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DEPARTMENT OF TRANSPORTATION

ROADSIDE VEGETATION MANAGEMENT RESEARCH REPORT TWELFTH YEAR REPORT

THE PENNSYLVANIA STATE UNIVERSITY
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The twelfth 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.

Comparing various herbicides for total vegetation control under guiderails and agricultural sites.

Evaluation of Giant knotweed control and conversion into low maintenance grasses.

Wildflower research evaluating the establishment of annual flowers into turfgrass suppressed with herbicides.

The twelfth 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:

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Exacto Chemical Company
Loft's Seeds
Monsanto
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PBI / Gordon Corporation
Riverdale Chemical Company
Spraying Systems, Inc.
Waldrum Specialties, Inc.

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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 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

Report # PA90-4620 + 85-08 - Roadside Vegetation Management Research Report - Fourth Year Report

Report # PA91-4620 + 85-08 - Roadside Vegetation Management Research Report - Fifth Year Report

Report # PA92-4620 + 85-08 - Roadside Vegetation Management Research Report Sixth Year Report

Report # PA93-4620 + 85-08 - Roadside Vegetation Management Research Report Seventh Year Report

Report # PA94-4620 + 85-08 - Roadside Vegetation Management Research Report Eighth Year Report

Report # PA95-4620 + 85-08 - Roadside Vegetation Management Research Report Ninth Year Report

Report # PA96-4620 + 85-08 - Roadside Vegetation Management Research Report Tenth Year Report

Report # PA97-4620 + 85-08 - Roadside Vegetation Management Research Report Eleventh Year Report

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. 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, 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, 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, roadside vegetation management demonstrations, and total vegetation control under guiderails.

Herbicides are referred to as product names for ease of reading. The herbicides used in each research area are listed 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
Accord	glyphosate	4 S	Monsanto
Arborchem Basal Oil	diluent	- - -	Arborchem Products, Inc.
Arsenal	imazapyr	2 S	American Cyanamid Co.
BreakThru	adjuvant	- - -	Goldschmidt Chemical Co.
Clean Cut	adjuvant	- - -	Arborchem Products, Inc.
Endurance	prodiamine	65 WG	Novartis Crop Protection, Inc.
Escort	metsulfuron methyl	60 DF	E.I. DuPont de Nemours & Co.
Finale	glufosinate-ammonium	1 S	AgrEvo USA Company
Formula 358	drift retardent	- - -	Exacto Chemical Company
Garlon 4	triclopyr	4 EC	DowElanco
HyGrade Basal Oil	diluent	- - -	CWC Chemical Company
Karmex	diuron	80 DF	E.I. DuPont de Nemours & Co.
Krenite S	fosamine ammonium	4 S	E.I. DuPont de Nemours & Co.
MON 59120	adjuvant	- - -	Monsanto
Oust	sulfometuron methyl	75 DF	E.I. DuPont de Nemours & Co.
Pathfinder II	triclopyr	RTU	DowElanco
Pendulum	pendimethalin	3.3 EC	American Cyanamid Co.
Penevator 9	adjuvant	- - -	Exacto Chemical Company
Penevator Basal Oil	diluent	- - -	Exacto Chemical Company
Plateau	imazameth	2 S	American Cyanamid Co.
Polytex A1001	drift retardent	- - -	Exacto Chemical Company
Predict	norflurazon	80 DF	Novartis Crop Protection, Inc.
Princep	simazine	4L	Novartis Crop Protection, Inc.
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.
Sahara	diuron + imazapyr	DG	American Cyanamid Co.
SAN 1269H	experimental	70 WG	Novartis Crop Protection, Inc.
Stalker	imazapyr	2 EC	American Cyanamid Co.
Sun-it II	MSO surfactant	- - -	American Cyanamid Co.
Thinvert (RTU)	invert emulsion	- - -	Waldrum Specialties, Inc.
Tordon K	picloram	2 S	DowElanco
Transline	clopyralid	3 S	DowElanco
Turf Hi-Dep	2,4-D	3.8S	PBI / Gordon Corp.
Vanquish	dicamba-glycolamine	4 S	Novartis Crop Protection, Inc.

EVALUATION OF VARIOUS HERBICIDE MIXTURES FOR BASAL BARK APPLICATION

INTRODUCTION

Basal bark applications offer a very selective method of controlling unwanted brush species. A study was established to compare the current 'standards', Garlon 4 in oil, or the RTU product Pathfinder II, with several herbicide and diluent combinations for their effectiveness at controlling green ash (*Fraxinus pennsylvanica*), black locust (*Robinia pseudoacacia*), and red maple (*Acer rubrum*).

MATERIALS AND METHODS

Treatments were applied on March 26 and 27, and April 3, 1997 to green ash, red maple and black locust, respectively. The treatments included an untreated check, Pathfinder II, Garlon 4 alone or in combination with Tordon K or Stalker, Stalker alone, Accord plus MON 59120 at various rates, Accord plus Stalker, and Krenite S plus Stalker. The green ash plots were located along SR 322 east near Port Matilda, PA; the red maple site was established along SR 219 north near Ebensburg, PA; and the black locust was along I-99 near the Duncansville, PA exit. Both the green ash and red maple were arranged in a completely randomized design with ten replications of one stem each, while the black locust was arranged in a randomized complete block design with two replications. The dimensions of the black locust plots were, on average, 15 by 61 feet. The calipers ranged from 0.5 to 3.25 inches for all three species treated. The lower 12 to 18 inches of the stems were treated using a CO_2-powered backpack sprayer operating at 30 psi equipped with a basal wand containing a Spraying Systems #5500 Adjustable ConeJet nozzle with a Y-2 tip. First year injury ratings were taken using a scale of 1 to 10 with, '1' denoting no injury, '5' indicating moderate defoliation including the terminal, and '10' indicating complete control of the tree. The green ash was rated August 14, red maple August 12, and black locust September 10, 1997. Analysis of covariance was used to adjust tree injury according to stem caliper in red maple.

RESULTS

All the treatments containing triclopyr (the active ingredient in both Pathfinder II and Garlon 4) provided excellent control by the time of the first season rating (Table 1). The addition of Tordon K or Stalker to Garlon 4 did not add to the control of the treated stems since almost complete control was achieved with Garlon 4 alone. The rate of Garlon 4 was reduced to 10 percent, v/v, with the addition of Stalker without sacrificing control. Stalker alone at 5% v/v was not as effective as Pathfinder II, or any of the treatments containing Garlon 4 at 20 percent, v/v.

Accord plus MON 59120 provided excellent to moderate control of green ash and moderate to poor control of black locust and red maple (Table 2). Increasing the rate of MON 59120 from 5 percent to rates of 10 or 25 percent, v/v, did not significantly increase injury. There was a significant increase in injury when the Accord was increased from 25 to 50% v/v and the MON 59120 rate remained the same. Adding Stalker to the Accord plus MON 59120 did not significantly improve control. The Krenite plus Stalker and MON 59120 provided excellent control of green ash only, but this treatment has previously been observed take two seasons before treated plants died.

CONCLUSIONS

Pathfinder II and Garlon 4 alone will provide excellent control of a wide range of tree species at the rates tested in this study. In this trial no advantage was demonstrated by adding either Tordon K or Stalker to the Garlon 4 and at higher rates may actually increase the risk of damage to adjacent desirable vegetation. None of the treatments containing Accord or Krenite S plus MON 59120 provided satisfactory control of all three tree species during the season of treatment. .

Table 1: Treatments were applied March 26, 27 and April 3, 1997 to green ash, red maple and black locust, respectively. Ratings of injury were taken August 12, 14, and September 10, 1997 for red maple, green ash, and black locust, respectively. Injury was rated on a scale of 1 to 10, where '1'=no injury, '5'=moderate defoliation including the terminal, and '10'=complete control of the tree. Each rating value is the mean of ten replications for green ash and red maple and two replications for black locust. The number of black locust stems treated are given in parentheses. Treatment means followed by the same letter within a given column are not significantly different according to Fisher's LSD.

