN 1269H[1/] alone and in combination with 16 oz/ac Vanquish, 10 oz/ac Transline, 24 oz/ac Vanquish in combination with 5 oz/ac Transline or 0.33 oz/ac Escort, 64 oz/ac RoundUp Pro, 32 oz/ac Garlon 4, and 12 oz/ac Plateau. All treatments, except RoundUp Pro, contained 0.125% (v/v) QwikWet 357 surfactant and all contained 0.25% (v/v) Polytex A1001 drift control agent. The study area was located within an established stand of fine fescue, comprised predominantly of hard fescue (*Festuca longifolia* Thuill.), and arranged in a randomized complete block design with three replications. The application was made to 6 by 10 ft plots on June 12, 1996, using a CO_2-powered hand held sprayer equipped with Spraying Systems XR 8004 VS spray tips, delivering 40 GPA at 35 psi. Ground cover ratings of the fine fescue were taken June 12; July 24, 43 days after treatment (DAT); and August 30, 79 DAT. An initial count of thistle stems within the plots was taken June 12. A count of uncontrolled thistle stems and thistle resprouts was taken July 24 and August 30. These values were utilized for determining percent thistle resprouts and percent thistle decline, which evaluates the extent of decline of the originally treated stems which were affected by either treatment or natural senescence. Percent decline and resprouting results are reported in Table 1.

RESULTS

All treatments, except Garlon 4 or Plateau, provided excellent thistle control and similar levels of thistle decline at the July 24 rating. Garlon 4 was slightly lower, while Plateau was not different from the untreated check. Due to natural senescence of the thistle plants, an increase in thistle decline was evident at the August rating, as the untreated check escalated from 15 percent decline in July to 64 percent in August. All other treatments, excluding the check and Plateau, provided similar levels of decline at the August rating. Percent thistle resprouting values at the July rating were similar for all treatments, except Garlon 4 with the highest amount at 37 percent. There was no significant difference among treatments at the August rating except for Plateau, which actually resprouted by 151 percent. None of the treatments thinned the fine fescue stand but Plateau provided slight chlorosis to the leaf tips.

CONCLUSIONS

All treatments provided selective control of treated thistles; but all still had significant resprouting occur. No treatment provided an overall acceptable level of control.

[1/] SAN 1269H, experimental product, 70 WG, Sandoz Agro, Inc., Des Plaines, IL.

TABLE 1: Herbicide treatments were applied June 12, 1996. All treatments, except RoundUp Pro, contained 0.125% (v/v) QwikWet 357 surfactant and all contained 0.25% (v/v) Polytex A1001 drift control agent. The percentage of Canada thistle decline and thistle resprouts from ratings taken July 24 and August 30, 1996 are presented. Each value is the mean of three replications.

Herbicide	Application Rate	Thistle Decline July 24	Thistle Decline August 30	Thistle Resprouts July 24	Thistle Resprouts August 30
	(oz/ac)	(-----------%-----------)		(-----------%------------)	
untreated check	- -	15	64	6	37
Vanquish	24	90	98	25	79
SAN 1269H	8	90	99	15	72
Vanquish SAN 1269H	16 8	94	98	15	46
Transline	10	80	99	13	52
Vanquish Transline	24 5	90	99	21	49
Vanquish Escort	24 0.33	87	98	12	78
RoundUp Pro	64	96	99	20	34
Garlon 4	32	78	98	37	78
Plateau	12	28	84	10	151
Significance Level (p)		0.0001	0.0001	0.2	0.1
LSD (p=0.05)		15	11	22	72

EVALUATION OF PLATEAU FOR SELECTIVE CONTROL OF CANADA THISTLE IN CROWNVETCH

INTRODUCTION

A demonstration was established to evaluate Plateau herbicide for selective control of Canada thistle (*Cirsium arvense L.*) within a planting of crownvetch (*Coronilla varia*). Canada thistle, a noxious weed, has become an increasing problem along Pennsylvania's roadways as it has become a companion plant with the desirable crownvetch groundcover. Because both the thistle and crownvetch are broadleaved plants, selective removal with herbicides has been difficult. However, the unique chemistry of Plateau permits the selective removal of some broadleaf weeds from within stands of other broadleaves (including crownvetch).

MATERIALS AND METHODS

A 2,000 sq. feet test area was located along Park Avenue near State College, PA, within an established planting of crownvetch infested with Canada thistle. An application of 12 oz/ac Plateau, 0.125% (v/v) QwikWet 357, and 0.25% (v/v) Polytex A1001 drift control was made to the test area on June 3, 1996. The application was made just prior to bud break of the thistle. A follow-up application of 12 oz/ac Plateau, 32 oz/ac Sun-It II, and 0.25% (v/v) Polytex A1001 drift control was made to half of the test area on September 25, 1996. Application equipment included a CO_2 powered backpack sprayer equipped with Spraying Systems XR 8004 VS nozzles, delivering 40 gal/ac at 38 psi. Observations were made June 27, July 26, and August 30, 1996.

RESULTS

On June 27, the thistle and crownvetch showed some injury symptoms and discoloration. By July 26, the above-ground portion of the treated thistle stems had been controlled, but significant resprouting was beginning to occur from the base of the treated plants and from the root systems. The treated crownvetch had recovered to a dark green color but its growth was stunted and its maturity was delayed. The treated crownvetch was not flowering and was shorter than the untreated crownvetch, which was in full bloom. On August 30, the treated crownvetch was flowering and thistle resprouts were abundant.

CONCLUSIONS

The application of Plateau in June prevented the thistle plants from flowering and setting seed but did not control the existing colony of plants. The application stunted the growth and flowering of the crownvetch but did not cause any permanent damage. The manufacturer of Plateau recommends the use of a methylated seed oil (MSO) surfactant, such as Sun-It II, with their product for optimum results. However, an organosilicone surfactant was used with the June application. A follow-up application was made in the fall using an MSO surfactant. The manufacturer also recommends that Plaeau be applied when the Canada thistle is at an early stage of development, with most in the 6 to 8 inch range. In this test the application was made to mature plants. If this application results in acceptable thistle control in 1997, further evaluations will be conducted to determine which factor (a repeat application, fall timing, or MSO surfactant) has the most influence.

Further testing of various application rates, timings, and mixes still need to be evaluated to determine if Plateau can provide acceptable levels of selective control of Canada thistle in crownvetch.

EVALUATION OF PLANT GROWTH REGULATORS FOR ELIMINATING MOWINGS ALONG ROADSIDES

INTRODUCTION

A study was initiated to evaluate two plant growth regulator (PGR) products for suppressing seedhead expression and vegetative growth of the treated turfgrass. This test was also established to determine if an effective application, prior to seedhead emergence, could eliminate the mowing that Pennsylvania's roadsides receive each year (to primarily eliminate seedheads).

MATERIALS AND METHODS

The test area was located in the median area of the Mt. Nittany Expressway (SR 322) near Oak Hall, PA. The established turf was a mixed stand of Kentucky-31 tall fescue (*Festuca arundinacea*), Kentucky bluegrass (*Poa pratensis*), and hard fescue (*Festuca longifolia*). Treatments included an untreated check, mowed, 8.7 oz/ac EH 1094 (Embark/Event), and 8 oz/ac SAN 1269H plus 0.25% (v/v) Clean Cut. All treatments contained 0.25% (v/v) Formula 358 drift control. Treatments of EH 1094 and SAN 1269H were applied to the unmowed stand of turf on May 14, 1996. Application equipment included a CO_2 powered sprayer equipped with Spraying Systems XR 8004 VS nozzles, delivering 40 GPA at 38 psi. The 6 by 20 ft plots were arranged in a randomized complete block design with three replications. At the time of application, tall fescue seedheads were in the boot stage and bluegrass seedheads had begun to emerge. The average canopy height of the tall fescue was approximately 8 in. Following the rating on June 2, the plots with the mowing treatment were cut with a flail mower to a height of 6 in. At the time of this mowing, the majority of tall fescue seedheads had emerged. Ratings of percent seedhead reduction, turf color, and average turf canopy height were taken June 2, June 24, July 26, August 28, and October 28, 1996.

RESULTS

No turf color differences were observed among treatments at any rating, and therefore the data is not reported. All treatments, including the untreated check, showed some slight discoloration of the leaf blades during the July and August ratings.

Seedhead suppression (Table 1) ratings were taken in comparison to the untreated check. Prior to cutting the mowed plots on June 2, a rating was taken; therefore, the mowed plots were comparable to the untreated check (0 percent reduction). The mowed plots provided the best seedhead reduction, 100 percent, throughout the study while EH 1094 declined from an initial rating of 98 percent to 77 percent in October. SAN 1269H provided a maximum reduction of only 42 percent, which occurred on the June 2 rating.

There were no differences in heights on the June 2 rating (Table 2). However, as expected, the mowed plots had significantly lower heights than all other treatments at all rating periods, except July 24. There were no height differences for turf treated with EH 1094 or SAN 1269H, and they both had heights similar to the untreated check.

At the October rating, the researchers determined whether the appearance of the treated plots would be acceptable to passing motorists (i.e. few seedheads and a smooth, contoured appearance). They concluded that the mowed and EH 1094 treated turf appeared favorable.

CONCLUSIONS

Based upon the results of this study, mowing of the turf provided the best seedhead and turf height reduction. However, the mowing must be conducted following seedhead emergence to be successful. EH 1094 provided favorable results and would possibly be a viable alternative to the mowing, depending on cost.

TABLE 1: Treatments were applied May 14, 1996. The mowed plots were cut to a height of 6 in on June 2, following rating. Ratings of percent seedhead reduction were taken June 2, June 24, July 26, and August 28, 1996. Each value is the mean of three replications.

	Application	Seedhead Reduction			
PGR	Rate	Jun 2	Jun 24	Jul 25	Aug 28
	(oz/ac)	(-------------------------------- % ------------------------------)			
untreated check	- -	0	0	0	0
mowed	- -	0	100	100	100
EH 1094	8.7	98	80	82	77
SAN 1269H Clean Cut	8 0.25% (v/v)	42	30	22	30
Significance Level (p)		0.0001	0.0001	0.0001	0.0001
LSD (p=0.05)		15	8	17	10

TABLE 2: Treatments were applied May 14, 1996. The mowed plot was cut to a height of 5 in on June 2. Measurements of average canopy height were taken June 2, June 24, July 26, and August 28, and October 28, 1996. Each value is the mean of three replications.

