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NINETEENTH YEAR REPORT

THE PENNSYLVANIA STATE UNIVERSITY

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The nineteenth 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:
Evaluating herbicides for *Lonicera* control.
Controlling tree-of-heaven and converting the site to fine fescue.
Evaluating herbicides for Oriental Bittersweet (*Celastrus orbiculatus*) control.
Comparison of broadleaf weed control products.
Control of giant and Japanese knotweed.
Evaluation of herbicides for Japanese stiltgrass, mile-a-minute, and poison hemlock control.
Comparing herbicides for bareground weed control applications.
Comparing seed mixes under varying soil conditions.
Review of 2004 Roadside Vegetation Management Conference Field Day.

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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

Report # PA98-4620 + 85-08 - Roadside Vegetation Management Research Report - Twelfth Year Report

Report # PA99-4620 + 85-08 - Roadside Vegetation Management Research Report - Thirteenth Year Report

Report # PA00-4620 + 85-08 - Roadside Vegetation Management Research Report - Fourteenth Year Report

Report # PA01-4620 + 85-08 - Roadside Vegetation Management Research Report - Fifteenth Year Report

Report # PA02-4620 + 85-08 - Roadside Vegetation Management Research Report - Sixteenth Year Report

Report # PA03-4620 + 85-08 - Roadside Vegetation Management Research Report - Seventeenth Year Report

Report # PA04-4620 + 85-08 - Roadside Vegetation Management Research Report - Eighteenth Year Report

These reports are available by request from the authors, and are available online in portable document format (PDF) at http://rvm.cas.psu.edu.

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 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. 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 least significant difference (LSD). When analysis of variance indicates that the probability that the variation in the data is due to chance 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 probability that the variation in the data is due to chance is greater than 0.05, the L.S.D value is reported as 'n.s.', indicating non-significant.

This report includes information from studies relating to roadside brush control, herbaceous weed control, total vegetation control, native species establishment and roadside vegetation management demonstrations. Herbicides are referred to as product names for ease of reading. The herbicides used 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.

Trade Name	Active Ingredients	Formulation	Manufacturer
Arborchem Basal Oil	diluent	- - -	Arborchem Products, Inc.
Arsenal	imazapyr	2 S	BASF Specialty Products
Assure II	quizalofop-P	0.88 EC	E.I. DuPont de Nemours & Co.
Basagran T/O	bentazon	4 S	BASF Specialty Products
Endurance	prodiamine	65 WG	Syngenta Crop Protection, Inc.
Escort	metsulfuron methyl	60 DF	E.I. DuPont de Nemours & Co.
Garlon 3A	triclopyr amine	3 S	DowAgroSciences LLC
Garlon 4	triclopyr ester	4 EC	DowAgroSciences LLC
Glyphosate	glyphosate	4 S	E.I. DuPont de Nemours & Co.
GlyPro	glyphosate	5.4 S	DowAgroSciences LLC
Goal	oxyfluorfen	1.6 E	DowAgroSciences LLC
Journey	glyphosate + imazapic	0.75+1.5 S	BASF Specialty Products
Karmex	diuron	80 DF	E.I. DuPont de Nemours & Co.
Krenite S	fosamine ammonium	4 S	E.I. DuPont de Nemours & Co.
Landmark II MP	sulfometuron + chlorsulfuron	75 DG	E.I. DuPont de Nemours & Co.
Milestone VM	aminopyralid	2 S	DowAgroSciences LLC
Oust Extra	sulfometuron + metsulfuron	71.25 DG	E.I DuPont de Nemours & Co.
Oust XP	sulfometuron	75 DG	E.I. DuPont de Nemours & Co.
Overdrive	dicamba + diflufenzopyr	70 DG	BASF Specialty Products
Payload	flumioxazin	51 WDG	Valent Professional Products
Pendulum	pendimethalin	3.3 EC	BASF Specialty Products
Pendulum AQ	pendimethalin	3.8 ME	BASF Specialty Products
Plateau	imazapic	2 S	BASF Specialty Products
QuickSilver IVM	carfentrazone	1.9 EC	FMC Corporation
QwikWet 357	adjuvant	- - -	Exacto Chemical Company
RoundUp PRO	glyphosate	4 S	Monsanto
Speedzone	carfentrazone + 2,4-D + MCPP + dicamba	2.2 EC	PBI/Gordon Corporation
Stalker	imazapyr	2 EC	BASF Specialty Products
Tordon 101M	picloram + 2,4-D	2.5S (0.5+2)	DowAgroSciences LLC
Tordon K	picloram	2 S	DowAgroSciences LLC
Transline	clopyralid	3 S	DowAgroSciences LLC
Triplet	2,4-D + MCPP + dicamba	3.2 S	Nufarm Turf & Specialty
Vanquish	dicamba-glycolamine	4 S	Syngenta Professional Products
Velpar DF	hexazinone	75 DF	E.I. DuPont de Nemours & Co.
Vista	fluroxypyr	1.5 EC	DowAgroSciences LLC

CONTROL OF EXOTIC SHRUB HONEYSUCKLES WITH LATE-SEASON FOLIAR HERBICIDE APPLICATIONS

Herbicide trade and common names: Arsenal (*imazapyr*), Escort (*metsulfuron*), Garlon 3A (*triclopyr*), Krenite S (*fosamine*), Glyphosate (*glyphosate*), Vanquish (*dicamba*), Vista (*fluroxypyr*).

Plant common and scientific names: Amur honeysuckle (*Lonicera maackii*), Morrow's honeysuckle (*Lonicera morrowii*), Tartarian honeysuckle (*Lonicera tatarica*).

ABSTRACT

Canopy reduction of exotic shrub honeysuckle treated with Glyphosate alone at 128 oz/ac was 95 percent, which left no room for improvement by tank-mixing Garlon 3A or Arsenal. Garlon 3A at 64 oz/ac alone or tank mixed with Vista at 32 oz/ac provided no significant canopy reduction. Adding Escort at 0.5 oz/ac or Vanquish at 64 oz/ac to Garlon 3A did improve crown reduction to significant, but still unacceptable levels. Escort alone at 0.5, 1, or 2 oz/ac was rated at 20, 53, or 99 percent canopy reduction, respectively. Honeysuckle treated with Krenite S alone at 128 or 256 oz/ac was rated at 62 and 88 percent canopy reduction, respectively.

INTRODUCTION

Exotic bush honeysuckles are common on Pennsylvania roadsides, old fields, and forest understories, and appear to still be spreading. Introduced to the U.S. in the 1700 and 1800's as ornamentals, and for wildlife food and habitat, these species have become increasingly problematic. The most prevalent species in the state are Amur, Morrow's, and Tartarian honeysuckles.

Previous work conducted in 1999 investigated the control of Tartarian honeysuckle using several herbicide combinations with low volume backpack applications. This work was reported in the Roadside Vegetation Management Fifteenth Year Report[1] and resulted in unacceptable levels of control. The reasons for poor results were not completely resolved, but were mostly attributed to the selected mixtures and the application method. This trial investigates control of exotic bush honeysuckle using alternate herbicide combinations and increased carrier rates.

MATERIALS AND METHODS

This study was established along SR 322 near State College, PA. Thirteen treatments, including an untreated check, were applied on September 17 and 18, 2003 to individual shrubs using a randomized complete block design with five replications. Treatments were mixed based on a target application volume of 100 gallons/ac, which we approximated as 'spray-to-wet' coverage. Treatments included Escort alone at targeted rates of 0.5, 1, and 2 oz/ac; Krenite S alone at 128 or 256 oz/ac; Garlon 3A at 64 oz/ac alone or in combination with Vista at 64 oz/ac, Vanquish at 64 oz/ac, or Escort at 0.5 oz/ac; and Glyphosate at 128 oz/ac, alone or in combination with Garlon 3A at 32 oz/ac or Arsenal at 8 oz/ac. CADCO 90 non-ionic surfactant was added to all treatments at 0.25 percent v/v. The species targeted in this study were identified

[1] Evaluation of Herbicides for Control of Tartarian Honeysuckle Using Low Volume Backpack Applications. 2000. Roadside Vegetation Management Research Report - Fifteenth Year Report. http://rvm.cas.psu.edu/2000/AR2000.html

as Morrow's and Tartarian honeysuckle. Individual plants were not distinguished by species. Treatments were made using a CO_2-powered backpack sprayer equipped with a single Spraying Systems #5500 Adjustable ConeJet nozzle with an X-12 tip. Canopy measurements taken at the time of treatment were used to estimate canopy basal area. Based on these measurements and measured total solution used for each treatment, an average application volume between 102 and 149 gallons/ac was calculated for the treatments, and used to calculate an estimated application rate (Table 1). Treatments will be described by targeted rate in this discussion.

Injury ratings were taken October 14, 2003, 4 weeks after treatment (WAT). Injury ratings were taken on a scale from 0 to 10 where "0" indicates no observable effect and "10" = dead. Percent live crown reduction was rated on August 2, 2004, 45 WAT. Data were subjected to analysis of variance, and means separated using Fisher's Protected LSD where appropriate.

RESULTS AND DISCUSSION

Injury ratings taken 4 WAT ranged from 3.0 to 7.4. Plots treated with Escort at 1 or 2 oz/ac, and Glyphosate plus Arsenal, or tank-mixes that included Garlon 3A had the highest ratings.

At 45 WAT, honeysuckle treated with Glyphosate alone was rated at 95 percent canopy reduction. The ratings for plants treated with Glyphosate plus Garlon 3A or Arsenal; Krenite at 256 oz/ac, or Escort at 2 oz/ac were not significantly different, and ranged between 88 and 99 percent.

Garlon 3A alone or in combination with Vista, and Escort at 0.5 oz/ac stood out as the least effective treatments, rated at 10, 10, and 20 percent reduction. Escort at 1 oz/ac, Krenite S at 128 oz/ac, and Garlon 3A in combination with Vanquish or Escort were intermediate in activity, with ratings between 51 and 62 percent reduction.

CONCLUSIONS

Glyphosate alone was highly effective and did not require a tank mix partner to control honeysuckle. However, an application targeting honeysuckle would target other undesirable woody species and a tank-mix would ensure activity against a broad species spectrum. Garlon 3A alone at 64 oz/ac is ineffective against these honeysuckles, and requires a tank mix partner. Adding Vista to Garlon 3A provided no additional activity, and Vanquish at 64 oz/ac or Escort at 0.5 oz/ac did not provide enough additional activity. There was a distinct rate response with Escort from 0.5 to 2.0 oz/ac. An intermediate rate of 1 oz/ac may serve as a viable tank mix rate. Unfortunately, we did not test this rate in combination with Garlon 3A, the most widely used tank mix partner with Escort. Krenite S alone at 256 oz/ac was effective, which reinforces observations of effective control under operational conditions with Krenite S targeted at 192 oz/ac.

MANAGEMENT IMPLICATIONS

If shrub honeysuckles are going to be effectively targeted during the weed and brush program, the activity of the widely used Garlon 3A plus Escort treatment will need to be increased. From the perspective of minimizing additional cost and retaining safety to grass groundcovers, this will probably entail an increase in the rate of both materials or the addition of Vanquish to the mix. Additional evaluations will need to be conducted to optimize this mixture. More importantly, each District will need to explicitly target the shrub honeysuckles during this program and make sure that opportunities to treat these targets are not missed during the regularly scheduled program. The same approach should also be taken during the sidetrimming program in the late summer. Krenite S-based mixtures will significantly injure shrub honeysuckles, but the applicators need to aggressively target these plants. The combination of more aggressive targeting and enhanced mixtures will allow much of the shrub honeysuckle on the ROW to be addressed without running a species-specific program.

Table 1: Response of a mixed stand of Tartarian and Morrow's honeysuckle to foliar herbicide treatments. Treatments were mixed assuming an application volume of 100 gallons per acre, and applied on a spray-to-wet basis to individual plants on September 17 and 18, 2003. Injury was rated October 14, 2003, 4 weeks after treatment (WAT), on a scale of 0 to 10 with "0"=no observable effect and "10"=dead. Percent live crown reduction was evaluated August 2, 2004, 45 WAT. Each value is the mean of 5 replications.

treatment	targeted application rate	estimated[1/] application rate	Oct 14, 2003 injury	Aug 2, 2004 canopy reduction
	oz/ac	oz/ac	0-10	%
Escort	0.5	0.7	3.0	20
Escort	1	1.2	6.2	53
Escort	2	2.6	6.8	99
Krenite S	128	138	4.8	62
Krenite S	256	260	4.4	88
Garlon 3A	64	66	4.4	10
Garlon 3A Vista	64 64	66 66	5.6	10
Garlon 3A Vanquish	64 64	67 67	7.4	53
Garlon 3A Escort	64 0.5	76 0.6	6.2	51
Glyphosate	128	136	5.4	95
Glyphosate Garlon 3A	128 32	147 37	7.4	98
Glyphosate Arsenal	128 8	191 12	6.6	99
LSD (p=0.05)			2.0	22

[1/] Application rates are based on actual spray volumes and canopy measurements used to estimate the basal area for each shrub.

UPDATE: CONTROL OF TREE-OF-HEAVEN AND CONVERSION TO A FINELEAF FESCUE GROUNDCOVER

Herbicide trade and common names: Escort (*metsulfuron*), Garlon 3A (*triclopyr, amine formulation*), Garlon 4 (*triclopyr, ester formulation*), Roundup Pro (*glyphosate*), Stalker (*imazapyr*), Tordon 101M (*2,4-D + picloram*).

Plant common and scientific names: black locust (*Robinia pseudoacacia*), broomsedge (*Andropogon virginicus*), bush honeysuckle (*Lonicera* spp), creeping red fescue (*Festuca rubra* ssp. *rubra*), deertongue (*Panicum clandestinum*), flowering dogwood (*Cornus florida*), goldenrod (*Solidago* spp.), hard fescue (*Festuca trachyphylla*), hawthorn (*Crataegus* spp.), Japanese honeysuckle (*Lonicera japonica*), milkweed (*Asclepias syriaca*), multiflora rose (*Rosa multiflora*), poison ivy (*Toxicodendron radicans*), pokeweed (*Phytolacca americana*), privet (*Ligustrum* spp.), purpletop (*Tridens flavus*), red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), common teasel (*Dipsacus fullonum*), tree-of-heaven or ailanthus (*Ailanthus altissima*), wild grape (*Vitis* spp.).

