# THE COMMONWEALTH OF PENNSYLVANIA
# DEPARTMENT OF TRANSPORTATION

# ROADSIDE VEGETATION MANAGEMENT
# RESEARCH REPORT
# EIGHTH YEAR REPORT

THE PENNSYLVANIA STATE UNIVERSITY
RESEARCH PROJECT # 85-08
REPORT # PA 94-4620 + 85-08

PENNSTATE

1 8 5 5

# REPORT DOCUMENTATION PAGE



| 1. AGENCY USE ONLY (Leave blank) | 2. REPORT DATE | 3. REPORT TYPE AND DATES COVERED |
|---|---|---|
| | July 31, 1994 | Eighth Annual Report (3/23/93 to 3/22/94) |

4. TITLE AND SUBTITLE

Roadside Vegetation Management Research Report - Eighth Year Report

5. FUNDING NUMBERS

359704 WO#2

6. AUTHOR(S)

Arthur E. Gover
Nathan L. Hartwig
Larry J. Kuhns
Robert W. Parks, III
Chad W. Spackman
Thomas L. Watschke

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

The Pennsylvania State University
College of Agricultural Sciences
University Park, PA 16802

8. PERFORMING ORGANIZATION REPORT NUMBER

PA-4620-94-01

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Pennsylvania Department of Transportation
Office of Roadside Development
1005 T&S Building
Harrisburg, PA 17120

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

Research Project - 4620
Project Manager - Ron Stahl - Bureau of Maintenance and Traffic Operations, Office of Roadside Development

12A. DISTRIBUTION/AVAILABILITY STATEMENT

12B. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The eighth year report on a cooperative research project between the Department of Transportation, Bureau of Maintenance and Operations; and the Pennsylvania State University, College of Agricultural Sciences; including:
Brush control research evaluating implementation of mechanical, conventional, and integrated brush control methods; basal bark herbicide applications; low volume foliar applications; and different backpack sprayer configurations.
Evaluation of low maintenance grasses emphasizing species and cultivars, mixtures, and maintenance practices.
Plant growth regulator use on turf, evaluating fall and spring applications to tall fescue, and mefluidide combined with flurprimidol or paclobutrazol.
Herbaceous weed control research evaluating the tolerance of tall fescue and fine fescues to metsulfuron methyl and chlorsulfuron, and the evaluation of the herbicide Accent in a variety of settings.
Wildflower research evaluating the effect of fertilizer rate and type on establishment of annual wildflower species.

14. SUBJECT TERMS

Keywords: roadside vegetation management, integrated vegetation management, brush control, basal groundcover, low maintenance turf, herbicide tolerance, metsulfuron methyl, chlorsulfuron, plant growth, paclobutrazol, flurprimidol, wildflower, regulators, mefluidide

15. NUMBER OF PAGES

16. PRICE CODE

| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT |
|---|---|---|---|
| None | None | None | |

ACKNOWLEDGEMENTS

This research represents a cooperative effort between the College of Agricultural Sciences at the Pennsylvania State University and the Pennsylvania Department of Transportation. Personnel contributing to the production of this report include the following Penn State faculty and staff:

| | |
|---|---|
| Arthur E. Gover | Project Associate |
| Nathan L. Hartwig | Professor of Weed Science |
| Larry J. Kuhns | Professor of Ornamental Horticulture |
| Robert W. Parks, III | Research Technician |
| Chad W. Spackman | Research Technologist |
| Thomas L. Watschke | Professor of Turfgrass Science |

We would like to thank the PennDOT District Roadside Specialists for their cooperation in all phases of the project. Thanks must also be extended to the Central Office staff, Ron Stahl and Connie Tyson, who have been extremely helpful and highly committed to this project. We would also like to gratefully acknowledge the assistance of the representatives of the various manufacturers providing products for the vegetation management industry, who have lent their time, expertise, and material support on many occasions. The following manufacturers assisted this research project during the 1993 season with material support:

Arborchem Products, Inc.
American Cyanamid Company
BASF
CWC Chemical
DowElanco
DuPont
Exacto Chemical Company
Hoechst-Roussel
Monsanto
Nalco Chemical Company
Sandoz Agro, Inc.
Waldrum Specialties, Inc.

This project was funded by the Pennsylvania Department of Transportation.

TABLE OF CONTENTS

## INTRODUCTION

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

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

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

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

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

This report includes information from studies relating to roadside brush control, evaluation of low maintenance grasses, herbaceous weed control, plant growth regulator applications to roadside turf, and wildflower evaluation. Project activities intended for demonstration purposes only are not reported.

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

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

| Trade Name | Active Ingredients | Formulation | Manufacturer |
|---|---|---|---|
| Accent | nicosulfuron | 75 DF | E.I. DuPont de Nemours & Co. |
| Access | picloram, triclopyr | 3 OS (1+2) | DowElanco |
| Accord | glyphosate | 4 S | Monsanto |
| Arsenal | imazapyr | 2 S | American Cyanamid Co. |
| Assure II | quizalofop-p-ethyl | 0.88 EC | E.I. DuPont de Nemours & Co. |
| CideKick II | adjuvant | - - - | JLB International Chemical Co. |
| Clean Cut | adjuvant | - - - | Arborchem Products, Inc. |
| Cutless | flurprimidol | 50 W | DowElanco |
| Embark | mefluidide | 2 S | PBI/Gordon Corporation |
| Escort | metsulfuron methyl | 60 DF | E.I. DuPont de Nemours & Co. |
| Event | imazethapyr, imazapyr | 1.46 S (1.43+0.03) | American Cyanamid Company |
| Fusilade 2000 | fluazifop-p-butyl | 1 EC | ICI Americas |
| Garlon 3A | triclopyr | 3 S | DowElanco |
| Garlon 4 | triclopyr | 4 EC | DowElanco |

continued

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

| Trade Name | Active Ingredients | Formulation | Manufacturer |
|---|---|---|---|
| Hy-Grade | adjuvant | - - - | CWC Chemical Company |
| Hyvar X | bromacil | 80 DF | E.I. du Pont de Nemours & Co. |
| Karmex | diuron | 80 DF | E.I. du Pont de Nemours & Co. |
| Krenite S | fosamine ammonium | 4 S | E.I. DuPont de Nemours & Co. |
| Oust | sulfometuron methyl | 75 DF | E.I. du Pont de Nemours & Co. |
| - - - | paclobutrazol | 50 W | ICI Americas |
| Penevator 9 | spray adjuvant | - - - | Exacto Chemical Company |
| Primo | trinexapac-ethyl | 1 EC | CIBA Corporation |
| RoundUp | glyphosate | 4 S | Monsanto |
| San-Ag 41A | drift retardent | - - - | |
| Sta-Put | drift retardent | - - - | Nalco Chemical Company |
| Telar | chlorsulfuron | 75 DG | E.I. DuPont de Nemours & Co. |
| Tordon 101M | picloram, 2,4-D | 2.5 S (0.5+2) | DowElanco |
| Transline | clopyralid | 3 S | DowElanco |
| Vantage | sethoxydim | 1 EC | BASF |
| Velpar L | hexazinone | 2 S | E.I. du Pont de Nemours & Co. |
| Weedone 170 | 2,4-D, 2,4-DP | 3.7 EC (1.85, 1.85) | Rhone Poulenc Ag Company |

## Use of Statistics in This Report

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

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

# COMPARISON OF MECHANICAL, CONVENTIONAL, AND INTEGRATED BRUSH CONTROL PROGRAMS ON A FORESTED, LIMITED ACCESS HIGHWAY

## INTRODUCTION

Controlling brush is the most difficult and expensive part of a roadside vegetation management program in Pennsylvania. Mechanical removal through brush mowers, or chainsaws and chippers is time consuming, equipment maintenance intensive, and can be hazardous to operators. However, mechanical removal is the method of choice of people who are opposed to the use of herbicides in roadside ROW's.

The standard methods of brush control currently used by PennDOT include broadcast or spot applications of herbicides applied from moving trucks. These methods often result in the death of the vegetative groundcover surrounding the target brush. The treated brush species are often the first plants to regrow in the treated areas, resulting a vicious cycle of treat and retreat.

Selective brush control applications techniques are available that result in the death of the brush with little effect on the groundcover under it. The competitive effects of the groundcover minimize the establishment and growth of additional brush in the treated area. This should result in a longer period between treatments. It should also reduce the time required to complete subsequent treatments. The objective of this study is to compare the long-term cost and effectiveness of several brush control techniques that could be used along Pennsylvania highways.

Prior to initiating treatments, a clearance standard was developed to provide guidelines for treatment. The clearance standard divides the ROW into two zones, a clear zone and a selective zone. The clear zone extends from the pavement edge for a distance of 30 ft. All woody stems within the clear zone are to be treated. Stems that are four inches or more in diameter are to be cut. The selective zone extends from the 30 ft boundary to a distance of 60 ft from the road, or the original tree clearance distance, or the ROW fence; whichever is closest to the roadway. In the selective zone, only tall growing species that could potentially fall on to the roadway are to be treated. The most commonly treated species in the plot areas were red maple (*Acer rubrum*), black cherry (*Prunus serotina*), red oak (*Quercus rubra*), and quaking aspen (*Populus tremuloides*). The most common low growing species that were left untreated in the selective zone included common witchhazel (*Hammemelis virginiana*), bear oak (*Quercus ilicifolia*), and serviceberry (*Amelanchier* spp.). Existing stems in herbicide treated areas are cut when they exceed 25 ft in height

## MATERIALS AND METHODS

A long-term study comparing the cost and effectiveness of mechanical-only, truck-based herbicide applications relying on broadcast or high-volume spot treatments (conventional), and integrated methods for brush control was initiated along SR 80, in western Centre County. The mechanical and integrated treatment areas were established in the shoulder and median areas of SR 80, in Rush Township.

Two plots each of the four treatment types were established between mile markers 139 and 141 of SR 80, in Rush Township, Centre County. The entire study area was divided into native and cut slope areas, and each treatment was randomly assigned to one plot within each area. Each plot was approximately 0.5 miles long. The four treatments included mechanical, low-volume basal bark/cut and stump treat (basal bark/cut stump), low-volume foliar/cut stump (foliar/cut stump), and spot concentrate/cut stump. Cut stump, basal bark, and foliar treatments are highly selective because the treatment is applied directly to the target brush. The spot concentrate soil treatment is less selective, as non-target plants can be injured if their roots extend into the treatment area and take up the herbicide. The conventional treatments will be Department-applied during 1993, and monitored beginning in 1994. The areas used to evaluate the conventional treatments will be determined in cooperation with District 2-0 personnel.

Mechanical Only

This technique consisted of hand cutting all stems above a height of 2 ft, without any stump treatment. These plots were treated July 9, July 12-16, and November 18, 1993. The cut brush was either left where cut, or dragged out of the clear zone, therefore no chipping was utilized. A total of 5,633 stems were cut in 67 hours.

Basal Bark/Cut Stump

This treatment consisted of treating the lower 12 to 15 inches of target brush stems with a solution of Garlon 4 and oil diluent[1/] , in a ratio of 15/85 percent. This treatment was applied with a piston pump backpack sprayer equipped with a B&G Extenda-Ban low volume basal wand equipped with a Spraying Systems #5500 adjustable ConeJet tip, size Y-2. The applications were made May 27 and June 1, 1993 A total of 2,980 stems were treated in 15.25 person-hours (hours), using 8 gallons of solution.