	Application	Average Canopy Height				
PGR	Rate	Jun 2	Jun 24	Jul 25	Aug 28	Oct 28
	(oz/ac)	(--- in --)				
untreated check	- -	11	10	12	15	13
mowed	- -	11	6	9	11	9
EH 1094	8.7	11	8	12	16	11
SAN 1269H Clean Cut	8 0.25% (v/v)	11	9	13	15	11
Significance Level (p)		0.6	0.0002	0.04	0.0003	0.002
LSD (p=0.05)		n.s.	1	3	1	1

COMPARISON OF PLANT GROWTH REGULATORS TO MOWINGS ALONG ROADSIDES

INTRODUCTION

A trial was initiated to compare several plant growth regulator (PGR) and mowing treatments for turfgrass growth suppression. The PGR application was to be made following one mowing cycle in June (to eliminate seedheads) to determine if the chemicals could reduce the need to mow the rest of the growing season.

MATERIALS AND METHODS

The site was located in the median of the Mt. Nittany Expressway (SR 322) near Oak Hall, PA. The established turf was a mixed stand of Kentucky-31 tall fescue (*Festuca arundinacea*), Kentucky bluegrass (*Poa pratensis*), and hard fescue (*Festuca longifolia*). Treatments included an untreated check, a single application of 96 oz/ac Primo, 8 oz/ac SAN 1269H plus 0.25% (v/v) Clean Cut, and a dual application of Primo or SAN 1269H. The dual applications were applied in June and September. All treatments contained 0.25% (v/v) Formula 358 drift control. The entire study area was flail mowed to a 5 inch height by PennDOT personnel on May 31, 1996. On June 11, all single and dual application PGR plots were treated with a CO_2 powered sprayer equipped with Spraying Systems XR 8004 VS nozzles, delivering 40 GPA at 38 psi. The second application of the dual Primo or SAN 1269H treatments were made on September 12, 1996. The 6 by 20 ft plots were arranged in a randomized split-block design with three replications. Half of each replication was mowed with a flail mower to a 6 inch height again on July 29 and September 3, and are presented as the mowed (3X) plots. These two additional mowings were done to simulate the standard maintenance this area annually receives. Ratings of turf color and average turf canopy height were taken across the entire plot on June 24 and July 26. Color ratings and height measurements for both halves of each plot were taken on September 3 and October 28, 1996.

RESULTS

All treatments had turf color ratings comparable to the untreated check on both the July and September ratings, therefore the data is not reported. In June, Primo treated plots had more discoloration than SAN 1269H treated plots, and both were more discolored than the check. By October, all treatments, except Primo applied in June and September, were similar in color to the check.

On June 24, there were no differences in canopy height between Primo and SAN 1269H; however, Primo treated turf was slightly shorter than the check. In July, Primo treated turf plots had significantly less height than the untreated check and SAN 1269H plots. However, by September and October, there were no differences in height across treatments.

When the September and October data was analyzed by mowing treatment (Table 3), there was a significant difference for turf color in October. The mowed (3X) portion of the plot provided significantly better color than the mowed (1X) portion of the plot. No differences were observed for turf color at the September rating, therefore the data was not reported. There were no significant differences in turf height.

CONCLUSIONS

Based on the conditions of this study, Primo applied in June was effective in reducing turf height into August. However, by September the applications of the PGR materials and/or additional mowings (3X) provided no significant benefits in reducing turf heights compared to the untreated check mowed once.

TABLE 1: Treatments were applied June 11 and September 12, 1996. The entire study area was mowed to a 5 inch height on May 31, 1996. The mowed halves of the plots were cut to a 6 in height on July 29 and September 3. Ratings of turf color were taken across the entire plot on June 24 and July 26, where '1' denotes no green tissue remaining and '10' denotes healthy, green turf. Ratings were taken for each half of the plot on September 3 and October 28, 1996. There were no differences in turf color at the July and September ratings, therefore the data is not reported. Also, there was no significant interaction between the mowed (3X) vs.mowed (1X) portions of each plot and the values reported for the October rating are an average between mowed (3X) and mowed (1X) values. Each value for the June rating is the mean of three replications and October values are the mean of six observations (three replications, two mowing treatments).

PGR	Application Rate	Application Timing	Turf Color Jun 24	Turf Color Oct 28
	(oz/ac)		(-------------1-10------------)	
untreated check	- -	- -	10	9
Primo	96	June	6	9
Primo	96	June, September	6	7
SAN 1269H Clean Cut	8 0.25% (v/v)	June	8	9
SAN 1269H Clean Cut	8 0.25% (v/v)	June, September	8	8
Significance Level (p)			0.0001	0.0001
LSD (p=0.05)			1	1

TABLE 2: Treatments were applied June 11 and September 12, 1996. The entire study area was mowed to a 5 inch height on May 31, 1996. The mowed halves of the plots were cut to a 6 in height on July 29 and September 3. Measurements of average canopy height were taken across the entire plot on June 24 and July 26. Measurements were taken for each half of the plot on September 3 and October 28, 1996. There was no significant interaction between the mowed (3X) vs. mowed (1X) portions of each plot and the values reported for the September and October ratings are an average between mowed (3X) and mowed (1X) values. Each value for the June and July ratings is the mean of three replications, and September and October values are the mean of six observations (three replications, two mowing treatments).

PGR	Application Rate	Application Timing	Turf Canopy Height Jun 24	Jul 26	Sep 3	Oct 28
	(oz/ac)		(-------------------------------- in -----------------------------)			
untreated check	- -	- -	6	9	10	9
Primo	96	June	4	7	10	8
Primo	96	June, September	4	7	10	7
SAN 1269H Clean Cut	8 0.25% (v/v)	June	5	9	11	9
SAN 1269H Clean Cut	8 0.25% (v/v)	June, September	5	10	11	9
Significance Level (p)			0.03	0.007	0.05	0.07
LSD (p=0.05)			1	1	n.s.	n.s.

TABLE 3: Effect of mowing on turf color and canopy height. Treatments were applied June 11 and September 12, 1996. The entire study area was mowed to a 5 inch height on May 31, 1996. The mowed (3X) halves of the plots were cut to a 6 inch height again on July 29 and September 3. Ratings of turf color and average canopy height were taken for each half of the plot on September 3 and October 28, 1996, where '1' denotes no green tissue remaining and '10' denotes healthy, green turf. There were no differences in turf color at the September rating, therefore the data is not reported. Each value is the mean of fifteen observations (three replications, five treatments).

	Turf Color	Turf Canopy Height	
	Oct 28	Sep 3	Oct 28
	(1-10)	(-----------in------------)	
mowed (1X)	7	11	9
mowed (3X)	9	10	8
Significance Level (p)	0.04	0.8	0.6
LSD (p=0.05)	1	n.s.	n.s.

EVALUATION OF VARIOUS MULCHES FOR USE IN NEW SEEDINGS

INTRODUCTION

A study was established along a roadside right-of-way in 1996 to evaluate various mulches used in the establishment of new seedings. The first objective of the study was to evaluate the effectiveness of the mulches for aiding in the development of new seedlings and the second was the ability of the mulch to avoid being displaced due to wind. PennDot currently utilizes straw mulch or wood-cellulose based hydromulches to establish newly seeded areas. Although the straw mulch has proven to be an effective mulching material for assisting in seedling growth, the relentless winds created by traffic movement cause the straw mulch adjacent to the road shoulder to be blown off the site. The stability and support of seedling development of several new mulches were evaluated in this study.

MATERIALS AND METHODS

The study was established in the median on SR 15 near Williamsport, PA. The area was sprayed with 4 qts/ac RoundUp on April 22, 1996 by PennDot employees to control all existing vegetation. On May 9, 1996, plots were seeded and mulch was applied. The various mulch treatments included no mulch, PennMulch[1/] alone, PennMulch plus tackifier[2/] , PennMulch (wetted), Standard Hydroseeding, Straw Mulch plus tackifier, and Airtrol Geobinder[3/]. Soil Guard[4/] was also a treatment intended for this study, but due to inclement weather conditions at the time of the application, Soil Guard was not applied. The proposed treatment area then served as an unseeded, unmulched plot for evaluating the extent of weed pressure at the site.

All plots were seeded with identical rates of seed, lime and fertilizer in an aqueous solution through a Finn Hydroseeder. Pelletized lime was distributed at 89 lbs/1000 sf. Two fertilizer blends were applied, including 10-20-20 at 15.6 lbs/1000 sf and 39-0-0 sulfur coated urea (SCU) at 5.6 lbs/1000 sf. The turfgrass seed used was annual ryegrass plus PennDot's Formula L mix at 0.33 lb/1000 sf and 2.7 lbs/1000 sf, respectively. Formula L is comprised of 60% hard fescue and 40% creeping red fescue by weight. All plots were 50 by 100 ft and arranged in a randomized complete block design with three replications.

The seed and soil amendments were first applied to the unmulched, PennMulch, and straw mulch plots in a water carrier through a Finn Hydroseeder. The appropriate mulching material was then applied to the plots. For both the standard hydroseeding and the Airtrol treatments, the seed and soil amendments were applied in combination with the mulch material.

PennMulch is a recycled paper mulch that is manufactured in a pelletized form and is formulated with a 1-3-1 starter fertilizer. At the rate used in this study, 75 lbs/1000 sf, it provides 0.75 lbs of nitrogen, 2.2 lbs of phosphorus, and 0.75 lbs of potassium per 1000 sf. This fertilizer would be in addition to what was applied and made available from the 10-20-20 and 39-0-0. PennMulch can be applied using a variety of dry spreaders. In this study, a 3 ft Gandy drop spreader was utilized. Following seeding and mulch application, the PennMulch was either left alone, wetted with water, or sprayed with a tackifier. The plots wetted after application were sprayed with water through a hydroseeder at approximately 100 gal/1000 sf. PennMulch plus tackifier plots were sprayed with a mixture including Finn A500 Hydro Stik applied at 0.7 lb/1000 sf and a hydro mulch[5/] applied at 3.4 lbs/1000 sf. This tackifier mix was applied in water through a hydroseeding unit.