Treatment	Application Rate	Average Tree Injury Rating		
		Green Ash	Black Locust	Red Maple[1/]
	(% v/v)	(average injury rating (no. stems) T-Grouping)		
Check	----	1.1 e	2.0 (47) f	1.2 h
Pathfinder II	RTU	10 a	10 (22) a	10 a
Garlon 4/Arborchem Basal Oil (ABO)	20/80	10 a	10 (69) a	10 a
Garlon 4/Tordon K/ABO	20/5/75	9.8 ab	10 (53) a	10 a
Garlon 4/Stalker/ABO	20/1/79	9.9 a	9.9 (50) a	10 a
Garlon 4/Stalker/ABO	15/3/82	10 a	9.9 (77) a	9.9 ab
Garlon 4/Stalker/ABO	105/85	9.9 a	9.6 (78) a	9.7 ab
Stalker/ABO	5/95	9.8 ab	8.2 (66) ab	8.0 bc
Accord/MON 59120/water	2510/65	8.9 c	2.4 (59) f	2.2 h
Accord/MON 59120/water	25/25/50	9.4 abc	3.4 (29) def	2.8 gh
Accord/MON 59120/water	50/1/49	6.7 d	3.0 (34) ef	4.3 fg
Accord/MON 59120/water	50/5/45	9.0 bc	3.3 (56) ef	4.5 efg
Accord/MON 59120/water	50/10/40	9.8 ab	5.5 (46) cde	6.6 cd
Accord/MON 59120/water	50/10/40	9.8 ab	5.2 (38) cde	4.9 def
Accord/Stalker/MON 59120/water	50/5/22.5/22.5	10 a	6.6 (60) bc	6.4 cde
Krenite S/Stalker/MON 59120/water	50/5/22.5/22.5	9.9 a	5.6 (65) cd	7.7 c

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

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*), red maple (*Acer rubrum*), and tree-of-heaven, AKA Ailanthus (*Ailanthus altissima*) treated with basal bark applications of a standard, Garlon 4 in oil, compared to treatments using Accord or Krenite S.

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 Y-2 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. First season control ratings were taken August 9 and 13, 1996 for ash and maple, respectively; while injury and percent groundcover of resprouts was rated for Ailanthus on September 16. Second year injury ratings were taken August 12 and 14, 1997 for maple and ash, respectively; while tree injury and percent groundcover of resprouts was rated for Ailanthus on September 23, 1997. 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.

RESULTS

Stem caliper had a significant effect on control of ash. Ash data were subject to analysis of covariance, and reported means were adjusted according to stem caliper (Table 1).

Garlon 4 was the only treatment that provided excellent control of treated stems of all three species the first season. This treatment also significantly suppressed Ailanthus resprouting.

Second year results indicated that Accord diluted in Thinvert R was ineffective at all concentrations. Accord diluted in MON 59120 and water was effective on ash; showed a significant response to increasing concentration on maple; and provided variable control of treated Ailanthus stems, but allowed an unacceptable amount of resprouting. The addition of Stalker boosted the performance of Accord at 50 percent, v/v, by improving control of treated stems of Ailanthus and suppressing suckering; despite the reduced dosage at which this combination was applied. Both the Accord plus Stalker, and Krenite S plus Stalker treatments provided the same level of treated stem control and resprout suppression as the Garlon 4 in oil; but took much longer to take full effect.

CONCLUSIONS

Garlon 4 diluted in oil is still the standard by which other basal bark treatments must be judged. However, results from this trial were surprising because previous trials and experience have indicated that Garlon 4 applied during the dormant season through early spring does not suppress suckering in Ailanthus. The significant suppression of suckering during this trial suggests that the phyisiology of basal bark applications is even more complex than we suspected. Krenite S plus Stalker and Accord plus Stalker also provided excellent control of all

three species, but at higher cost and risk to adjacent desirable vegetation. These combinations could only be considered superior to Garlon 4 if they can be demonstrated to provide consistently better resprout suppression of suckering species.

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. First season ratings were taken August 9 and 13, 1996, for ash and maple, respectively; and September 16 for Ailanthus. Second season ratings were taken August 12 and 14, and September 23, 1997, for maple, ash, and Ailanthus, respectively. 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.

		First Season Control				Second Season Control			
				Ailanthus				Ailanthus	
Herbicide	Mix Rate	Green Ash	Red Maple	treated stems	resprout cover	Green Ash	Red Maple	treated stems	resprout cover
	(% v/v)	(average injury rating)			(percent)	(average injury rating)			(percent)
Untreated Check	- -	1.7 d	1.0	1.3	5	1.2 e	1.0	1.0	4
Accord	10	8.8 a	2.7	5.7	47	8.8 ab	2.8	4.3	42
MON 59120	45								
Water	45								
Accord	25	8.9 a	5.3	9.3	68	8.9 ab	8.3	10.0	81
MON 59120	37.5								
Water	37.5								
Accord	50	9.1 a	9.0	4.7	37	9.3 a	10.0	5.7	40
MON 59120	25								
Water	25								
Accord	10	4.4 c	1.0	7.0	70	4.9 cd	1.4	6.7	70
Thinvert R	90								
Accord	25	5.5 bc	1.4	6.0	66	5.4 cd	1.7	6.3	72
Thinvert R	75								
Accord	50	6.6 b	1.2	6.7	43	6.8 bc	2.5	6.0	40
Thinvert R	50								
Garlon 4	20	9.9 a	10.0	10.0	9	10.0 a	10.0	10.0	15
Penevator Basal Oil	80								
Accord	50	10.0 a	6.0	6.7	2	10.0 a	8.9	9.0	8
Stalker	5								
MON 59120	22.5								
Water	22.5								
Krenite S	50	9.2 a	7.9	8.3	3	9.8 a	9.4	10.0	2
Stalker	5								
MON 59120	22.5								
Water	22.5								
Significance Level (p)		0.0001	0.0001	0.003	0.02	0.0001	0.0001	0.001	0.003
LSD (p=0.05)		- -	1.8	3.4	47	- -	1.4	3.6	42

EVALUATION OF BRUSH CONTROL PROVIDED BY BASAL BARK APPLICATIONS OF ACCORD

INTRODUCTION

A study was established to evaluate the control of green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), and tree-of-heaven, AKA Ailanthus (*Ailanthus altissima*) treated with basal bark applications of Accord and MON 59120.

MATERIALS AND METHODS

Treatments included an untreated check; Accord in MON 59120 and water; Garlon 4 in Penevator Basal Oil; and a combination of either Accord or Krentie S with Stalker in MON 59120 and water. Treatments were applied to three separate colonies, or replications, of Ailanthus divided into equal portions on February 12 and 13, 1997 near State College and Bellefonte, PA. Treatments were applied to ten stems each of green ash and eleven stems each of red maple near Port Matilda, PA on February 10. 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 MON 59120 and water 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 backpack sprayer equipped with a Spraying Systems #5500 Adjustable ConeJet nozzle with a Y-2 tip, operating at 30 psi. Stem diameters ranged from 1 to 4 inches for Ailanthus, 0.75 to 3.25 inches for red maple, and 0.5 to 3 for green ash. Ratings of tree injury were taken August 14, 1997 for ash and maple; while tree injury and percent groundcover of resprouts was rated for Ailanthus on September 13, 1997. 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.

RESULTS

Stem caliper had a significant effect on control of maple. Maple data were subject to analysis of covariance, and reported means were adjusted according to stem caliper (Table 1). Accord when used without MON 59120 resulted in poor control of all three species. All treatments including Accord at 25 percent, v/v, provided very good control of green ash and Ailanthus, but only moderate control of red maple. All treatments including Accord at 50 percent, v/v, with MON 59120 provided excellent control of all three species. Garlon 4 in oil, the current industry standard, provided excellent control of all species. Accord plus Stalker and Krenite S plus Stalker provided very good to excellent control of all three species. None the of the treatments provided acceptable suppression of Ailanthus resprouts.