The cut and stump treatment portion of these plots was applied May 27, June 9, June 11, and July 9, 1993. The herbicide solution used for the stump treatment was the same as the basal bark solution. The solution was applied immediately after cutting with a household spray bottle to the cut surface of the stump. The two plots were completed in a total of 36.75 hours, treating 761 stems with slightly over one gallon of solution. After cutting, the brush was either cut to smaller pieces and left in place, or drug into the forest or the top of the cut slope. None of the brush cut in any treatment plot was chipped.

Foliar/Cut Stump

The treatments were applied September 24 and 29, 1993, using piston pump backpack sprayers equipped with handguns configured with a two position swivel valve using a Spraying Systems 1502 flat fan and a Y-2 adjustable Cone Jet. The application of the herbicide involved light, uniform coverage of the leaf surfaces on the entire tree. The herbicide mixture used consisted of, on a volume basis, 5% Krenite S, 0.25% Arsenal, 0.5% Clean Cut and 0.25% StaPut (a drift control agent). A total of 6,326 stems were treated in 18.5 hours with 19 gallons of solution. Larger trees growing towards the roadway may have only been sprayed from one side, while smaller brush was completely covered.

The cut stump treatments in these plots were applied November 22, 1993. The two plots were completed in a total of 6 hours treating 72 stems with about 1 pint of solution.

Spot Concentrate /Cut Stump

This treatment consists of applying precise amounts of undiluted Velpar L near the base of target brush. Dosage is based on stem or canopy diameter. The application rate used was 4 ml per inch of stem diameter, or per 3 ft of canopy diameter. The treatment in the cut slope plot was applied November 18, 1993, using a piston-pump backpack sprayer equipped with a Spraying Systems MeterJet with a D2 straight stream spray tip. One applicator treated 1,244 stems in 2 hours using 0.9 gallons of solution. The native terrain plots were treated April 15 and May 3, 1994, and required 4.3 hours to treat 2,877 stems, using 1.1 gallon of solution.

The cut and stump treatment portion of these plots was carried out November 22, 1993. The stems cut were generally greater than 20 ft in height, or were located adjacent to a water source. A total of 14 stems were treated in 2 hours, using 2 oz solution. This seems like a lot of time to treat so few stems, but this primarily reflects the amount of time required for two operators to walk through both plots and cut the few stems that were there. The terrain was severe in the cut slope area, and the dragging of stems off the rock slope was time consuming.

---

[1/] The diluents used were Arborchem Basal Oil, or CWC HyGrade.

## RESULTS

Table 1 summarizes the results gathered from the initial treatment data. The material costs only include the cost of herbicides, fuels, and lubricants used for the treatments. The initial treatments established a baseline for future comparisons, but due to differences in stem densities between plots, the initial differences between the plots should not be overemphasized. The comparison between treatments becomes important in subsequent seasons as the amount of follow-up effort required to maintain the clearance standards is measured.

TABLE 1: Initial data gathered from the application of brush control treatments. Material costs include herbicides, and fuel and oil for the chainsaws.

| Treatment | Treated Acres | Stems per Acre | Man Hours per Acre | Material Cost per Acre | Total Cost[1/] per Acre |
|---|---|---|---|---|---|
| | | | | ($) | ($) |
| Basal Bark | 7.25 | 411 | 2.10 | 16.30 | 68.88 |
| Cut/Stump Treat | 7.25 | 105 | 5.07 | 3.79 | 130.52 |
| *Total* | *7.25* | *516* | *7.17* | *20.09* | *199.40* |
| Mechanical | 6.60 | 853 | 10.15 | 6.05 | 259.84 |
| LVF | 7.85 | 806 | 2.36 | 6.37 | 65.26 |
| Cut/Stump Treat | 7.85 | 9 | 0.70 | 0.34 | 17.86 |
| *Total* | *7.85* | *815* | *3.06* | *6.71* | *83.12* |
| Spot Concentrate | 8.5 | 485 | 0.74 | 11.02 | 29.52 |
| Cut/Stump Treat | 8.5 | 2 | 0.24 | 0.11 | 6.11 |
| *Total* | *8.5* | *295* | *0.71* | *11.13* | *35.63* |

[1/] Total Cost per Acre values are based upon labor rates of $25.00 per hour.

## BRUSH CONTROL PROVIDED BY FALL BROADCAST APPLICATIONS OF COMBINATIONS OF KRENITE OR ACCORD WITH ARSENAL

### INTRODUCTION

Repeated trials and field observations have demonstrated the effectiveness of Krenite S plus Arsenal combinations to provide control of roadside brush with fall applications. Addition of Arsenal to Krenite S greatly increases the control spectrum, while maintaining the desired slow onset of symptoms. A difficulty with the combination has been finding rates that would limit control to the treated portion of the target brush, without reducing the spectrum of control. This study was designed to evaluate the effectiveness of three rates of Krenite S combined with Arsenal in controlling a mixture of brush species. A combination of Accord plus Arsenal was included for comparative purposes.

### MATERIALS AND METHODS

Krenite S at 4, 5, or 6 qt/ac, in combination with 4 oz/ac Arsenal; and Accord plus Arsenal at 3 qt/ac plus 4 oz/ac, respectively, were applied to brush at the edge of a utility ROW on the grounds of The Pennsylvania State University, on October 6, 1992. Treatments were applied with a $CO_2$-pressurized plot sprayer equipped with a Radiarc spray head, delivering 30 gal/ac at 30 psi at a speed of 4 mph, to a 13 ft vertical swath in 180 ft plots. All treatments included Clean Cut at 0.25% (v/v). The predominant species were green ash (*Fraxinus pennsylvanica*), black cherry (*Prunus serotina*), red oak (*Quercus rubra*), tatarian honeysuckle (*Lonicera tatarica*), and black locust (*Robinia pseudoacacia*). Visual ratings of brush control were taken for each plant in the treated area September 21, 1993, using a scale of 1 to 7, where '1' = no control, '5'= complete control of treated branches, '6'= control beyond treated branches, and '7'= complete control of the plant. Smaller plants that were completely controlled were assigned ratings of '5' if it appeared the entire plant was sprayed, or a '7' if only the side of the plant facing the sprayer was treated.

### RESULTS

All treatments provided excellent control of black cherry, tatarian honeysuckle, green ash, and all oak species, which included red oak, white oak (*Quercus alba*), bear oak (*Quercus ilicifolia*), and pin oak (*Quercus palustris*) (Table 1). Reducing the rate of Krenite S reduced the control of black locust, while the Accord combination completely killed this species. Control of hickory with the Accord combination was variable, as one plant approaching 15 ft in height was completely controlled, while another marked for fall coloration at treatment had only slight injury. Accord plus Arsenal caused only slight injury to the one red maple (*Acer rubrum*) in the treatment area. Impact of the treatments on the understory was difficult to determine as there was very little herbaceous growth present at treatment due to brush density. There was herbaceous growth scattered throughout the treated area when the study was rated.

### CONCLUSIONS

Reducing the Krenite S rate from 6 to 4 qt/ac in combination with Arsenal at 4 oz/ac, had little effect on the degree of control provided, except on black locust. The desired decrease in control of branches not treated was not achieved with these rate reductions.

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

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

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

## EVALUATION OF BRUSH CONTROL PROVIDED BY BASAL BARK APPLICATIONS USING VARIOUS FORMULATIONS OF ACCESS

### INTRODUCTION

Access is a combination of picloram, and the butoxyethyl ester (BEE) of triclopyr, containing 0.25 and 0.50 lb ae/gal respectively. The picloram in Access is formulated as the iso-octyl ester (IOE). The IOE is a polymolecular chain, meaning it can take a variety of configurations in the formulation. This variation has posed problems with regards to registration and regulation of the product. Another experimental formulation of Access contains the ethylheptyl ester (EHE) of picloram; which is a monomolecular chain, meaning it can take only one form. From a regulatory standpoint this is highly desirable. The ratio of picloram to triclopyr, and the diluent in the formulation can also effect the degree of control provided by a basal bark application. This experiment was established to evaluate the effect of picloram formulation, picloram:triclopyr BEE ratios, and diluent on the control of brush treated with basal bark applications.

### MATERIALS AND METHODS

The six herbicide treatments evaluated (Table 1) consisted of Access, which is a 1:2 formulation of picloram:triclopyr containing the iso-octyl ester (IOE) of picloram, diluted in kerosene; an alternate 1:2 formulation containing the ethylheptyl ester (EHE) of picloram, diluted in either kerosene, Exxsol D-80, or methyl oleate; and a 1:6 formulation containing the EHE picloram ester, diluted in either Exxsol D-80, or methyl oleate. The 1:2 formulations contained a total of 0.75 lb ae/gal (0.25:0.50), while the 1:6 formulations contained 0.875 lb ai/gal (0.125:0.75).

The six treatments were applied to 10 stems each of red maple (*Acer rubrum*), black birch (*Betula lenta*), and black locust (*Robinia pseudoacacia*) on November 26, 1991, along I-80, in Centre and Clinton counties. Each treatment was applied at the rate of 1.0 ml/in circumference, measured to the nearest 0.25 in, using a syringe and a 14 ga pipetting needle. At this rate, the height of the coverage band on the locust stems was about 6 inches, and coverage of the smooth barked birch and maple was 8 to 10 inches. The experimental design was a randomized complete block, with each stem being an experimental unit. Prior to the first injury rating, about 70% of the locust stems were cut down during brushing operations conducted by the Department. The treatments were initially rated for injury on July 1, 1992, on a scale of 1 to 5, where '1'=no injury, and '5'=dead stem. Final ratings of percent canopy reduction were taken September 28, 1993. For the 1993 rating, untreated trees adjacent to the treated stems in each replication were also rated for percent canopy reduction. Results from both rating periods for black birch are reported in Table 1.

### RESULTS

Red maple was completely controlled by all treatments at the time of the first rating. Treatment effects were not significant for birch for the 1992 rating. When the untreated check was deleted from the analysis of variance for the 1993 data, treatment effect was not significant ($p=0.089$). Using stem diameter as covariate in the analysis of the 1993 data was also not significant ($p=0.181$). There was no significant difference in canopy reduction between the EHE and IOE formulations of picloram when diluted in kerosene. When the rate of picloram EHE plus triclopyr was 0.25 plus 0.50 lb ae/gal, respectively, greater canopy reduction was observed with the diluents methyl oleate or kerosene compared to Exxsol D-80. When Exxsol D-80 was the diluent, a picloram EHE/triclopyr ratio of 0.125/0.75 provided better control than a ratio of 0.25/0.50. Both methyl oleate and Exxsol D-80 provided 100 percent canopy reduction of birch when the picloram EHE/triclopyr ratio was 0.125/0.75.

## CONCLUSIONS

The application rates used in this study were too high to observe differences in treatment efficacy on red maple. On black birch, a species more difficult to control, EHE formulation was more effective when diluted in kerosene or methyl oleate, compared to Exxsol D80. The EHE formulation provided control equal to the IOE formulation. When diluted in Exxsol D80, the 1:6 formulation of picloram:triclopyr was more effective than the 1:2 formulation.