ABSTRACT

A demonstration was established in March 1996 to investigate the long-term success of eliminating an existing ailanthus stand while using groundcovers and periodic, selective herbicide treatments to prevent reinfestations from occurring. Initially, the ailanthus stand was treated with a basal bark application followed later that year by a low volume foliar treatment. Half the site was seeded to a fineleaf fescue seed mixture. Herbicide spot treatments were made in 1997, 2000, and 2003 to control ailanthus resprouts. In 2004, the site was free of ailanthus. A concerted effort to remove ailanthus followed by programmed maintenance will clear a site of ailanthus and allow for a longer interval between subsequent maintenance visits.

INTRODUCTION

Tree-of-heaven, or ailanthus, is a problematic tree species along roadway corridors throughout the northeastern United States. It is a root-suckering species that forms large colonies where it becomes established. Ailanthus is capable of growing to heights of 80 ft, is weak wooded and spreads readily. It is capable of spreading not only by the wind-borne seed it produces but also through vigorous suckering and transport of root fragments in soil. This tree has no significant insect or disease pests in the U.S. and has the ability to grow in poor soils and under stressful environmental conditions. Because it grows in full sun and thrives in poor growing conditions the roadside environment provides a tremendous opportunity for the establishment, growth, and spread of this tree.

This project was initiated for the 1997 Roadside Vegetation Management Conference field day to demonstrate the combination of chemical control of ailanthus with the cultural technique of establishing a competitive groundcover. Ailanthus is a species that can be characterized as a 'below-ground' perennial - the focus of a management program is the root system. After eliminating the canopy, management efforts must include follow-up treatment of suckers and periodic maintenance treatments to prevent reinfestation. A groundcover that competes with the ailanthus root system and facilitates selective control of suckers enhances long-term management.

Previous results from this site have been reported in the Roadside Vegetation Management Thirteenth[1/], Fifteenth[2/], and Eighteenth[3/]Year Reports.

MATERIALS AND METHODS

The demonstration site was located in the infield at the intersection of SR 22 West and SR 217, near Blairsville, PA. The ailanthus infestation was approximately 0.75 acres in size. The stand was divided into two distinct areas by an old roadbed. One side had a dense understory of the vine Japanese honeysuckle, and the other side was a thin stand of mixed herbaceous vegetation. The honeysuckle side was not seeded during the course of the demonstration to determine whether the naturally occurring vegetation would provide a competitive and manageable groundcover.

The diameter of the ailanthus stems ranged from 0.25 to 12 in. The first treatment was a basal bark application made on March 22, 1996. The solution used was 20 percent (v/v) Garlon 4 and 80 percent (v/v) Arborchem Basal Oil. The lower 15 to 18 in of all the stems were treated. On September 4, 1996 all ailanthus resprouts were treated with a low volume foliar application of 4 percent (v/v) Roundup Pro, 1 percent (v/v) Garlon 3A, and 0.25% (v/v) Formula 358 drift control. The foliar application also targeted other unwanted species such as poison ivy. Species such as dogwood, hawthorn, and sycamore were not targeted by the application. The herbicide treatments were applied with backpack sprayers with basal wands or handguns and a TeeJet #5500 Adjustable ConeJet nozzle with a Y-2 tip. The non-honeysuckle portion of the area was seeded to a 60:40 mixture, by weight, of hard fescue and creeping red fescue on September 19, 1996. The seed was applied at 115 lbs/ac using hand seeders. On September 22, 1997, a selective low volume foliar application of Garlon 4 plus Escort at 5 percent, v/v, plus 1 oz/20 gal, respectively, was made to control existing ailanthus resprouts and other unwanted vegetation. This mixture included 0.25 percent v/v Polytex A1001 drift control and 0.12 percent v/v QwikWet 357 surfactant.

A low volume foliar treatment was applied on August 4, 2000, using backpack sprayers equipped with TeeJet #5500 Adjustable ConeJet nozzles and Y-2 tips. Four gallons of a 5 percent (v/v) solution Tordon 101M was applied to the site. The targets included not only the ailanthus, but also poison ivy, privet, red maple, grape, and some Japanese honeysuckle on the seeded portion of the infield.

A basal bark application was made September 30, 2003, targeting ailanthus, multiflora rose, and privet. The herbicide mixture contained a 15:3:82 percent (v/v) mixture of Garlon 4, Stalker, and Arborchem Basal Oil. Approximately 1 quart of the herbicide solution was applied. The application equipment included a backpack sprayer equipped with a TeeJet #5500 Adjustable ConeJet nozzle and Y-2 tip.

Activities at the site are summarized in Table 1.

On August 26, 2004 the control of previously targeted species and presence of both desirable and undesirable species was evaluated. No treatments were made during this calendar year.

[1/] Control of Tree-of-Heaven and Conversion to Fine Fescue. 1998. Roadside Vegetation Management Research Report - Thirteenth Year Report. http://rvm.cas.psu.edu/1998/AR1998.html

[2/] Control of Tree-of-Heaven and Conversion to Fine Fescue Update. 2000. Roadside Vegetation Management Research Report - Fifteenth Year Report. http://rvm.cas.psu.edu/2000/AR2000.html

[3/] Update: Control of Tree-of-Heaven and Conversion to Fine Fescue. 2003. Roadside Vegetation Management Research Report – Eighteenth Year Report. http://rvm.cas.psu.edu/2003/AR2003.html

RESULTS AND DISCUSSION

By September 18, 1997 the trees treated during 1996 were completely controlled and the fine fescue stand had become well established. The Japanese honeysuckle understory that dominated the other half of the demonstration area was thriving. Ailanthus resprouts were evident throughout both areas but were effectively controlled with the application made on September 22, 1997.

Four gallons of solution were sprayed on August 4, 2000 versus 1.6 gallons on September 22, 1997. Three years had passed between these follow-up visits and ailanthus resprouts were present but, minimal. Other troublesome species were targeted during both visits. The area left with an understory of honeysuckle remained intact with scattered ailanthus resprouts. These resprouts were easily targeted selectively with the low volume foliar application. The area seeded to fine fescue has largely been transformed to a stand of these grasses.

Only five ailanthus stems were found during the treatment on September 30, 2003. The tallest was 7 feet. Japanese honeysuckle continued to thrive on one half of the infield area where it formed a nearly impenetrable groundcover. The infield was used as a staging area for construction activity in recent years. As a result, much of the fine fescue was destroyed. Japanese honeysuckle has infiltrated this part of the infield as well - possibly moved during the construction activity. It now occupies nearly 50 percent of the area seeded to fine fescue.

During the August 26, 2004 visit only a single ailanthus stem was observed. Japanese honeysuckle remains the dominant groundcover. The remnant stand of fine fescue is almost gone as it is replaced by Japanese honeysuckle. Other species found within the infield included: goldenrod, common milkweed, teasel, pokeweed, privet, and poison ivy. A few multiflora rose bushes that were targeted in 2003 were completely controlled. Three native species (purpletop, broomsedge, and deertongue) were appearing on the area previously used as a staging site for construction equipment.

CONCLUSIONS

Eight years after the initial treatment the area still remains nearly free of ailanthus. Periodic management is necessary to prevent ailanthus and other troublesome species from invading the site. Minimal time and material has gone into the maintenance of this location since the ailanthus was controlled. The approach of leaving naturally occurring understory where it exists has proven successful with this demonstration. The fineleaf fescue can either serve as a permanent or temporary cover, depending on the competitiveness of existing vegetation.

MANAGEMENT IMPLICATIONS

This project demonstrates that a stand of ailanthus can be successfully converted to a low maintenance groundcover. Selectively controlling the ailanthus and converting the area to a competitive groundcover is economically feasible and offers long-term benefits. The Japanese honeysuckle proved to be a competitive, naturally occurring groundcover, though in many settings this species is an invasive species and may warrant removal. Where areas are devoid of an existing groundcover grasses are a logical choice for establishment. They are competitive and selective chemistry can be used to control the ailanthus and other broadleaf weeds without destroying the integrity of the groundcover.

Table 1: Estimated cost figures for converting an established stand of ailanthus to fine fescue. The treatments outlined are the five visits made from 1996 to 2003. Labor costs are based on $20.00/hr.

treatment	date	material cost	labor hours	labor costs
basal bark	3/26/96	$76.18	4	$80.00
low volume foliar	9/04/96	$37.80	2	$40.00
seeding	9/19/96	$79.90	2	$40.00
low volume foliar	9/22/97	$7.64	1.5	$30.00
low volume foliar	8/04/00	$6.66	1.5	$30.00
basal bark	9/30/03	$7.38	0.5	$10.00

Total Cost (to date) = $445.56 for treating 0.75 ac and seeding 0.40 ac.

Based on these figures, it would cost $733.96/ac to initially treat, seed, and provide three subsequent follow-up treatments on a similar ailanthus infestation.

CONTROL OF ORIENTAL BITTERSWEET WITH FOLIAR HERBICIDE APPLICATIONS

<u>Herbicide trade and common chemical names</u>: Escort XP (*metsulfuron*), GlyPro (*glyphosate*), Krenite S (*fosamine*).
<u>Plant common and scientific names:</u> ailanthus (*Ailanthus altissima*), crownvetch (*Coronilla varia*), fireweed (*Erechtites hieracifolia*), Japanese honeysuckle (*Lonicera japonica*), Oriental bittersweet (*Celastrus orbiculatus*), staghorn sumac (*Rhus typhina*), Tartarian honeysuckle (*Lonicera tatarica*).

ABSTRACT

Two-year old resprouts of Oriental bittersweet were treated June 16, 2004, along SR 283, near Harrisburg, PA. The treatments included Escort at 1, 2, or 3 oz/ac; Krenite S at 128 oz/ac; and GlyPro at 96 oz/ac. GlyPro caused 90 percent reduction of Oriental bittersweet on September 24, 2004, 100 DAT. Other treatments ranged from 35 to 58 percent reduction by this date. A final evaluation was made June 22, 2005, 371 DAT. Only Krenite S and GlyPro were significantly better than the untreated check with values of 63 and 68 percent reduction. Escort treatments ranged from 23 to 37 percent reduction.

INTRODUCTION

Oriental bittersweet is a woody, perennial vine or trailing shrub native to eastern Asia. The plant is found from New York to North Carolina westward to Illinois[2]. It occupies disturbed sites, like roadsides. The plant likes sunny areas, but will also tolerate shade. Therefore, it will infest coastal areas to woodlands and open sites in between.

The plant is distinguished by almost-round, alternate, glossy leaves, with finely toothed margins. It is dioecious – meaning it occurs as separate male and female plants. The female plants produce a large number of small greenish flowers, fruits and seeds. The fruits are yellow capsules that split open at maturity to reveal three red-orange fleshy arils containing one or two seeds apiece. Spread of this plant occurs by the abundant seed produced or vegetatively from root suckers. Its spread is facilitated by its use as a decorative element in floral arrangements and wreaths.

This plant is problematic because it smothers surrounding vegetation by growing over it. The added weight can also contribute to uprooting trees when it grows high into the canopy. Both these situations can lead to problems along the road.

MATERIALS AND METHODS

The study was located along SR 283, near Harrisburg, PA on an east facing cut slope. Treatments were applied on June 16, 2004 using a CO_2-powered backpack sprayer equipped with a GunJet 30 handgun and single Spraying Systems #5500 Adjustable ConeJet nozzle with an X-2 tip. The targeted carrier volume was 20 gallons per acre.

Treatments were arranged in a randomized complete block design with three replications. The treatments included Escort XP at 1, 2, or 3 oz/ac; Krenite S at 128 oz/ac; GlyPro at 96 oz/ac; and an untreated check. All herbicide treatments included Activator 90 non-ionic surfactant at

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[2] Swearingen, J. 2006. Oriental Bittersweet (*Celastrus orbiculatus*). PCA Alien Plant Working Group. http://www.nps.gov/plants/alien/fact/ceor1.htm.

0.25 percent, v/v. Plots were 10 by 20 ft. in size. The Oriental bittersweet was fully leafed out with green fruits appearing at the time of application. Other species commonly found within the plots included crownvetch, Tartarian honeysuckle, ailanthus, staghorn sumac, Japanese honeysuckle, and fireweed. To prevent untreated bittersweet from climbing into the plots, the perimeter of the study area was treated with GlyPro at 5 percent, v/v, plus Activator 90 at 0.25 percent, v/v.

Percent injury of Oriental bittersweet was rated July 21, 2004, 35 days after treatment (DAT). Percent reduction of Oriental bittersweet was evaluated September 24, 2004 and June 22, 2005, 100 and 371 DAT. Data were subjected to analysis of variance and means compared using Fisher's Protected LSD (p=0.05).

It appeared that portions of the plots closest to the road were oversprayed by Department contractors during the fall of 2004. These areas within the plot were avoided during the evaluation.

RESULTS AND DISCUSSION

On July 21, 2004, 35 DAT, the highest amount of injury occurred with GlyPro. GlyPro continued to significantly reduce the Oriental bittersweet stand during 2004. September 24, 2004, 100 DAT, the study was rated again. GlyPro caused 90 percent reduction of Oriental bittersweet, the greatest percentage of all treatments. Other treatments ranged from 35 to 58 percent reduction by this date.

A final evaluation was made June 22, 2005, 371 DAT. Only Krenite S and GlyPro treatments were significantly better than the untreated check with values of 63 and 68 percent reduction. Escort treatments ranged from 23 to 37 percent reduction.

CONCLUSIONS

GlyPro at 96 oz/ac or Krenite S at 128 oz/ac demonstrated the most effective long-term control by eliminating approximately two-thirds of the stand. The Escort was used at typical roadside application rates. Even though the higher rates, 2 and 3 oz/ac, looked good initially at 371 DAT they did not cause the efficacy required for a significant impact on reducing the stand. Tank mixes and additional combinations need to be evaluated. Due to relatively small patches of bittersweet available, this trial was somewhat cursory and served primarily to identify three active ingredients that cannot be used alone. We feel Oriental bittersweet is a species worthy of aggressive targeting, and we need to evaluate a larger selection of treatments.

MANAGEMENT IMPLICATIONS

Where infestations of this plant occur it should be aggressively targeted during the weed and brush or sidetrim programs. Future research will identify the most effective treatments, but there should be no hesitation to use the current mixtures whenever the opportunity arises.

Table 1: Response of Oriental bittersweet (*Celastrus orbiculatus*) to herbicide treatments applied June 16, 2004. Visual ratings of percent injury were taken July 21, 2004, 35 days after treatment (DAT). Percent reduction was evaluated September 24, 2004 and June 22, 2005, 100 and 371 DAT. Values shown are the mean of three replications.

treatment[1]	product rate	Jul 21, 2004 injury	Sep 24, 2004 reduction	Jun 22, 2005 reduction
	(oz/ac)	----------------------------%	------------------------------	
untreated	- -	0	0	0
Escort XP	1	15	35	30
Escort XP	2	18	53	23
Escort XP	3	20	58	37
Krenite S	128	27	43	63
GlyPro	96	53	90	68
Protected LSD (p=0.05)		16	18	46

[1] All treatments included 0.25% v/v Activator 90, surfactant.