CONCLUSIONS

Accord when applied at 50% with MON 59120 and water has provided excellent control in both this and previous work with the exception of a questionable weakness on Ailanthus on a study established in 1996. MON 59120 is necessary in the mix to obtain control and rates of Accord at 25% or less have shown reduced control of some species. Garlon 4 and the Accord or Krenite S plus Stalker treatments all provided excellent control. However, here is a higher cost and risk to adjacent desirable vegetation when Stalker is added to the mix..

TABLE 1: Tree injury provided by various basal bark treatments applied to green ash and red maple plots February 10, and Ailanthus February 12 and 13, 1997. Treatments were rated August 14, 1997, for maple and ash, respectively; and September 13 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, ten replications for green ash and eleven replications for red maple.

Herbicide	Application Rate	Average Tree Injury Rating			Groundcover of Ailanthus Resprouts
		Green Ash	Red Maple[1/]	Ailanthus	
	(% v/v)	(average injury rating)			(%)
Untreated Check	- -	---	---	1.0	27
Accord	25	9.4	7.5 bc	9.3	65
MON 59120	10				
Water	65				
Accord	25	9.6	8.2 abc	10.0	62
MON 59120	25				
Water	50				
Accord	25	8.9	6.8 c	10.0	54
MON 59120	37.5				
Water	37.5				
Accord	50	6.8	3.3 d	2.7	22
Water	50				
Accord	50	9.2	9.4 ab	10.0	42
MON 59120	5				
Water	45				
Accord	50	9.5	9.8 a	9.7	56
MON 59120	10				
Water	40				
Accord	50	9.5	9.5 ab	10.0	62
MON 59120	25				
Water	25				
Garlon 4	20	10.0	9.8 a	10.0	47
Penevator Basal Oil	80				
Accord	50	9.5	8.4 abc	9.7	30
Stalker	5				
MON 59120	22.5				
Water	22.5				
Krenite S	50	9.9	9.0 abc	8.0	23
Stalker	5				
MON 59120	22.5				
Water	22.5				
Significance Level (p)		0.0001	0.0001	0.0001	0.0746
LSD (p=0.05)		1.0	----	1.9	n.s.

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

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 81 near Wilkes-Barre, PA.

MATERIALS AND METHODS

Treatments included an untreated check; Vanquish or Banvel alone at rates of 32 or 64 oz/ac; Vanquish in combination with either San 1269H, Garlon 4, Arsenal, or RoundUp Pro; Arsenal and Garlon 4 alone; and both Krenite S or RoundUp Pro plus, Arsenal (Table 1). Treatments were applied on August 22, 1996, to approximately 25 by 75 ft plots which were arranged in a randomized complete block design with two replications. A CO_2-powered backpack sprayer equipped with a handgun and a Spraying Systems #5500 Adjustable ConeJet with Y-2 tip, operating at 30 psi was used to approximate an application volume of 30 gal/ac. All 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 birch (*Betula lenta*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), oaks (*Quercus* spp.), quaking aspen (*Populus tremuloides*) and sassafras (*Sassafras albidum*). Visual ratings of foliar necrosis, or 'brown-out', were taken September 5, 1996, 14 days after treatment (DAT). Visual ratings of tree injury were taken September 12, 1997 (372 DAT). Average tree injury results are reported in Table 1.

RESULTS

The average injury rating on the far right side of the table includes all tree species in the statistical analysis. Table 1 includes a T-Grouping for determining which treatments are statistically different. LSD values could not be reported because of the unequal replication among the species.

Foliar necrosis data is not reported: however, the treatments including Roundup Pro or Garlon 4 caused the most foliar necrosis 14 DAT. The treatments providing the highest average tree injury ratings 372 DAT were Vanquish plus Garlon, Garlon alone, 64 oz/ac Vanquish plus 12 oz/ac Arsenal, Arsenal alone, Vanquish plus Roundup Pro, Krenite S plus Arsenal and Roundup Pro plus Arsenal. Vanquish or Banvel when applied alone and Vanquish when applied with Arsenal at rates of 8 oz/ac or less did not provide acceptable results.

CONCLUSIONS

Vanquish or Banvel when applied alone have not provided acceptable results in this or previous studies. SAN 1269H did not serve as a good tank mix partner for Vanquish when used at the rates tested in this study. All of the treatments containing Garlon 4, Roundup Pro, or Arsenal at rates of 8 oz/ac or greater (with the exception of 64 oz/ac Vanquish plus 8 oz/ac Arsenal) provided satisfactory first year injury ratings. Treatments containing Garlon 4 or Roundup Pro will cause brown-out and should not be used where this is a concern. Arsenal when combined with other products enhanced the control of the treatments, but caution should be taken when using these treatments due to the soil activity of Arsenal.

INFLUENCE OF HERBICIDE, TARGET, AND APPLICATION TIMING AND METHOD ON DORMANT SEASON BRUSH TREATMENTS

INTRODUCTION

An effective dormant season treatment for small multi-stemmed targets would allow vegetation managers to extend their season, in the same way that basal bark applications facilitate dormant season treatments of larger stems. This type of application has evolved from high volume handgun or broadcast applications to low volume, backpack based applications. The intended target for this type of application are small stems occurring in low to moderate densities, such as resprouts from cutting operations. Because the target stems are smaller, and have a thinner bark, herbicide options are not limited to oil soluble formulations applied in an oil diluent.

The objectives of the four trials discussed below were to evaluate target size and species, active ingredients and concentrations, adjuvant types and concentrations, and application technique and timing on the effectiveness of dormant stem applications.

MATERIALS AND METHODS

The first three trials were established at the interchange of SR 219 and 22, near Ebensburg, PA. The first trial was initiated April 5, 1996. The target brush was second and third year resprouts from a hand-cutting operation. Treatments included three rates of Accord alone, diluted in either a 1:1 mixture of water and the adjuvant MON 59120, or Thinvert; Accord plus Stalker diluted with water:MON 59120; and Garlon 4 alone and in combination with Stalker, diluted in water and crop oil concentrate (Table 1). The treatments were applied with a CO_2-powered, hand-held sprayer, equipped with a Spraying Systems #5500 ConeJet, with a Y-2 tip. Predominant species were green ash (*Fraxinus pensylvanica*), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*). Plant heights ranged from 3 to 10 ft, with most falling between 6 and 8 ft. The solution was applied to provide complete coverage of the lower 24 to 36 in of each primary stem in a cluster. First season control ratings were taken September 14, 1996, using a 1 to 10 scale, where '1' indicated no effect, and '10' indicated a dead plant. Second season control ratings were taken September 22, 1997, using a 1 to 4 scale. In this scheme, '1' indicated no effect, '2' indicated injury, but the plant would recover; '3' indicated that the plant was judged to be mortally wounded, and '4' was assigned to plants that were killed. A percent control rating was calculated by dividing the number of stems rated '3' and '4' by the total number of treated stems.

The second trial was established December 16, 1996. In this study the herbicide solution was applied to only one side of each stem to a height of 24 to 36 inches, depending on stem size. This would provide a much quicker, and therefore more commercially viable application. The sprayer was the same configuration as that used for the April, 1996 trial. Each plot was 45 by 100 ft, with an average sprout cluster density of 2,460/acre. Solution applied ranged from 3.5 to 4.7 gallons/acre. Treatments (Table 2) included Accord at 25 percent, v/v, diluted in MON 59120 alone, water alone, and combinations of MON 59120/water of 5/70, 10/65, and 25/50 percent, v/v; Accord at 25 percent, v/v, plus MON 59120 at 25 percent, v/v plus either Stalker at 1.0 percent, v/v, or Garlon 3A at 3.0 percent, v/v, in water; Krenite S at 25 percent, v/v, plus an organosilicone surfactant at 0.25 percent, v/v, alone or with Stalker at 1.0 percent, v/v, in water; and Garlon 4 at 10 percent, v/v, diluted in a basal oil. The predominant species were quaking aspen (*Populus tremuloides*) and black cherry. The majority of the sprout clusters ranged from 1.5 to 6 ft in height. Control ratings were taken September 15, 1997, using the 1 to 4 rating scheme described above.