TABLE 1: Visual ratings taken July 1, 1992, and September 28, 1993, for black birch treated November 26, 1991 with basal bark applied herbicides. Each value is the mean of 10 replications.

| Treatment | Picloram + Triclopyr | Diluent | Injury Jul 1, 1992 | Canopy Reduction Sep 28, 1993 |
|---|---|---|---|---|
| | (lb ae/gal) | | (1-5) | ( % ) |
| Access (IOE)[1/] | 0.25 + 0.50 | kerosene | 2.7 | 93 |
| XRM 5360 (EHE)[2/] | 0.25 + 0.50 | kerosene | 3.2 | 97 |
| XRM 5359 (EHE) | 0.25 + 0.50 | methyl oleate | 2.9 | 100 |
| XRM 5358 (EHE) | 0.25 + 0.50 | Exxsol D-80 | 2.5 | 89 |
| XRM 5359 + triclopyr BEE[3/] | 0.125 + 0.75 | methyl oleate | 2.8 | 100 |
| XRM 5358 + triclopyr BEE | 0.125 + 0.75 | Exxsol D-80 | 3.0 | 100 |
| Untreated Check | - - - | - - - | - - - | 4 |
| Significance Level (p) | | | 0.4500 | 0.0001 |
| C.V. (%) | | | 25 | 11 |
| lsd (p=0.05) | | | n.s. | 8 |

1/ IOE is the iso-octyl ester of picloram.
2/ EHE is the ethylheptyl ester of picloram.
3/ BEE is the butoxyethyl ester of triclopyr, which was the triclopyr formulation used in all treatments.

# COMPARISON OF TWO READY-TO-USE BASAL BARK HERBICIDE FORMULATIONS FOR CONTROL OF BLACK LOCUST, BLACK CHERRY, AND BLACK BIRCH

## INTRODUCTION

A trial evaluating the effect of picloram:triclopyr ratios, and application dates on brush control provided by basal bark applications was initiated along SR 80, in Clinton County, PA.

## MATERIALS AND METHODS

The herbicide treatments were a picloram plus triclopyr formulation containing 0.25 plus 0.50 lb ae/gal, respectively (NAF-6); and a 0.125:0.625 lb ae/gal picloram:triclopyr formulation (NAF-6 + NAF-5). These treatments were applied January 14, and April 13, 1993, to 10 stems each of black locust (*Robinia pseudoacacia*), black cherry (*Prunus serotina*), and black birch (*Betula lenta*), using a syringe and a 14 ga pipetting needle. The herbicides were applied at a rate of 0.5 ml/in of circumference, based on caliper measurements to the nearest 0.25 in, taken at a height of 6 in on each stem of each plant. The experimental design was a randomized complete block, with each plant used as an experimental unit. Treatments to the locust were applied at a height of 6 in, and covered a band 2 to 4 in wide, depending on bark texture. Treatments to cherry were applied at 6 in, and usually provided coverage to the soil line. Treatments to birch provided full cover from the soil line to a height of 8 in. Visual ratings of percent canopy reduction were taken September 29, 1993. The untreated cherry was showing fall coloration, and some leaf drop which accounted for the canopy reduction in the checks. Birch and locust were showing very little fall color (<5%). Results for all species are reported in Table 1.

## RESULTS

Both treatments, applied on both application dates, caused a 100 percent reduction in the canopy of black cherry. The was no difference in the level of control balck birch or black locust provided by the two combinations of picloram plus triclopyr. Applicaton of both combinations resulted in greater canopy reduction when applied in January than when applied in April. All trees will be evaluated again to determine if there is any delayed response to the treatments.

## CONCLUSIONS

Basal bark treatments produce a girdling effect on trees, and may take longer than one season to be completely effective. These first year results should not be relied upon to determine eventual control, but rather the quickness of control. In locust and birch, January applied treatments produced more effects than April treatments, but also had three additional months to act upon the brush. There were no differences between the activity of the two formulations at either date.

Table 1: Visual ratings of percent canopy reduction of black locust, black cherry, and black birch resulting from application of two herbicide formulations at two dates, January 14 and April 13, 1993. All herbicides were applied at the rate of 0.5 ml/inch of circumference measured at 6 in. Ratings were taken September 28, 1993. Each value is the mean of 10 replications.

| Herbicide | Picloram:Triclopyr | Application Date | Canopy Reduction black locust | black cherry | black birch |
|---|---|---|---|---|---|
| | (lb ae/gal) | | (------------------(%)-----------------) | | |
| NAF-6 | 0.25:0.50 | Jan 14 | 80 | 100 | 97 |
| NAF-6 + NAF-5 | 0.125:0.625 | Jan 14 | 87 | 100 | 99 |
| NAF-6 | 0.25:0.50 | Apr 13 | 66 | 100 | 80 |
| NAF-6 + NAF-5 | 0.125:0.625 | Apr 13 | 62 | 100 | 74 |
| Untreated Check | - - - | - - - | 5 | 30 | 2 |
| Significance Level (p) | | | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | | | 26 | 4 | 19 |

# COMPARISON OF BRUSH CONTROL PROVIDED BY FOLIAR APPLICATIONS OF TWO FORMULATIONS OF PICLORAM PLUS 2,4-D

## INTRODUCTION

This experiment was established to evaluate brush control provided by low volume foliar applications of Tordon 101M; and NAF-8, an experimental dry formulation (60 WDG) with the same 1:4, picloram:2,4-D ratio as Tordon 101M.

## MATERIALS AND METHODS

Each herbicide formulation was applied at rates of 0.625 and 1.25 lb ai/ac (Table 1) to ten stems each of black locust (*Robinia pseudoacacia*) on August 24, 1993; black cherry (*Prunus serotina*), and red (*Quercus rubra*) or blackjack oak (*Quercus marilandica*) on September 8, 1993. The locust stems were located along SR 3007 near State College. The oak and cherry site was at the University Park Airport. Prior to the herbicide application, canopy height from the lowest branch to the plant top, and canopy width were measured to determine treatment area for each plant. Treatment area was calculated as canopy height by width. Black locust was treated with 10 gal/ac spray solution, but this volume was insufficient to satisfactorily suspend the dry formulation. The cherry and oak were treated with 15 gal/ac. The treatments were applied using a $CO_2$-powered backpack sprayer operating at 20 psi, using a Spraying Systems MeterJet, equipped with a two-tip rollover valve which allowed for the use of either a 1502 or 4002 flat fan spray tip. The MeterJet allowed each plant to be treated with a different volume, based on the calculated spray area. All treatments included 0.25% (v/v) Penevator 9, and 0.25% (v/v) Sta-Put.

Visual ratings of percent defoliation were taken October 6, 1993 (43 DAT), for the black locust stems. On October 8, 1993 (30 DAT), visual injury ratings of percent defoliation, and percent fall coloration of remaining leaves were taken for red and blackjack oak; and visual ratings of percent defoliation, and percent foliar necrosis of remaining leaves were taken for black cherry.

## RESULTS

Black locust was the easiest species on which to rate injury, as affected foliage became necrotic and dropped off the plant. The Tordon 101M treatments provided excellent control of locust, and caused more injury than the NAF-8 treatments. For each formulation, there was no significant difference in defoliation between rates. Locust seems to be quite sensitive to these herbicides, as bark splitting of the primary stem was observed on the most severely affected plants. Treated oaks showed much less defoliation than locust, and the only significant differences were between the high rate of Tordon 101M, and the low rate of Tordon 101M and the untreated check. Fall coloration ratings of the remaining oak foliage were higher for the treated plants, but the effects were not significant ($p=0.08$). There were no significant differences in leaf drop in black cherry. The treated plants did show significant necrosis of the remaining foliage compared to the check, but there were no significant differences between the treatments.

## CONCLUSIONS

These interim results show that black locust responds more quickly to treatments of picloram plus 2,4-D than red oak, blackjack oak, and black cherry. The full effect of these treatments will not be evident until the summer of 1994.

TABLE 1: Injury ratings from foliar herbicide treatments applied to black locust on August 24, 1993; black cherry, red and blackjack oak on September 8, 1993, at University Park, PA. Injury was rated October 6 and 8, 1993. Each injury value is the mean of 10 replications.

| Treatment | Application[1/] Rate | Black Locust Defoliation | Red and Blackjack Oak Defoliation | Red and Blackjack Oak Fall[1/] Coloration | Black Cherry Leaf Drop | Black Cherry Foliar[2/] Necrosis |
|---|---|---|---|---|---|---|
| | (lb ai/ac) | (%) | (%) | (%) | (%) | (%) |
| Tordon 101M | 0.625 | 93 | 14 | 80 | 74 | 67 |
| Tordon 101M | 1.25 | 95 | 45 | 86 | 57 | 92 |
| NAF-8 | 0.625 | 84 | 24 | 91 | 73 | 67 |
| NAF-8 | 1.25 | 75 | 25 | 96 | 70 | 70 |
| Untreated Check | - - - | 2 | 0 | 69 | 69 | 0 |
| Significance Level (p) | | 0.0001 | 0.02 | 0.08 | 0.46 | 0.0001 |
| LSD (p=0.05) | | 12 | 26 | n.s. | n.s. | 28 |

[1/] Total picloram plus 2,4-D rate. The rate of 0.625 lb ai/ac is equal to 0.125 plus 0.50; and 1.25 lb ai/ac is equal to 0.25 plus 1.0 lb picloram plus 2,4-D, respectively.

[2/] Represents percentage of remaining leaves.

## EFFECT OF NOZZLE TYPE, SPRAY PRESSURE, AND DRIFT CONTROL AGENT CONCENTRATION ON SPRAY DISTANCES ACHIEVED WITH BACKPACK SPRAYERS

### INTRODUCTION

A motorized backpack and a hand-pump backpack were evaluated with several types of nozzles, at varying pressures and drift control agent concentrations, to determine the configurations capable of propelling an intact spray stream the greatest distance. These configurations will be useful for spray operations conducted where target vegetation occurs on steep, inaccesible slopes close to the roadway.

### MATERIALS AND METHOD

Two backpack sprayers, a lever-actuated piston pump sprayer (Birchmeier closed system back sprayer), and a motorized diaghragm pump sprayer (Echo Power Sprayer SHR-200E), were utililized for this procedure. Both sprayers were equipped with a pressure guage. The Birchmeier was fitted with a trigger valve spray gun while the Echo carried a Spraying Systems Gunjet 30L spray gun. The pressure for the Birchmeier sprayer ranged from 50 to 75 psi, while the Echo, although it could attain pressure up to 150 psi, was also operated at 50 to 75 psi. A 1 percent active ingredient solution polyvinyl polymer[1/] was mixed with 1500 ml of water at rates of 1, 3, and 5 percent. The nozzle tips used were Spraying Systems D-2, D-4, and D-6 hardened stainless steel type D orifice discs and a Spraying Systems #5500 Adjustable ConeJet with X-6 and Y-2 tips. Each sprayer was operated with each nozzle type and spray solution and the greatest distance that maintained a uniform pattern without drift was then noted.