COMPARISON OF BROADLEAF WEED CONTROL PRODUCTS

<u>Herbicide trade and common names</u>: Escort XP (*metsulfuron*), Garlon 3A (*triclopyr*), Overdrive (*dicamba + diflufenzopyr*), QuickSilver IVM (*carfentrazone*), Speedzone (*carfentrazone + 2,4-D + MCPP + dicamba*), Transline (*clopyralid*), Triplet (*2,4-D + MCPP + dicamba*), Vanquish (*dicamba)*, Vista (*fluroxypyr*).
<u>Plant common and scientific names</u>: crownvetch (*Coronilla varia*), plumeless thistle (*Carduus acanthoides*).

ABSTRACT

Broadleaf herbicides were evaluated alone and tank-mixed for control of crownvetch and plumeless thistle. Treatments containing carfentrazone (QuickSilver IVM or Speedzone) were rated higher for injury to crownvetch and plumeless thistle at 5 and 35 days after treatment (DAT). At 88 DAT, there was no indication of carfentrazone causing antagonism to the activity of the other systemic herbicides in the treatments. Crownvetch cover recovered to untreated levels in plots treated with QuickSilver IVM alone, and Overdrive alone or in combination with QuickSilver IVM. All other herbicide combinations - tank mixed or premixed - provided effective suppression of crownvetch. Garlon 3A or Vanquish alone provided intermediate-level control and suppression of crownvetch.

INTRODUCTION

Several new herbicides intended for selective control of broadleaf weeds have recently been introduced to the right-of-way market. These include Overdrive, QuickSilver IVM, Speedzone, and Vista. Overdrive is a premix of dicamba plus diflufenzopyr. Diflufenzopyr is an herbicide additive that has been found to enhance the activity of synthetic auxin herbicides such as 2,4-D or dicamba. Carfentrazone, the active ingredient in QuickSilver IVM, is a selective, contact herbicide, providing symptoms on treated plants within hours of application. Speedzone also contains carfentrazone, but combined with 2,4-D, MCPP, and dicamba. These herbicides are marketed to provide quick foliar symptoms plus systemic control. Vista is on the state herbicide contract, but to date we have not identified a particular use for it in a market that already has several broad-spectrum broadleaf products.

The overall objective was to determine which products, or combinations provide effective broadleaf control, and whether the quick symptom development provided by carfentrazone is antagonistic to the systemic herbicides in a tank mix. This trial was part of the 2004 Roadside Vegetation Management Conference field day, and served as an opportunity to both review well-known treatments and new or little-used combinations. The primary target species was crownvetch. As a resilient, creeping perennial, crownvetch provides a stern test of herbicide effectiveness, and it is relatively easy to find a site with a stand uniform enough to conduct a trial. In this particular situation, later season regrowth of crownvetch would provide an indication of antagonism caused by adding the quick-acting carfentrazone to herbicides that are expected to translocate to be fully effective.

MATERIALS AND METHODS

The study was located within the interchange of westbound SR 322 and SR 3010, near Boalsburg, PA. The infield area was originally established to crownvetch, but had become infested with plumeless thistle. Treatments were applied on May 28, 2004 using a CO_2-powered, hand-held sprayer equipped with a six ft. boom and four TeeJet XR 8002 VS tips, at a carrier volume of 20 gal/ac. The individual plots were 6 by 20 ft, laid out in a randomized complete block design with three replications.

Ratings of percent total vegetative cover, and percent cover by crownvetch, first-year plumeless thistle, and second-year plumeless thistle were taken on May 28, 2004, 0 days after treatment (DAT). Crownvetch and plumeless thistle injury were evaluated on June 2 and July 2, 2004, 5 and 35 DAT. Injury was rated on a scale from 0 to 10 with "0"= no injury, and "10"= dead. On July 28 and August 24, 2004, 61 and 88 DAT, visual ratings were taken for percent cover by total vegetation, crownvetch, first-year and second-year plumeless thistle, and turf (composite rating of all perennial grasses). Data were subjected to analysis of variance, and where appropriate, means compared using Fisher's Protected LSD (p=0.05). Percent crownvetch cover at 0 DAT was used as a covariate for analysis of crownvetch cover at 61 and 88 DAT. An orthogonal contrast was used to compare the effect of carfentrazone on injury to crownvetch and plumeless thistle at 5 and 35 DAT, using Overdrive at 8 oz/ac, Garlon 3A plus Escort, Garlon 3A plus Vanquish, or Garlon 3A plus Vista, with or without QuickSilver; and Triplet vs. Speedzone, which served as a comparison of the common pre-mix of 2,4-D, MCPP, and dicamba with and without carfentrazone. When results are described referring to with or without carfentrazone, these are the treatments being discussed.

RESULTS AND DISCUSSION

The addition of carfentrazone increased injury ratings to crownvetch (highly significant at 5 and 35 DAT) and plumeless thistle (p=0.09 at 5 DAT, significant at 35 DAT) (Table 1). At 5 DAT, average injury ratings for crownvetch were 6.5 and 5.0, with and without carfentrazone, and the differences were still present at 35 DAT, with average crownvetch injury ratings of 9.4 and 8.5, with and without carfentrazone. Injury to plumeless thistle followed a similar pattern, with 5 DAT averages of 6.1 and 5.6 for with and without carfentrazone, and 35 DAT averages of 8.8 and 7.9 for with and without.

Plots treated with Speedzone and Garlon 3A plus Vanquish plus QuickSilver IVM had average crownvetch injury ratings of '10' on the 0 to 10 scale at 35 DAT. Garlon 3A plus Escort XP plus QuickSilver IVM; and Garlon 3A plus Vista, with our without QuickSilver IVM were rated at 9.3 or better, and were not significantly different from the two best-rated treatments. All premix or tank-mix treatments had average injury ratings of at least 8.3, except for Overdrive at 4 or 8 oz/ac, which had ratings of 5.3 and 6.3. Plots treated with QuickSilver IVM alone, Vanquish, or Garlon 3A had average crownvetch injury ratings of 5.0, 7.7, and 8.3, respectively.

Average injury to plumeless thistle at 35 DAT was 10 (0 to 10) in plots treated with Garlon 3A plus Vista plus QuickSilver IVM. Plots treated with Garlon 3A plus Escort XP, with or without QuickSilver IVM; Garlon 3A plus Overdrive, and Vanquish plus Transline had average plumeless thistle injury ratings of at least 9.0, and were not significantly different from the best rated treatment. The pre-mix and tank-mix treatments had average injury ratings of at least 7.0. QuickSilver IVM, Garlon 3A, and Vanquish-treated plots were rated at 1.7, 5.7, and 6.3 for plumeless thistle injury, respectively.

Crownvetch cover at 0 DAT was significant as a covariate for crownvetch cover at 61 and 88 DAT. Average crownvetch cover in the untreated plots at 88 DAT was 67 percent. Crownvetch cover was not significantly different in the plots treated with Overdrive alone at 4 or 8 oz/ac, QuickSilver IVM alone, or Overdrive plus QuickSilver IVM. The tank-mix and pre-mix treatments (except for Overdrive alone or plus QuickSilver IVM) were highly injurious to crownvetch, which averaged 0 to 15 percent cover at 88 DAT in these plots. Garlon 3A alone and Vanquish alone were intermediate in injury, as crownvetch had recovered to 30 and 40 percent cover respectively, at 88 DAT.

Turf cover at 88 DAT was variable, and was a function of both original turf cover and crownvetch suppression (or turf release) (Table 2). The effect of herbicide treatment was not significant, despite turf cover ranging from 0 to 41 percent. At 0 DAT, turf was present, but was under the crownvetch canopy, so it did not contribute to initial cover ratings.

Second-year plumeless thistle was either killed by the herbicide treatments, or went through some level of recovery, flowered and was largely senescent by the 61 and 88 DAT ratings. First year plumeless thistle at 88 DAT appeared to be a function herbicide residue, crownvetch suppression, and turf release. Plots treated with Garlon 3A plus Escort XP, with or without QuickSilver IVM, had 0 and 1 percent plumeless thistle cover at 88 DAT, despite little crownvetch or turf cover. We believe this was a function of the existing thistle being eliminated and the soil activity of Escort XP suppressing subsequent germination. Plumeless thistle cover was low (0 to 5 percent) where crownvetch cover was heavy, and highest where crownvetch and turf cover was low to moderate but the herbicide treatments had little residual soil activity.

The addition of QuickSilver IVM did not have a significant effect at 61 or 88 DAT, suggesting that the carfentrazone did provide increased injury at 5 and 35 DAT without antagonizing control of the perennial crownvetch.

CONCLUSIONS

QuickSilver IVM did provide enhanced foliar injury at 5 and 35 DAT on crownvetch and plumeless thistle. This early enhancement did not have a significant effect on later evaluations of crownvetch response to the herbicide treatments. Overdrive alone or in combination with QuickSilver IVM had only short-term effects on crownvetch, and by 88 DAT crownvetch cover was no different in Overdrive or Overdrive plus QuickSilver IVM-treated plots compared to the untreated check. The other tank mix and pre-mix treatments were quite lethal to crownvetch. Where crownvetch was eliminated and soil activity from Escort XP was not present, plumeless thistle was a common pioneer plant.

MANAGEMENT IMPLICATIONS

If speed of foliar symptom onset is an issue, QuickSilver IVM can provide that benefit without antagonizing the activity of translocated herbicides used for selective control of broadleaf weeds. This effect could be utilized in situations where tall-growing weeds are causing sight-distance issues and mowing or cutting them is not a practical option. Adding QuickSilver IVM to an herbicide treatment may remove that foliage from line-of-sight more quickly.

Table 1: Response of crownvetch and plumeless thistle to herbicides applied May 28, 2004. Injury was rated June 2 and July 2, 2004, 5 and 35 days after treatment (DAT). Injury was evaluated on a scale from 0 to 10 with "0"=no injury and "10"=dead. An orthogonal contrast was used to determine if adding QuickSilver IVM increased crownvetch injury at 5 and 35 DAT. The treatments included in the contrast are indicated in italics. Each value reported for individual treatments is the mean of three replications.

product	application rate	crownvetch injury 5 DAT	crownvetch injury 35 DAT	plumeless thistle injury 5 DAT	plumeless thistle injury 35 DAT
	(oz/ac)	0 - 10			
Untreated	---	0.0	0.0	0.0	0.0
QuickSilver IVM	1	5.0	5.0	2.3	1.7
Garlon 3A	32	4.3	8.3	5.0	5.7
Vanquish	16	4.3	7.7	5.3	6.3
Overdrive	4	4.7	5.3	5.5	7.0
Overdrive	*8*	*4.7*	*6.3*	*5.7*	*7.7*
Overdrive *QuickSilver IVM*	*8* *1*	*6.7*	*8.3*	*6.7*	*8.3*
Garlon 3A *Escort*	*32* *0.5*	*4.7*	*9.0*	*5.0*	*9.3*
Garlon 3A *Escort* *QuickSilver IVM*	*32* *0.5* *1*	*6.3*	*9.3*	*5.3*	*9.0*
Vanquish Transline	16 8	5.0	8.7	6.3	9.3
Overdrive Garlon 3A	4 32	4.3	8.7	5.0	9.0
Garlon 3A *Vanquish*	*32* *16*	*5.3*	*8.7*	*5.3*	*7.7*
Garlon 3A *Vanquish* *QuickSilver IVM*	*32* *16* *1*	*6.3*	*10*	*5.7*	*8.3*
Triplet	*43*	*5.0*	*9.0*	*5.7*	*7.0*
Speedzone	*64*	*6.3*	*10*	*6.0*	*8.7*
Garlon 3A *Vista*	*32* *32*	*5.3*	*9.7*	*6.3*	*8.0*
Garlon 3A *Vista* *QuickSilver IVM*	*32* *32* *1*	*6.7*	*9.3*	*7.0*	*10*
Protected LSD (p=0.05)		1.0	0.9	1.5	1.5
orthogonal contrast					
no carfentrazone		5.0	8.5	5.6	7.9
with carfentrazone		6.5	9.4	6.1	8.8
Significance Level (p)		0.0001	0.0001	0.09	0.005

Table 2: Response of crownvetch (CZRVA) and first-year plumeless thistle (CRUAC), and turf on a percent cover basis, after herbicides were applied May 28, 2004. Percent cover was evaluated May 28, July 28, and August 24, 2004, or 0, 61, and 88 days after treatment (DAT). Crownvetch ratings for 61 and 88 DAT were adjusted using crownvetch cover at 0 DAT as a covariate. Results for CRUAC and turf at 0 and 61 DAT are not reported. Column means followed by the same letter are not significantly different (p=0.05). Each value is the mean of three replications.

		-------------- CZRVA --------------			CRUAC	turf
product	application rate	0 DAT cover	61 DAT cover	88 DAT cover	88 DAT cover	88 DAT cover
	(oz/ac)		------------------------ %	------------------------	------------------------	
untreated	---	68	53 a	67 a	1	25
QuickSilver IVM	1	75	51 ab	72 a	5	2
Garlon 3A	32	76	2 e	30 cd	23	11
Vanquish	16	62	10 de	40 bc	18	2
Overdrive	4	90	38 abc	83 a	0	0
Overdrive	8	77	26 cd	62 ab	0	20
Overdrive QuickSilver IVM	8 1	64	33 bc	76 a	0	14
Garlon 3A Escort	32 0.5	76	0 e	0 e	0	10
Garlon 3A Escort QuickSilver IVM	32 0.5 1	50	5 e	15 de	1	17
Vanquish Transline	16 8	70	1 e	2 e	5	26
Overdrive Garlon 3A	4 32	78	0 e	12 de	3	41
Garlon 3A Vanquish	32 16	70	2 e	7 de	13	27
Garlon 3A Vanquish QuickSilver IVM	32 16 1	71	1 e	4 e	4	40
Triplet	43	75	0 e	3 e	15	13
Speedzone	64	66	2 e	3 e	15	40
Garlon 3A Vista	32 32	73	0 e	1 e	2	31
Garlon 3A Vista QuickSilver IVM	32 32 1	65	1 e	5 e	7	36
Protected LSD (p=0.05)		- -	- -	- -	15	n.s.

UPDATE: REPLACING A GIANT KNOTWEED INFESTATION WITH FINELEAF FESCUES

<u>Herbicide trade and common names</u>: Arsenal (*imazapyr*), Roundup Pro (*glyphosate*), Tordon 101M (*picloram + 2,4-D*), Scythe (*pelargonic acid*), Transline (*clopyralid*), Vanquish (*dicamba*), Vista (*fluroxypyr*).