The third trial was established April 1, 1997. Each plot was 20 by 60 ft, arranged in a randomized complete block design with two replications. The average sprout cluster density was 4,925/acre. The same sprayer configuration was used as in the April and December, 1996 trials. The spray coverage was to one side of the sprout cluster, as in the December trial. Application volume ranged from 7 to 10 gallons/acre. Treatments (Table 3) included MON 59120 at 25 percent, v/v, plus Accord at rates of 10, 15, 20, or 25 percent, v/v, in water; Accord at

25 percent, v/v, plus MON 59120 at 1, 5, and 10 percent, v/v, in water; Krenite S at 25 percent, v/v, plus MON 59120 at 25 percent, v/v, in water; Garlon 4 at 4 or 8 percent, v/v, in Thinvert, and Garlon 4 at 4 percent, v/v, in a basal oil. Predominant species were quaking aspen and black cherry, most ranging from 1.5 to 6 ft. in height.

The fourth trial was established April 11, 1997, near Port Matilda, PA. The site was a wooded pasture border composed of brush ranging from 3 to 20 ft in height. Predominant species were black cherry, red maple, striped maple (*Acer pennsylvanica*), green ash, and red oak (*Quercus rubra*). The treatments were the same as applied in Ebensburg on April 1, 1997. Treatments were broadcast applied using a CO_2-pressurized, hand-held sprayer, equipped with a Waldrum Specialties WideCast nozzle. The WideCast provides a 180 degree fan pattern, and is specifically designed for low volume applications with Thinvert. Aqueous treatments were applied at 60 psi, and were calibrated to deliver 7.2 gallons/acre. The Thinvert treatments were applied at 80 psi, delivering 5.2 gallons/acre. Plots were 200 ft long, and were treated with a 10 ft vertical swath. The experimental design was a randomized complete block with two replications. Control ratings were taken September 5, 1997, with injury rated on a 1 to 10 scale. A '1' rating indicated no herbicide effect, and a '10' indicated complete control.

RESULTS AND DISCUSSION

A departure in this testing, compared to previous investigations of dormant applications, was the targeting of the application to the stem base. The rationale for this was to provide a more specific targeting of the material, while trying to achieve commercially acceptable efficacy. Previous experience had shown that treating the crown area could substantially injure dormant-treated stems, but resprouting often occurred from the base of the plant. Targeting the base of the plant reduced solution used and solution bypassing the target, as well meeting the objectives of trying to control the plant. As long as the bark at the base is relatively thin, the basal approach should allow for the use of less material, and the one-sided application would be quick enough to be commercially viable. As target size increases, the crown-targeted application would be quicker, but would use more solution, and increase the amount of solution missing the leafless target.

The April 1996 treatments demonstrated that Thinvert was not an effective carrier for high concentrations of Accord, and that the aqueous Garlon 4 mixtures were not effective applied basally. Accord at 10, 25, and 50 percent, v/v, provided 70, 79, and 86 percent control, respectively, when rated the second season. Some red maple sprout clusters rated as controlled in September 1996 resprouted the second season after treatment.

The one-side applications of December 1996 provided unacceptable control, with 59 percent being the best rating. Water alone was an ineffective carrier for Accord at 25 percent, v/v, and MON 59120 at 25 percent, v/v, provided better control than lower concentrations, or undiluted MON 59120, which was too viscous to spray. Stalker or Garlon 3A added to Accord did not improve control. Krenite S alone was ineffective (8 percent), but the addition of Stalker improved control to 50 percent. Garlon 4 in basal oil was not effective (15 percent).

The one-side applications of April 1997 provided average control ratings as high as 75 percent, but there was no statistical separation between the Accord treatments. Poplar was controlled better than black cherry. Accord plus MON 59120, at 25 plus 25 percent, v/v, provided 58 percent control of cherry, and 92 percent control of poplar. The Krenite S and Garlon 4 treatments were not effective.

The broadcast treatments of April 1997 addressed two issues - the targeting of more mature plants, and the use of a controlled droplet broadcast application. The poor control (Table 3) was likely due to both factors. This dormant application approach is based on using directed, fine-droplet treatments on thin-barked plants, and specifically targeting the spray stream with individual-plant treatments. Control of larger stems with thicker bark in the dormant season is most effectively accomplished with basal bark applications. The Thinvert system, with its uniform droplets, is ideal for low volume foliage applications, but less well suited to providing coverage on a leafless target, particularly on a broadcast basis. The relatively large, uniform droplets provided by the system are actually a disadvantage in this setting.

We feel that the results to date suggest that an operationally viable, one-pass application to small, dormant brush is attainable, justifying additional investigation. Spring applications appear to be more effective. The trials

described have focused on glyphosate combinations, but previous work with aqueous Garlon 4 applications to the crown (Ninth Year Report in this series) showed similar promise. The degree of control achieved is encouraging, particularly since the approach by our project has been to minimize solution sprayed. Spray volumes can be increased and still be economically feasible. Trials established in early 1998 have used larger spray tips, to deliver more material to the plant. It is our feeling that this methodology will provide vegetation managers with an additional brush resprout management tool to supplement foliar programs and lengthen the operational season.

Table 1: Control ratings taken September 22, 1997, on plants treated April 5, 1996. Plants were rated as controlled if they were dead, or judged to be fatally wounded. Number of treated stems are indicated in parentheses.

Treatment	Product Mix	Average	Red Maple	Black Cherry	Sugar Maple	Green Ash
	(% v/v)	---------- percent control (no. of stems)----------				
Accord MON 59120 water	10 45 45	70 (129)	25 (20)	75 (16)	56 (32)	91 (53)
Accord MON 59120 water	25 37.5 37.5	79 (116)	27 (15)	73 (11)	84 (19)	91 (65)
Accord MON 59120 water	50 25 25	86 (94)	75 (4)	89 (18)	71 (7)	88 (65)
Accord Thinvert	10 90	33 (27)	20 (5)	25 (8)	0 (1)	46 (13)
Accord Thinvert	25 75	55 (76)	8 (25)	0 (5)	0 (3)	100 (40)
Accord Thinvert	50 50	27 (37)	0 (6)	40 (10)	0 (6)	86 (7)
Garlon 4 COC water	5 2 93	23 (13)	25 (4)	50 (2)	0 (2)	20 (5)
Garlon 4 Stalker COC water	5 0.5 2 92.5	9 (23)	0 (6)	50 (2)	0 (7)	13 (8)
Accord Stalker MON 59120 water	10 1 44.5 44.5	36 (59)	43 (23)	50 (16)	7 (14)	- - - - - -

Table 2: Control of second year brush resprouts with dormant stem treatments applied December 16, 1996. Stems were rated September 15, 1997. Stems counted as controlled were dead, or judged to be fatally wounded by the treatment.

	Product	Mixture	Black Cherry < 5ft		Black Cherry > 5 ft		Populus < 5 ft		Populus > 5 ft		Average	
		(%)	percent control (no. of stems)									
1.	Accord MON 59120	25 75	42	(125)	20	(51)	54	(50)	33	(46)	38	(272)
2.	Accord Water	25 75	26	(159)	3	(35)	12	(49)	7	(27)	19	(270)
3.	Accord MON 59120 Water	25 5 70	40	(158)	0	(10)	47	(97)	28	(43)	39	(308)
4.	Accord MON 59120 Water	25 10 65	41	(108)	21	(19)	31	(78)	26	(27)	34	(232)
5.	Accord MON 59120 Water	25 25 50	56	(141)	47	(19)	55	(95)	69	(26)	56	(281)
6.	Accord Stalker MON 59120 Water	25 1 25 49	59	(32)	33	(3)	64	(214)	43	(53)	59	(302)
7.	Accord Garlon 3A MON 59120 Water	25 3 25 47	51	(103)	35	(17)	52	(279)	35	(83)	48	(482)
8.	Krenite S BreakThru Water	25 0.25 75	26	(72)	3	(35)	4	(96)	3	(117)	8	(320)
9.	Krenite S Stalker BreakThru Water	25 1 0.25 74	68	(74)	53	(47)	31	(58)	45	(49)	50	(228)
10.	Garlon 4 Oil	10 90	0	(3)	0	(1)	16	(31)	37	(40)	15	(102)

Table 3: Control ratings for dormant brush treatments applied on an idividual-plant basis on April 1, 1997, in Ebensburg, PA; and as broadcast treatments on April 11, 1997, near Port Matilda, PA. Control was rated at Ebensburg on September 15, 1997, using a 1 to 4 scale, where '1' was no effect, '2' was observable injury but the plant would live, '3' indicated mortal injury, and '4' was a dead plant. Percent control was calculated by dividing the number of stems rated '3' and '4', divided by total number of stems. Brush plants in the Port Matilda trial were rated September 5, 1997 on a 1 to 10 scale, where '1' indicated no effect, and '10' indicated the plant was dead. For each trial, values are the mean of two replications.