### RESULTS

The distances obtained ranged from 20 to 35 feet (Table 2). Nine combinations had distances more than 30 ft with one reaching 35 ft. With the 1 percent solution, the greatest distance obtained was 30 ft with the Birchmeier and Y-2 nozzle. With a 3 percent solution, 30 ft was obtained with the Echo sprayer using a D-4 and X-6 nozzle tip and 35 ft was obtained using an X-6 nozzle tip on the Birchmeier sprayer. A distance of 30 ft was obtained with the Birchmeier and the Echo with an X-6, D-2 and Y-2, using a 5 percent solution. The D-6 nozzle tip could not be used with the Echo sprayer as it produced a spray stream that was very broken up. Although the Echo sprayer had six combinations of nozzle tips and solution that produced a 30 foot stream, the nozzle output was much greater than that produced by the Birchmeier sprayer. The Birchmeier sprayer produced a 30 foot stream with the Y-2 nozzle at the 1 percent solution and a 35 and 30 ft stream with the 3 and 5 percent solutions, respectively, using an X-6 nozzle tip. Pressures beyond 75 psi could not be obtained with the Birchmeier sprayer and were not feasible with the Echo sprayer as it resulted in spray streams that produced fine particles.

---

[1/] STA-PUT Deposition Aid, NALCO Chemical Company, Chicago Illinois.

TABLE 1: Drift control agent concentration, nozzle tip, spray pressure, and distance for the Birchmeier and Echo sprayers.

| Drift Control | Nozzle tip | Birchmeier Pressure | Throw | Echo Pressure | Distance |
|---|---|---|---|---|---|
| (%) | | (psi) | (ft) | (psi) | (ft) |
| 1 | D-2 | 75 | 25 | 50 | 25-30 |
| 1 | D-4 | 50 | 25 | 50 | - - /2 |
| 1 | D-4 | 25 | 20 | - - | - - |
| 1 | D-6 | 50 | 25 | - - | - - |
| 1 | Y-2 | 75 | 30 | 50 | 25 |
| 1 | X-6 | 50 | 25 | 50 | 25 |
| 3 | D-2 | 50 | 25 | 60 | 25 |
| 3 | D-4 | 50 | 25 | 50 | 30 |
| 3 | Y-2 | 75 | 25 | 50 | 25 |
| 3 | X-6 | 50 | 30-35 | 50 | 30 |
| 5 | D-2 | 75 | 25 | 75 | 30 |
| 5 | D-4 | 50 | 25 | 75 | - - |
| 5 | Y-2 | 50 | 20 | 75 | 30 |
| 5 | X-6 | 75 | 30 | 50 | 30 |

/2 Spray pattern contained too many fine particles.

# EVALUATION OF FINE FESCUE AND PERENNIAL RYEGRASS CULTIVARS UNDER LOW MAINTENANCE CONDITIONS WITH AND WITHOUT NITROGEN FERTILIZATION

## INTRODUCTION

The objective of this trial is to evaluate the long-term performance of fine fescue and perennial ryegrass cultivars under low maintenance conditions, with and without supplemental nitrogen fertilization.

## MATERIALS AND METHODS

Twenty-four fine fescue and two low-growing perennial ryegrass cultivars (Table 1) were planted May 8, 1990, at the Russell E. Larson Agricultural Research Center, Rock Springs, PA. Prior to seeding, the site was plowed, disked, and harrowed. The seed was dropped on 7.5 by 30 ft plots, and the area was cultipacked. The experimental design is a randomized complete block design with a split-block treatment arrangement with three replications. An application of 2,4-D at 0.75 lb ai/ac was made July 16, 1990, to control annual broadleaf weeds. The entire study area was treated November 10, 1992, with dicamba plus chlorsulfuron at 1.0 plus 0.023 lb ai/ac, to control perennial broadleaf weeds such as Canada thistle (*Cirsium arvense*), black medic (*Medicago lupulina*), red clover (*Trifolium pratense*), and common dandelion (*Taraxacum officinale*). The study area was mowed in August, 1990; September, 1991; July and September, 1992; and June 1993. The area was mowed each time at a height of 6 inches, and very little leaf tissue removal occurred. An application of urea (46-0-0) at 44 lb N/ac was made to half of each cultivar plot on October 18, 1990; October 8, 1991; and October 19, 1992. On October 4, 1993, half of each cultivar plot was fertilized with 44 lb N/ac of sulfur-coated urea (39-0-0). Data collected in 1993 included percent green turf cover (percent turf cover), and canopy height on April 23; and percent turf cover, canopy height, and percent weed cover on May 19, July 6, September 22, November 5, and December 3. Percent turf cover and percent weed cover were rated visually. Canopy height was averaged from two measurements per sub-plot taken with a graduated dowel measuring the height at which a 12 in diameter by 0.25 in thick wooden disk was suspended when dropped from a height of 3 ft. The most prevalent weed species were Canada thistle , common dandelion, and red clover.

## RESULTS AND DISCUSSION

All fine fescue cultivars provided essentially 100 percent groundcover, and have produced a thick thatch layer. In most instances, percent weed cover in fine fescue plots represents a separate, higher canopy. The perennial ryegrass cultivars have thinned since 1990, when turf cover ratings approached 90 percent. The 'Barclay' perennial ryegrass was severely infected with what appeared to be snow mold at the April 23 rating, while the 'Lex86' perennial ryegrass and the fine fescues showed no signs of the disease.

The data for turf cover, weed cover, and canopy height were analyzed by cultivar (Tables 2, 4, and 6), and by species (Tables 3, 5, and 7). There was a significant interaction between cultivar and nitrogen rate for the turf cover ratings taken in May, July, November, and December (Table 2). At these dates, turf cover ratings were analyzed by cultivar for each nitrogen rate. At the April 23 rating, 'Lex86' perennial ryegrass, rated at 43 percent, provided significantly more green cover than all other cultivars. The fine fescue cultivars ranged 6 to 18 percent green turf cover, and 'Barclay' perennial ryegrass provided only 8 percent turf cover, due to snow mold damage. Turf cover ratings taken May 19 were higher for each cultivar where nitrogen was applied, but the degree of response varied. Unfertilized fine fescue turf cover ratings varied from 10 to 25 percent, while ratings in the fertilized plots ranged from 15 to 33 percent. 'Dawson' showed the least difference between fertility levels at 12 and 15 percent cover at 0 and 44 lb N/ac, respectively; and 'Jamestown' showed the greatest difference, at 17 and 32 percent cover at 0 and 44 lb N/ac, respectively. There was essentially no difference between cover ratings for fertilized or unfertilized perennial ryegrass, but 'Barclay' provided poor cover due to thinning from the disease damage observed in April. Turf cover ratings taken July 6 were higher in fertilized plots for all cultivars except 'Barclay', where they were the same as the unfertilized plots, at 22 percent. As in May, the degree of difference in turf cover between fertility levels among the cultivars was quite variable. 'Dawson', 'Durar', and 'Crystal' each had turf cover ratings 2 percent higher when fertilized, but 'Crystal' was among the best rated cultivars for turf cover at this date, while 'Dawson' was one of the lowest. The greatest ratings differences were seen with 'SHE', at 20 and 32 percent, at 0 and 44 lb N/ac, respectively. There was no interaction between cultivar and nitrogen rate for the ratings taken September 22. Fine fescue turf cover ratings ranged from 19 percent for 'Covar', to 38 percent for 'HF 8250', 'Reliant', and 'SR 3100'. 'Lex86' was rated highest for turf cover at 45 percent, while 'Barclay' was rated at 33 percent, and continued to show recovery from the early season disease injury. There was a significant interaction between cultivar and fertility level for turf cover ratings taken November 5, 32 days after nitrogen application. All cultivars were rated higher for turf cover when fertilized. The perennial ryegrasses were rated significantly higher than the fine fescues whether fertilized or unfertilized, and showed greater response than the fine fescues to the fertilizer applications. Green turf cover decreased from November to December in fine fescues, and in unfertilized perennial ryegrass. The perennial ryegrasses were rated significantly higher for green turf cover than the fine fescues under both fertility levels.

When turf cover was evaluated by species, there were significant interactions between fertility level and species for the November and December ratings (Table 3). In April, perennial ryegrass ratings were significantly higher than the fine fescue species, and chewings and creeping red fescues were significantly higher than hard and sheep fescues. In May, turf cover ratings for creeping red and slender creeping fescues were significantly lower than all other species, as these two species showed almost no additional greenup between April and May. Hard and sheep fescues showed the greatest increase from April to May, and perennial ryegrass decreased slightly. The July ratings were very similar to May in terms of species rankings, as creeping red and slender creeping fescue were significantly lower than the other species. All species showed a slight increase in turf cover between May and July. Perennial ryegrass and hard fescue were rated significantly higher than all other species for turf cover in September, and all species had increased cover ratings compared to July. Perennial ryegrass was rated significantly higher for turf cover than all the fine fescue species at both fertility levels in November, and increased in cover compared to September. Slender creeping fescue showed increased turf cover from September, and was the highest rated unfertilized fine fescue. In December, perennial ryegrass was again rated significantly higher for green turf cover than all the fine fescues at both fertility levels. Fertilized ryegrass showed a slight increase in cover from November, and there was a slight decrease when unfertilized. Turf cover decreased for all fine fescues at both fertility levels from November to December, but slender creeping fescue showed the least reduction, and was the highest rated fine fescue for those ratings.

There were significant interactions between cultivar and fertility level for visual ratings of weed cover in July, November, and December (Table 4). This was due to the differences of weed population response in the perennial ryegrass plots. The highest weed cover rating in a fine fescue plot at any date was 5 percent, and most were 2 percent or less. The 'Lex86' had significantly less weed cover than 'Barclay' at all rating dates, and significantly more weed cover than all fine fescues at all rating dates except July. When rated in July, fertility level did not change weed cover in 'Lex86' plots, while the fertilized 'Barclay' plots had more weed cover than unfertilized plots. In November and December, fertilized plots had increased weed cover in 'Lex86' plots, and decreased weed cover in 'Barclay' plots. When the weed cover ratings were analyzed by species, perennial ryegrass had significantly greater weed cover than all fine fescue species at all dates, and there were no significant differences between any of the fine fescue species (Table 5).

Vegetative canopy heights were highest for the fine fescues in July, and in November for perennial ryegrass (Table 6). Only three fine fescue cultivars exceeded a height of six inches; 'Reliant', 'Bighorn', and 'HF 8250', at 6.4, 6.3, and 6.1 inches, respectively. The greatest heights measured for the perennial ryegrass cultivars were 2.5 inches for 'Lex86', and 2.3 inches for 'Barclay'. When canopy heights were analyzed by species, hard and sheep fescue were significantly taller than all other species at every rating date (Table 7). The leaf blades of creeping red and chewings fescues were generally longer than those of the hard and sheep fescues, but they fell over and lay across the ground, effectively lowering the height of the cover proveded.

When the data were analyzed by fertility level, the application of 44 lb N/ac year produced significant higher turf cover ratings in May, July, November, and December (Table 8). There were no significant differences in vegetative canopy heights or weed cover ratings due to fertility level.