[1/] PennMulch, PennTurf Products, Inc., State College, PA.
[2/] Finn A500 HydroStik, Finn Corporation, Fairfield, OH.
[3/] Airtrol Geobinder, United States Gypsum Company, Chicago, IL.
[4/] Soil Guard Bonded Fiber Matrix, Weyerhaeuser Engineered Fiber Products, Snoqualmie, WA.
[5/] Conwed Hydro Mulch, Conwed Fibers, Hickory, NC.

Following seeding, the straw mulch was applied by hand to achieve approximately 133 lbs/1000 sf. This is the recommended application rate as described in Penn Dot's current Publication 408 specifications. The same tackifier mixture utilized on PennMulch was then applied.

The standard hydroseeding treatment included the seed, lime, fertilizer, hydro mulch[5/], and Finn A500 Hydro Stik tackifier in a single aqueous mix. The A500 tackifier was applied at 40 lbs/acre and the hydro mulch was applied at 1,500 lbs/acre.

Airtrol is a product marketed for erosion control on steep slopes where it has proven very successful at aiding in the establishment of vegetation while minimizing soil loss. Like the standard hydroseeding treatment, all the seed, soil amendments, and mulching materials were applied in one complete aqueous mix. The Airtrol mulch mixture included the plaster-like Airtrol Geobinder applied at 6,000 lbs/acre, a hydro mulch[5/] applied at 1,675 lbs/acre, and Finn A-700 Fiber Plus tackifier at 20 lbs/ac.

All treatments include filling, mixing, and applying all necessary materials. All of the treatments, with the exception of the unseeded/unmulched plots, utilized a hydroseeding unit with a two person crew to apply the seed and soil supplements. The tackified and wetted PennMulch treatments had the hydroseeding unit return and apply either the tackifier or water after the PennMulch was spread on the plot. Tackifier was also applied by the hydroseeding unit after the straw mulch was applied. These additional steps added to the overall time needed to accomplish these treatments.

On August 1, 1996 the study was mowed at a height of six inches using a six foot rotary mower mounted on a Ford tractor. This mowing was performed to control the tall growing weeds that were present throughout the study and threatened to shade the establishing turfgrass stand. Ratings of percent groundcover of the mulch material were taken May 15, June 7, July 8, August 29, and October 7. A rating of total vegetative groundcover of the plot, including desirable grasses and undesirable weeds, and a rating of desirable turf groundcover was taken June 7, July 8, August 29, and October 7. The amount of time required for application of each treatment and the associated expenses of the mulching materials were recorded.

RESULTS

Though the unmulched control had a high percentage of vegetative groundcover, all of the mulch treatments resulted in higher percentages of desirable turf groundcover (Table 1).

Other than a slight difference in mulch groundcover on May 15, there were no differences between the PennMulch treatments in mulch, vegetative, or desirable turf groundcovers at any rating period. Most of the mulch was decomposed within two months of application. Two months after application over 80% of the treated area was covered with vegetation, with about half of it desirable turf. Five months after application there was almost total vegetative cover, with about two-thirds of it desirable turf.

Vegetative and desirable groundcover ratings for the standard hydroseeding treatment were initially lower than the PennMulch treatments, but were nearly the same by the final rating. The initial mulch cover was higher for standard hydroseeding than the PennMulch treatments, but like the PennMulch, the mulch was essentially gone by the final rating.

The straw mulch plus tackifier and the AirTrol provided the highest percent mulch groundcover initially, and the highest percent desirable turf groundcover in the last two months of the study. Straw mulch had the largest percentage of desirable turf cover establish early with 42% desirable turf groundcover by June 7, 1996 (29 DAT). Both mulches provided longer coverage of the soil than the other treatments, with the straw mulch still providing over 80 percent coverage at the conclusion of the study.

The Airtrol treatment required the longest time to apply in this study. This may not be an accurate assessment because the hydroseeding unit used to apply this treatment only had a 300 gallon capacity. This required two tanks to apply the total 4,500 sf treated. Most of the other hydroseeding work was accomplished using an 800 gallon capacity unit. A larger capacity hydroseeder would have eliminated the time to refill with water half way through the plots, thus reducing the amount of man-hours required.

CONCLUSIONS

Though the unmulched control had a high percentage of vegetative groundcover, it had a low percentage of desirable turf groundcover, meaning it had a large infestation of weeds. The mulched plots all had higher amounts of desirable turf groundcover with fewer weeds. The application of any of these mulches at the time of seeding is highly desirable.

The man-hours in table 2 reflect the time it took to apply the treatments to small plots in a research setting. These are not necessarily an accurate measurement of what may occur under field conditions, in which the contractor is geared up to apply larger volumes and the source of water may be closer or perhaps further than what was encountered for this study. However, the major cost involved was not the manhours required, but the cost of materials.

The straw mulch was the most persistent mulching material used in the study. However, even though a tackifier was applied, it was lost from wind along the five feet adjacent to the roadway shoulder. PennMulch, standard hydroseeding, and Airtrol were not greatly affected by the wind created from traffic.

PennMulch served as an acceptable mulching material for this test. The mulch itself was not lost by the forces of wind. It also had 63% - 67% desirable turf groundcover by the final rating period. Wetting or tackifying the mulch did not statistically improve the results.

Standard hydroseeding statistically proved as effective as PennMulch in aiding in the establishment of desirable turf. It's low cost makes it a more feasible treatment for large areas along roadsides.

Straw mulch is the standard method currently being used by Penn Dot for mulching newly seeded areas. Although there was some loss of the straw on the shoulders of the roadway, the straw remained relatively intact over the remainder of the plot. This treatment provided successful turf establishment and the mulch remained in the plots even five months after application. Standard hydroseeding proved to be the most cost effective mulching material applied in this study. It is the opinion of the authors that the manhours listed in Table 2 may not be valid if the work were performed on an operational scale. The time to apply straw mulch may actually be less than the time needed to hydroseed a given area.

Airtrol provided the greatest percentage of desirable turf establishment. However, in this study the required man hours and the material costs are substantially higher than all other treatments. The price of this treatment makes it cost prohibitive for use against wind loss on relatively flat, large acreage areas where there are other suitable, less expensive options available.

A possible solution to the blowing of the straw mulch along the roadways, could be to utilize another mulch, such as PennMulch or Airtrol, over the 5 or 10 ft closest to the road edge. The rest of the area could then be mulched with straw.

Table 1: Treatments were applied May 9, 1996. Initial ratings of percent mulch groundcover were taken May 15, 1996. Ratings of percent mulch groundcover, total vegetative groundcover and desirable turf groundcover were taken on June 6, July 8, August 29, and October 7, 1996. Each value is the mean of 3 replications.

	Mulch Groundcover					Vegetative Groundcover				Desirable Turf Groundcover			
	5/15	6/7	7/8	8/29	10/7	6/7	7/8	8/29	10/7	6/7	7/8	8/29	10/7
	(---------------------------%---------------------------)					(---------------------%-----------------------)				(---------------------%-----------------------)			
Control - unmulched	0	0	0	0	0	23	84	89	96	10	18	23	35
PennMulch alone	73	60	12	12	3	42	87	94	97	28	37	50	63
PennMulch + Tackifier	82	70	16	9	4	42	83	93	97	28	40	52	65
PennMulch (wetted)	69	67	11	5	2	43	87	94	97	27	40	50	67
Hydro Seeding	88	73	6	2	0	27	75	92	97	12	29	43	57
Straw Mulch + Tackifier	95	78	80	82	82	52	88	91	97	42	65	70	75
AirTrol	97	97	60	65	10	15	81	92	97	10	46	73	82
Unseeded and Unmulched	--	--	--	--	--	9	45	78	80	--	--	2	7
Significance Level (p)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0031	0.0059	0.0001	0.0001	0.0001	0.0001
LSD (p=0.05)	6	11	13	9	4	12	12	7	8	8	12	12	10

Table 2: The manhours needed to apply each treatment in the study and the material costs for the mulch and associated products used.

	Manhours	Material Costs[1/]
	(hrs/1000 sf)	($/1000 sf)
Control - unmulched	0.22	0
PennMulch alone	0.37	18.00
PennMulch + Tackifier	0.70	20.58
PennMulch (wetted)	0.70	18.00
Hydro Seeding	0.44	7.52
Straw Mulch + Tackifier	0.56	14.26
AirTrol	0.89	51.26

[1/] Seed, lime and fertilizer prices are not included in the material costs listed since they would remain constant regardless of the mulch treatment chosen. These prices reflect the cost of the mulching materials only.

CONVERSION OF A MECHANICALLY BRUSHED AREA TO A DESIRED GROUNDCOVER

INTRODUCTION

A demonstration was established to evaluate the conversion of an area previously infested with weeds and brush into an area of PennDOT's Formula L (55% hard fescue, 35% creeping red fescue, and 10% annual ryegrass). Formula L serves as a very beneficial groundcover along roadways because it requires little maintenance and is very competitive against weed and brush invasion. Also, a grass groundcover can permit a <u>selective</u> herbicide application to be performed for control of any broadleaf weeds or brush which may encroach.

MATERIALS AND METHODS

As part of a brush clearing demonstration on November 8, 1995, an area along SR 322 near Port Royal, PA, was cleared with a machine containing a 'mulching' unit on the front. This unit was similar to hydroaxes used on utility rights-of-way and was capable of removing vegetation ranging in size from herbaceous weeds to large trees. The unit traveled through the area and mowed or mulched the existing vegetation (weeds and brush) into small fragments. The existing weeds included goldenrod (*Solidago* spp.), crownvetch (*Coronilla varia*), and foxtails (*Setaria* spp.); and the existing brush was comprised of poplar (*Populus* spp.), maple (*Acer* spp.), and cedar (*Juniperus* spp.).

Because the area had been cleared of weeds and brush, it was an opportune time to reseed it to a desired groundcover. Therefore, this 'mulched' area, approximately one half acre in size, was seeded with 100 lbs/ac of Formula L on April 8, 1996. Belly mounted spreaders were utilized for the seeding operation. The litter remaining on the surface from November, served as an excellent mulch cover for the seeding.