			Individual Plant Treatment - Ebensburg			
Treatment		Mix Rate	Average	Black Cherry	Quaking Aspen	Broadcast Treatment Port Matilda
		(% v/v)	(--------percent control---------)			(1 - 10)
1.	Accord MON 59120 water	10 25 65	43	29	67	4.6
2.	Accord MON 59120 water	15 25 60	59	35	82	5.8
3.	Accord MON 59120 water	20 25 55	66	43	84	5.6
4.	Accord MON 59120 water	25 1 74	40	19	41	3.9
5.	Accord MON 59120 water	25 5 70	63	32	77	4.2
6.	Accord MON 59120 water	25 10 65	75	33	93	4.7
7.	Accord MON 59120 water	25 25 50	75	58	93	6.4
8.	Krenite S MON 59120 water	25 25 50	21	28	15	3.2
9.	Garlon 4 Arborchem Basal Oil	4 96	25	20	29	4.6
10.	Garlon 4 Thinvert	4 96	23	13	33	3.3
11.	Garlon 4 Thinvert	8 92	37	51	36	4.2
12.	Untreated Check	- - -	0	0	0	
Significance Level			0.01	0.01	0.001	
LSD (p=0.05)			36	24	39	

EVALUATION OF HERBICIDES FOR CONTROL OF CANADA THISTLE AND TOLERANCE OF CROWNVETCH

INTRODUCTION

A study was established to evaluate several herbicides applied at two dates, for the selective control of Canada thistle (*Cirsium arvense*) growing in a stand of crownvetch (*Coronilla varia*).

MATERIALS AND METHODS

The study was located within an established stand of crownvetch at the Old Fort interchange of PA SR 322 and 45, near Boalsburg, PA. The application was made to 6 by 10 ft plots using a CO_2-powered backpack sprayer equipped with Spraying Systems XR 8004 VS spray tips, delivering 40 GPA at 38 psi. Treatments included an untreated check, 24 oz/ac Vanquish alone or in combination with either 5 oz/ac Transline or 0.33 oz/ac Escort; 10 oz/ac Transline; 64 oz/ac Roundup Pro; 32 oz/ac Garlon 4; and 12 oz/ac Plateau plus 0.25% (v/v) Sun-It II[1/]. All treatments contained 0.25% (v/v) Polytex A1001 drift control agent. All treatments except those containing Roundup Pro or Sun-It II contained 0.125% (v/v) QwikWet 357 surfactant. Treatments were arranged in a randomized complete block design with a factorial treatment arrangement and three replications. The first application date was May 15, 1997, when Canada thistle height was 6 to 8 in. On the second application date, May 29, thistle was 10 to 12 in high. An initial count of thistle stems within all plots was made on May 15. A count of uncontrolled thistle stems, thistle resprouts and percent green crownvetch cover ratings corresponding to 4, 8, and 12 weeks after treatment (WAT) were taken on June 13, July 10, and August 11 for May 15 treatments; and June 26, July 29, and August 22 for May 29 treatments. The percent decline and percent resprouting were based on the initial number of thistle plants found in each plot.

RESULTS

The effect of application timing on thistle decline was significant at 4 and 8 WAT, with the earlier applications causing more injury. At 12 WAT the May 15 and May 29 applications were rated 92 and 91 percent decline, respectively (Table 1), compared to 42 percent for the untreated plots. Treatment effect was significant at all three ratings. At 4 WAT, Roundup Pro provided 81 percent decline, while the other treatments ranged from 22 to 46 percent. At 12 WAT, thistle decline ranged from 86 percent for Plateau, to 99 percent for Vanquish plus Escort.

Thistle resprouting was highly variable (coefficient of variation of 165, 53, and 60 percent, respectively, at 4, 8, and 12 WAT), and unacceptably high. The effect of application time was significant at 12 WAT, where May 15 treatments had 54 percent resprouting compared to 84 percent for May 29 applications. Treatment effect was significant at 8 WAT. Garlon 4 treatments averaged 62 percent resprouting, which was significantly higher than all other treatments.

There was a significant interaction between treatment and time for crownvetch cover at 4 and 12 WAT. May 29 applications averaged more cover at each date, but the differential between the May 15 and May 29 applications varied among treatments, and Roundup Pro treatments had less cover for the later application. Treatment effect was highly significant. Transline alone and with Vanquish, Vanquish plus Escort, and Roundup Pro almost eliminated crownvetch cover; while Plateau, particularly at the May 29 timing, caused no reduction in crownvetch cover.

CONCLUSIONS

Although several treatments provided excellent control of treated Canada thistle stems, no treatment in this trial provided acceptable suppression of resprouts and preservation of crownvetch cover.

[1/] Sun-It II, 100% methylated seed oil, American Cyanamid Company, Wayne, NJ.

TABLE 1: Control of treated stems (Thistle Decline), thistle resprouts (percent of original), and effect on crownvetch cover of herbicide treatments applied May 15 (Time 1) and May 29 (Time 2), 1997. Ratings for Time 1 were taken June 13, July 10, and August 11, 1997. Ratings for Time 2 were taken June 26, July 29, and August 22, 1997. Due to a significant interaction between application time and treatment for crownvetch cover at 4 and 12 WAT, herbicide treatment results are reported for each application date (n=3). All other herbicide results are the mean of the two application dates and three replications (n=6). Results reported by application date are the mean of seven treatments and three replicaitons (n=21). Reported values for the untreated plots were not included in the analysis of variance.

								Crownvetch Cover				
	Application	Thistle Decline			Thistle Resprouts			4 WAT		8 WAT	12 WAT	
Treatment[1/]	Rate	4 WAT	8 WAT	12 WAT	4 WAT	8 WAT	12 WAT	(Time 1)	(Time 2)		(Time 1)	(Time 2)
	(oz/ac)	(----------%----------)			(----------%----------)			(----------%----------)				
untreated	---	7	22	42	1	5	9	90	90	94	87	87
Vanquish	24	22	63	90	3	33	81	17	70	38	52	74
Transline	10	40	86	93	1	15	42	14	25	5	4	8
Vanquish Transline	24 5	31	79	92	1	29	67	7	42	9	5	22
Vanquish Escort	24 0.33	39	96	99	1	21	58	11	57	2	3	6
Roundup Pro	64	81	93	95	8	30	80	2	1	10	28	4
Garlon 4	32	46	86	90	6	62	103	4	43	7	20	37
Plateau	12	30	71	86	1	23	51	37	91	83	73	92
Significance Level (p)		0.0001	0.0001	0.016	0.087	0.001	0.20	0.004	0.001	0.0001	0.001	0.0001
LSD (p=0.05)		21	9	6	n.s.	19	n.s.	14	31	14	28	17
Time 1		49	85	92	2	33	54	13	- - -	21	27	- - -
Time 2		33	79	91	4	28	84	- - -	47	23	- - -	35
Significance Level (p)		0.008	0.009	0.57	0.12	0.36	0.025	- - -	- - -	0.46	- - -	- - -

[1/] All herbicide treatments contained Polytex A1001 drift control agent at 0.25% v/v. Roundup Pro treatments contained no additional surfactant, the Plateau treatment contained Sun-It II methylated seed oil 0.25% v/v, and Qwikwet 357 was added at 0.125% v/v to all other treatments.