## CONCLUSIONS

At the completion of four growing seasons, the fine fescues in this trial are providing very effective, low growing groundcover, with or without annual applications of fertilizer. Hard fescue cultivars are providing the best turf cover of the fine fescues. No fine fescue cultivar was rated at higher than 5 percent weed cover during the season. The two perennial ryegrass cultivars are providing more late season green turf cover, but less total ground cover, and significantly more weeds than the fine fescues. The ryegrasses grow well in the fall, and respond rapidly to fertilizer applications, but they are not providing a reliable low maintenance groundcover.

TABLE 1: Cultivars and species evaluated under low maintenance conditions with and without application of nitrogen fertilizer

| Cultivar | Species | Cultivar | Species |
|---|---|---|---|
| 1. Dover | chewings fescue | 14. Spartan | hard fescue |
| 2. Jamestown | chewings fescue | 15. SR 3000 | hard fescue |
| 3. Shadow | chewings fescue | 16. SR 3100 | hard fescue |
| 4. SHE | chewings fescue | 17. Dawson | slender creeping fescue |
| 5. SR 5000 | chewings fescue | 18. Bargena | creeping red fescue |
| 6. Victory | chewings fescue | 19. Ensylva | creeping red fescue |
| 7. Wilma | chewings fescue | 20. Jasper | creeping red fescue |
| 8. AUE | hard fescue | 21. Pennlawn | creeping red fescue |
| 9. Biljart | hard fescue | 22. Bighorn | sheep fescue |
| 10. Crystal | hard fescue | 23. Covar | sheep fescue |
| 11. Durar | hard fescue | 24. MX-86 | sheep fescue |
| 12. HF 8250 | hard fescue | 25. Lex86 | perennial ryegrass |
| 13. Reliant | hard fescue | 26. Barclay | perennial ryegrass |

TABLE 2: Visual ratings of percent turf cover, taken on a green tissue basis. Ratings were taken April 23, May 19, July 6, September 22, November 5, and December 3, 1993. There was a significant interaction between cultivar and fertility treatments for the May, July, November, and December ratings, and a LSD value is reported for both the 0 and 44 lb N/ac applications at each date. The values for May, July, November and December are the mean of three replications; and the April and September values are the mean of six observations (three replications, two maintenance levels).

| | | May 19 (lb N/ac) | | Jul 6 (lb N/ac) | | | Nov 5 (lb N/ac) | | Dec 3 (lb N/ac) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultivars | Apr 23 | 0 | 44 | 0 | 44 | Sep 22 | 0 | 44 | 0 | 44 |
| | (---percent green turf cover---) | | | | | | | | | |
| 1. Dover | 12 | 18 | 30 | 27 | 32 | 28 | 20 | 27 | 10 | 22 |
| 2. Jamestown | 17 | 17 | 32 | 25 | 35 | 22 | 20 | 28 | 8 | 20 |
| 3. Shadow | 18 | 17 | 27 | 22 | 30 | 28 | 22 | 32 | 12 | 23 |
| 4. SHE | 11 | 17 | 30 | 20 | 32 | 27 | 23 | 32 | 10 | 20 |
| 5. SR 5000 | 13 | 15 | 25 | 23 | 30 | 24 | 22 | 28 | 13 | 20 |
| 6. Victory | 13 | 15 | 27 | 18 | 25 | 27 | 22 | 28 | 12 | 22 |
| 7. Wilma | 13 | 20 | 27 | 22 | 25 | 23 | 22 | 32 | 10 | 20 |
| 8. AUE | 8 | 18 | 25 | 25 | 35 | 36 | 23 | 28 | 17 | 22 |
| 9. Biljart | 8 | 18 | 23 | 22 | 25 | 34 | 22 | 27 | 15 | 22 |
| 10. Crystal | 10 | 25 | 32 | 28 | 30 | 38 | 27 | 35 | 22 | 32 |
| 11. Durar | 10 | 20 | 25 | 23 | 25 | 27 | 23 | 30 | 8 | 22 |
| 12. HF 8250 | 11 | 22 | 30 | 25 | 33 | 38 | 23 | 30 | 20 | 25 |
| 13. Reliant | 13 | 20 | 33 | 23 | 35 | 38 | 23 | 32 | 18 | 28 |
| 14. Spartan | 6 | 18 | 27 | 23 | 28 | 34 | 23 | 32 | 20 | 28 |
| 15. SR 3000 | 9 | 20 | 25 | 25 | 30 | 35 | 25 | 32 | 18 | 27 |
| 16. SR 3100 | 6 | 20 | 27 | 27 | 30 | 38 | 23 | 28 | 18 | 25 |
| 17. Dawson | 12 | 12 | 15 | 15 | 17 | 23 | 27 | 32 | 23 | 30 |
| 18. Bargena | 11 | 13 | 20 | 12 | 20 | 29 | 25 | 32 | 15 | 25 |
| 19. Ensylva | 16 | 12 | 17 | 13 | 18 | 28 | 25 | 35 | 15 | 30 |
| 20. Jasper | 13 | 13 | 18 | 15 | 18 | 28 | 27 | 33 | 15 | 25 |
| 21. Pennlawn | 16 | 10 | 20 | 18 | 23 | 28 | 25 | 35 | 17 | 25 |
| 22. Bighorn | 6 | 18 | 27 | 27 | 32 | 35 | 20 | 25 | 12 | 20 |
| 23. Covar | 18 | 22 | 28 | 17 | 20 | 19 | 25 | 35 | 18 | 28 |
| 24. MX-86 | 6 | 20 | 23 | 22 | 28 | 33 | 22 | 28 | 13 | 20 |
| 25. Lex86 | 43 | 32 | 33 | 28 | 32 | 45 | 50 | 65 | 45 | 73 |
| 26. Barclay | 8 | 8 | 10 | 22 | 22 | 33 | 45 | 62 | 38 | 65 |
| Significance Level (p) | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | 5 | 5 | 9 | 7 | 8 | 6 | 5 | 6 | 5 | 7 |

TABLE 3: Visual ratings of percent turf cover, on a green tissue basis, for turf species under low maintenance conditions. There was a significant interaction between species and maintenance level treatments for the November and December ratings, and a LSD value is reported for both the 0 and 44 lb N/ac applications at each date. The number in parentheses after each species indicates the number of cultivars evaluated.

| | | | | | Nov 5 (lb N/ac) | | Dec 3 (lb N/ac) | |
|---|---|---|---|---|---|---|---|---|
| Species | Apr 23 | May 19 | Jul 6 | Sep 22 | 0 | 44 | 0 | 44 |
| | (---percent green turf cover---) | | | | | | | |
| chewings fescue (7) | 14 | 23 | 26 | 25 | 21 | 30 | 11 | 21 |
| creeping red fescue (4) | 14 | 15 | 17 | 28 | 25 | 34 | 15 | 26 |
| hard fescue (9) | 9 | 24 | 27 | 35 | 24 | 30 | 17 | 26 |
| sheep fescue (3) | 10 | 23 | 24 | 29 | 22 | 29 | 14 | 23 |
| slender creeping fescue (1) | 12 | 13 | 16 | 23 | 27 | 32 | 23 | 30 |
| perennial ryegrass (2) | 26 | 21 | 26 | 39 | 48 | 63 | 42 | 69 |
| Significance Level (p) | 0.0001 | 0.0020 | 0.0050 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | 4 | 5 | 6 | 6 | 3 | 4 | 5 | 7 |

TABLE 4: Visual ratings of percent weed cover taken May 19, July 6, September 22, November 5, and December 3, 1993. There was a significant interaction between cultivar and fertility treatments for the July, November, and December ratings, and a LSD value is reported for both the 0 and 44 lb N/ac applications at each date. The values for July, November and December are the mean of three replications; and the May and September values are the mean of six observations (three replications, two maintenance levels).

| | | Jul 6 (lb N/ac) | | | Nov 5 (lb N/ac) | | Dec 3 (lb N/ac) | |
|---|---|---|---|---|---|---|---|---|
| Cultivar | May 19 | 0 | 44 | Sep 22 | 0 | 44 | 0 | 44 |
| | (----------percent weed cover | | | | | | | ----------) |
| 1. Dover | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 1 |
| 2. Jamestown | 2 | 4 | 2 | 2 | 4 | 2 | 2 | 1 |
| 3. Shadow | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 1 |
| 4. SHE | 2 | 5 | 2 | 2 | 4 | 2 | 3 | 1 |
| 5. SR 5000 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 6. Victory | 1 | 2 | 3 | 2 | 3 | 2 | 2 | 2 |
| 7. Wilma | 1 | 3 | 1 | 2 | 3 | 2 | 3 | 1 |
| 8. AUE | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| 9. Biljart | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 |
| 10. Crystal | 2 | 4 | 2 | 2 | 4 | 1 | 3 | 2 |
| 11. Durar | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| 12. HF 8250 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| 13. Reliant | 1 | 2 | 3 | 2 | 3 | 3 | 2 | 2 |
| 14. Spartan | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 15. SR 3000 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| 16. SR 3100 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| 17. Dawson | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 1 |
| 18. Bargena | 2 | 2 | 3 | 4 | 4 | 5 | 3 | 4 |
| 19. Ensylva | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 |
| 20. Jasper | 1 | 3 | 1 | 1 | 3 | 1 | 2 | 1 |
| 21. Pennlawn | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 |
| 22. Bighorn | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| 23. Covar | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| 24. MX-86 | 1 | 3 | 4 | 2 | 4 | 2 | 3 | 2 |
| 25. Lex86 | 15 | 8 | 8 | 13 | 18 | 25 | 18 | 25 |
| 26. Barclay | 23 | 42 | 48 | 53 | 63 | 55 | 63 | 55 |
| Significance Level (p) | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | 6 | 5 | 6 | 6 | 7 | 9 | 7 | 8 |

TABLE 5: Visual ratings of percent weed cover for turf species under low maintenance conditions. The number in parentheses after each species indicates the number of cultivars in trial. Values for all cultivars of each species were averaged for each replication. Each value reported is the mean of three replications.

| Species | May 19 | Jul 6 | Sep 22 | Nov 5 | Dec 3 |
|---|---|---|---|---|---|
| | (----------percent weed cover | | | | ----------) |
| chewings fescue (7) | 2 | 3 | 2 | 3 | 2 |
| creeping red fescue (4) | 1 | 1 | 2 | 2 | 1 |
| hard fescue (9) | 1 | 2 | 2 | 2 | 2 |
| sheep fescue (3) | 1 | 2 | 2 | 2 | 1 |
| slender creeping fescue (1) | 2 | 3 | 4 | 4 | 3 |
| perennial ryegrass (2) | 19 | 27 | 33 | 41 | 41 |
| Significance Level (p) | 0.0031 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | 8 | 5 | 9 | 8 | 8 |

TABLE 6: Measurements of vegetative canopy height taken April 23, May 19, July 6, September 22, November 5, and December 3, 1993. There was a significant interaction between cultivar and fertility treatments for the April, May, and December measurements, and a LSD value is reported for the 0 and 44 lb N/ac treatments. Values for July, September, and November measurements are the mean of six observations (three replications, two maintenance levels), and the April, May, and December values are the mean of three replications.