An observation of the Formula L establishment was made on September 18, 1996.

RESULTS

By September 1996, there was over 80% groundcover of Formula L at the site. A few areas had sparse turf, but they were shaded by the canopy of goldenrod plants. Weeds present throughout the area included goldenrod, hemp dogbane (*Apocynum cannabinum* L.), crownvetch, clover (*Trifolium* spp.), common dandelion (*Taraxacum officinale*), foxtail, Pennsylvania smartweed (*Polygonum pensylvanicum*), common burdock (*Arctium minus*), and common eveningprimrose (*Oenothera biennis*). A few poplar resprouts were also present. Overall, the amount of weeds and brush present in 1996 were less than in 1995.

CONCLUSIONS

It appears this method of converting a weed and brush infested area along the roadside to a desirable groundcover can be successful. To further promote the growth and success of the Formula L, a herbicide application to control broadleaf weeds and brush should be made to the site during 1997. This site will continue to be monitored and maintained as necessary for several more years.

ROADSIDE VEGETATION MANAGEMENT DEMONSTRATIONS - DISTRICT 4-0

INTRODUCTION

In a continuing effort to evaluate different vegetation management practices along the roadside, several demonstrations were established near Wilkes-Barre, PA throughout the 1994 and 1995 seasons. These demonstrations included three for the control of brush: comparing broadcast versus spot foliar applications, evaluation of basal bark application timing, and evaluation of several basal bark diluents. Two other demonstrations were established evaluating the control of Giant knotweed (*Polygonum sachalinense* F. Schmidt ex Maxim) and selective weed control in a planting of Daylillies (*Hermerocallis* spp.). Each of the demonstrations are separately discussed within this article.

BROADCAST VERSUS SPOT FOLIAR APPLICATIONS

Foliar brush control can be performed either through broadcast applications or spot treatments. Broadcast applications are usually truck based which limits the treatment area. Spot applications can be either truck based or backpack applied. A wide variety of equipment and herbicide options are available to accommodate either application method. Both of these application methods were evaluated in this demonstration for their effectiveness in controlling brush and also their ability to limit damage to desirable understory. Thinvert RTU, a ready-to-use invert emulsion, was also compared against water as a carrier. When Thinvert is used as a carrier the total mixture is usually applied at low volume rates, typically in the range of 5 gallons per acre (GPA).

MATERIALS AND METHODS

On September 13, 1994, the foliar treatments were applied for a total distance of three miles along both sides of SR 2040 in Luzerne County, PA. Three of the four treatments evaluated were truck based. The first treatment was a broadcast application and utilized a mounted Radiarc delivering approximately 15.5 GPA. The targeted treatment area included stems 4 to 13 feet above the ground (a 9 foot vertical spray pattern). This treatment contained 6 qts/ac Krenite S, 2 oz/ac Arsenal, 0.125% v/v QwikWet 357, and 0.5% v/v Formula 358 drift control. A total volume of 2.6 gallons of solution/mile was applied. The two remaining truck based applications were spot treatments with an applicator situated on the bed of the vehicle applying more selectively to the targets. Each application was made with a treatment of 5% Krenite S and 0.5% Arsenal in either water (aqueous) or Thinvert RTU. The aqueous spot treatment also had QwikWet 357 and drift control (Formula 358) added at 0.125% v/v and 0.5% v/v, respectively. The handgun used for this application was equipped with either a 1508 tip for applying the aqueous solution or a Thinvert 15105 tip for applying the Thinvert solution. The aqueous spot treatment used an average of 3.6 gallons of solution/mile and the Thinvert spot treatment used an average of 1.3 gallons of solution/mile.

The fourth treatment was a backpack applied spot treatment. Applicators equipped with piston pump backpack sprayers and a Spraying Systems #5500 adjustable ConeJet nozzle with a Y-2 tip, walked and treated the treatment area. The herbicide mixture used contained 5% Krenite S, 0.5% Arsenal, 0.125% v/v QwikWet 357, and 0.5% v/v Formula 358. A total of 2 gallons of solution/mile was applied.

The targeted brush consisted of both low growing trees and overhanging branches of red maple (*Acer rubrum* L.), red oak (*Quercus rubra* L.), white oak (*Quercus alba* L.), green ash (*Fraxinus pennsylvanica* Marsh.), american beech (*Fragus grandifolia* Ehrh.), quaking aspen (*Populus tremuloides* Michx.), and black cherry (*Prunus serotina* Ehrh.). Evaluations were made on September 8, 1995, and September 5, 1996.

RESULTS AND CONCLUSIONS

The broadcast application with the Radiarc provided complete control of any trees smaller than ten feet that were located within the target area. Larger trees were side trimmed. Very little understory damage was noted at either rating. The truck based aqueous and Thinvert spot treatments allowed greater flexibility over the Radiarc in reaching overhanging branches. Some of the lower overhanging branches were controlled with these treatments. However, due to the translocation of the herbicides applied, several red maples greater than 20 feet in height were severely injured in the aqueous plots and moderately injured in the Thinvert plots. No understory damage was noted with any of these applications.

The backpack application provided good control of the smaller trees and only side-trimmed larger stems. The spray zone was less than the truck based applications because the applicators were applying the material from the ground. No understory damage was noted with this application.

All four treatments provided good control overall with very little ground cover damage. The truck based Thinvert spot treatment used the least material (1.3 gallons/mile) followed by the backpack application (2 gallons/mile), Radiarc (2.6 gallons/mile), and truck based aqueous spot treatment (3.6 gallons/mile). These application volumes will vary however from site to site depending upon the conditions. The aqueous spot treatments provided some objectionable injury to trees greater than 20 feet in height. This was due primarily to a more aggressive application technique (which targeted overhanging branches) than the broadcast treatment and a higher application rate than in the Thinvert plot. Any of the treatment methods used in this demonstration have proven to provide favorable results. However, the more aggressive the application the greater the likelihood of off-target damage.

EVALUATION OF BASAL BARK APPLICATION TIMING

Previous basal bark applications conducted in April on tree-of-heaven or ailanthus (*Ailanthus altissima* Mill.) have produced significant root sprouting. This demonstration was established to determine the effect of different application timings on the control of the treated stems and on the control of root sprouts for ailanthus. Two basal bark herbicide treatments, applied at three different times, were compared.

MATERIALS AND METHODS

The two herbicide treatments were 20% (v/v) Garlon 4 and 20% (v/v) Access, each diluted in HyGrade Basal Oil. The demonstration area was located along SR 81 near Wilkes-Barre, PA. The average plot size was 55 feet by 45 feet. The treatments were applied on December 13, 1994, February 17, 1995, and April 13, 1995. Piston pump backpack sprayers equipped with adjustable conejet nozzles and Y-2 tips were used in the application. The lower 15 inches of the stems were treated. The predominant species was ailanthus; however, some poplar (*Populus* spp.), sumac (*Rhus* spp.), black birch (*Betula lenta* L.), and gray birch (*Betula populifolia* Marsh.) were also present within the demonstration area. The diameters of the treated ailanthus ranged in size from 0.5 inch to 6 inches.

Penevator Basal Oil was also used as a basal diluent during the April application. On the morning of April 13, 1995, rainfall had caused the stems to become wet. The application for the timing demonstration was applied after the rain had stopped and the bark was dry when the stems were treated. However, in an attempt to evaluate applications made to wet bark, both Garlon 4 and Access at 20% (v/v) in HyGrade Basal Oil at 80% (v/v), were applied to an area adjacent to the timing demonstration. The same application equipment used for the timing demonstration was utilized.

The demonstration was reviewed on June 15 and August 7, 1995, and September 5, 1996.

RESULTS AND CONCLUSIONS

All treatments were effective in controlling the treated stems regardless of timing or material. Root sprouts from ailanthus were present in every plot. However, Access had fewer root sprouts ranging from 5% to 10% groundcover within the plot during the August 1995 rating. These percentages increased by the second year (September 1996 rating) to 10% to 25%. The root sprouts in the Access plots continued to express obvious herbicide symptoms even in the second year. The February timing for Access had the lowest root sprout groundcover rating at both rating dates (5% and 10%, respectively), but the differences were not great enough to suggest that this timing was more effective.

The Garlon 4 treatments had from 25% to 65% groundcover from ailanthus root sprouts by the August 1995 rating. These percentages increased to 65% to 90% by the second year rating. For this treatment, the April timing had the lowest groundcover from root sprouts rating at both dates (25% and 65%, respectively). Again, this difference is not great enough to suggest that this timing was more effective.

Where understory was present (primarily crownvetch) it was significantly more damaged by the Access treatments regardless of timing. Minimal groundcover damage was encountered with the Garlon 4 treatments.

The April 13, 1995, application made to wet stems provided over 95% control of the treated trees. Minimal resprouting was encountered primarily due to the small percentage of ailanthus located in these plots. Some visible damage was evident on the understory by the August 1995 rating, but by September 1996 the understory covered approximately 80% of both plots (primarily crownvetch).

It was apparent in this demonstration that timing did not play a critical role in the control of ailanthus using basal bark applications. Both Garlon 4 and Access provided complete control of the treated stems. Access provided a noticeable reduction in root sprouts over Garlon 4, but also created greater understory damage. This would suggest that some of the picloram from the Access was present in the soil around the treated stems. Also, it does not appear that the wet bark had a great impact on the movement of these materials into the plant. However, there was no rainfall encountered following the application. It is difficult to distinguish treated stems when the bark is wet with this type of application. Perhaps a dye indicator would help resolve this problem when wet stems are encountered.

EVALUATION OF BASAL BARK DILUENTS

A demonstration was established to evaluate the effect of six herbicide diluents on the control of black locust (*Robinia pseudoacacia* L.) with basal bark applications. These diluents, utilized as the carrier in basal bark applications, assist the chemical in penetrating the bark of the tree.