<u>Plant common and scientific names</u>: American burnweed (*Erechtites hieraciifolia*), common evening primrose (*Oenothera biennis*), creeping red fescue (*Festuca rubra* ssp rubra), crownvetch (*Coronilla varia*), dewberry (*Rubus* spp), giant knotweed (*Polygonum sachalinense*), hard fescue (*Festuca trachyphylla*), Japanese knotweed (*Polygonum cuspidatum*), orchardgrass (*Dactylis glomerata*), common teasel (*Dipsacus fullonum*).

ABSTRACT

In 1996 several herbicide mixes, mainly glyphosate-based, were evaluated for control of giant knotweed. This treatment was preceded by a broadcast seeding a mixture of hard fescue and creeping red fescue. This conversion from knotweed to grasses was largely successful. In 1997 the replicated trial ended and the area has since been maintained to monitor long-term control and maintenance inputs. After seven years of periodic follow-up treatments the site has less than 4 percent cover by knotweed. The established groundcover is composed primarily of fine fescue and crownvetch.

INTRODUCTION

Giant and Japanese knotweed have become a significant problem along Pennsylvania's roads. These plants block sight distance, impact the integrity of the road surface, and form large monocultures while displacing more desirable vegetation. Many studies and demonstrations have been undertaken to establish the best approach to controlling these two species. This particular demonstration began as a study to investigate several herbicide mixes to control a giant knotweed infestation in combination with seeding a fineleaf fescue mixture in the late winter. Using a combination of chemical and cultural practices together can help to improve the long-term success of managing these knotweed stands. The cultural practice of planting grasses in these areas is meant to provide the benefit of forming a competitive groundcover where selective materials can later be applied to control any knotweed resprouts. In many areas the grass stand has inevitably given way to crownvetch where this plant was the initial groundcover. The question is whether it is more practical to maintain the grass stand by targeting crownvetch or allow it to develop into the primary groundcover.

Early results of this study can be referenced in The Roadside Vegetation Management Research Twelfth Year Report. Since July 1997, the area has been maintained to monitor long-term control and maintenance inputs. At first, the goal was to selectively remove all broadleaf weeds, including knotweed and crownvetch, and encourage the fine fescue grass stand. Beginning in 2003 the focus changed. Similar demonstration sites throughout the state were being overrun by crownvetch. Rather than remaining in a perpetual battle with crownvetch, it was decided to allow it to either co-exist with the grasses or restore itself to its original splendor.

The Roadside Vegetation Management Thirteenth and Fifteenth Year Reports summarize the findings of the initial study and detail the events and findings that have occurred from July 1997 to August 2000. This report adds details of site visits and observations made in 2003 and 2004.

MATERIALS AND METHODS

The 0.65 ac study area was located in an established giant knotweed stand along SR 2019 near Luciusboro, PA. The entire study area was seeded with a 60:40 mix of hard fescue and creeping red fescue at 100 lb/ac on March 22, 1996, with hand-held rotary spreaders. Approximately 2-4 inches of snow was present at the time of seeding. The area was divided into plots and five separate herbicide treatments were applied on July 17, 1996, as part of the initial study to evaluate the effectiveness of the treatments and the amount of turf that established.

On July 2, 1997, at the conclusion of the study, the treated plots were sprayed with 0.75 percent (v/v) Vanquish and 0.0625 percent (v/v) Transline. Previously untreated areas were sprayed with 1 percent (v/v) Roundup Pro and 0.0625 percent (v/v) Arsenal. The treatments were applied using a truck-mounted sprayer equipped with a hose reel and GunJet handgun with a D6 spray tip, at 60 psi at approximately 100 gal/ac. All treatments included 0.125 percent (v/v) QwikWet 357 surfactant and 0.25 percent (v/v) Polytex A1001 drift control agent. Fifty gallons of solution was applied to approximately 0.5 ac. On September 18, 1997 all areas devoid of turf were seeded with the fineleaf fescue mixture.

On September 15, 1998 5.0 gallons of a mixture containing 2.5 percent (v/v) Vanquish, 0.31 percent (v/v) Transline, 0.1 percent (v/v) QwikWet 357 surfactant, and 0.25 percent (v/v) Polytex A1001 drift control agent was applied using backpacks, targeting 20 gal/ac. An additional 45 lbs of the fineleaf fescue mix was seeded to areas sprayed on this date.

On August 10, 1999 4.5 gallons of a spray mixture containing 4 qts/ac Garlon 4, 8 oz/ac Transline and 0.125 percent (v/v) QwikWet 357 was applied using backpack sprayers, targeting 20 gal/ac.

During a visit made on August 4, 2000 the area was spot sprayed to selectively remove any knotweed and crownvetch that was infesting the site. A low volume backpack application was made using a 5 percent, v/v, Tordon 101M solution. The total volume sprayed was 4 gallons.

Subsequent visits to the site were made on September 30, 2003 and August 26, 2004. Spot treatments were made to control persistent knotweed, but crownvetch was no longer targeted. In 2003, 4 gallons of a mixture containing 2.5 percent (v/v) Vanquish, 0.625 percent (v/v) Transline, plus 0.1 percent (v/v) Freeway surfactant was sprayed using backpack sprayers. During the 2004 visit, another 4 gallons of 2.5 percent (v/v) Vanquish plus 0.6 percent (v/v) Vista was applied using backpack sprayers. Both treatments targeted an application volume of 20 gal/ac.

RESULTS AND DISCUSSION

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. The establishment of the fine fescue had been significantly reduced during the initial trial. This was in part due to the late initial application, which resulted in a shading effect by the knotweed and also the high volume application of a Roundup Pro based mixture applied after turf establishment that provided further damage to the developing turf stand. Since the trial was completed and the demonstration established in July 1997, a slow progression took place toward a solid turf stand replacing the knotweed. By September 1997 about 50 percent of the area was covered by fineleaf fescues with the remainder of the area infested with knotweed. By this date, the knotweed was in varying stages of injury from the July 1997 herbicide treatment. Injury ranged from 50 to 99 percent across the demonstration site. During the September 1998 visit the area was approximately 30 percent knotweed with the remaining area predominately covered with fineleaf fescue.

On August 4, 2000 the site had approximately 5 percent cover by knotweed. Some of the knotweed was showing the phenoxy-like symptoms of curled leaves. The knotweed canopy was 4 to 5 feet tall, though stems were longer but drooping. The knotweed was in early bloom. The fine fescue stand was thinning at one end of the study, where the soil was stonier and shallower. As the fineleaf fescue was reduced, crownvetch became more prominent.

On September 30, 2003 plots within the original study were rated for cover by knotweed, fine fescue, and crownvetch. There were no significant differences. The effects of the 1996 treatments were overshadowed by several years of growth and spot treatments to the site. Knotweed has, for the most part, continued to decline or stabilize with percent cover values between 2 and 28 percent. Fine fescue comprised the greatest amount of cover with values from 45 to 67 percent. Crownvetch cover ranged from 10 to 35 percent (Table 1).

Many of the markings used to delineate plots were lost by August 26, 2004. The initial plots were evaluated based on a few markers that were located. The numbers generated by these ratings indicate that knotweed and fine fescue continue to decline. Percent knotweed cover ranged from 1 to 4 percent for treatments based on the initial study design, whereas fine fescue averaged from 2 to 40 percent. Crownvetch is thriving throughout much of the demonstration area. A few weed species have also encroached. These include American burnweed, dewberry, teasel, common evening primrose, and orchardgrass.

CONCLUSIONS

All treatments effectively reduced the knotweed stand and a significant amount of fineleaf fescue was established in the voids. The spring applied broadcast seeding of fine fescue performed well; however, the mid-summer herbicide treatments were later than originally intended and allowed the knotweed canopy to close over the young grasses, which was an early setback. After seven years of periodic follow-up spot treatments the area is now primarily a mix of crownvetch and grasses. The amount of herbicide applied to the site has remained fairly constant with each visit.

The knotweed is still present at the site. The knotweed has been reduced to less than 4 percent cover, and is easily dealt with by the spot treatment approach. Periodic visits to the site to monitor and provide follow-up treatments continue to be an integral part of the management of this species. We continue to reevaluate our groundcover approach to knotweed rehabilitation. Crownvetch maintains a persistent seedbank in areas where it was previously planted. The hard seed coat of crownvetch allows it to lie dormant for many years. Rather than battle the crownvetch at this site it will be allowed to co-exist with, or even overtake the fine fescue stand.

MANAGEMENT IMPLICATIONS

It is important to realize that established knotweed stands have tremendous tenacity. A well-executed control program will eliminate the existing stand along with the hazards it presents for the short-term. The best treatment has been using a glyphosate-based mix late in the season between post-flowering and the first frost. The following spring a grass mix, well suited to the site, can be broadcast seeded. Visits to the site to follow-up on resprouts are necessary to prevent the reestablishment of knotweed. These efforts will begin the summer following the initial treatment. Care must be taken to use selective chemistry or application methods to avoid injury to the new groundcover. Where crownvetch was originally present at the site it will likely become reestablished. Rather than engaging in an unending battle with crownvetch it may be best to leave it be and target knotweed and other undesirable species with directed applications.

Table 1. A roadside stand of giant knotweed was converted to a stand of fineleaf fescues. The fescues were seeded March 22 and herbicide treatments were applied July 17, 1996. Percent knotweed cover was rated July 17, 1996; July 2, 1997; and September 30, 2003. The percentage of fineleaf fescue cover was rated on July 2, 1997 and September 30, 2003. Percent cover by crownvetch was rated on September 30, 2003. Each value is the mean of three replications.

treatment	application rate	--- giant knotweed --- 7/17/96	7/2/97	9/30/03	fineleaf fescue 7/2/97	9/30/03	crownvetch 9/30/03
	oz/ac	%					
untreated	---	74	80	3	15	45	35
Roundup Pro	128	74	27	5	22	67	20
Roundup Pro Scythe	128 384	77	27	14	25	51	32
Roundup Pro Arsenal	128 8	80	14	28	20	60	10
Vanquish Transline	96 8	64	6	2	42	60	29
Roundup Pro Transline	128 8	83	14	15	22	47	32
Protected LSD (p=0.05)		n.s.	28	n.s	n.s.	n.s.	n.s.

CONTROL OF JAPANESE KNOTWEED WITH LATE-SEASON FOLIAR HERBICIDE APPLICATIONS

Herbicide trade and common chemical names: Arsenal (*imazapyr*), Escort (metsulfuron), Garlon 3A (*triclopyr*), Glyphosate (*glyphosate*), Krenite S (*fosamine*), Tordon K (*picloram*), Transline (*clopyralid*), Vista (*fluroxypyr*)

Plant common and scientific names: common pokeweed (*Phytolacca americana*), Japanese knotweed (*Polygonum cuspidatum*), pale jewelweed (*Impatiens pallida*).

ABSTRACT

A September 5 application of Glyphosate at 128 oz/ac averaged 96 percent reduction of Japanese knotweed when rated 47 weeks later. The combination of Glyphosate plus Arsenal at 128 plus 8 oz/ac (89 percent), Arsenal alone at 48 oz/ac (89 percent), Tordon K at 64 oz/ac (85 percent), and Vanquish at 64 oz/ac (73 percent) were not significantly different from Glyphosate alone. Escort at 2 oz/ac and Vista at 16 oz/ac provided significant, but unsatisfactory suppression, and Krenite S at 128 or 256 oz/ac, Garlon 3A at 128 oz/ac, Transline at 16 oz/ac, and Escort at 1 oz/ac provided no significant effect.

INTRODUCTION

Japanese knotweed is a rhizomatous, herbaceous perennial native to East Asia that commonly grows to heights of 7 to 10 ft. It grows in dense patches in a wide range of site conditions, and thrives in the disturbed soils on roadsides. Very small rhizome fragments give rise to new plants. One of the primary means knotweed is spread is through conventional roadway maintenance, when infested soil is relocated. When growing close to the road, Japanese knotweed poses an acute sight distance hazard because the tall stems lean out over the roadway. Japanese knotweed can begin rapid growth as soon as early April, and grows tall enough to impair line-of-sight early in the season. Experience to date suggests that early season applications are less effective than late-summer applications. This trial was established to compare herbicides applied late in the season to intact knotweed. In the trade, Glyphosate and Arsenal are touted as the best treatments, so these herbicides were included alone and in combination. We also chose to evaluate the broadleaf herbicides Escort, Garlon 3A, Tordon K, Transline, and Vista. Krenite S was included because work at Virginia Tech suggests that fosamine may be active on knotweed, and the fall brush application window would be an excellent opportunity to target knotweed.

MATERIALS AND METHODS

The treatments were applied September 5, 2003, to a stand of knotweed along SR 405, near Watsontown, PA. The application was made to 5 to 10 ft tall knotweed using a CO_2-powered, hand-held sprayer equipped with a spray wand with a single Spraying Systems #5500 Adjustable ConeJet nozzle with an X-12 tip, applying 200 gal/ac to 10 by 20 ft plots. The herbicide treatments included Glyphosate at 128 oz/ac, Escort at 1 or 2 oz/ac, Garlon 3A at 128 oz/ac, Transline at 16 oz/ac, Vista at 16 oz/ac, Vanquish at 64 oz/ac, Tordon K at 64 oz/ac, Krenite S at 128 or 256 oz/ac, Arsenal at 48 oz/ac, and the combination of Glyphosate plus Arsenal at 128 plus 8 oz/ac. All treatments included 'CADCO 90' non-ionic surfactant at 0.25 percent, v/v.

Response evaluations included a visual rating of foliar injury on a 0 to 10 scale, where 0=no visible injury and 10=complete necrosis, on October 10, 2003, five weeks after treatment (WAT); and a visual rating of percent reduction on August 2, 2004, 47 WAT. Data were subjected to analysis of variance, and means were compared using Fisher's Protected LSD (p=0.05).

RESULTS AND DISCUSSION

The highest rated foliar injury at 5 WAT was for plots treated with Arsenal, with a rating of 7.3. The ratings for the high rate of Escort, Glyphosate plus Arsenal, Garlon 3A, or Vanquish were not significantly different. The ratings for both rates of Krenite S, and for Transline were not significantly different than a rating of '0' (Table 1).

Plots treated with Glyphosate alone had the highest rating for percent reduction at 47 WAT with an average rating of 96 percent. The treatments that were not significantly different included Glyphosate plus Arsenal at 89 percent, Arsenal alone at 89 percent, Tordon K at 85 percent, and Vanquish at 73 percent. Plots treated with the low rate of Escort, Garlon 3A, or Transline were rated at 0 percent reduction, and both rates of Krenite S were rated at 10 percent reduction. In plots where knotweed was significantly reduced, the most common species was pale jewelweed. The exception to this was the plots treated with Arsenal alone, which were colonized primarily by common pokeweed.