| Cultivars | Apr 23 (lb N/ac) 0 | Apr 23 (lb N/ac) 44 | May 19 (lb N/ac) 0 | May 19 (lb N/ac) 44 | Jul 6 | Sep 22 | Nov 5 | Dec 3 (lb N/ac) 0 | Dec 3 (lb N/ac) 44 |
|---|---|---|---|---|---|---|---|---|---|
| | (------------vegetative canopy height, inches------------) | | | | | | | | |
| 1. Dover | 2.5 | 2.8 | 3.5 | 3.8 | 4.8 | 4.0 | 3.0 | 3.5 | 3.2 |
| 2. Jamestown | 2.9 | 2.6 | 3.5 | 4.6 | 5.2 | 4.2 | 3.6 | 3.0 | 3.6 |
| 3. Shadow | 1.9 | 2.3 | 3.3 | 4.2 | 4.6 | 3.9 | 3.2 | 3.0 | 3.0 |
| 4. SHE | 2.3 | 2.8 | 3.3 | 4.3 | 4.4 | 4.3 | 3.5 | 3.1 | 3.3 |
| 5. SR 5000 | 1.8 | 2.8 | 3.0 | 4.3 | 4.7 | 3.7 | 3.3 | 3.1 | 3.6 |
| 6. Victory | 2.6 | 2.4 | 3.0 | 4.5 | 4.4 | 3.8 | 3.1 | 3.3 | 3.3 |
| 7. Wilma | 2.0 | 2.1 | 3.3 | 4.5 | 4.0 | 3.5 | 3.4 | 3.2 | 3.3 |
| 8. AUE | 2.9 | 2.9 | 3.7 | 4.1 | 5.6 | 4.3 | 4.0 | 4.7 | 3.8 |
| 9. Biljart | 2.7 | 3.1 | 3.6 | 3.7 | 5.5 | 4.5 | 3.8 | 4.3 | 3.3 |
| 10. Crystal | 3.0 | 3.3 | 3.8 | 4.8 | 5.5 | 4.9 | 4.3 | 3.8 | 4.2 |
| 11. Durar | 2.7 | 3.2 | 3.9 | 4.3 | 5.3 | 4.3 | 3.3 | 3.0 | 3.2 |
| 12. HF 8250 | 3.2 | 2.8 | 4.0 | 4.4 | 6.1 | 5.2 | 4.8 | 4.7 | 3.8 |
| 13. Reliant | 3.0 | 2.5 | 4.2 | 4.2 | 6.4 | 5.0 | 4.7 | 4.6 | 4.2 |
| 14. Spartan | 3.0 | 3.2 | 3.3 | 4.0 | 5.6 | 4.8 | 4.3 | 3.6 | 4.3 |
| 15. SR 3000 | 3.2 | 2.8 | 3.7 | 4.2 | 5.7 | 5.0 | 4.0 | 4.3 | 4.7 |
| 16. SR 3100 | 2.8 | 3.2 | 3.9 | 4.5 | 5.4 | 5.1 | 3.3 | 4.1 | 4.3 |
| 17. Dawson | 1.9 | 2.3 | 2.4 | 2.8 | 3.4 | 3.3 | 3.1 | 2.7 | 2.8 |
| 18. Bargena | 2.0 | 2.1 | 2.8 | 3.9 | 5.0 | 4.2 | 3.5 | 3.2 | 3.2 |
| 19. Ensylva | 2.2 | 2.2 | 2.1 | 3.0 | 3.8 | 3.5 | 3.2 | 2.8 | 3.6 |
| 20. Jasper | 2.2 | 2.3 | 2.9 | 3.8 | 5.0 | 4.1 | 3.4 | 2.8 | 3.4 |
| 21. Pennlawn | 1.7 | 2.0 | 3.1 | 4.1 | 4.9 | 4.3 | 3.0 | 3.2 | 3.2 |
| 22. Bighorn | 2.8 | 3.3 | 4.3 | 4.9 | 6.3 | 5.6 | 5.0 | 4.3 | 3.4 |
| 23. Covar | 2.8 | 2.9 | 3.8 | 5.2 | 5.9 | 5.2 | 4.9 | 3.7 | 4.3 |
| 24. MX-86 | 2.3 | 2.5 | 3.3 | 3.8 | 5.3 | 4.7 | 3.2 | 3.6 | 2.9 |
| 25. Lex86 | 1.4 | 1.7 | 1.8 | 1.5 | 1.9 | 2.1 | 2.3 | 1.9 | 2.0 |
| 26. Barclay[1/] | - - | - - | 1.1 | 1.2 | 1.9 | 2.3 | 2.5 | 1.8 | 1.8 |
| Significance Level (p) | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | 0.6 | 0.6 | 0.7 | 0.8 | 1.1 | 0.8 | 1.1 | 1.0 | 1.0 |

[1/] No canopy heights were measured for this variety in April due to the lack of growth caused by severe snow mold.

TABLE 7: Canopy height measurements for turf under low maintenance conditions. There was a significant interaction between species and fertility treatments for the May measurements, and a LSD value is reported for both the 0 and 44 lb N/ac applications at each date. Number in parentheses after species indicates number of cultivars in trial.

| Species | Apr 23 | May 19 (lb N/ac) 0 | May 19 (lb N/ac) 44 | Jul 6 | Sep 22 | Nov 5 | Dec 3 |
|---|---|---|---|---|---|---|---|
| | (------------canopy height, inches ------------) | | | | | | |
| chewings fescue (7) | 2.4 | 3.3 | 4.3 | 4.6 | 3.9 | 3.3 | 3.2 |
| creeping red fescue (4) | 2.1 | 2.7 | 3.7 | 4.7 | 4.0 | 3.3 | 3.2 |
| hard fescue (9) | 3.0 | 3.8 | 4.2 | 5.7 | 4.8 | 4.1 | 4.0 |
| sheep fescue (3) | 2.8 | 3.8 | 4.6 | 5.8 | 5.2 | 4.4 | 3.7 |
| slender creeping fescue (1) | 2.1 | 2.4 | 2.8 | 3.4 | 3.3 | 3.1 | 2.8 |
| perennial ryegrass (2) | 1.5 | 1.5 | 1.3 | 1.9 | 2.2 | 2.4 | 1.9 |
| Significance Level (p) | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0028 | 0.0001 |
| LSD (p=0.05) | 0.2 | 0.5 | 0.6 | 0.5 | 0.5 | 0.8 | 0.4 |

TABLE 8: Effect of fertility treatments on turf cover, vegetative canopy height, and weed cover, measured April 23, May 19, July 6, September 22, November 5, and December 3, 1993. No percent weed cover rating was taken in April. Each value is the mean of 78 observations (three replications, 26 cultivars).

| | Apr 23 | May 19 | Jul 6 | Sep 22 | Nov 5 | Dec 3 |
|---|---|---|---|---|---|---|
| | | | percent green turf cover | | | |
| 0 lb N/acre | 10 | 18 | 22 | 31 | 25 | 17 |
| 44 lb N/acre | 15 | 25 | 27 | 30 | 33 | 28 |
| Significance Level (p) | 0.0989 | 0.0123 | 0.0175 | 0.1201 | 0.0189 | 0.0101 |
| L.S.D. (p=0.05) | n.s. | 5 | 5 | n.s. | 7 | 7 |
| | | | vegetative canopy height, inches | | | |
| 0 lb N/acre | 2.5 | 3.2 | 4.7 | 4.1 | 3.6 | 3.4 |
| 44 lb N/acre | 2.6 | 3.9 | 5.0 | 4.3 | 3.6 | 3.4 |
| Significance Level (p) | 0.1687 | 0.0706 | 0.3083 | 0.3169 | 0.9734 | 0.8821 |
| L.S.D. (p=0.05) | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |
| | | | percent weed cover | | | |
| 0 lb N/acre | - - | 3 | 4 | 4 | 5 | 5 |
| 44 lb N/acre | - - | 3 | 4 | 4 | 5 | 4 |
| Significance Level (p) | - - | 0.2643 | 0.8325 | 0.4669 | 0.4112 | 0.1533 |
| L.S.D. (p=0.05) | - - | n.s. | n.s. | n.s. | n.s. | n.s. |

# PERFORMANCE OF FINE FESCUE CULTIVARS UNDER LOW MAINTENANCE CONDITIONS

## INTRODUCTION

As part of the National Turfgrass Evaluation Program 1989 Fineleaf Fescue test, 93 cultivars of fine fescue were seeded to be evaluated under low maintenance conditions. The maintenance level of this test could be described as a low maintenance turf, in contrast to a conservation planting, which would be a more appropriate description of a roadside. Still, we feel information from this test will be useful to the Department to evaluate cultivars for use in seed mixes used on roadsides, such as Formula L.

## MATERIALS AND METHODS

Cultivars of chewings, creeping red, hard, sheep, and slender creeping fescue were drop seeded to 4 by 6 ft plots arranged in a randomized complete block design with three replications on October 5, 1990. Starter fertilizer was applied at 30, 44, and 9 lbs/ac of N, $P_2O_5$, and $K_20$, respectively. Additional fertilizer applications have included applications of urea (46-0-0) at 22 lb N/ac on May 23 and October 23, 1991, an application of urea at 44 lb N/ac on October 19, 1992, and application of sulfur-coated urea (39-0-0) at 44 lb N/ac on October 4, 1993. The entire study area was treated with 2,4-D plus dicamba at 0.48 plus 0.25 lb ai/ac on May 29, 1991 to remove winter annual weeds. The study area has never been irrigated. The study is mowed at a height of 4 inches, when needed. During 1993, a relatively dry year, the study was mowed five times; April 28, May 12, June 16, August 24, and October 5. Weeds are sparse in this test, with the primary species being common dandelion (*Taraxacum officinale*), and quackgrass (*Elytrigia repens*). Data collected in 1993 included spring greenup on April 20; genetic color and seedhead density on June 14; and turf quality on May 11, June 11, August 13, October 4, and December 2. Spring greenup was rated as percent cover by green tissue, where '0' indicates 0% green and '10' indicates 100% green. Genetic color and turf quality were visually rated on a scale of 1 to 9, where '1' indicates dead or brown turf and '9' indicates ideal turf. The seedhead density values were determined by counting the number of seedheads counted in a 0.25 $m^2$ quadrat. The five turf quality ratings were averaged to determine a mean quality rating, and the cultivars are sorted in descending order based on mean quality in Table 1.

## RESULTS

The 13 fine fescue cultivars that received the highest average turf quality ratings, which were not significantly different from each other, were all hard fescues. Of the top 22 cultivars, 20 were hard fescues. The others were the only two sheep fescue cultivars in the study. The next lower 31 cultivars included 29 chewings, one hard, and one slender creeping fescue cultivars. The 40 fine fescue cultivars that received the lowest average turf quality ratings included all 25 of the creeping red fescue cultivars, seven slender creeping fescue cultivars, seven chewings fescue cultivars, and only one of the hard fescue cultivars.

The hard and sheep fescues provided best mean quality, followed by chewings fescue, and then the creeping red and slender creeping fescues. One of the reasons the hard and sheep fescues received the highest quality ratings is they provided much denser stands than the other species. The others produced longer leaf blades but fewer tillers.

All species produced thick layers of thatch, which would not be undesirable for turf grown under low maintenance conditions. A thatch layer provides an excellent groundcover than is an effective barrier to the establishment of many annual weeds.