MATERIALS AND METHODS

The demonstration area was located along SR 81 near Wilkes-Barre, PA, on a west facing cut slope. The diluents tested included three petroleum-based products; Arborchem Basal Oil, HyGrade I Basal Oil, and Penevator Basal Oil; two vegetable-based products; JLB Oil Plus and Penevator Vegetable Oil; and Dyne-Amic, an organosilicone/methylated seed oil blend. Dyne-Amic is not currently labeled for basal bark applications, but it has proven to be an effective spray adjuvant in other applications. The black locust stems were treated February 17, 1995, with a solution containing 95 percent (v/v) diluent and 5 percent (v/v) Garlon 4. The concentration of Garlon 4 was below label rates, but was used to isolate any differences in control provided by the various diluents. The treatments were applied using a CO_2 powered backpack sprayer equipped with an adjustable conejet nozzle and a Y-2 tip. Typically, the lower 12 to 18 inches of the stems are treated, however in this demonstration only the lower 6 to 8 inches were treated. This simulated the coverage height used in other concurrent basal bark diluent studies using syringes and applying 1 ml/inch circumference of the tree. The plot size averaged 35 feet by 40 feet. Although black locust was the predominate species, other species present included: staghorn sumac (*Rhus typhina* L.), ailanthus, gray birch, and boxelder maple (*Acer negundo* L.). The site was evaluated on June 15, 1995, and September 5, 1996.

RESULTS AND CONCLUSIONS

At the June 1995 rating all treatments had 70 percent or greater control except Dyne-Amic which caused only moderate injury to the treated stems. By September 1996, all treatments had total control of the treated stems except Dyne-Amic which had approximately 50 percent control. No understory damage was noted with any of the treatments. Differences in resprouting of the black locust were observed during the September 1996 rating. HyGrade I Basal Oil and Arborchem Basal Oil treatments resulted in minimal resprouting. Penevator Basal Oil, Penevator Vegetable Oil, JLB Oil Plus, and Dyne-Amic all had significant resprouting occur.

All the diluents used in the demonstration provided favorable results on controlling the treated stems except Dyne-Amic. HyGrade I Basal Oil and Arborchem Basal Oil appeared to provide better control of resprouts with this species.

GIANT KNOTWEED CONTROL

Giant knotweed (*Polygonum sachalinense* F. Schmidt ex Maxim) and Japanese knotweed (*Polygonum cuspidatum* Sieb and Zucc.) are becoming an increasing problem along Pennsylvania's roadways. A study was established in 1994 to evaluate several herbicide combinations that would successfully control this problem weed species with limited soil residual activity. Two of the best performing treatments from that study were applied in this demonstration to substantiate the effectiveness of these combinations.

MATERIALS AND METHODS

The demonstration area was located on the shoulder of I-81 south, exit 49B near Wilkes-Barre, PA. The two treatments were each applied to half of a large stand of Giant knotweed on September 13, 1994, using an Echo motorized backpack sprayer equipped with a GunJet handgun and D8 tip. The targeted application rate was 50 gallons per acre. Treatments were either 2% (v/v) RoundUp plus 0.125% (v/v) Arsenal or 1.5% (v/v) Vanquish plus 0.125% (v/v) Transline. Both herbicide treatments contained 0.125% (v/v) QwikWet 357 and 0.5% (v/v) Formula 358 drift control agent. An evaluation of the control was made on June 15, 1995, and September 5, 1996.

RESULTS AND CONCLUSIONS

Both herbicide combinations provided excellent control. A few resprouts and misses were present in the center of each treatment area during the first year following treatment. Approximately 10 to 30 percent groundcover from resprouts was present in each plot by September 1996. Therefore, a follow-up treatment would be necessary to obtain 100 percent control. The original groundcover damage was limited to the actual treatment area with no lateral movement of the herbicides evident with either combination. By September 1996 very little understory damage, which was comprised primarily of crownvetch, was evident in either plot.

SELECTIVE WEED CONTROL IN DAYLILLIES

A demonstration was established to evaluate selective weed control in daylilly (*Hermerocallis* spp.) plantings and to observe the tolerance of the daylillies to Fusilade 2000 and Transline herbicides.

MATERIALS AND METHODS

An area located adjacent to SR 309 near Wilkes-Barre, PA was planted to daylillies in 1993. At the time the applications were made (May 11, 1995) the daylillies were well established. The daylilly plantings were divided into five separate plots including an untreated check and 48 oz/ac Fusilade 2000 alone or in combination with 2, 4, or 6 oz/ac Transline. All treatments contained a surfactant (QwikWet 357) and drift control agent (StaPut) at 0.125% v/v and 0.25% v/v, respectively. The treatments were applied using either a CO_2 powered backpack sprayer or an Echo motorized backpack sprayer equipped with a six foot boom and XR 8002 VS tips to achieve 20 GPA. Weeds covered from 5 to 30 percent of the plots at the time of application and included: hairy vetch (*Vicia villosa* Roth.), Canada bluegrass (*Poa compressa* L.), Tall fescue (*Festuca arundinacea* Schreb.), fine fescue (*Festuca* spp.), crownvetch (*Coronilla varia*), goldenrod (*Solidago nemoralis*), Canada thistle (*Cirsium arvense* L.), buckhorn plantain (*Plantago lanceolata* L.), spotted knapweed (*Centaurea maculosa* Lam.), bull thistle (*Cirsium vulgare*), common dandelion (*Taraxacum officinale* Weber.), black medic (*Medicago lupulina* L.), and rough cinquefoil (*Potentilla norvegica* L.). An evaluation was made on August 7, 1995, 88 days after treatment.

RESULTS AND CONCLUSIONS

There was no apparent damage to the daylillies 88 DAT with any of the treatments, as many of the plants were in bloom. Therefore, if weed infestations become a problem in daylilly plantings, an application of Fusilade 2000 at 48 oz/ac plus Transline at rates up to 6 oz/ac, can provide selective weed control.

EVALUATION OF ENDURANCE AND PREDICT FOR PREEMERGENCE VEGETATION CONTROL UNDER GUIDERAILS

INTRODUCTION

A combination of Oust and Karmex is the standard treatment for total preemergence vegetation control under guiderails in Pennsylvania. A study was established in Luzerne County to evaluate the preemergence herbicides Endurance and Predict for broad spectrum weed control under a guiderail. Oust and Karmex were used as standard control products. A similar study was conducted in 1995 and is included in the tenth year annual report.

MATERIALS AND METHODS

The study area was located along SR 3036 near Wapwallopen, PA. It was treated with 4 qts/ac RoundUp Pro on May 6, 1996, to control existing vegetation. Preemergence treatments included Endurance and Predict alone, in combination, and with Karmex or Arsenal (Table 1). A standard treatment of Oust plus Karmex and an untreated check were also included. All treatments contained 0.25% (v/v) Polytex A1001 drift control. Preemergence treatments were applied May 6, with a CO_2-powered hand held sprayer equipped with two Spraying Systems OC-04 spray nozzles, delivering 35 GPA at 35 psi. The experimental plots were 3 by 25 feet, arranged in a randomized complete block design with three replications. An initial rating of total vegetative cover present within the plots was taken May 6. Ratings of total vegetative cover and cover by annual weed species within the plots were taken June 7, July 8, and August 12, 1996.

During the June rating, it was noted that poison ivy (*Toxicodendron radicans* L.) was beginning to encroach into many of the plots. A backpack spot application of Garlon 3A was applied on June 9 to control any poison ivy within or behind the test plots.

The plots covered an area 2 ft wide in front and 1 ft behind the guiderail. The 2 ft area in front of the guiderail was accidentally graded by PennDOT crews just prior to the August 12 rating. This disturbance removed a fair amount of the vegetation and any herbicide barrier remaining in the soil surface in front of the rail. Therefore, the study was abandoned following the August rating.

RESULTS

Any decline in values between July and August were associated with the grading process conducted in front of the guiderail. A slight decline may have also been caused by the spot treatment of Garlon 3A for the control of the encroaching poison ivy into the plots.

Initial ratings showed no differences in the amount of vegetation present within the plots. The ratings in June, July, and August, showed no significant difference between treatments, with all providing good to excellent preemergence weed control (Table 1). Predominant biennial or perennial species present within the study area included common eveningprimrose (*Oenothera biennis* L.) and poison ivy. Predominant annual species were common ragweed (*Ambrosia artemisiifolia* L.), giant foxtail (*Setaria faberi* Herrm.), yellow foxtail (*Setaria glauca* (L.) Beauv.), ladysthumb (*Polygonum persicaria* L.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.) and smooth crabgrass (*Digitaria ischaemum* (Schreb.) Muhl.).

CONCLUSIONS

The grading of the road shoulder had a significant affect on the study by displacing any existing vegetation or herbicide barrier within the soil and therefore did not permit a season long evaluation. However, up to the rating in August (96 days after treatment), the results of this study showed that Endurance and Predict alone or in combination with other herbicides, provided control of the vegetation. Results from a similar test conducted in 1995 showed these materials provided season long control; therefore, further testing should be performed to validate this information.

TABLE 1: An initial rating of vegetation was taken May 6, 1996. The study area was treated with 4 qts/ac RoundUp Pro to control existing vegetation, and preemergence treatments were applied, all on the same day. Ratings of percent total vegetative cover and percent cover of annual species were taken June 7, July 8, and August 12, 1996. Each value is the mean of three replications.

		Total Vegetative Cover				Cover of Annuals		
Treatment	Rate	May 6	Jun 7	Jul 8	Aug 12	Jun 7	Jul 8	Aug 12
	(oz/ac)	(------------------------ % ----------------------)				(-------------- % ----------------)		
Untreated Check	- - -	23	11	55	47	7	40	30
Endurance	24.6	35	3	8	17	1	4	6
Predict	48	37	3	6	7	1	3	5
Endurance Predict	24.6 48	42	2	8	9	1	3	4
Endurance Predict Karmex	24.6 32 80	37	1	4	3	1	1	2
Endurance Predict Karmex	24.6 48 80	33	1	1	1	0	1	1
Endurance Karmex	24.6 80	28	1	2	2	1	1	2
Endurance Arsenal	24.6 16[1/]	33	2	3	2	1	1	2
Oust Karmex	3 80	32	1	2	6	0	1	6
Significance Level (p)		0.7	0.0001	0.0001	0.02	0.0001	0.0001	0.02
LSD (p=0.05)		n.s.	2	9	24	1	4	15

[1/] Fluid ounces

USING BURN-DOWN MATERIALS FOR TOTAL VEGETATION CONTROL UNDER GUIDERAILS

INTRODUCTION

Finale and Scythe are classified as 'contact' herbicides that kill or injure all green plant tissue with which they come in contact. They are also sometimes called 'burn down' herbicides because they can induce rather quick control of the tops of actively growing weeds. However, most products like these act only upon the plant surface they come in contact with and have little or no effect on the root system. Therefore, total control of many species may not be obtained as the plant utilizes its energy reserves stored in the root system and produces new growth. Other herbicides, such as Roundup PRO, are classified as 'systemic' herbicides which are absorbed through the leaves and translocated to the plant's root system. Injury symptoms caused by systemic herbicides develop slower than those caused by contact herbicides. Roadside vegetation managers would like a herbicide that provides both rapid and complete control of weeds. The producers of Finale claim it has characteristics of both contact and systemic herbicides by providing quick control of the tops, followed by control of the root system, thus providing complete control of the plant. The producers of Scythe claim it can be combined with Roundup Pro to provide both rapid and complete control.