The 5 WAT injury ratings did not reliably predict percent reduction at 47 WAT, as Garlon 3A and the high rate of Escort were rated high for initial injury but resulted in 0 and 43 percent reduction at 47 WAT, and Glyphosate had a 5 WAT injury rating of 3.3, but provided the highest rated control a year later.

CONCLUSIONS

Glyphosate was effective and is an inexpensive treatment. It is a non-selective treatment, but knotweed typically grows in a near- to total monoculture so there would be little, if any, desirable vegetation in the targeted area. Glyphosate is also a non-residual treatment, which allows for optimal recruitment of the seedbank to revegetate treated areas. At the time of treatment, the material costs for a glyphosate treatment would be $22.08/ac. The material costs for the Arsenal, Tordon K, and Vanquish treatments would be $97.88, $47.50, and 34.97 per acre, respectively.

MANAGEMENT IMPLICATIONS

The current roadway maintenance scheme is well suited to propagating Japanese knotweed. In the absence of specific spoil-management protocols, knotweed rhizomes are moved from one roadside location to another in infested soil. The current herbicide programs only serve to injure knotweed, but do not appear to provide any net reduction. Knotweed management approaches will either be knotweed-specific, or will require augmentation of existing programs so that knotweed is controlled. Where knotweed is common, a short-duration, late-season (before frost) knotweed-specific program utilizing glyphosate would be a viable approach. An alternate approach is to take advantage the knotweed activity of Vanquish, and use Vanquish plus Escort rather than the commonly used Garlon 3A plus Escort in the selective weed and brush program.

Table 1: Response of Japanese knotweed to herbicide treatments applied September 5, 2003. Foliar injury was evaluated October 10, 2003, five weeks after treatment (WAT) on a scale of 0 to 10, where 0=no injury and 10=complete necrosis. Percent reduction was visually rated August 2, 2004, 47 WAT. Each value is the mean of three replications.

treatment	application rate	5 WAT foliar injury	47 WAT reduction
	oz/ac	0-10	%
untreated	- -	0.0	0
Glyphosate	128	3.3	96
Escort	1	4.3	0
Escort	2	7.0	43
Garlon 3A	128	6.3	0
Transline	16	1.3	0
Vista	16	3.7	37
Vanquish	64	5.3	73
Tordon K	64	5.0	85
Krenite S	128	0.7	10
Krenite S	256	2.0	10
Arsenal	48	7.3	89
Glyphosate + Arsenal	128 8	6.7	89
Fisher's Protected LSD (p=0.05)		2.2	29

COMPARISON OF HERBICIDES FOR POSTEMERMERGENCE CONTROL OF JAPANESE STILTGRASS

Herbicide trade and common chemical names: Assure II (*quizalofop-P*), GlyPro (*glyphosate*), Journey (*glyphosate plus imazapic*), Oust XP (*sulfometuron*), Overdrive (*dicamba plus diflufenzopyr*), Plateau (*imazapic*)

Plant common and scientific names: clearweed (*Pilea pumila*), garlic mustard (*Alliaria petiolata*), Japanese stiltgrass (*Microstegium vimineum*), spreading dogbane (*Apocynum androsaemifolium*), whitegrass (*Leersia virginica*), white snakeroot (*Eupatorium rugosum*).

ABSTRACT

When evaluated in September after a June application to 6-inch tall stiltgrass, Oust XP (1 or 3 oz/ac), Assure II (4, 12, or 16 oz/ac), Journey (4 or 8 oz/ac), or GlyPro (12 oz/ac) reduced stiltgrass cover by at least 95 percent compared to untreated plots. Overdrive plus Plateau (4 plus 2 oz/ac) significantly reduced stiltgrass cover, but to a lesser degree than the best-rated treatments. Overdrive alone at 4 oz/ac caused significant reduction of stiltgrass five weeks after treatment, but this effect was transient and stiltgrass recovered.

INTRODUCTION

Japanese stiltgrass is an annual, shade tolerant, warm-season grass that is becoming increasingly common in Pennsylvania. It is source of alarm in forested areas where it is becoming a dominant species in the understory, further hindering forest regeneration in already disturbed areas. Stiltgrass does not commonly pose a threat to roadway function or safety, but we believe infested rights-of-way (ROW) serve as an invasion pathway into uninfested areas. Management of stiltgrass in ROW will slow the spread and allow the Department to act as a good neighbor to adjacent property owners. A commonly observed scenario is stiltgrass being released on the roadside after a treatment targeting broadleaf weeds and brush removes the existing vegetation and has no active ingredient that injures stiltgrass.

To address this release scenario, we established a trial that included a broadleaf herbicide, Overdrive, alone and in combination with Plateau at 2 oz/ac. This Plateau rate is the recommended rate to suppress roadside turf growth as a plant growth regulator treatment. The intended effect of an Overdrive plus Plateau treatment would be to remove broadleaf species and emerged stiltgrass, provide preemergence activity to prevent subsequent stiltgrass germination, and preserve any existing perennial grasses present. This trial also served as an opportunity to evaluate Journey, a premix with pre- and postemergence activity against stiltgrass. Oust XP and Assure II treatments were included at the request of the manufacturer. The designated standard treatment was GlyPro at 12 oz/ac, which would be equivalent to 16 oz/ac of a 4 lb/gal glyphosate isopropylamine salt product.

MATERIALS AND METHODS

The treatments were applied June 15, 2004, when stiltgrass was beginning to branch, with a canopy height of 6 in. The study site was located on an underground cable right-of-way in a forested setting near State College, PA. The herbicide combinations included Oust XP at 1 or 3 oz/ac; Assure II at 4, 12, or 16 oz/ac; the combination of Oust XP plus Assure II at 1 plus 12 oz/ac; Overdrive at 4 oz/ac, alone or in combination with Plateau at 2 oz/ac; Journey at 4 or 8 oz/ac; and GlyPro at 12 oz/ac. All treatments included Activator 90 non-ionic surfactant at 0.25 percent, v/v. The Overdrive alone and with Plateau combination was intended to determine if addition of Plateau to a broadleaf treatment (Overdrive) would prevent stiltgrass release.

The treatments were applied to 3 by 15 ft plots arranged in a randomized complete block design with three replications, using a CO_2-powered, hand-held sprayer equipped with a single TeeJet 9504E spray tip, delivering 20 gal/ac. A visual rating of percent stiltgrass reduction was taken July 20, 5 weeks after treatment (WAT), and a visual rating of vegetative cover and stiltgrass cover was taken September 24, 14 WAT.

RESULTS AND DISCUSSION

At 5 WAT, plots treated with Overdrive alone were rated at 82 percent stiltgrass reduction. All other herbicide treatments were rated between 95 and 100 percent reduction (Table 1). At 14 WAT, in plots where stiltgrass was reduced, the most common species included clearweed, garlic mustard, white snakeroot, and spreading dogbane. The untreated plots were rated at 100 percent vegetative cover and 97 percent stiltgrass cover. All herbicide-treated plots had significantly less cover for both variables. Total vegetative cover in the treated plots fell into three groupings: combinations including Oust XP, and the high rate of Journey were rated between 0 and 14 percent cover; the Assure II-alone treatments, GlyPro, the low rate of Journey, and Overdrive plus Plateau were rated between 23 and 40 percent cover; and Overdrive alone was rated at 77 percent vegetative cover. The only plots rated with significantly greater stiltgrass cover than the best-rated treatments (Oust XP treatments, 0 percent) were those treated with Overdrive, with or without Plateau, at 21 and 75 percent, respectively. All other herbicide treatments were rated at 5 percent or less stiltgrass cover.

Plateau added to Overdrive did significantly suppress stiltgrass. However, the combination could still be regarded as a release treatment as half the 38 percent cover was stiltgrass. Higher rates of Plateau may be required to provide the desired suppression of stiltgrass, but these rates may be injurious to existing desirable grasses. Oust XP treatments provided bare ground at both 3 and 1 oz/ac. Applying Assure II at the low label rate - 4 oz/ac - provided nearly complete elimination of stiltgrass, and left the desirable whitegrass largely intact. Increasing Assure II application rates above 4 oz/ac did not provide a significant effect on stiltgrass reduction or total vegetative cover. Journey effectively controlled stiltgrass at both 4 and 8 oz/ac. For stiltgrass control, it appears Journey can be used in the spring postemergence window at the same oz/ac rates as Plateau, at less than half the cost. The glyphosate provides a boost in postemergence activity and the amount of imazapic is sufficient to provide preemergence control of subsequent germinants. GlyPro alone at 12 oz/ac eliminated stiltgrass. A potential downside of this low rate is that it seems to release garlic mustard.

CONCLUSIONS

This trial and previous trials demonstrate that stiltgrass is susceptible to low-to-moderate rates of many herbicides. Herbicide selection for stiltgrass removal is dictated by the plant community you wish to have after treatment. Continued work is necessary to develop a broadleaf weed/brush treatment that will control target weeds and brush and suppress stiltgrass but leave other desired grasses. The Overdrive plus Plateau combination of 4 plus 2 oz/ac was not active enough on stiltgrass.

MANAGEMENT IMPLICATIONS

There are two stiltgrass management scenarios for the Department. The first is adjusting the ongoing maintenance program so that it does not release stiltgrass after broadleaf weeds and brush have been targeted. A satisfactory solution has not yet been developed, but continued work will produce treatment options to prevent stiltgrass release. The second possible scenario is specifically targeting stiltgrass to prevent its spread to uninfested, adjacent properties. Ongoing projects since 2001 have identified a wide selection of herbicides that will control stiltgrass, allowing Roadside Specialists to choose an approach tailored to the desired vegetation at that site.

Table 1. Response of Japanese stiltgrass to herbicides applied June 15, 2004. Percent stiltgrass reduction was visually rated July 20, 5 weeks after treatment (WAT), and percent total vegetative cover and percent stiltgrass cover was rated September 24, 14 WAT. Each mean is the value of three replications.

		Jul 20, 5 WAT	---------Sep 24, 14 WAT ---------	
product	application rate	stiltgrass reduction	vegetative cover	stiltgrass cover
	oz product/ac	------------------------- % -------------------------		
untreated	- -	0	100	97
Oust XP	1	99	0	0
Oust XP	3	100	0	0
Assure II	4	97	23	1
Assure II	12	100	40	1
Assure II	16	100	35	2
Assure II Oust XP	12 1	100	1	0
Overdrive	4	82	77	75
Overdrive Plateau	4 2	95	38	21
Journey	4	98	33	5
Journey	8	99	14	1
GlyPro	12	100	28	1
Protected LSD (p=0.05)		3	23	20

PRE- AND POSTEMERGENCE CONTROL OF MILE-A-MINUTE WITH HERBICIDES

<u>Herbicide trade and common chemical names</u>: Basagran T/O (bentazon), Escort (metsulfuron), Garlon 3A (*triclopyr*), Goal 1.6 E (*oxyfluorfen*), Plateau (*imazapic*), Milestone VM (*aminopyralid*), Velpar DF (*hexazinone*), Vista (*fluroxypyr*)
<u>Plant common and scientific names:</u> American burnweed (*Erechtites hieraciifolia*), giant foxtail (*Setaria faberi*), mile-a-minute (*Polygonum perfoliatum*)

ABSTRACT

Preemergence applications of Velpar DF at 10.5 and 21 oz/ac, Goal 1.6 E at 30 and 60 oz/ac, and Plateau at 4 or 8 oz/ac provided effective control of mile-a-minute when evaluated 4 months after treatment on August 7, 2004. Plateau at 2 oz/ac was not effective, and provided only 65 percent control. Postemergence treatments of Milestone VM at 3, 5, or 7 oz/ac alone or in combination with 16 oz/ac Garlon 3A, Vanquish at 16 oz/ac, Plateau at 4 oz/ac, Overdrive at 4 oz/ac, Vista at 16 oz/ac, or Escort at 0.5 oz/ac provided 95 percent or better control of mile-a-minute, when evaluated 2 MAT on August 7, 2004. Garlon 3A alone at 16 oz and a tank-mix of Basagran T/O, Plateau, and Velpar DF at 32, 2, and 5 oz/ac, respectively were rated at 88 and 86 percent control, significantly lower than the best rated treatments.

INTRODUCTION

Mile-a-minute (POLPR) is an annual vine in the buckwheat family (*Polygonaceae*), native to East Asia, which was first reported in the United States in the late-1940's in a York County nursery. POLPR is characterized by stout, downward-pointing spines, bright, blue berry-like fruits that begin maturing in July, and up to 20 ft of growth per season. It germinates relatively early in the spring, and is capable of growing over and smothering herbaceous plants and groundcovers, as well as shrubs and small trees. POLPR is a Noxious Weed in Pennsylvania, and is still limited in its distribution (Figure 1). It is very common in the counties neighboring the initial infestation, but not yet reported in much of the northern part of the state, especially the northwest quadrant. Limiting the spread of POLPR should be a high priority, especially in areas at the edges of its current range.

Considerable research was conducted in the early 1990's as part of a Penn State/PA Department of Agriculture project. We established pre- and postemergence trials to compare newer materials against previously identified standard treatments.

MATERIALS AND METHODS

The pre- and postemergence trials were established in the median of SR 70, near Claysville, Washington County, PA. This site had been cleared of woody vegetation, but not yet successfully established to a perennial herbaceous cover. The preemergence trial was initiated April 7, 2004. Treatments were applied to 6 by 15 ft. plots arranged in a randomized complete block design with three replications, using a CO_2-powered, hand-held boom equipped with TeeJet XR 8004VS tips, delivering 35 gallons/acre at 30 psi. The soil surface was covered with 0.4 to 0.8 inches of residue from giant foxtail and POLPR from the previous season, and POLPR was observed at the cotyledon stage. The herbicide treatments included Velpar DF at 10.5 or 21 oz/ac, Goal 1.6E at 30 or 60 oz/ac, and Plateau at 2, 4, or 8 oz/ac. Velpar and Goal were

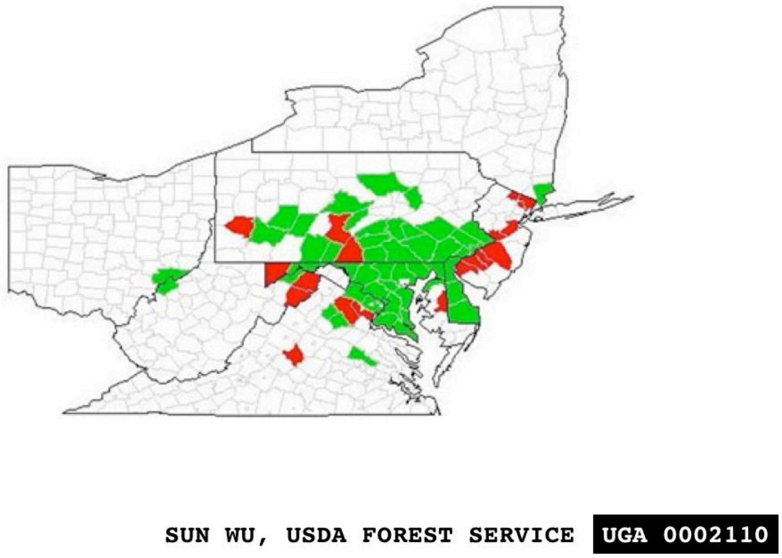

Figure 1. Reported distribution of *Polygonum perfoliatum* as of 2000. Washington County is not shown as having mile-a-minute at that time. (Source: http://www.plants.usda.gov).

previously identified as effective treatments, while Plateau has not yet (to our knowledge) been tested against POLPR. No surfactant was added to the treatments. The treatments were evaluated May 11, June 10, July 8, and August 4, 2004. POLPR cover was highest in the untreated plots July 8, with a rating of 20 percent, and declined to 6 percent by August 4.