EVALUATION OF FINALE FOR TOTAL VEGETATION CONTROL UNDER GUIDERAILS

INTRODUCTION

Many preemergence herbicides, alone or in combination, have not consistently provided season long weed control along roadsides in Pennsylvania. One approach to shortening the length of time a preemergence herbicide needs to be effective is delaying the application until later in the spring and including a Roundup Pro with them. This would control the weeds before they could fully mature and possibly allow the preemergence products to remain effective through the remainder of the growing season. This trial was initiated to evaluate the performance of Finale, a recently introduced produect, compared to Roundup Pro.

MATERIALS AND METHODS

Roadside treatments were applied to 3 by 25 ft plots along a guiderail on SR 2002 near Blairsville, PA on May 23, 1997. The study was arranged in a randomized complete block design with three replications. The treatments were applied using a CO_2-powered hand held sprayer equipped with two Spraying Systems OC-04 spray tips, delivering 35 GPA at 28 psi. All treatments except those with Roundup Pro contained 0.125% (v/v) QwikWet 357 surfactant and all contained 0.25% (v/v) Polytex A1001 drift control agent. Green cover ratings of weeds were taken the day of application; June 5, 13 days after treatment (DAT); June 23, 31 DAT; July 18, 56 DAT; September 11, 111 DAT; and October 13, 143 DAT. Predominant weed species were white sweetclover (*Melilotus alba*), wild carrot (*Daucus carota*), common ragweed (*Ambrosia artemisiifolia*), common evening primrose (*Oenothera biennis*), Virginia creeper (*Parthenocissus quinquefolia*), quackgrass (*Elytrigia repens*), and chicory (*Cichorium intybus*). The fringe of the study area was treated on July 2, 1997 with a mixture of 4% (v/v) Roundup Pro, 1% (v/v) Garlon 3A, 0.125% (v/v) QwikWet 357 surfactant, and 0.25% (v/v) Polytex A1001 drift control agent to control poison ivy (*Toxicodendron radicans* L.) and Virginia creeper that was encroaching into the site.

RESULTS

The initial rating at the time of application showed there were no significant differences in vegetative cover among the plots, with average green cover ratings between 58 and 80 percent. Finale alone provided fair control of the weeds for a short time following application, but weeds steadily regrew in the plots and by 111 DAT there was no difference between the treated and untreated areas. Oust plus Karmex reduced the level of weeds in the plots until the final rating period, but not to acceptable levels. Finale plus Arsenal provided very good early season control, but by 111 DAT the weed cover in treated plots was not significantly different from the untreated plots. Adding Finale to either Oust and Karmex; 2,4-D and Oust; or 2,4-D, Oust and Karmex provided good post- and preemergence activity with all green cover ratings ranging between 4 and 17 percent from 31 to 111 DAT. Beyond 31 DAT there were no statistical differences found when any of the rates of Finale tested in this study were replaced with 2 qts/ac Roundup Pro and combined with either 3 oz/ac Oust plus 6 lb/ac Karmex or 1 qt/ac 2,4-D plus 3 oz/ac Oust.

CONCLUSIONS

At the rates tested; Finale alone, Oust plus Karmex, Finale plus Arsenal, or Roundup Pro plus 2,4-D plus Oust, will not provide adequate season-long bare ground weed control. The remaining treatments provided good weed control throughout the growing season.

TABLE 1: Green cover ratings of weed species located under a guiderail near Blairsville, PA. Treatments were applied May 23, 1997. Green cover ratings were taken 0, 13, 31, 56, 111, and 143 DAT. Each value is the mean of three replications.

Treatment	Application Rate	Green Cover of Weed Species					
		0 DAT	13 DAT	31 DAT	56 DAT	111 DAT	143 DAT
	(oz/ac)	(----------%----------)					
Untreated Check	---	75	76	82	86	75	52
Finale	96	78	23	47	55	71	51
Oust	3	67	65	50	33	38	43
Karmex	96						
Finale	64	63	30	15	11	16	27
Oust	3						
Karmex	96						
Finale	80	63	23	10	6	12	23
Oust	3						
Karmex	96						
Finale	96	72	32	17	4	4	9
Oust	3						
Karmex	96						
Roundup Pro	64	72	45	15	7	5	19
Oust	3						
Karmex	96						
Finale	96	75	19	12	4	15	27
2,4-D	32						
Oust	3						
Finale	96	63	7	4	2	7	14
2,4-D	32						
Oust	3						
Karmex	96						
Roundup Pro	64	80	37	6	5	19	50
2,4-D	32						
Oust	3						
Finale	80	68	27	18	18	50	26
Arsenal	16						
Finale	96	58	17	10	15	45	42
Arsenal	16						
Significance Level (p)		0.88	0.0001	0.0001	0.0001	0.0003	0.12
LSD (p=0.05)		n.s.	20	17	20	31	n.s.

EVALUATION OF R-6447 FOR TOTAL VEGETATION CONTROL

INTRODUCTION

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. The trial was conducted on an agricultural site, which provides heavier weed pressure, and reduces the environmental variability associated with guiderail sites.

MATERIALS AND METHODS

The entire study area was initially sprayed on October 26, 1996 with 4 qts/ac Accord, 0.125% (v/v) QwikWet 357 surfactant, and 0.25% (v/v) Polytex A1001 drift control agent to control any existing vegetation. Both fall and spring treatments were applied to 6 by 10 ft plots. The fall applications were made on November 6, 1996; spring treatments were applied on May 7, 1997. 2 qts/ac Roundup Pro was included in all spring applied treatments, including the check plot for the spring applications, to control vegetation that had already emerged. The study was arranged in a randomized complete block design with a factorial treatment arrangement and three replications. The treatments were applied using a CO2-powered backpack sprayer equipped with a six-foot boom that contained four XR 8004 VS spray tips, delivering 40 GPA at 38 psi. Green cover ratings of weed species were taken for the fall and spring applications on July 10, August 5, and September 25, 1997. Predominant weed species were yellow woodsorrel (*Oxalis stricta*), quackgrass (*Elytrigia repens*), yellow foxtail (*Setaria lutescens*), and dandelion (*Taraxacum officinale*).

RESULTS

There was a significant interaction between application time and treatment for all three rating dates. Therefore, fall and spring applied treatments are reported separately in Table 1. Five fall-applied treatments provided an acceptable level of control at the July 10 rating. All included at least 3 oz/ac Oust. Not even the highest rate of R-6447 provided any control on July 10 when fall applied. By the August 5 rating the only treatments providing acceptable control were those containing Oust plus Karmex. None of the fall-applied treatments provided acceptable levels of control throughout the following growing season.

Nine of the spring applied treatments provided excellent to acceptable season-long weed control. The combinations including Oust plus Karmex, Arsenal plus Karmex, Oust plus R-6447 at 3.73 oz/ac and a combination of Oust, R-6447, and Karmex provided almost total control through the year. Oust alone at 3 oz/ac and the combination of R-6447 with either Karmex at 120 or 150 oz/ac, or Oust at 2.27 or 3 oz/ac, provided an acceptable level of control throughout the year. The control provided by the R-6447 alone was totally rate and time dependent- the higher the rate the longer the control lasted, with even the highest rate providing poor control at the final rating.

CONCLUSIONS

The results of this test again show that fall applications of these non-selective herbicide treatments do not provide enough residual activity to provide acceptable weed control through the following growing season. Spring applied combinations of the industry standards, Oust or Arsenal in combination with Karmex have again been proven effective. Combinations of R-6447 with Oust and/or Karmex were also proven effective in this study. Additional tests with varying rates and on sites with coarser soils and different weed pressures should be done to determine how useful this product will ultimately be.

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

TABLE 1: Green cover ratings of weed species for fall and spring applied treatments. The fall applied treatments were applied November 6, 1996; the spring applied treatments were applied May 7, 1997. Ratings for both application timings were taken on July 10, August 5, and September 25, 1997.