## CONCLUSIONS

The hard fescue clearly outperformed the chewings, creeping red, and slender creeping fescue cultivars in this test. They provided a dense, low growing, high quality groundcover requiring minimal maintenance. The inclusion of hard fescue as the primary species in the Department's Formula L seeding mixture is well justified.

TABLE 1: Spring greenup, genetic color, seedhead density, and turf quality evaluations of fine fescue cultivars during 1993. Greenup was visually rated on a scale of 0 to 10, where 0=0% green and 10=100% green. Genetic color and turf quality were visually rated on a scale of 1 to 9, where 1=dead, or brown turf and 9=ideal. Each value is the mean of three replications.

| | | Spring Greenup | Genetic Color | Seedhead Density | Turf Quality | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry | Species[1/] | Apr 20 | Jun 14 | Jun 14 | May 11 | Jun 11 | Aug 13 | Oct 4 | Dec 2 | Mean |
| | | (0-10) | (1-9) | (sdhd./0.25 $m^2$) | (-------------------------1-9---------------------------) | | | | | |
| SR 3000 | H | 4.0 | 5.7 | 17 | 5.0 | 5.7 | 5.7 | 6.3 | 5.3 | 5.6 |
| Discovery | H | 3.0 | 6.0 | 17 | 5.0 | 5.7 | 5.7 | 6.7 | 5.2 | 5.6 |
| HF 9032 | H | 3.7 | 6.3 | 18 | 4.7 | 6.0 | 6.0 | 6.0 | 5.5 | 5.6 |
| SR 3100 | H | 3.0 | 7.0 | 20 | 4.3 | 6.0 | 6.0 | 6.0 | 5.3 | 5.5 |
| Aurora w/endo. | H | 3.3 | 6.0 | 35 | 4.7 | 5.7 | 6.0 | 6.0 | 5.2 | 5.5 |
| Reliant w/endo. | H | 4.3 | 6.3 | 15 | 4.7 | 5.3 | 6.0 | 6.0 | 5.3 | 5.5 |
| HF 8250 | H | 3.7 | 6.0 | 9 | 4.7 | 5.7 | 5.7 | 5.7 | 5.3 | 5.4 |
| Serra | H | 3.7 | 6.3 | 7 | 4.3 | 5.0 | 5.7 | 5.7 | 5.8 | 5.3 |
| Attila | H | 3.7 | 7.0 | 45 | 4.0 | 5.0 | 5.7 | 6.0 | 5.7 | 5.3 |
| PST-4AG | H | 3.7 | 6.0 | 27 | 3.7 | 6.0 | 5.7 | 6.0 | 5.0 | 5.3 |
| Aurora | H | 4.0 | 6.0 | 17 | 4.7 | 5.3 | 6.0 | 5.7 | 4.8 | 5.3 |
| Biljart | H | 3.3 | 6.0 | 8 | 4.0 | 5.7 | 5.3 | 6.3 | 5.0 | 5.3 |
| Spartan | H | 4.0 | 6.0 | 21 | 4.3 | 5.7 | 5.7 | 5.7 | 5.3 | 5.3 |
| Scaldis | H | 3.7 | 5.7 | 10 | 4.3 | 5.0 | 5.0 | 5.7 | 5.5 | 5.1 |
| Bardur | H | 4.0 | 6.3 | 12 | 4.0 | 5.3 | 5.0 | 6.0 | 5.3 | 5.1 |
| Bighorn | Sh | 2.7 | 6.3 | 25 | 4.0 | 5.3 | 5.3 | 5.7 | 5.0 | 5.1 |
| Eureka | H | 3.3 | 5.7 | 23 | 3.7 | 5.3 | 5.7 | 6.0 | 5.0 | 5.1 |
| Reliant | H | 4.3 | 5.7 | 12 | 4.0 | 5.3 | 5.3 | 5.7 | 4.5 | 5.0 |
| Valda | H | 3.0 | 6.0 | 5 | 4.3 | 5.7 | 4.7 | 5.3 | 5.2 | 5.0 |
| Brigade | H | 3.3 | 5.7 | 9 | 4.0 | 5.0 | 5.3 | 5.7 | 4.3 | 4.9 |
| MX 86 | Sh | 2.3 | 6.0 | 11 | 4.3 | 5.0 | 5.3 | 5.3 | 4.7 | 4.9 |
| Silvana | H | 2.3 | 6.0 | 10 | 3.3 | 5.0 | 5.3 | 5.7 | 5.0 | 4.9 |
| Barlander | Ch | 2.7 | 6.3 | 34 | 3.0 | 5.7 | 3.7 | 5.0 | 4.7 | 4.4 |
| Barreppo | H | 3.3 | 6.3 | 27 | 3.3 | 4.3 | 4.3 | 5.0 | 4.7 | 4.3 |
| Bargreen | Ch | 2.7 | 6.0 | 25 | 3.7 | 5.0 | 3.3 | 4.7 | 4.3 | 4.2 |
| Waldorf | Ch | 2.0 | 6.0 | 24 | 3.0 | 5.0 | 3.7 | 5.3 | 4.0 | 4.2 |
| Trophy | Ch | 2.7 | 6.0 | 14 | 3.3 | 5.0 | 4.0 | 4.7 | 4.2 | 4.2 |
| Proformer | Ch | 2.7 | 5.7 | 26 | 3.0 | 5.3 | 3.0 | 5.0 | 4.0 | 4.1 |
| Fernando | Ch | 3.3 | 5.7 | 60 | 3.7 | 5.3 | 3.0 | 4.7 | 4.0 | 4.1 |
| Jamestown II | Ch | 2.7 | 5.7 | 14 | 3.3 | 5.0 | 3.0 | 5.0 | 4.3 | 4.1 |
| Dignity | Ch | 2.3 | 6.0 | 33 | 3.3 | 4.7 | 3.0 | 5.0 | 4.3 | 4.1 |
| SR 5000 | Ch | 3.0 | 5.3 | 55 | 3.0 | 5.0 | 3.3 | 4.3 | 4.3 | 4.0 |
| Shadow w/endo. | Ch | 2.3 | 6.0 | 43 | 3.0 | 4.3 | 3.3 | 5.0 | 4.2 | 4.0 |
| PST-4FE | Ch | 2.3 | 6.0 | 109 | 3.3 | 5.0 | 3.0 | 4.7 | 4.2 | 4.0 |
| Belmont | Ch | 2.3 | 5.7 | 44 | 3.0 | 4.7 | 3.3 | 4.7 | 4.2 | 4.0 |
| Rainbow | Ch | 2.3 | 5.7 | 35 | 3.3 | 5.0 | 3.0 | 4.7 | 4.2 | 4.0 |
| Tiffany | Ch | 2.0 | 6.0 | 66 | 3.0 | 4.7 | 3.0 | 4.7 | 4.0 | 3.9 |
| Scarlet | Ch | 2.7 | 6.0 | 23 | 3.7 | 5.0 | 3.0 | 4.3 | 3.7 | 3.9 |
| Capitol | Ch | 2.7 | 6.0 | 29 | 3.0 | 4.3 | 3.0 | 4.7 | 4.7 | 3.9 |
| Puma | Ch | 2.3 | 5.7 | 36 | 3.0 | 4.3 | 3.0 | 5.0 | 4.2 | 3.9 |
| Camaro | Ch | 3.0 | 6.0 | 33 | 3.0 | 4.7 | 2.7 | 4.3 | 4.3 | 3.8 |
| Shadow | Ch | 2.3 | 5.7 | 30 | 3.0 | 4.3 | 3.3 | 4.3 | 4.2 | 3.8 |
| Atlanta | Ch | 2.7 | 6.0 | 68 | 3.3 | 4.7 | 3.0 | 4.3 | 3.8 | 3.8 |
| Mary | Ch | 2.7 | 6.0 | 27 | 3.0 | 5.0 | 2.7 | 4.3 | 4.2 | 3.8 |
| Jamestown | Ch | 3.0 | 6.0 | 7 | 3.0 | 4.7 | 3.0 | 4.3 | 3.8 | 3.8 |
| Southport | Ch | 1.7 | 5.7 | 90 | 3.0 | 4.3 | 3.0 | 4.7 | 4.0 | 3.8 |
| Raymond | Ch | 2.3 | 6.0 | 19 | 3.0 | 4.0 | 3.0 | 4.7 | 4.3 | 3.8 |
| Herald | CR | 3.0 | 5.0 | 4 | 3.3 | 5.0 | 3.0 | 4.0 | 3.8 | 3.8 |

continued

TABLE 1: (continued) Spring greenup, genetic color, seedhead density, and turf quality evaluations of fine fescue cultivars during 1993. Greenup was visually rated on a scale of 0 to 10, where 0=0% green and 10=100% green. Genetic color and turf quality were visually rated on a scale of 1 to 9, where 1=dead, or brown turf and 9=ideal. Each value is the mean of three replications.