The postemergence trial was initiated June 10, 2004. At this time, POLPR vines were up to 4 ft. long, and ripe fruit was observed. The treatments were applied to 6 by 15 ft. plots arranged in a randomized complete block design with three replications, using the same spray apparatus as for the preemergence trial. The treatments[1] included Milestone VM at 3, 5, or 7 oz/ac, alone or in combination with Garlon 3A at 16 oz/ac; Garlon 3A alone at 16 oz/ac, Vanquish at 16 oz/ac, Basagran plus Plateau plus Velpar DF at 32 plus 2 plus 5 oz/ac, Plateau at 4 oz/ac, Overdrive at 4 oz/ac, Vista at 16 oz/ac, and Escort at 0.5 oz/ac. Vanquish at 16 oz/ac and Garlon 3A at 32 oz/ac have provided excellent control in previous studies. The tank mix of Basagran, Velpar, and Plateau was included because we felt this was a mix that could be used to selectively control a broad spectrum of weeds in crownvetch and limit injury if applied to turf areas. Visual evaluations of POLPR control and plot composition were made July 8 and August 4, 2004.

[1] The Basagran plus Plateau plus Velpar DF treatment included crop oil concentrate at 32 oz/ac, Plateau alone included methylated seed oil at 32 oz/ac, and all other treatments included Activator 90 non-ionic surfactant at 0.25 percent, v/v.

RESULTS AND DISCUSSION

Preemergence Treatments

POLPR was a minority component of the vegetation in the preemergence plots, and reached its maximum percent cover at 20 percent in the untreated plots for the June 10 ratings (Table 1). Giant foxtail continued to increase throughout the season, and by August 4, POLPR cover was rated at only 6 percent. On June 10, 67 days after treatment (DAT), all preemergence herbicide treatments reduced total cover compared to the untreated plots, and significantly reduced POLPR. Plots treated with Goal 1.6 E were rated at 68 percent POLPR reduction, significantly lower than all other herbicide treatments, which ranged from 93 to 100 percent reduction. The low rate of Goal 1.6E did not reduce giant foxtail cover compared to the control (62 and 72 percent, respectively), while other herbicide treatments were rated between 0 and 25 percent giant foxtail cover. On August 4, 119 DAT, the untreated plots were rated at 99 percent vegetative cover and 93 percent giant foxtail cover. POLPR cover was light, averaging 6 percent in the untreated plots. Plateau at 8 oz/ac was rated at 12 percent total cover and 3 percent giant foxtail cover, significantly lower than all other treatments for both variables. Plateau at 2 oz/ac was rated at 65 percent POLPR reduction, while all other herbicide treatments were rated between 90 and 100 percent.

Velpar DF prevented POLPR establishment, and released monoculture of giant foxtail beginning in June. Goal 1.6E suppressed POLPR and released giant foxtail, which may have suppressed subsequent growth of POLPR. Plateau was active against both POLPR and giant foxtail. The 8 oz/ac rate of Plateau was rated at 12 percent total cover, 100 percent POLPR reduction, and 3 percent cover from giant foxtail. Plateau-treated plots had American burnweed in greater proportion than the other herbicide treatments.

These results indicate that POLPR can be managed using preemergence treatments, especially in crownvetch areas, where Velpar can be used selectively. Goal 1.6E could be used in turf areas for preemergence control, but the postemergence results (see below) indicate that there are several selective postemergence options for turf areas.

Postemergence Treatments

On August 4, mile-a-minute control was rated between 95 and 100 percent for plots treated with Milestone VM, Vanquish, Plateau, Overdrive, Vista, and Escort. Plots treated with Garlon 3A, or the combination of Basagran plus Plateau plus Velpar DF were rated at 88 and 86 percent control, which was significantly lower than the best rated treatments. Plots treated with Plateau at 4 oz/ac had significantly less vegetative cover than all other plots, due to reduction of giant foxtail cover. In grass situations, POLPR can be easily removed with a variety of products.

CONCLUSIONS

POLPR is readily controlled pre- or postemergence with products that are currently on the state herbicide contract. In addition, selective control can be achieved in grass or crownvetch groundcovers. POLPR is problematic, but it is quite susceptible to herbicides and a directed program should be successful.

MANAGEMENT CONSIDERATIONS

The primary issue in managing POLPR is tailoring existing programs to address it. POLPR is relatively easy to manage, but grows rampantly in areas where no management occurs. POLPR should be targeted anywhere in the right-of-way when new infestations occur, and in areas near the outer edge of current infestations. Where POLPR is already common, there will be a persistent seedbank and management would be an annual activity for the foreseeable future. Therefore, finite resources dictate that the outer reaches of these infestations be managed to prevent further spread.

Table 1: Mile-a-minute (POLPR) was treated with preemergence herbicides on April 7, 2004, and response of POLPR and giant foxtail (SETFA) are reported below. Percent total vegetative cover, percent reduction of POLPR, and percent cover of SETFA were visually rated on June 10 and August 4, 2004. Each value is the mean of three replications.

		June 10, 2004			August 4, 2004		
product	rate	total cover	POLPR reduction	SETFA cover	total cover	POLPR reduction	SETFA cover
	(oz/ac)	%					
untreated	---	93	0	72	99	0	93
Velpar DF	10.5	4	100	2	68	100	67
Velpar DF	21	1	100	1	57	100	57
Goal 1.6E	30	70	68	62	93	97	93
Goal 1.6E	60	33	93	25	78	93	78
Plateau	2	23	95	21	72	65	49
Plateau	4	5	97	3	38	90	25
Plateau	8	2	100	0	12	100	3
Protected LSD (0.05)		15	13	19	20	19	20

Table 2: Mile-a-minute (POLPR) was treated with postemergence herbicides on June 10, 2004. Control of POLPR, total vegetative cover, and giant foxtail (SETFA) cover were visually rated August 4, 55 days after treatment. Each value is the mean of three replications.

product	application rate	POLPR control	total cover	SETFA cover
	(oz/ac)	----------	%	----------
Milestone VM	3	98	58	58
Milestone VM	5	100	65	65
Milestone VM	7	100	68	65
Milestone VM Garlon 3A	3 16	100	58	58
Milestone VM Garlon 3A	5 16	100	57	57
Milestone VM Garlon 3A	7 16	100	50	50
Garlon 3A	16	88	57	56
Vanquish	16	100	58	58
Basagran Plateau Velpar DF	32 2 5	86	50	40
Plateau	4	98	28	23
Overdrive	4	99	57	56
Vista	16	95	65	65
Escort	0.5	100	52	43
Protected LSD (0.05)		7	17	19

SELECTIVE HERBICIDE MIXTURES FOR CONTROL OF POISON HEMLOCK IN A CROWNVETCH GROUNDCOVER.

Herbicide trade and common chemical names: Basagran T/O (*bentazon*), GlyPro (*glyphosate*), Plateau (*imazapic*), Velpar DF (*hexazinone*).
Plant common and scientific names: Canada thistle (*Cirsium arvense*), crownvetch (*Coronilla varia*), poison hemlock (*Conium maculatum*).

ABSTRACT

Trials evaluating selective control of poison hemlock in crownvetch were initiated April 6 (poison hemlock rosette-stage) and April 22, 2004 (bolt-initiation stage), near Canonsburg, PA. The treatments featured Velpar DF, Plateau, Basagran T/O, and GlyPro, alone and in combination. At the April 6 timing, Velpar DF at 21 oz/ac, and Basagran T/O at 32 oz/ac significantly reduced cover from rosette and seedling poison hemlock without reducing total vegetative cover. GlyPro at 48 oz/ac also significantly reduced hemlock rosette cover while not reducing vegetative cover, but had significantly more poison hemlock seedlings than plots treated with Velpar DF. For the April 22 timing, only Velpar DF at 21 oz/ac alone or in combination with GlyPro at 24 oz/ac provided acceptable reduction of poison hemlock without reducing cover from crownvetch.

INTRODUCTION

Poison hemlock (COIMA) is a biennial forb in the carrot family (*Apiacea*) native to Eurasia that is common along PA roadsides, particularly in crownvetch areas where no regular mowing or herbicide maintenance is practiced. COIMA appears to reduce crownvetch cover, and all of its parts are lethally poisonous to humans and livestock[3]. COIMA overwinters as a bright, lime-green rosette and resumes growth early in the spring. The rosette can be up to 24 in wide, and begins to bolt in mid-April to early-May, depending on environmental conditions. Bolted COIMA ranges from 3 to 8 ft tall, and produces clusters of convex umbels of white flowers. Our limited observations suggest that COIMA germinates throughout the growing season, so effective management must prevent the release of a new crop of seedlings when existing plants are controlled.

The objective of this trial was to determine if an early-season window would provide a viable opportunity within the current vegetation management calendar. This timing would take advantage of a traditional downtime for contracted applicators and the early growth of COIMA to increase the selectivity of herbicides that would not typically be used for selective weed control in crownvetch. Removing a broadleaf weed from a broadleaf groundcover limits herbicide selection. Velpar is specifically labeled for Canada thistle control in crownvetch, and Plateau and Basagran T/O have demonstrated some level of safety to crownvetch in past experiments, demonstrations, or operations. In addition to these selective materials, we also elected to determine if the active growth of COIMA and relative inactivity of crownvetch at an early timing would allow for selective control using the non-selective herbicide glyphosate.

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[3] Poisonous Plants of Pennsylvania. 1986. Robert J. Hill and Donna Folland. Pennsylvania Department of Agriculture. Pages 48-49.

MATERIALS AND METHODS

The trial was established at the interchange of SR 79/SR 519 near Canonsburg, PA, on east facing fill with a 2:1 (50 percent) slope. The application timings were April 6 and April 22, 2004, which corresponded to rosette and early-bolt growth stages for COIMA. The treatments included Velpar DF at 21 oz/ac, Plateau at 12 oz/ac, Basagran T/O at 32 oz/ac, GlyPro at 48 or 96 oz/ac, Velpar DF at 21 oz/ac plus GlyPro at 24 oz/ac or Plateau at 12 oz/ac; and Plateau at 12 oz/ac plus GlyPro at 24 oz/ac or Basagran T/O at 32 oz/ac.

The treatments were applied to 6 by 15 ft plots arranged in a randomized complete block design with three replications, using a CO_2-powered, hand-held boom equipped with TeeJet XR8004VS tips, delivering 35 gal/ac. At the first timing, April 6, COIMA rosettes were pre-bolt and new seedlings ranged between cotyledon and two-leaf stage, and new crownvetch growth had elongated about 2 in. Soil temperatures at 1 and 6 in were 52° and 49° F. The second trial was established April 22, when COIMA rosettes were beginning to bolt, and crownvetch growth was up to 4 in. Soil temperature at 1 in was 63° F. After application, one replication of the April 22 trial was lost due to overspray during the District's PGR program. The April 6 trial was rated April 22 for COIMA injury, and both trials were rated May 11 for COIMA and crownvetch injury. The untreated plots were assigned a zero value for all injury ratings. On June 10, ratings of percent total vegetative cover and cover by crownvetch and first- and second-season COIMA were taken for both application dates. Data were subjected to analysis of variance, and means were compared using Fisher's Protected LSD (p=0.05) where appropriate.

RESULTS AND DISCUSSION

All herbicide treatments applied at either date caused significant injury to COIMA (Table 1). April 6 applications evaluated on April 22 (16 days after treatment, or DAT) for COIMA injury ranged from 67 to 90 percent. When the April 6 treatments were rated on May 11 (35 DAT), COIMA injury ratings were reduced for plots treated with Velpar DF alone (70 vs. 59 percent) and Basagran T/O (82 vs. 73 percent) compared to April 22. COIMA injury ratings increased for all other treatments on May 11 compared to April 22, ranging from 93 to 99 percent. COIMA injury ratings for the April 22 treatments ranged from 85 to 99 percent when evaluated May 11 (18 DAT).

The April 6 treatments were rated for crownvetch injury on May 11 (35 DAT) (Table 1). The only treatment that was not significantly different from the untreated check was Basagran T/O alone, at 20 percent crownvetch injury. Crownvetch injury ratings for the other herbicide treatments ranged from 52 to 92 percent. When the April 22 treatments were evaluated for crownvetch injury on May 11 (18 DAT), all herbicide treatments caused significant injury (Table 1). The highest crownvetch injury rating was for GlyPro at 96 oz/ac, at 97 percent. The only treatments rated significantly lower than this GlyPro treatment were Velpar DF plus GlyPro, Velpar DF, and Basagran T/O, at 63, 48, and 48 percent injury, respectively.

On June 10, treatment effect on COIMA was evaluated by assessing percent cover of second-year (COIMA2) and seedling (COIMA1) plants. The untreated plots from the April 6 application averaged 90 percent total cover, 29 percent cover from crownvetch, 37 percent second-year COIMA (COIMA2) cover, and 4 percent cover from seedling COIMA (COIMA1) (Table 2). Total vegetative over in the plots treated with Velpar alone, Basagran T/O alone, and the two rates of GlyPro alone was not significantly different from the untreated check, and ranged from 72 to 96 percent. Plateau alone and the combination treatments significantly reduced vegetative cover compared to the check, and ranged from 28 to 49 percent. All herbicide treatments significantly reduced COIMA2 compared to the untreated plots, and there was no significant difference between the herbicide treatments. The two GlyPro-alone treatments were rated highest for COIMA1 cover, and these values were significantly higher than for all other treatments. The reduction of competition and lack of residual activity from glyphosate appeared to favor release of COIMA seedlings. There was no significant treatment effect on crownvetch cover for the April 6 applications. Crownvetch cover ranged from 23 to 56 percent, and the highest ratings were for Basagran T/O (56 percent) and Velpar DF (54 percent).