A study was established along a section of guiderail near State College, PA, to evaluate Finale and Scythe/Roundup Pro combinations for their quickness in producing necrosis and their ability to provide total control of perennial weeds. Another factor evaluated was spray volume, as the manufacturer of Scythe recommends higher volumes for increased efficacy. Another product evaluated in the study was Sahara, a newly released combination of imazapyr (Arsenal) and diuron (Karmex). Both materials are individually placed in a package (referred to as the co-pack). Oust plus Karmex, a standard combination used for long term preemergence control of weeds was used alone or in combination with Finale or Scythe to provide extended weed control.

MATERIALS AND METHODS

Treatments (Table 1) were applied to 3 by 25 foot plots on July 20, 1996, 0 days after treatment (DAT); using a CO_2-powered hand held sprayer. To compare any potential differences in spray volumes, Scythe treatments were applied in 40 GPA and 80 GPA using either two Spraying Systems OC-04 spray tips at 23 psi or two OC-08 spray tips at 36 psi, respectively. Green cover ratings of annual and perennial weed species were taken July 18, 0 DAT; to assess the original weed pressure and July 29, 9 DAT; August 30, 41 DAT; and October 4, 1996, 76 DAT. Predominant weed species were common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.), wild carrot (*Daucus carota* L.), wild parsnip (*Pastinaca sativa* L.), spotted knapweed (*Centaurea maculosa* Lam.), chicory (*Cichorium intybus* L.), white sweetclover (*Melilotus alba* Medik.), giant foxtail (*Setaria faberi* Herrm.), and green foxtail (*Setaria viridis* L.).

RESULTS

The initial green cover ratings (Table 1) were, on average, between 78 and 94 percent for all plots. Finale resulted in the most significant early signs of necrosis to the treated plants 9 DAT. Treatments containing Scythe and Roundup Pro had 50 to 72 percent vegetative green cover 9 DAT. Though Scythe alone at recommended rates can cause tissue necrosis in several hours, the rates used in this study were too low to provide rapid symptoms. Areas treated with combinations of Oust and Karmex or Arsenal and Karmex without a postemergence herbicide had green cover values similar to the control 9 DAT. By 41 DAT, treatments containing Oust and Karmex combined with a postemergence product, and Sahara, provided significantly better control than all other treatments, with green cover 15 percent or less. Finale alone; Finale plus 2,4-D; Finale plus Arsenal; Scythe plus Roundup PRO; and Oust plus Karmex alone all provided poor control.

All treatments began to show an increase in weed pressure 76 DAT. The Finale, Finale plus 2,4-D, and Roundup PRO all continued to show excellent long-term control when used in combination with Oust and Karmex. The Sahara mix also maintained excellent control at this rating period.

Finale, when tank mixed with Oust and Karmex, provided statistically similar results at both the 64 and 128 oz/ac rates. Roundup PRO at 64 oz/ac performed well at both 41 DAT and 76 DAT when tank mixed with Oust and Karmex. Reducing the rate of Roundup PRO to 32 oz/ac and adding Scythe did not significantly reduce control. Treatments comparing Scythe, Roundup PRO, Oust, and Karmex at 40 versus 80 GPA showed no statistical differences between spray volumes at any rating period.

CONCLUSIONS

If both rapid burndown and long-term control are desired, Finale at both 64 and 128 oz/ac, and Finale plus 2,4-D, when combined with Oust and Karmex can be used.

TABLE 1: Treatments were applied July 20, 1996. All treatments, except Roundup PRO, contained 0.125% (v/v) QwikWet 357 and all contained 0.25% (v/v) Polytex A1001 drift control agent. Green cover ratings were taken 0, 9, 41, and 76 DAT. Ratings are the mean of 3 replications. Unless indicated otherwise, all treatments were applied at 40 GPA.

	Treatment	Application Rate	Green Cover of Weed Species 0 DAT	9 DAT	41 DAT	76 DAT
		(oz/ac)	(%)	(%)	(%)	(%)
1.	Untreated Check	- - -	83	82	85	87
2.	Finale	128	82	5	62	75
3.	Finale 2,4-D	128 32	81	4	42	65
4.	Finale Oust Karmex	128 3 96	84	4	4	7
5.	Finale 2,4-D Oust Karmex	128 32 3 96	81	4	2	5
6.	Oust Karmex	3 96	94	73	75	88
7.	Roundup PRO Oust Karmex	64 3 96	85	47	7	17
8.	Finale Oust Karmex	64 3 96	89	7	7	15
9.	Finale Arsenal	128 6	89	7	62	78
10.	Scythe Roundup PRO Oust Karmex	64 32 3 96	78	52	15	32
11.	Scythe @ 80 GPA Roundup PRO	64 32	88	72	86	88
12.	Scythe @ 80 GPA Roundup PRO Oust Karmex	64 32 3 96	86	50	13	28
13.	Scythe @ 80 GPA Roundup PRO Oust Karmex	48 32 3 96	94	57	14	35
14.	Scythe @ 80 GPA Roundup PRO Oust Karmex	32 32 3 96	81	52	14	28
15.	'Sahara' @ 80 GPA Arsenal Karmex	3 ac/co-pack 48 120	91	67	4	11
Significance Level (p)			n.s.	0.0001	0.0001	0.0001
LSD (p=0.05)			--	14	17	21

COMPARISON OF FALL AND SPRING HERBICIDE APPLICATIONS FOR TOTAL VEGETATION CONTROL ON AN AGRICULTURAL SITE

INTRODUCTION

Total vegetation control (TVC) is desired in some commercial, industrial, and roadside situations. To obtain season-long control at recommended rates, herbicides have had to be applied in the spring. Having a product or combination of products that could be applied in the fall and provide control through the following season would widen the application window for total vegetation control. A study was established to evaluate the vegetation control provided by several herbicide combinations, including the experimental product R-6447[1/] , when either fall or spring applied.

MATERIALS AND METHODS

Treatments were applied to an agricultural site located at Penn State's Landscape Management Research Center, near State College, PA. The treatments (Table 1) included an untreated check, R-6447 alone and in combination with Oust. Oust plus Karmex and Spike 80W plus Karmex were also evaluated. All spray treatments included Polytex A1001 drift control agent at 0.25% (v/v). Fall treatments were applied December 8, 1995; and spring applications were made April 22, 1996. The treatments were applied with a CO_2-powered, hand-held sprayer equipped with Spraying Systems XR 8004 VS spray nozzles, delivering approximately 36 gal/ac at 25 psi. The experimental plots were 3 by 15 feet with a 1 foot untreated border between plots. The plots were arranged in a randomized complete block design with three replications. At the time of both the fall and spring application, the test area had very little green vegetation. Ratings of vegetative cover within the plots were taken July 10, August 15, and October 9, 1996.

RESULTS

During the winter of 1995/1996, there was a continuous snow cover from mid-December to late March. The study area was observed throughout the growing season; however, none of the treated plots had enough vegetation to rate until July 10.

All treatments had significantly less cover than the untreated check at all rating periods (Table 1). By October 9, the fall applied Spike plus Karmex treatment and all of the spring applied treatments, except R-6447 alone, were still providing almost total control, with less than 5 percent total groundcover present. The other fall applied treatments provided excellent control through mid-August and by October still had only 10 to 32 percent vegetative cover. For each particular treatment, there were no statistical differences between the fall or spring applications. Most of the borders between plots were void of vegetation; indicating lateral movement of the herbicides into their borders. It was difficult to determine which products moved because of the narrow width of the borders.

Predominant weeds included shepherds purse (*Capsella bursa-pastoris* (L.) Medic.), plantain (*Plantago* spp.), quackgrass (*Agropyron repens* (L.) Beauv.), chicory (*Cichorium intybus* L.), common chickweed (*Stellaria media* (L.) Cyrillo.), and mouse-ear chickweed (*Cerastium vulgatum* L.).

CONCLUSIONS

In this study R-6447 applied alone at either date did not provide season long control. All other treatments, whether applied in the fall or spring, provided good long-term control. In studies conducted in the past fall applied Spike plus Karmex did not provide season-long control when applied under a roadside guiderail. Some possible reasons are the late fall application made in this study, and the coarse soil texture found under guiderails which has

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[1/] R-6447, experimental product, 80% DF, DuPont Agricultural Products, Wilmington, DE.

low chemical adsorptive properties, and the high amount of water that runs off of roadways under guiderails. Based upon the results of this study, further testing of these treatments should be conducted, with paired treatments on agricultural and roadside sites. More combinations of R-6447 should be tested, the fall application should be made earlier, and future studies should include larger borders between plots in an attempt to isolate any products which may move from one plot to another.

TABLE 1: Fall treatments were applied December 8, 1995, and spring treatments applied April 22, 1996. All treatments contained 0.25% (v/v) Polytex A1001 drift control agent. Ratings of percent vegetative cover of the entire plot were taken July 10, August 15, and October 9, 1996. Each value is the mean of three replications.