		Green Cover of Weed Species					
	Application	Fall Applied			Spring Applied		
Herbicide	Rate	7/10	8/5	9/25	7/10	8/5	9/25
	(oz/ac)	(----------%----------)					
Check	- -	98	96	99	99	100	100
R-6447	5	98	94	97	60	82	97
R-6447	10	92	96	97	18	40	93
R-6447	15	88	92	97	11	18	57
Oust	3	22	47	86	1	2	24
Karmex	120	74	65	98	12	23	40
R-6447 Oust	7.5 2.27	35	65	96	2	4	16
R-6447 Oust	10 3	12	40	90	0	1	15
R-6447 Oust	12.5 3.73	13	38	76	0	0	2
R-6447 Karmex	7.5 90	75	78	97	5	15	50
R-6447 Karmex	10 120	45	50	95	4	7	24
R-6447 Karmex	12.5 150	33	33	86	2	3	17
R-6447 Oust Karmex	7.5 3 90	5	21	61	1	1	4
Oust Karmex	3 120	12	15	67	1	1	4
Arsenal Karmex	48 120	48	50	88	0	1	1
Significance Level (p)	----	0.0001	0.0001	0.0056	0.0001	0.0001	0.0001
LSD (p=0.05)	----	17	27	20	14	16	22

EVALUATION OF PLATEAU FOR TOTAL VEGETATION CONTROL UNDER GUIDERAILS

INTRODUCTION

A study was established to evaluate Plateau for total vegetation control along roadsides. Plateau is a unique material that was recently introduced into the market. Because of its selectivity it has been marketed for a variety of uses including the establishment of native prairie grasses, release of wildflower and legume species from weed competition, turfgrass suppression, and bareground weed control. Plateau has both pre- and postemergence activity on a broad range of plant species.

MATERIALS AND METHODS

Roadside treatments were applied to 3 by 25 ft plots located along a guiderail near State College, PA on May 8, 1997. The study was arranged in a randomized complete block design with three replications. The treatments were applied using a CO_2-powered hand held sprayer equipped with two Spraying Systems OC-04 spray tips, delivering 35 GPA at 28 psi. All treatments, except those with Roundup Pro, contained 0.25 % (v/v) methylated seed oil[1/] and all contained 0.25% (v/v) Polytex A1001 drift control agent. Green cover ratings of weed species were taken May 16, 8 days after treatment (DAT); June 26, 49 DAT; September 2, 117 DAT; and October 6, 151 DAT. Predominant weed species were wild carrot (*Daucus carota*), spotted knapweed (*Centaurea maculosa*), white sweetclover (*Melilotus alba*), crownvetch (*Coronilla varia*), and western salsify (*Tragopogon dubius*).

RESULTS

The initial rating 8 DAT showed there were no significant differences among the treatments with average green cover ratings between 55 and 70 percent for all plots. Plateau or Roundup Pro alone; and Plateau plus Pendulum 3.3EC did not provide any lasting control of the weeds in the plots at the rates tested. At all four rating dates there was no difference in green cover between these treatments and the untreated check.

All other treatments provided excellent season-long weed control, with weed cover ranging from 3 to 18 percent, 151 DAT. There were no statistically significant differences noted among these treatments at any of the rating periods.

CONCLUSIONS

The treatment containing Roundup Pro, Oust, and Karmex could be considered the current industry standard Sahara alone, or Plateau at 12 oz/ac plus Roundup Pro or Karmex provided comparable control. Any of these treatments could be used to provide effective post emergence and long-term residual control of a variety of weeds in a roadside environment.

1/ Sun-It II, 100% methylated seed oil, American Cyanamid Company, Wayne, NJ.

TABLE 1: Green cover ratings of weed species located under a guiderail near University Park, PA. Treatments were applied May 8, 1997. Green cover ratings were taken 8, 49, 117, and 151 DAT. Ratings are the mean of three replications.

Treatment[1/]	Application Rate	Green Cover of Weed Species			
		8 DAT	49 DAT	117 DAT	151 DAT
	(oz/ac)	(----------%----------)			
Untreated Check	---	55	76	69	68
Plateau	12	63	63	60	63
Roundup Pro	32	68	65	72	72
Plateau	12	62	20	12	16
Roundup Pro	32				
Plateau	12	65	60	57	57
Pendulum 3.3EC	155				
Plateau	12	68	12	11	11
Karmex	96				
Plateau	12	70	4	3	3
Karmex	192				
Roundup Pro	64	58	10	12	18
Oust	3				
Karmex	96				
Sahara	160	62	4	0	3
Significance Level (p)		0.6453	0.0001	0.0001	0.0001
LSD (p=0.05)		n.s.	27	22	19

[1/] All treatments except those with Roundup Pro contained Sun-It II, methylated seed oil, (American Cyanamid) @ 0.25 % (v/v) and all treatments contained Polytex A1001 @ 0.25% (v/v).

EVALUATION OF ENDURANCE AND PREDICT FOR PREEMERGENCE VEGETATION CONTROL UNDER GUIDERAILS

INTRODUCTION

A study was established near State College, PA to evaluate the effectiveness of the preemergence herbicides Endurance and Predict for preemergence weed control under guiderails, using Oust plus Karmex as a standard.

MATERIALS AND METHODS

The study was located on the Park Avenue extension, near State College, PA. All the treatments were applied on May 8, 1997, and included 4 qts/ac RoundUp Pro to control existing vegetation. The control treatment was RoundUp only. Preemergence treatments included Endurance or Predict alone; in combination; the combination plus either Princep 4L or Oust; Endurance plus Karmex; Endurance plus Arsenal at two rates; and Oust plus Karmex (Table 1). All treatments contained 0.25% (v/v) Polytex A1001 drift control. Treatments were applied using a CO_2-powered backpack sprayer equipped with two Spraying Systems OC-04 spray nozzles, delivering 35 GPA at 28 psi. The experimental plots were 3 by 25 feet, arranged in a randomized complete block design with three replications.

The predominant weed species at the time of treatment included white sweetclover (*Melilotus alba*), wild parsnip (*Pastinaca sativa*), wild carrot (*Daucus carota*), and spotted knapweed (*Centaurea maculosa*). Common ragweed (*Ambrosia artemisiifolia*) was the most common annual species to appear during the trial. Control was evaluated July 10, August 22, and October 6, 1997; 63, 106, and 151 days after treatment (DAT), respectively. Ratings taken were percent total vegetative cover; and percent cover from annuals, which provided an index of the preemergence effectiveness of the treatments.

RESULTS

Based on the total vegetative cover ratings, it is apparent that the RoundUp Pro did not completely control the vegetation present in the plots. At the first evaluation, white sweetclover, spotted knapweed, wild carrot, and wild parsnip, all biennials, were in bloom and and 4 to 6 ft in height outside of the treatment area. Within the plots, the same species were also blooming or approaching bloom, indicating they had been present at the time of treatment. These species ranged from 6 to 18 inches in height in the treated plots. The plots that had been treated with Oust or Arsenal had the least vegetation, suggesting that combinations consisting of only RoundUp plus preemergence herbicides were not sufficiently potent to control the existing vegetation.

Percent cover from annuals was low throughout the course of the experiment, and was not signifcantly affected by herbicide treatment at any rating date. Because control of the existing vegetation was not complete, it is difficult to separate the effects of the preemergence herbicides from the effects of competition from the existing vegetation on the establishment of annual species.

CONCLUSIONS

The results of previous studies have shown that Endurance and Predict provide season long control of annual vegetation alone and in combination with other herbicides. Although the results of this study indicate that annual weeds may be suppressed by these products, total vegetative cover was only significantly reduced throughout the entire season with the Endurance and Predict combination when used in combination with Princep or Oust, and with Endurance when combined with Arsenal.

TABLE 1: The study area was treated May 8, 1997. All treatments, including the control contained 4 qts/ac Roundup Pro to control existing vegetation. Ratings of percent total vegetative cover and percent cover of annual species were taken July 10, August 22, and October 6, 1997. Each value is the mean of three replications.