When the April 22 treatments were evaluated on June 10, the untreated checks averaged 95 percent total vegetative cover, with 57 percent cover from crownvetch, 34 percent cover from COIMA2, and 3 percent cover from COIMA1 (Table 3). Crownvetch cover was rated highest in the Velpar DF (92 percent) and Velpar DF plus GlyPro (87 percent) plots. The only treatments that did not have significantly less crownvetch cover were Basagran T/O (63 percent) and the untreated checks (57 percent). Due to the loss of a replication and a difference in COIMA pressure between the remaining two replications, there was too much variability to distinguish a significant effect on COIMA2 from the herbicide treatments. Except for Basagran T/O (20 percent), all herbicide treated plots had 1 percent or less COIMA2 cover. COIMA1 was absent from all but the untreated, Basagran T/O-, and low rate of GlyPro alone-treated plots.

CONCLUSIONS

Velpar DF at 21 oz/ac demonstrated the best combination of safety to crownvetch and activity on COIMA, but it appeared to be more effective at the early-bolt timing as the April 22 treated plots had no COIMA present on June 10. Statistically, Basagran T/O was equal to Velpar in crownvetch safety and COIMA injury, though this treatment did not eliminate COIMA at either timing. Adding GlyPro at 24 oz/ac to Velpar DF did not reduce safety to crownvetch for the April 22 treatment, but did reduce total vegetative cover when applied April 6. The April 6 timing of GlyPro at 48 or 96 oz/ac controlled COIMA2 and did not reduce groundcover, but these treatments did appear to release seedling COIMA. At the April 22 timing these GlyPro rates caused significant injury to crownvetch and significantly reduced vegetative cover. Plateau alone was effective against COIMA at both timings, but was not safe to crownvetch. The combinations of Velpar DF plus Plateau, Plateau plus GlyPro, or Plateau plus Basagran T/O were very effective against COIMA, but caused significant injury to crownvetch and significantly reduced vegetative cover.

MANAGEMENT IMPLICATIONS

These first year results suggest that the early season may be a viable time to manage poison hemlock in crownvetch areas. With refinement, this approach would provide a tool to manage problem weeds in crownvetch areas with minimal schedule conflict with the bareground weed control program.

Table 1: Response of poison hemlock (COIMA), crownvetch (CZRVA), and Canada thistle (CIRAR) to herbicide treatments applied April 6 or April 22, 2004. Visual ratings of percent injury were taken April 22 and May 11, 2004. Canada thistle was not present in some plots treated April 6. Values for April 6 treatments are the mean of three replications, and values for April 22 treatments are the mean of two replications.

		------------- applied April 6 -------------				-- applied April 22 --	
treatment[4]	application rate	April 22 COIMA	May 11 COIMA	May 11 CZRVA	May 11 CIRAR[5]	May 11 COIMA	May 11 CZRVA
	oz /ac	------------	------------	%	------------	------------	------------
untreated	- -	0	0	0	0 c	0	0
Velpar DF	21	70	59	52	55 ab	98	48
Plateau	12	67	93	80	92 a	85	90
Basagran T/O	32	82	73	20	25 bc	85	48
GlyPro	48	67	93	70	55 ab	94	90
GlyPro	96	90	98	77	75 a	95	97
Velpar DF GlyPro	21 24	87	95	78	73 a	99	63
Velpar DF Plateau	21 12	88	99	92	95 a	95	85
Plateau GlyPro	12 24	81	97	65	95 a	93	83
Plateau Basagran T/O	12 32	88	98	87	85 a	90	80
Protected LSD (p=0.05)		19	25	40	- -	13	19

[4] All treatments including Plateau included methylated seed oil at 32 oz/ac. All other treatments included Freeway non-ionic surfactant at 0.1 percent v/v.

[5] A single LSD value could not be calculated for Canada thistle injury on May 11 for April 6 applications because thistle was not present in all plots.

Table 2: Response of poison hemlock (COIMA), crownvetch (CZRVA), and total cover on June 10, 2004 to herbicide treatments applied April 6, 2004. COIMA was evaluated as second-year (COIMA2) and first-year (COIMA1) plants. Values are the mean of three replications.

treatment[6]	application rate	total cover	CZRVA cover	COIMA2 cover	COIMA1 cover
	oz product/ac	%			
untreated	- -	90	29	37	4
Velpar DF	21	78	54	11	1
Plateau	12	47	36	0	1
Basagran T/O	32	96	56	12	6
GlyPro	48	78	32	0	10
GlyPro	96	72	27	0	16
Velpar DF GlyPro	21 24	43	35	0	0
Velpar DF Plateau	21 12	28	23	0	0
Plateau GlyPro	12 24	33	33	0	0
Plateau Basagran T/O	12 32	49	29	0	0
Protected LSD (p=0.05)		32	n.s.	19	7

[6] All treatments including Plateau included methylated seed oil at 32 oz/ac. All other treatments included Freeway non-ionic surfactant at 0.1 percent v/v.

Table 3: Response of poison hemlock (COIMA), crownvetch (CZRVA), and total cover on June 10, 2004 to herbicide treatments applied April 22, 2004. COIMA was evaluated as second-year (COIMA2) and first-year (COIMA1) plants. Values are the mean of two replications.

treatment[7]	application rate	total cover	CZRVA cover	COIMA2 cover	COIMA1 cover
	oz product/ac	------------------------	%	------------------------	
untreated	- -	95	57	34	3
Velpar DF	21	93	92	0	0
Plateau	12	20	19	0	0
Basagran T/O	32	90	63	20	5
GlyPro	48	48	36	1	9
GlyPro	96	4	3	0	0
Velpar DF GlyPro	21 24	88	87	0	0
Velpar DF Plateau	21 12	15	15	0	0
Plateau GlyPro	12 24	23	21	0	0
Plateau Basagran T/O	12 32	23	21	0	0
Protected LSD (p=0.05)		18	37	n.s.	5

7 All treatments including Plateau included methylated seed oil at 32 oz/ac. All other treatments included Freeway non-ionic surfactant at 0.1 percent v/v.

COMPARING OUST XP, OUST EXTRA, AND LANDMARK II MP FOR BAREGROUND WEED CONTROL

Herbicide trade and common names: GlyPro (*glyphosate*), Karmex DF (*diuron*), Landmark II MP (*sulfometuron + chlorsulfuron*), Oust Extra (*sulfometuron + metsulfuron*), Oust XP (*sulfometuron*).

Plant common and scientific names: buckhorn plantain (*Plantago lanceolata*), Canada thistle (*Cirsium arvense*), crownvetch (*Coronilla varia*), dandelion (*Taraxacum officinale*), orchardgrass (*Dactylis glomerata*), quackgrass (*Elymus repens*), wild carrot (*Daucus carota*), yellow foxtail (*Setaria pumila*).

ABSTRACT

An April application of Karmex DF plus GlyPro provided greater control 152 days after treatment (DAT) when mixed with Oust Extra or Landmark II MP, compared when mixed with Oust XP. Plots treated with Karmex DF plus GlyPro without any other tank mix partner had significantly more cover than other treated plots 56 DAT. When rated 96 DAT, there were no differences in cover between June applied treatments containing Oust XP, Oust Extra, or Landmark II MP.

INTRODUCTION

Since the late 1980's, sulfometuron, the active ingredient in Oust herbicide formulations, has been one of the fundamental ingredients in PENNDOT's bareground herbicide program. In 2003, DuPont introduced Landmark II MP and Oust Extra herbicides to the non-crop market. These products contain sulfometuron, combined with the active ingredient found in either Telar or Escort, respectively. These products are priced to provide the additional active ingredient at a low cost. This trial was established to provide a setting where PENNDOT vegetation managers could view these materials side-by-side at the 2004 Roadside Vegetation Management Conference field day. The treatments were applied at two timings. A 'too early' timing tested early season postemergence activity and residual activity, and a 'too late' application tested how well these treatments could eliminate well-established perennial weeds.

MATERIALS AND METHODS

This trial was conducted at the Penn State Landscape Management Research Center, University Park, PA. Seven herbicide combinations and an untreated check were applied April 8 or June 3, 2004. Treatments included an Oust XP at 3 oz/ac, Oust Extra at 3.5 oz/ac, or Landmark II MP at 3.5 oz/ac, each applied alone or in combination with 128 oz/ac Karmex DF and 48 oz/ac GlyPro. The Karmex DF and GlyPro combination was also applied alone.

Applications were made using a CO_2-powered hand-held sprayer equipped with a single 8002E (April) or 9504E (June) tip, applying 40 gal/ac. Plots were 3 by 12 feet with 1.5 ft. untreated buffers between each plot. The study was arranged as a randomized complete block design with a split-block arrangement and three replications. Predominant species included buckhorn plantain, Canada thistle, crownvetch, dandelion, orchardgrass, quackgrass, wild carrot, and yellow foxtail. The study area was disced one week prior to initial treatment to incorporate some of the surface residue prior to the preemergence treatments and to reduce the leaf area of the perennials present. The April 8 treatments were evaluated for percent green vegetative cover and injury on May 6, 28 days after treatment, DAT. Percent cover by green vegetation was also rated on June 3, August 9, and September 7, 2004, 56, 123, and 152 DAT. The June 3 treatments were evaluated for percent green vegetative cover on June 4, August 9, and September 7, 2004, 1, 67, and 96 DAT.

RESULTS AND DISCUSSION

The untreated plots in the April 8 treatment blocks averaged 23, 93, 93, and 95 percent vegetative cover at 28, 56, 123, and 152 DAT, respectively. There were no significant differences between the six treatments that included sulfometuron for cover ratings at 28, 56, or 123 DAT. At 152 DAT, the plots treated with Karmex DF and GlyPro in combination with Oust Extra or Milestone II MP had significantly less vegetative cover (10 and 7 percent, respectively) than the Oust XP treatments (35 and 38 percent) (Table 1). Plots treated with Karmex DF plus GlyPro had significantly more cover than the sulfometuron-containing treatments as soon as 28 DAT, and were not significantly different from the untreated plots by 123 DAT. The lack of activity of Karmex DF plus GlyPro was due primarily to reduced effect against the perennials species present. Plot composition by species (data not shown) at 152 DAT suggested that the Karmex DF plus GlyPro component did add residual activity in the combinations including Oust Extra or Landmark II MP. Where Oust Extra or Landmark II MP were applied alone, an increase in yellow foxtail was apparent in the plot censuses compared to where these herbicides were applied with Karmex DF and GlyPro.

The plots treated June 3 averaged 80 to 87 percent cover by treatment 1 DAT. At 67 DAT, the untreated plots averaged 73 percent cover and the treated plots ranged from 0 to 5 percent cover. When rated 96 DAT, the untreated plots averaged 93 percent cover. The Karmex DF plus GlyPro-treated plots averaged 25 percent cover, which was significantly higher than all the treatments that included sulfometuron (2 to 10 percent cover).

CONCLUSIONS

Replacing Oust XP with cost-equivalent rates of Oust Extra or Landmark II MP in a tank mix with Karmex DF and GlyPro provided a longer period of effective total vegetation control in a setting with existing perennial weeds and annual weed pressure. The additional active ingredient provided at minimal cost was beneficial.

MANAGEMENT IMPLICATIONS

At the rates tested in this study, Landmark II, Oust Extra, and Oust XP are similar in cost with prices of $27.44, $29.86, and $29.82/acre, respectively. With costs being so equivalent, there is clearly an advantage to using Landmark II or Oust Extra compared to Oust XP when tank mixing with Karmex DF and GlyPro.

Table 1: Weed response to herbicide treatments applied April 8, 2004. Ratings were taken May 6, June 3, August 9 and September 7, 2004, 28, 56, 123, and 152 days after treatment (DAT), respectively. Each value is the mean of three replications.

treatment	application rate	injury 28 DAT	green cover 28 DAT	green cover 56 DAT	green cover 123 DAT	green cover 152 DAT
	oz/ac	%	%	%	%	%
untreated	---	0	23	93	93	95
Oust XP	3	95	2	3	23	35
Karmex DF	128					
GlyPro	48					
Oust Extra	3.5	96	1	1	5	10
Karmex DF	128					
GlyPro	48					
Landmark II MP	3.5	95	1	1	4	7
Karmex DF	128					
GlyPro	48					
Oust XP	3	97	0	1	27	38
Oust Extra	3.5	99	0	1	13	27
Landmark II MP	3.5	96	1	1	13	25
Karmex DF	128	50	7	45	77	83
GlyPro	48					
Protected LSD (p=0.05)		3	2	4	26	22

Table 2: Weed response to treatments applied on June 3, 2004. Ratings were taken June 4, August 9 and September 7, 2004, 1, 67, and 96 days after treatment, respectively. Each value is the mean of three replications.

Treatment	Application Rate	Green Cover 1 DAT	Green Cover 67 DAT	Green Cover 96 DAT
	oz/ac	%		
untreated	---	87	73	93
Oust XP Karmex DF GlyPro	3 128 48	85	1	4
Oust Extra Karmex DF GlyPro	3.5 128 48	83	0	2
Landmark II Karmex DF GlyPro	3.5 128 48	82	1	2
Oust XP	3	80	4	10
Oust Extra	3.5	87	4	9
Landmark II	3.5	80	2	3
Karmex DF GlyPro	128 48	83	5	25
Protected LSD (p=0.05)			25	10

COMPARISON OF ESTABLISHMENT OF SPRING-PLANTED, RECLAMATION SEED MIXES UNDER DIFFERENT SOIL CONDITIONS

Herbicide trade and common names: GlyPro (*glyphosate*).
Plant common and scientific names: alfalfa (*Medicago sativa*), annual ryegrass (*Lolium multiflorum*), big bluestem (*Andropogon gerardii*), birdsfoot trefoil (*Lotus corniculatus*), Canada wildrye (*Elymus canadensis*), creeping red fescue (*Festuca rubra*), crownvetch (*Coronilla varia*), hard fescue (*Festuca trachyphylla*), Indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparius*), orange coneflower (*Rudbeckia fulgida*), redtop (*Agrostis gigantea*), spring oats (*Avena sativa*), tall fescue (*Festuca arundinacea*).