Treatment	Application Rate	Application Timing	Vegetative Cover July 10	Vegetative Cover August 15	Vegetative Cover October 9
	(oz/ac)		(------------------------	%	-------------------------)
Untreated Check	- -	- -	95	97	97
R-6447	20	Fall	2	12	32
R-6447 Oust	15 3	Fall	0	1	10
Oust Karmex	3 128	Fall	1	6	15
Spike Karmex	64 128	Fall	0	1	4
R-6447	20	Spring	5	9	43
R-6447 Oust	15 3	Spring	0	1	2
Oust Karmex	3 128	Spring	0	0	1
Spike Karmex	64 128	Spring	0	0	3
Significance Level (p)			0.0001	0.0001	0.0001
LSD (p=0.05)			3	7	26

EVALUATION OF WILDFLOWER ESTABLISHMENT IN ROADSIDE TURFGRASSES SUPPRESSED WITH HERBICIDES

INTRODUCTION

The establishment of wildflowers along roadsides has often been preceeded by the eradication of a turfgrass stand with an application of Roundup herbicide. After the flowers die, a void is left in the turfgrass which is open to the invasion of weeds.

A study was conducted in 1995 in which annual flowers were established in tall fescue (*Festuca arundinacea* Schreb.) suppressed with herbicides. The objective was to establish flowers into suppressed turf that could be mowed in the fall, removing the debris of the dead flowers and leaving a stand of established turf. With the turf remaining as a groundcover, it could reduce weed competition with the flowers and provide flexibility of moving the wildflower planting each year. A similar study was conducted in 1996 at Penn State's Landscape Management Research Center.

MATERIALS AND METHODS

Treatments included an untreated check and RoundUp Pro at 0.25, 0.50, 0.75, and 4 qts/ac. Several plant growth regulators were also used, including Ethrel (which is not currently labeled for use on turf) at 8 qts/ac; Primo at 1.5 and 3 qts/ac; Ethrel plus Primo at 8 and 1.5 qts/ac, respectively; and Plateau at 0.063 qts/ac plus 0.125% (v/v) QwikWet 357. All treatments contained Polytex A1001 drift control at 0.25% (v/v). The study area was arranged in a randomized complete block design with three replications. Treatments were applied to 6 by 10 ft plots in an unmowed, mixed stand of tall fescue and Kentucky bluegrass (*Poa pratensis* L.) on May 3, 1996, using a CO_2-powered sprayer equipped with Spraying Systems XR 8004 VS spray tips, delivering 40 GPA at 35 psi. On May 10, 7 days after treatment (DAT), the untreated check was mowed to 1.25 in and clippings removed; the entire study area was verticut two times to a depth of 0.5 in and excess thatch was removed; plots treated with RoundUp Pro at 4 qts/ac were rototilled to simulate a conventional seeding method; and all plots were seeded with annual flowers at 12 lbs/ac. The annual flower mix contained 68% cosmos (*Cosmos bipinnatus* Cav.), 21.5% cornflower (*Centaurea cyanus* L.), and 10.5% tall plains coreopsis (*Coreopsis tinctoria* Nutt.). The study area was mowed September 25. Turf green cover ratings were taken May 3; May 10; June 4, 32 DAT; July 25, 83 DAT; and October 10, 160 DAT. Average canopy height of the turf was measured at each rating period. A ground cover rating of weed pressure in each plot was taken September 10, 130 DAT. Ratings of ground cover and average heights of the flowers were taken July 25 and September 10. Results of turf ratings are reported in Table 1 and flower ratings in Table 2.

RESULTS

Prior to treatment, the plots showed no differences in the amount of desirable turf. All rates of RoundUp Pro initially reduced the turfgrass green cover; however, by July and October, only the 0.75 qts and 4 qts/ac rates of RoundUp Pro still had significantly reduced turf cover compared to the mowed check. No turf reestablished in the plots that were treated with 4 qts/ac RoundUp Pro and rototilled. The RoundUp Pro severely injured the bluegrass but only suppressed the tall fescue. The turf green cover for the plant growth regulator treatments were not significantly different than the mowed check, except for Primo plus Ethrel and Plateau in June. No differences in turf height were observed at any rating period, with initial heights of 5 inches and final heights of 14 inches.

Plots initially contained little weed pressure; however, by the end of the study RoundUp Pro treated plots at 0.5, 0.75, and 4 qts/ac had significantly more weeds than the mowed check and the plant growth regulator treatments.

RoundUp Pro treated plots provided significantly higher wildflower cover than other treatments at both rating periods. At the September rating, RoundUp Pro at 4 qts provided the tallest wildflowers with an average of 50 inches, and the other RoundUp Pro plots had heights from 31 to 39 inches. The mowed check average height was 20 inches. All three flower species germinated in all plots.

CONCLUSIONS

RoundUp Pro at 4 qts/ac plus rototilling resulted in increased wildflower cover and height, however no desirable turf remained. RoundUp Pro at 0.75 qts/ac resulted in increased wildflower cover and height but thinned the turf and had the highest percentage of weed cover at the end of the study. RoundUp Pro at 0.5 qts/ac provided an acceptable stand of wildflowers and desirable turf. The mowed check and plant growth regulator treatments had no reduction in turf and little weed invasion, but had fewer wildflowers.

TABLE 1: Herbicide treatments were applied May 3, 1996. The treatment of Plateau also contained 0.125% (v/v) QwikWet 357 surfactant and all treatments contained 0.25% (v/v) Polytex A1001 drift control agent. Green cover ratings of turfgrass were taken May 3, May 10, June 4, July 25, and October 10, 1996. A weed cover rating was taken September 10, 1996. Each value is the mean of three replications.

	Application	Turfgrass Green Cover					Weed Cover
Herbicide	Rate	May 3	May 10	Jun 4	Jul 25	Oct 10	Sep 10
	(qts/ac)	(------------------------------- %				-------------------------------)	(%)
mowed check	- -	98	100	97	98	99	1
RoundUp Pro	0.25	89	83	76	79	96	11
RoundUp Pro	0.5	99	82	48	78	92	20
RoundUp Pro	0.75	99	77	22	35	78	50
RoundUp Pro	4	98	58	0	0	0	33
Ethrel	8	99	99	94	98	98	1
Primo	1.5	99	98	95	98	99	0
Primo	3	95	99	90	98	99	1
Ethrel Primo	8 1.5	99	97	89	98	98	1
Plateau	0.063	92	97	78	97	99	1
Significance Level (p)		0.15	0.0001	0.0001	0.0001	0.0001	0.0001
LSD (p=0.05)		n.s.	6	7	22	11	13

TABLE 2: Herbicide treatments were applied on May 3, 1996, and the wildflowers were seeded at 12 lbs/ac on May 10, 1996. The treatment of Plateau also contained 0.125% (v/v) QwikWet 357 surfactant and all treatments contained 0.25% (v/v) Polytex A1001 drift control agent. Ground cover ratings and average canopy heights of wildflowers were taken July 25 and September 10, 1996. Each value is the mean of three replications.

Herbicide	Application Rate	Ground Cover Jul 25	Ground Cover Sep 10	Canopy Height Jul 25	Canopy Height Sep 10
	(qts/ac)	(-----------%------------)		(----------- in ------------)	
mowed check	- -	10	20	11	20
RoundUp Pro	0.25	27	50	20	31
RoundUp Pro	0.5	55	82	23	37
RoundUp Pro	0.75	80	93	29	39
RoundUp Pro	4	83	97	32	50
Ethrel	8	10	11	11	22
Primo	1.5	8	23	11	20
Primo	3	10	27	12	24
Ethrel Primo	8 1.5	13	24	13	25
Plateau	0.063	8	30	11	25
Significance Level (p)		0.0001	0.0001	0.0001	0.0001
LSD (p=0.05)		12	15	4	7

EVALUATION OF WILDFLOWER ESTABLISHMENT IN SUPPRESSED TURFGRASS

INTRODUCTION

Studies have been conducted evaluating the establishment of annual wildflowers into a stand of tall fescue (*Festuca arundinacea* Schreb.) suppressed with postemergence herbicides. In this system a sub-lethal dose of a postemergence herbicide is applied to the tall fescue sod. The flower seed is then planted into the suppressed sod. There are several advantages of the system. The remaining sod reduces weed competition with the flowers and provides a groundcover for the site after the flowers die in the fall. Also, this method provides flexibility of moving the wildflower planting each year, without causing permanent injury to the turf.

The injury caused by the herbicide applications can look fairly dramatic for four to six weeks following application. In higher maintenance turf areas, such as roadside rest areas, this injury may be unacceptable. Also, the turf in higher maintenance areas consists of different species of grass, usually Kentucky bluegrass and perennial ryegrass. There are several plant growth regulators (PGR's) on the market that reduce turf vigor without the severity or length of injury caused by the herbicides. This study was established to evaluate this same planting methodology, but using PGR's instead of postemergence herbicides, on the species of turf commonly found in high maintenance areas.

MATERIALS AND METHODS

The study area was located at Penn State's Valentine Turfgrass Research Center. The mixed stand of perennial ryegrass (*Lolium perenne* L.) and Kentucky bluegrass (*Poa pratensis* L.) was mowed May 1, 1996, to a height of 1.5 inches and clippings were removed. Treatments were established in a randomized complete block design with three replications. They included a mowed check and combinations of the PGR's Ethrel (which is not currently labeled for use on turf), Primo, and Embark LITE. FeRROMEC AC (a liquid iron supplement containing 15% urea nitrogen, 3% combined sulfur, and 6% iron) was added to some of the treatments to help reduce any discoloration the chemicals might cause to the turf. All treatments contained 0.25% (v/v) Polytex A1001 drift control. Treatments were applied May 3 to plots 6 ft by 15 ft with a CO2-pressurized sprayer delivering 40 GPA at 35 psi, through Spraying Systems XR 8004 VS spray tips. On May 13, 10 days after treatment (DAT), the check was mowed to 1.25 inches and clippings were removed. The entire study area was then verti-cut two times to a depth of 0.5 inch, excess thatch was removed, and all plots were seeded with annual flowers at 12 lbs/ac. The annual flower mix included 67% cosmos (*Cosmos bipinnatus* Cav.), 22% cornflower (*Centaurea cyanus* L.), and 11% tall plains coreopsis (*Coreopsis tinctoria* Nutt.). Turf green cover ratings were taken May 3; May 13; June 4, 32 DAT; July 25, 83 DAT; and October 9, 1996, 159 DAT. Average canopy heights of the turf were taken at each rating period. A rating of weed pressure within the plots was taken September 11, 131 DAT. Ground cover ratings and average canopy heights of the flowers were taken July 25 and September 11. The study area was mowed October 8 and clippings were removed prior to the turf green cover rating on October 9.