		Total Vegetative Cover			Cover from Annuals		
Treatment	Application Rate	Jul 10	Aug 22	Oct 6	Jul 10	Aug 22	Oct 6
	(oz product/ac)	(----------%----------)			(----------%----------)		
Control	- - -	20	42	45	4	9	10
Endurance	25	42	57	58	5	12	8
Predict	48	22	26	29	1	2	2
Endurance Predict	25 48	23	43	43	0	2	2
Endurance Predict Princep 4L	25 32 80	7	9	14	0	0	0
Endurance Predict Oust	25 48 3	1	1	1	0	0	0
Endurance Karmex	25 100	15	22	21	0	0	0
Endurance Arsenal	25 16	1	4	18	0	0	0
Endurance Arsenal	25 24	4	10	17	1	3	2
Oust Karmex	3 100	0	0	1	0	0	0
Significance Level (p)		0.0344	0.0022	0.0043	0.2135	0.1656	0.0756
LSD (p=0.05)		24	27	28	n.s.	n.s.	n.s.

EVALUATION OF GIANT KNOTWEED CONTROL AND CONVERSION INTO FINE FESCUES

INTRODUCTION

Giant knotweed (*Polygonum sachalinense*) and Japanese knotweed (*Polygonum cuspidatum*) are becoming an increasing problem along Pennsylvania's roadways. Complete control of a knotweed stand along the road is difficult since much of a population may exist outside the right-of-way. A combination of chemical and cultural practices may help to improve the long-term goal of managing these knotweed stands. The cultural practice of planting grasses in these areas would provide the benefit of forming a competitive groundcover where selective materials can later be applied to control any knotweed resprouts. A study was established to determine the effectiveness of converting a stand of giant knotweed to 'Formula L'[1/].

MATERIALS AND METHODS

The study area was located in an established giant knotweed stand along SR 2019 near Luciusboro, PA. The plots were 30 ft wide by 35 to 60 ft deep, arranged in a randomized complete block design with three replications. The entire study area was seeded with 100 lb/ac of 'Formula L' on March 22, 1996, with hand-held rotary spreaders. Approximately 2-4 inches of snow was present at the time of seeding. The five herbicide treatments presented in Table 1 were applied on July 17. The treatments were applied using a truck mounted sprayer equipped with a hose reel and GunJet handgun with a D6 spray tip, at 48 psi at approximately 100 gpa. The initial percentage of knotweed cover within each plot was rated on July 17, 1996. Knotweed injury was evaluated on September 4, 1996, using a scale of 1 to 10, in which '1' represents no injury, and '10' indicates the plant was dead. The percentage of knotweed and fine fescue cover was rated on July 2, 1997, 350 days after treatment (DAT).

RESULTS

Vanquish plus Transline killed the knotweed to the ground by September 4 (Table 1). Knotweed that received the other treatments was only showing slight injury symptoms at this time. At the time of the July 17, 1996 rating it was evident that the shading effect of the canopy from the knotweed had significantly reduced the establishment of the fine fescue. Competitiveness from the knotweed would have been reduced if the applications could have been made earlier, as planned. However, late frosts had defoliated the knotweed several times and the applications could not be made until it had completely regrown. The application volume of 100 GPA provided thorough coverage of the knotweed leaves but also resulted in some runoff. This could have further damaged the fine fescue stand beneath the canopy of the treated plants.

By July 2, 1997 (350 DAT) the knotweed cover was significantly reduced by all treatments compared to the untreated check; and there were no differences among treatments in the percentage of fine fescue cover that had become established. The knotweed cover ranged from 6 to 27 percent and fine fescue cover was between 20 and 42 percent for the treated plots.

CONCLUSIONS

All treatments effectively reduced the knotweed stand and a fairly significant amount of fine fescue was established in the voids. Because of the extremely competitive nature of the knotweed, it is imperative that selective followup treatments be made to totally eliminate the knotweed from the site to get the desired long-term effect. The spring applied broadcast seeding of fine fescue performed well; however, an earlier foliar herbicide treatment that is selective to grasses would probably have helped the developing turf. An alternative system to be evaluated would involve treating the knotweed in late summer, seeding the grass in early fall, and retreating the surviving knotweed with a selective herbicide combination the following summer.

[1/] Formula L contained 60% hard fescue and 40% creeping red fescue by weight.

TABLE 1: Grass was seeded March 22 and herbicide treatments were applied July 17, 1996. Percentage of knotweed cover was rated on July 17, 1996 and July 2, 1997. Knotweed injury was rated September 4, 1996 on a scale of 1 to 10, in which '1' represents no injury, and '10' is dead. The percentage of fine fescue cover was rated on July 2, 1997. Each value is the mean of three replications.

		Knotweed Cover		Knotweed Injury	Fine Fescue Cover
Treatment[1/]	Rate	7/17/96	7/2/97	9/4/96	7/2/97
	(oz/ac)	(----------%----------)			(%)
Untreated Check	- -	74	80	1	15
Roundup Pro	128	74	27	4	22
Roundup Pro Scythe	128 384	77	27	3	25
Roundup Pro Arsenal	128 8	80	14	3	20
Vanquish Transline	96 8	64	6	10	42
Roundup Pro Transline	128 8	83	14	3	22
Significance Level (p)		0.4980	0.0016	0.0001	0.2965
LSD (p=0.05)		n.s.	28	1	n.s.

[1/] All treatments contained Polytex A1001 (Exacto Chemical Co.) @ 0.25% (v/v) and the Vanquish plus, Transline treatment contained QwikWet 357 (Exacto Chemical Co.) @ 0.125% (v/v).

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 annual flowers die, the planting bed is open to the invasion of weeds.

This study is a continuation of work started in 1995 in which annual flowers were established in tall fescue (*Festuca arundinacea*) 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. This study compares mowing the turf versus chemical treatments to suppress the turf before establishing annual wildflowers.

MATERIALS AND METHODS

There were four treatments including an unmowed and unsprayed check; mowed only; Plateau (2 oz/ac) plus, Sun-It II (1 qt/ac); and Roundup Pro (0.5 qts/ac). All chemical 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. Chemical treatments were applied to the 24 by 75 ft plots on April 26, 1997, using an Echo motorized backpack sprayer equipped with a six foot boom and Spraying Systems XR 8004 VS spray tips, delivering 34 GPA at 28 psi. On May 2, the mowed treatment was cut to a height of 3 inches with a flail mower; the entire study area was verticut two times to a depth of 0.5 inches; and all plots were seeded with cosmos (*Cosmos bipinnatus*) at 12 lbs/ac. The area was predominantly composed of tall fescue with some fine fescue (*Festuca* spp.). Evaluations were made on June 13 and October 3, 1997. The evaluations took into account turf discoloration, number of cosmos plants present, number of turfgrass seedheads present, and average turf height.

RESULTS AND DISCUSSION

This study was the first attempt to take this method of wildlfower establishment to the roadside environment. The ratings taken on June 13 and October 3, 1997 both showed no discoloration to the turf for any of the treatments. Turf seedheads were abundant in the unmowed, unsprayed plots while the mowed and Roundup treated plots had moderate seedhead numbers and those sprayed with Plateau had significant seedhead reduction. Turf heights were reduced at the first rating for all treatments as compared to the unmowed, unsprayed plots with the heights averaging 10, 7.3, 6, and 6.6 inches for the unmowed, unsprayed; mowed only; Plateau at 2 oz/ac; and Roundup Pro at 0.5 qt/ac plots, respectively. By October 3, 1997 all the turf averaged between 9 and 10 inches regardless of treatment. The test was a failure based on the number of cosmos that actually became established within the plots. Very few cosmos could be found in any of the plots at either rating and by October the plot containing the most cosmos in bloom had less than 24 plants present. The cosmos were also stunted, averaging less than 15 inches in height. This resulted in no floral display within any of the plots.

There were a fair amount of clippings and thatch brought to the surface as a result of the mowing and verticutting operation but, this was not uniform over the entire test area. An annual mix containing cosmos was seeded on April 30, 1997 to an adjacent study after applying Roundup Pro and disking. This plot, although having significant weed pressure, resulted in 65% cover by wildlflowers (predominantly cosmos) by October 3, 1997. The reasons for the poor results obtained in this test are most likely due to insufficient suppression. Despite the poor results achieved, previous results suggest this method of establishing annual wildflowers is still worthy of continued investigation.