ABSTRACT

Five seed mixes were evaluated for first season establishment in a construction-impacted infield soil amended with 0, 1, 2, or 4 inches of topsoil. Soil amendment significantly reduced soil pH (8.0 for unamended) and increased soil organic matter, but was not a significant treatment effect for any variable. Seed mixes with annual ryegrass as a nurse crop had greater cover than mixes with spring oats, and less cover from weeds. PENNDOT Formula W (tall fescue plus birdsfoot trefoil, no nurse crop) had the greatest amount of perennial cover by far (51 vs. 0 to 4 percent for the other mixes). PENNDOT Formulas C (crownvetch) and L (creeping red fescue and hard fescue) include annual ryegrass, and had high ratings for desirable cover (49 and 63 percent) and the lowest ratings for weeds at 1 and 5 percent. Formula A, an experimental mix featuring native grasses, alfalfa, hard fescue, and spring oats, had less cover than the PENNDOT formulas, but did have desired perennial species present. The experimental mix Formula J (orange coneflower and spring oats) was rated lowest for cover and no coneflower was observed.

INTRODUCTION

Road construction has a negative impact on the ability of soil to support plant growth, primarily through construction practices that remove topsoil, create slopes, and cause compaction. PENNDOT has several seeding formulas in Publication 408, *Specifications*, to provide groundcover based on site conditions and intended future maintenance. The only specified mix that is consistently suitable for poor soils is Formula C, which is crownvetch plus annual ryegrass. Crownvetch has been in use on an operational basis for fifty years, and has successfully provided groundcover on thousands of acres of post-construction cut and fill slopes. However, crownvetch can be weedy and difficult to control when it grows outside of reclamation settings, and is increasingly being described as 'invasive', even in Pennsylvania. Crownvetch has the distinction of being designated the State Conservation Plant by the legislature, as well as being identified as a 'situational invasive' by the PA Department of Conservation and Natural Resources.

One objective of this trial is to evaluate the performance of Formula A (see Table 1 for seed formulas), a seed mix proposed as an alternative to crownvetch. Formula A relies on native grasses and alfalfa as the permanent component, and spring oats and hard fescue as the short- and intermediate-term components. A second experimental seed mix (Formula J) was proposed by Central Office to determine if orange coneflower, a durable and showy perennial in landscape settings, could be successfully seeded as a low maintenance groundcover. An additional objective was to compare the long-term performance of the two experimental seed mixes and three currently specified seed mixes (Formulas C, L, and W) over a range of soil-quality conditions. The different soil conditions were created by amending a poor quality soil with 0, 1, 2, or 4 inches of furnished topsoil.

MATERIALS AND METHODS

This study was established in the infield at the interchange of SR 220 S and SR 3041 (Shiloh Road), near State College, PA. On October 3, 2003 the entire trial area was treated with GlyPro at 3 qts/ac plus CADCO non-ionic surfactant at 0.25 percent, v/v.

On November 3, 2003 a grader equipped with a ripper attachment was used to loosen the soil on the site, which we felt was too compact and stony to be effectively loosened with a roto-tiller. The study was laid out as a randomized complete block with a split-plot treatment arrangement with three replications. Soil amendment was the whole-plot treatment, which was divided into five, 10 by 10 ft sub-plots for the seeding formulas. Topsoil was spread at depths of 0, 1, 2, or 4 inches over the plots on April 28 and 29, 2004. Table 2 summarizes soil pH, cation exchange capacity (CEC) and organic matter for the four soil treatments and for the topsoil used to amend the plots. On April 30, 2004 the site was roto-tilled, and raked where needed to provide a seed-ready grade. Pre-weighed seed mixes were sown onto the surface of each plot and straw mulch was applied by hand at a rate of 5800 lbs/ac over the entire study area. On May 5, 2004, each plot was fertilized with 10-20-20 (N, P_2O_5, K_2O) at 680 lb/ac, and all plots except those seeded to Formula C received 31-0-0 (IBDU, controlled release N) analysis fertilizer at 295 lb/ac.

Ratings of percent total cover, cover by annual nurse crop, weed cover, and permanent desirable cover were taken July 7, 2004, 68 days after seeding (DAS).

RESULTS AND DISCUSSION

The effect of soil treatment was not significant for any variable, and there was no interaction between soil treatment and species. Subsequent discussion is based on seed mix performance averaged over the soil treatments. The added topsoil decreased soil pH favorably, and increased soil organic matter. However, the added soil had low CEC values, and reduced CEC compared to no amendment. We cannot explain the low CEC values for the topsoil based on soil test results, and we do not have particle size analysis to determine if soil texture played a role.

Formulas L and W had the highest ratings for total cover 68 DAS, at 68 and 64 percent. Formula C was intermediate at 50 percent total cover, and Formulas A and J were rated significantly lower than the other three formulas at 36 and 35 percent cover (Table 3). Formula W was unique in that there is no nurse crop in the mix, and all the desirable cover was produced by tall fescue and birdsfoot trefoil. Formula W was rated at 51 percent cover by desirable perennial species, compared to 0 to 4 percent for the other seeding formulas.

In the four mixes that included a nurse crop, mixes with annual ryegrass were rated significantly higher for nurse crop cover (60 percent Formula L, 48 percent Formula C) than the mixes with spring oats (18 percent each for Formulas A and J). Added nitrogen appeared to provide a significant boost to annual ryegrass growth. Annual ryegrass seeded at 12 lb/ac in Formula L, receiving 68 lb N/ac from 10-20-20 (fast release) and 91 lb N/ac from controlled release IBDU (31-0-0) was rated at 60 percent cover. Annual ryegrass seeded at 24 lb/ac in Formula C and receiving only 68 lb N from 10-20-20 was rated at 48 percent cover, significantly lower than the ratings for annual ryegrass in Formula L. The formulas containing annual ryegrass also had the lowest ratings for weed cover, at 1 and 5 percent for Formulas C and L. The formulas with no nurse crop or spring oats were rated at 13 to 17 percent weed cover. It may be that the early, quick growth of annual ryegrass suppressed weed growth better than spring oats or no nurse crop as in Formula W.

Future success seemed most assured with Formula W, as there was significant perennial cover at 68 DAS. We observed no orange coneflower in the Formula J plots, suggesting that the best case scenario was a transition to weeds and perhaps a future stand of orange coneflower if germination still occurred. Formulas A, C, and L did have the desired perennial species present in satisfactory number, but the plants were small and not contributing substantial cover.

CONCLUSIONS

First season assessment of perennial groundcovers can only characterize initial establishment, and even that may be difficult. Mixes that contain a nurse crop and a perennial component are intended to strike a balance between providing initial cover and still allowing the slower-establishing perennials to establish. Annual ryegrass provided more cover with less seed (on a weight basis) than spring oats, and responded significantly to added nitrogen. PENNDOT can point to many operational acres of establishing Formulas C and L to state that annual ryegrass does allow crownvetch and fineleaf fescues to establish. Continued observation and experimentation is necessary to determine if the native perennial grasses in Formula A can successfully establish with a more vigorous nurse crop.

The only seed mix that appears to be an outright failure is Formula J. We saw one orange coneflower seedling in the entire study area. Otherwise, the Formula J plot were spring oats and weeds, and look to become just weeds in the second growing season. Formula A had was no different from Formula J in desirable cover, but the desired perennial species were present, and should become more prominent in the second growing season.

MANAGEMENT IMPLICATIONS

After one season, there is little information available to evaluate these seed formulas, except that it is apparent that orange coneflower is not a viable plant material for groundcover use.

Table 1: Composition of the seeding formulas evaluated in a poor soil amended with 0, 1, 2, or 4 inches of topsoil. Formulas C, L, and W are from PENNDOT Publication 408, Chapter 804. An '*' indicates lbs. pure live seed (PLS)/ac.

seed mix	common name	lb/ac
Formula A		
	big bluestem	5*
	little bluestem	5*
	Indiangrass	5*
	Canada wildrye	5*
	hard fescue	20
	spring oats	40
	alfalfa	12
Formula C		
	crownvetch	19
	annual ryegrass	24
Formula L		
	hard fescue	63
	red fescue	41
	annual ryegrass	12
Formula J		
	orange coneflower	4*
	spring oats	40
Formula W		
	birdsfoot trefoil	10
	tall fescue	36
	redtop	5

Table 2. A summary of soil pH, cation exchange capacity (CEC), and organic matter (OM), for a soil amended with 0, 1, 2, or 4 inches of topsoil prior seeding. Each value is the mean of three replications. The average values for the furnished topsoil used to amend the site are listed at the bottom of the table.

added soil	pH	CEC	OM
in		meq/100 g	%
0	8.0	18.6	1.5
1	7.8	18.0	1.7
2	7.6	15.4	1.9
4	7.4	12.6	2.1
Protected LSD (p=0.05)	0.3	3.4	0.3
added soil	*7.1*	*10.3*	*2.1*

Table 3: Five seed mixes were sown on April 30, 2004. Ratings of establishment and weed cover were taken on July 7, 2004. Mixtures that had an annual nurse crop component were rated for nurse crop and perennial species. These ratings are combined for the rating of 'total desirable'. Each value is the mean of twelve observations.

seed mix	total cover	nurse crop	weeds	desirable perennial	total desirable
	------------	------------	%	------------	------------
A	36	18	15	2	21
C	50	48	1	1	49
J	35	18	17	0	18
L	68	60	5	4	63
W	64	0	13	51	51
LSD (p=0.05)	11	9	9	6	12

2004 ROADSIDE VEGETATION MANAGEMENT CONFERENCE (RVMC)
FIELD DAY REVIEW

'Diamond Wet-Blade' Boom-arm Mower Demonstration

The Diamond Wet-Blade (formerly known as the Burch Wet-Blade) is designed to cut brush and apply herbicide in a single pass. The Diamond Wet-Blade and the Brown Brush Monitor are the only two machines (we know of) on the market with this capability.

The Diamond Wet-Blade apparatus wets the underside of the cutting blade, wiping the just-cut stem as it passes through and over on successive turns of the blade. The premise behind this approach is that depositing the herbicide solution on the stem as it is cut enhances uptake because the cutting breaks the tension of the water column in the stem xylem and the water is initially pulled back down into the stump. As the cutting occurs, the herbicide solution is drawn off the underside of the blade and down into the xylem of the cut stump with the water column as it retreats into the xylem vessels.

The latest innovation with the Wet Blade technology is the adaptation to a boom-arm mower. The mowing deck itself has a cutting width of 48 inches while it can apply up to 2.5 gallons of solution per acre. This apparatus allows the operator to cut brush up to 4 inches in diameter and applies herbicide simultaneously. Chemical output is adjusted automatically through the use of a radar device that monitors ground speed. Additionally, the operator can simply turn off the flow for situations where larger plants are being incrementally cut back to the stump but treatment is not needed until the final basal cut is made. Since the herbicide is distributed under the mowing deck, the potential for drift is minimal.

The Diamond Wet-Blade was demonstrated by cutting a stand of small trees, mainly staghorn sumac (*Rhus typhina*), using a dye indicator. Since no actual herbicide was applied to the site, a later determination of its effectiveness was not possible. The stumps that remained were certainly marked with the colorant, but largely shattered. If the xylem is destroyed by the cutting process, the uptake-via-xylem-cavitation premise is not likely. Until some sort of testing or more operational acres are established, we are inclined to believe that soil active chemistry such as Arsenal or Tordon K is beneficial for this application.

This application is best suited to contract application for PENNDOT. Use by Departmental forces would require the operator to be a PA Department of Agriculture certified applicator or registered technician, and the cost of the unit would probably be best borne by several counties, making the scheduling of the unit that much more difficult.

DuroTrim Vegetation Control Mats

Bareground weed control is an integral part of any roadside vegetation management program. Areas around signposts, guiderails, and delineators need to be free of weeds. Improving sign visibility, allowing access for maintenance, reducing mowing requirements, prolonging the life of hardware, and improving the flow of surface water are a few of the many benefits of maintaining ‘weed free’ zones around these structures. For PENNDOT, herbicide treatments are the most common method of preventing or eliminating weeds in these areas.

‘DuroTrim’ is the trade name for rubber tiles manufactured by Recycled Rubber Resources LLC, Macon, MO., and Welch Products, Inc., Carlisle, IA. These tiles were designed for providing a weed barrier around roadside structures. They are constructed of crumb rubber, derived from discarded tires. Each tile is 2 by 2 foot with scribed lines to allow for cutting tiles to fit around varying sized posts. The individual tiles are constructed with an edge that allow them to overlap and form a flat surface. A proprietary caulking is used to join the tiles and fill spaces between post and tiles. The tiles are said to have a life expectancy of ten years or more.

On June 5, 2002, 42 tiles (168 sq. ft) were installed around existing structures along SR 220 in Centre County. In addition, 21 tubes of caulking were used to join the tiles and seal gaps.

Use of these tiles is not cost effective. The cost per tile was $11.00 in 2001[1/]. Notes taken during installation indicate that, on average, 52 sq ft. of tile was placed each hour. Economics alone suggest use of this product is not viable compared to herbicide treatments. Assuming a labor cost of $50.00/hour, which includes a two person crew plus truck, and the above-mentioned cost per tile the resulting cost is $3.71/sq. ft. This does not take into account the adhesive required to install this product. Granted, the entire installation process could be made much more efficient on a large-scale operation. However, the cost of tiles alone accounts for 2.75/sq. ft. Even with a streamlined operation there remains a considerable cost for materials.

A study established in 1996 that investigated various weed management alternatives, resulted in a very conservative cost of $703/acre, or $0.016/sq. ft., for treating similar bareground areas with herbicides[2/]. These costs are inflated due to the method by which they were treated. Costs for labor and equipment have increased since these estimates were calculated. Current operational prices for PENNDOT to treat, even the most labor intensive areas, such as sign posts, and assuming treatment of one-tenth acre/day (622 posts @ 7 sq. ft./each), costs remain under $0.12/sq. ft. At this cost it would take 23 years of treatments to equal the price of the tiles alone.

Although DuroTrim tiles are an excellent use of waste products, they are cost prohibitive for this application. Furthermore, with the terrain found in Pennsylvania, proper installation of the tiles remains difficult. The promotional videos always show flat terrain where mowers drive over the tiles with no issue. Putting tiles around posts on cut or fill slopes, or posts in concrete is much more difficult and requires more trimming than posts in a flat setting. They do not easily conform to the uneven ground and are potentially caught by mowing decks or do not join properly and allow weed growth between seams. For our area, an asphalt-like product using the crumb-rubber would be more useful. Such a product could be sprayed or poured, then shaped as it cured and would conform to any terrain.

[1/] http://www.iwrc.org/news/ia_full_story.cfm?NewsId=179

[2/] Comparing Chemical Versus Mechanical Methods Of Vegetation Control Under Guiderails, Thirteenth Annual Research Report.