RESULTS

All plots initially contained between 93 and 96 percent green turf cover with little weed pressure (Table 1). There was little change in the amount of green cover throughout the growing season, with all treatments having 97 percent cover in October. Rainfall during the growing season was approximatly double the average, and the turf never entered a summer dormancy. The only rating which showed any statistically significant difference in turf green cover was on June 4, when Ethrel plus Primo had less green cover than the other treatments. But the difference was not significant on practical basis, because it still had 94% green cover and was almost indistinguishable from the other treatments.

By September, the average turf canopy height reached 5 in. No differences were observed for the average canopy height of the turf for any rating period and the data is not reported. The rating of weed cover in September showed an increase in weeds, but there were no differences between treatments (Table 1). Several turf diseases were more prevelant in 1996 because of the high amount of rainfall that fell consistently through the growing season. Rust and red thread were present throughout the study area in September.

All of the wildflower species germinated in all of the plots. Embark LITE plus FeRROMEC had the lowest groundcover of flowers of all of the treatments at both rating periods (Table 2). On July 25, plots treated with Ethrel alone had a lower groundcover than Ethrel plus Primo or Primo plus FeRROMEC. On September 11, plots treated with Ethrel alone had a lower groundcover of flowers than Ethrel plus Primo. No differences were observed for the canopy height of the wildflowers at either rating period (Table 2).

CONCLUSIONS

All treatments provided a fair stand of flowers. PGR treatments including Primo provided little discoloration or thinning of the turf and had the highest amount of flowers. However, none of the chemical treatments provided any improvement in flower establishment or growth over the untreated control, even in a year when the growing conditions were close to ideal for the turfgrasses. These preliminary results show no benefits from the PGR treatments.

This method of seeding appeared to be effective for growing flowers in an established turf, without severely damaging it. However, the turfgrass did not exceed 5 inches in height during the course of the study, despite the ideal growing conditions. There is some question whether the untreated diseases on the turf suppressed its growth, thus permitting the flowers to become established. Further investigation is necessary to more thoroughly evaluate this wildflower establishment method and the chemicals and their rates used in this study.

TABLE 1: Plant growth regulator (PGR) treatments were applied May 3, 1996. All treatments contained 0.25% (v/v) Polytex A1001 drift control. Percent green cover ratings of turf were taken May 3, May 13, June 4, July 25, and October 9, 1996. The rating of percent weed cover in the plots was taken September 11, 1996. Each value is the mean of three replications.

	Application	Green Cover					Weed Cover
PGR	Rate	May 3	May 13	Jun 4	Jul 25	Oct 9	Sep 11
	(pts/ac)	(------------------------------------ %				------------------------------------)	(%)
mowed check	- -	95	96	98	92	97	12
Ethrel	16	93	96	97	92	97	9
Primo	3	96	95	97	92	97	4
Primo FeRROMEC	6 14	94	98	96	94	97	9
Ethrel Primo	16 3	94	94	94	93	97	3
Embark LITE FeRROMEC	5 14	95	97	98	93	97	2
Significance Level (p)		0.51	0.07	0.01	0.94	- -	0.46
LSD (p=0.05)		n.s.	n.s.	2	n.s.	- -	n.s.

TABLE 2: Plant growth regulator (PGR) treatments were applied May 3, 1996, and the flowers were seeded at 12 lbs/ac on May 13, 1996. All treatments contained 0.25% (v/v) Polytex A1001 drift control. Visual ground cover ratings and average canopy heights of the flowers were taken July 25 and September 11, 1996. Each value is the mean of three replications.

	Application	Ground Cover		Avg. Height	
PGR	Rate	Jul 25	Sep 11	Jul 25	Sep 11
	(qts/ac)	(------------ %	----------)	(--------- in	----------)
mowed check	- -	20	65	8	22
Ethrel	16	12	52	8	20
Primo	3	18	67	8	24
Primo FeRROMEC	6 14	27	70	8	24
Ethrel Primo	16 3	23	72	8	25
Embark LITE FeRROMEC	5 14	8	45	8	23
Significance Level (p)		0.01	0.049	- -	0.25
LSD (p=0.05)		9	19	- -	n.s.

EVALUATION OF PLATEAU FOR WEED CONTROL IN WILDFLOWER ESTABLISHMENT

INTRODUCTION

Plateau (imazameth) has recently been introduced into the vegetation management market to be used as a turf growth regulator, for selective control of Canada thistle in crownvetch, and for weed control in warm season grasses and wildflowers. Plateau is unique because it will selectively remove broadleaf weeds within stands of other broadleaved plants (crownvetch, wildflowers, etc.). A study was established at Penn State's Landscape Management Research Center to evaluate Plateau herbicide for both pre and postemergence weed control during the establishment of annual wildflowers.

MATERIALS AND METHODS

Plateau was applied in both preemergence (pre) and postemergence (post) applications at 6 and 12 oz/ac. Each treatment contained 0.125% (v/v) QwikWet 357 surfactant and 0.25% (v/v) Polytex A1001 drift control agent. The study area was arranged in a randomized complete block design with three replications. The test area was treated with 4 qts/ac Roundup Pro on May 6, 1996, to control all existing vegetation. On May 20, it was rototilled to a depth of 8 inches, and seeded with an annual wildflower mix containing cosmos (*Cosmos bipinnatus* Cav.), cornflower (*Centaurea cyanus* L.), corn poppy (*Papaver rhoeas* L.), rocket larkspur (*Delphinium ajacis* L.), sweet alyssum (*Dianthus barbatus* L.), and tall plains coreopsis (*Coreopsis tinctoria* Nutt.) at 14 lbs/ac. Pre treatments were applied May 31, as a few cosmos seedlings were emerging. The plots were 6 by 10 feet in size and were sprayed using a CO_2-powered hand held sprayer equipped with Spraying Systems XR 8004 VS spray tips, delivering 40 GPA at 35 psi. Post treatments were applied June 28. All wildflower species, except rocket larkspur, were present within the treated plots. Predominant weeds included smooth pigweed (*Amaranthus hybridus* L.), common yellow woodsorrel (*Oxalis stricta* L.), green foxtail (*Setaria viridis* L.), common lambsquarters (*Chenopodium album* L.) and common dandelion (*Taraxacum officinale* L.), and were uniformly mixed among the flowers. Ground cover ratings and average canopy heights of both wildflowers and weeds were taken June 28, July 25, and September 11. Results of the weed ratings are reported in Table 1 and wildflower ratings in Table 2.

RESULTS

A germination test was conducted and all wildflower species germinated; however, rocket larkspur did not germinate in any field plots, including the check. All other species were present within the untreated and postemergence plots and these same species, except sweet alyssum, were present within the preemergence plots. Weed species present at the end of the study were identical to the initial species.

Plateau provided excellent preemergence weed control through the September rating period. Compared to the untreated check, the postemergence applications reduced weed height at the July rating, but not weed cover. By September, there were no differences in weed cover or height between the post treated areas and the untreated check. Ground cover provided by wildflowers was not significantly different for treatments at either the June or September rating periods, however the 12 oz/ac post treatment had less cover in July than the pre treated plots. Pre treatments provided the lowest wildflower canopy heights in June but were not different from the check by September, while the post treated plots stunted the wildflowers and provided the lowest canopy heights in both July and September. Overall, there was little difference between application rate for either the pre or post emergence treated plots for all ratings of weeds and wildflowers. It was observed that the Plateau treatments did affect the growth of the wildflowers compared to the untreated check; especially cosmos, which had a noticeable increase in stem diameter and axillary branching near the base of the stem.

CONCLUSIONS

A permanence treatment at either application rate provided a significant decrease in the amount of weeds and provided a comparable amount of wildflowers to the untreated check. Sweet alyssum does not appear to be tolerant to a preemergence treatment so species must be carefully selected when seeding. Postemergence applied treatments showed no improvement of weed control compared to the check and temporarily thinned the wildflowers.

TABLE 1: Preemergence herbicide treatments were applied May 31 and postemergence treatments June 28, 1996. All treatments contained 0.125% (v/v) QwikWet 357 surfactant and 0.25% (v/v) Polytex A1001 drift control agent. Ground cover ratings of weed pressure and average weed canopy heights were taken June 28, July 25, and September 11, 1996. Each value is the mean of three replications.

Herbicide	Application Rate	Application Timing	Ground Cover Jun 28	Ground Cover Jul 25	Ground Cover Sep 11	Canopy Height Jul 25	Canopy Height Sep 11
	(oz/ac)		(--------------%---------------)			(--------in--------)	
untreated check	- -	- -	83	70	33	40	22
Plateau	6	pre	3	4	5	36	4
Plateau	12	pre	1	1	5	35	4
Plateau	6	post	92	67	22	17	11
Plateau	12	post	90	58	23	15	9
Significance Level (p)			0.0001	0.002	0.05	0.0001	0.3
LSD (p=0.05)			18	32	21	7	19

TABLE 2: Preemergence herbicide treatments were applied May 31 and postemergence treatments June 28, 1996. All treatments contained 0.125% (v/v) QwikWet 357 surfactant and 0.25% (v/v) Polytex A1001 drift control agent. Ground cover ratings of wildflowers and average wildflower canopy heights were taken June 28, July 25, and September 11, 1996. Each value is the mean of three replications.

Herbicide	Application Rate	Application Timing	Ground Cover Jun 28	Ground Cover Jul 25	Ground Cover Sep 11	Canopy Height Jun 28	Canopy Height Jul 25	Canopy Height Sep 11
	(oz/ac)		(----------------%---------------)			(----------------in----------------)		
untreated check	- -	- -	28	30	67	11	35	56
Plateau	6	pre	21	57	50	3	26	52
Plateau	12	pre	24	63	37	3	25	58
Plateau	6	post	30	27	70	11	16	35
Plateau	12	post	37	8	45	11	12	27
Significance Level (p)			0.7	0.1	0.2	0.0001	0.0006	0.0001
LSD (p=0.05)			25	47	35	2	7	7