| | | Spring Greenup | Genetic Color | Seedhead Density | Turf Quality | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry | Species[1/] | Apr 20 | Jun 14 | Jun 14 | May 11 | Jun 11 | Aug 13 | Oct 4 | Dec 2 | Mean |
| | | (0-10) | (1-9) | (sdhd/0.25 $m^2$) | (--------------------------1-9---------------------------) | | | | | |
| Longfellow | Ch | 2.3 | 6.0 | 37 | 3.0 | 4.7 | 2.7 | 4.7 | 4.2 | 3.8 |
| Enjoy | Ch | 2.0 | 5.7 | 15 | 2.7 | 4.7 | 3.0 | 4.7 | 4.2 | 3.8 |
| Marker | SC | 2.7 | 6.7 | 17 | 2.7 | 4.3 | 3.7 | 4.3 | 4.0 | 3.8 |
| ERG 1143 | Ch | 2.3 | 6.0 | 44 | 3.7 | 4.3 | 2.7 | 4.3 | 4.2 | 3.8 |
| Banner | Ch | 2.7 | 6.0 | 34 | 3.0 | 4.3 | 3.0 | 4.7 | 4.2 | 3.8 |
| Dover | Ch | 1.7 | 6.0 | 37 | 3.0 | 4.0 | 2.7 | 4.7 | 4.0 | 3.7 |
| WW Rs 130 | CR | 3.0 | 5.3 | 42 | 3.0 | 4.3 | 3.0 | 4.3 | 3.7 | 3.7 |
| Barnica | Ch | 2.7 | 5.3 | 54 | 2.7 | 4.7 | 3.0 | 4.0 | 4.2 | 3.7 |
| Shademaster | CR | 2.7 | 5.7 | 2 | 3.0 | 4.7 | 2.7 | 4.3 | 3.7 | 3.7 |
| PST-4C8 | CR | 2.7 | 6.0 | 3 | 2.7 | 3.7 | 4.0 | 3.7 | 4.3 | 3.7 |
| Comfort | SC | 2.7 | 5.7 | 8 | 2.7 | 4.3 | 3.0 | 4.3 | 4.0 | 3.7 |
| Dawson | SC | 3.0 | 6.0 | 36 | 3.0 | 4.3 | 3.3 | 4.0 | 3.8 | 3.7 |
| Cindy | CR | 2.7 | 5.7 | 1 | 2.7 | 4.3 | 3.0 | 4.3 | 4.2 | 3.7 |
| Koket | Ch | 3.0 | 6.0 | 96 | 3.3 | 4.3 | 3.0 | 4.0 | 4.0 | 3.7 |
| Wilma | Ch | 2.0 | 6.0 | 28 | 3.0 | 4.3 | 2.7 | 4.3 | 4.2 | 3.7 |
| 89.LKR | Ch | 2.3 | 6.3 | 26 | 3.0 | 4.3 | 3.0 | 4.3 | 4.0 | 3.7 |
| Molinda | Ch | 2.7 | 5.7 | 59 | 3.3 | 4.0 | 2.7 | 4.0 | 4.0 | 3.6 |
| PST-43F | CR | 3.0 | 6.0 | 3 | 3.0 | 4.3 | 3.0 | 4.0 | 3.8 | 3.6 |
| Belvedere | CR | 2.0 | 6.0 | 9 | 3.0 | 4.0 | 3.0 | 4.3 | 3.5 | 3.6 |
| Flyer | CR | 2.7 | 6.3 | 6 | 3.0 | 4.0 | 3.3 | 4.0 | 3.8 | 3.6 |
| Vista | CR | 2.3 | 5.0 | 3 | 3.0 | 4.0 | 3.0 | 4.0 | 4.0 | 3.6 |
| Salem | CR | 2.0 | 6.0 | 5 | 2.7 | 4.0 | 3.0 | 4.0 | 4.2 | 3.6 |
| Talus | CR | 2.3 | 6.0 | 10 | 3.0 | 4.7 | 3.0 | 3.7 | 3.8 | 3.6 |
| Simone | Ch | 2.0 | 6.0 | 17 | 3.0 | 4.3 | 3.3 | 3.7 | 3.8 | 3.6 |
| Elanor | CR | 2.7 | 5.3 | 2 | 3.0 | 4.3 | 3.0 | 3.7 | 3.7 | 3.5 |
| Barskol | SC | 2.0 | 6.0 | 1 | 2.7 | 4.3 | 3.0 | 4.0 | 3.7 | 3.5 |
| ZW 42-148 | CR | 2.0 | 5.3 | 14 | 2.7 | 4.3 | 3.0 | 4.0 | 3.5 | 3.5 |
| PST-4NI | CR | 2.3 | 5.7 | 3 | 3.0 | 4.0 | 2.7 | 4.0 | 3.8 | 3.5 |
| Ensylva | CR | 2.0 | 6.0 | 31 | 2.7 | 4.3 | 2.7 | 4.0 | 3.8 | 3.5 |
| Jasper | CR | 2.7 | 6.0 | 3 | 2.7 | 4.0 | 3.0 | 4.0 | 3.8 | 3.5 |
| Boreal | CR | 3.3 | 5.3 | 18 | 2.7 | 4.3 | 3.0 | 4.0 | 3.7 | 3.5 |
| Franklin | CR | 2.0 | 5.7 | 6 | 2.3 | 4.3 | 3.0 | 3.7 | 3.5 | 3.4 |
| WW Rs 143 | CR | 2.0 | 5.3 | 5 | 2.3 | 4.0 | 3.0 | 4.0 | 3.7 | 3.4 |
| Barcrown | SC | 2.0 | 5.7 | 0 | 2.3 | 4.0 | 3.3 | 3.7 | 3.7 | 3.4 |
| PST-4R3 | CR | 3.0 | 6.0 | 4 | 2.3 | 3.7 | 3.0 | 4.0 | 3.8 | 3.4 |
| Seabreeze | SC | 3.0 | 6.0 | 27 | 2.7 | 4.3 | 2.7 | 3.7 | 3.7 | 3.4 |
| HF 138 | H | 2.3 | 6.0 | 27 | 2.3 | 3.7 | 3.0 | 4.0 | 4.0 | 3.4 |
| Bargena | CR | 2.0 | 5.3 | 0 | 2.3 | 4.3 | 3.0 | 4.0 | 3.5 | 3.4 |
| Bargena | CR | 3.0 | 6.0 | 30 | 2.7 | 4.0 | 3.0 | 4.0 | 3.5 | 3.4 |
| Claudia | CR | 2.7 | 6.0 | 5 | 2.7 | 4.0 | 3.0 | 3.7 | 3.8 | 3.4 |
| Collo | CR | 2.0 | 6.0 | 2 | 2.7 | 4.0 | 3.0 | 3.7 | 3.5 | 3.4 |
| Napoli | SC | 2.7 | 6.3 | 21 | 2.7 | 4.7 | 3.0 | 3.3 | 3.5 | 3.4 |
| WW Rs 138 | CR | 1.7 | 6.0 | 2 | 2.0 | 4.0 | 3.0 | 4.0 | 3.7 | 3.3 |
| Sylvester | CR | 3.0 | 5.7 | 27 | 2.7 | 3.7 | 3.0 | 3.3 | 3.5 | 3.2 |
| Barlotte | SC | 2.3 | 5.0 | 2 | 2.3 | 3.3 | 2.7 | 3.0 | 3.3 | 2.9 |
| Significance Level (p) | | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | | 1.0 | 0.6 | 21 | 0.8 | 0.9 | 0.8 | 0.8 | 0.6 | 0.5 |

1/ Ch = chewings, CR = creeping red, H = hard, SC = slender creeping, and Sh = sheep fescue.

# PERFORMANCE OF TALL FESCUE CULTIVARS UNDER LOW MAINTENANCE CONDITIONS

## INTRODUCTION

As part of the National Turfgrass Evaluation Program 1992 Tall Fescue test, 92 cultivars of tall fescue were established for evaluation under low maintenance conditions. The test includes varieties currently used for roadside seedings, as well as new cultivars bred for shorter, denser growth. Comparison of newer cultivars with older cultivars such as 'Kentucky 31' will provide information about the utility of newer cultivars for roadside conditions.

## MATERIALS AND METHODS

Cultivars of tall fescue were drop seeded to 4 by 6 ft plots arranged in a randomized complete block design with three replications on September 13, 1992. Seedbed preparation consisted of removal of the existing sod, rototilling, secondary tillage with a Roterra, rough-grade raking, and finish raking. A 10-20-20 fertilizer was applied to the soil surface prior to seeding at a rate of 22, 44, and 44 lb/ac of N, $P_2O_5$, and $K_2O$, respectively. After seeding, the area was rolled in two directions; and mulched with straw at a rate of approximately 2500 lb/ac. The study was irrigated twice during the two weeks after establishment with 0.75 in of water each time. A visual rating of seedling vigor, based on plant heights and stand density, was taken October 15, 1992. The study area maintenance for 1993 included mowing six times at a height of 4 in; and an application of urea (46-0-0) at 22 lb N/ac on May 13, and an application of sulfur-coated urea (39-0-0) at 44 lb N/ac on October 4. Data collected in 1993 included percent ground cover on April 20; average canopy height on June 2; genetic color on June 11, and turf quality on May 11, June 11, July 31, August 24, September 29, November 5, and December 2. Percent ground cover was rated instead of greenup because the newly established stand never senesced during the winter. Canopy height was measured with a graduated dowel 21 days after mowing. Genetic color and turf quality were visually rated on a scale of 1 to 9, where '1' indicates dead or brown turf and '9' indicates ideal turf. Turf quality ratings incorporate stand ground cover, evenness, density, color, and weed infestation. The seven quality ratings were averaged to calculate a mean quality, and the cultivars are ranked in descending order of mean quality in Table 1.

## RESULTS

'Kentucky 31', with and without endophyte, and 'SR 8010' were the best rated cultivars for mean quality at 4.9. The cultivars 'Cafa 101', 'Arid', 'Anthem', 'Olympic II', 'Phoenix', 'Safari', 'PSTF-401', and 'Astro 2000' were not rated significantly different from the top three cultivars for mean quality. The high ratings for the 'Kentucky 31' cultivars was due to quicker establishment. Most other cultivars provided a darker green turf with a higher tiller density, but due to slower establishment, the other cultivars had less ground cover and more weeds than the 'Kentucky 31' entries. The most common weed in the study was annual bluegrass (*Poa annua*). Other species included creeping bentgrass (*Agrostis palustris*), common chickweed (*Stellaria media*), and bull thistle (*Cirsium vulgare*). The annual bluegrass stand declined in the summer months, but creeping bentgrass became well established in plots where tall fescue establishment was poor. The 'Kentucky 31' entries had the highest canopy heights among the best rated cultivars, but some of the poorly established entries were taller, probably due to greater individual plant growth from thin stands.

## CONCLUSIONS

The 'Kentucky 31' entries provided the best performance in this test during the first season due to quicker establishment. Establishment of a full stand overcame the coarse texture, low tiller density, and less desirable color of these cultivars. For roadside plantings, establishment and durability outweigh aesthetic qualities. Future results may demonstrate the durability of other cultivars, but the quicker establishment of 'Kentucky 31' reaffirms its utility for conservation plantings.

TABLE 1: Seedling vigor, spring ground cover, canopy height, genetic color, and turf quality evaluations of tall fescue cultivars planted in September, 1992. Ground cover was visually rated on a scale of 0 to 10, where 0=0% cover and 10=100% cover. Seedling vigor, genetic color and turf quality were visually rated on a scale of 1 to 9, where 1=dead, or brown turf and 9=ideal. Canopy height was measured 21 days after mowing. Each value is the mean of three replications.

| Entry | Seedling Vigor Oct 15 | Ground Cover Apr 20 | Canopy Height Jun 2 | Genetic Color Jun 11 | Turf Quality May 11 | Jun 11 | Jul 31 | Aug 24 | Sep 29 | Nov 5 | Dec 2 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1-9) | (0-10) | ( in ) | (1-9) | (---1-9--- | | | | | | | ---) |
| KY-31 | 7.0 | 5.7 | 5.1 | 4.3 | 5.3 | 5.7 | 5.0 | 5.2 | 5.7 | 4.0 | 3.5 | 4.9 |
| KY-31 w/e | 7.7 | 5.7 | 5.1 | 4.3 | 5.7 | 5.7 | 5.0 | 5.2 | 5.7 | 3.7 | 3.7 | 4.9 |
| SR 8010 | 6.0 | 4.7 | 4.8 | 5.3 | 5.0 | 5.3 | 5.0 | 5.3 | 6.0 | 4.0 | 3.7 | 4.9 |
| Cafa101 | 6.0 | 5.0 | 4.8 | 5.0 | 5.0 | 5.7 | 4.3 | 5.0 | 5.7 | 4.0 | 3.7 | 4.8 |
| Arid | 6.0 | 5.3 | 4.7 | 5.0 | 5.3 | 5.7 | 4.3 | 4.8 | 5.3 | 4.0 | 3.5 | 4.7 |
| Anthem | 6.7 | 4.3 | 4.8 | 4.7 | 5.3 | 5.3 | 4.0 | 4.8 | 5.0 | 4.0 | 3.7 | 4.6 |
| Olympic II | 4.7 | 4.3 | 4.6 | 5.7 | 4.7 | 5.0 | 4.3 | 5.3 | 5.7 | 4.0 | 3.5 | 4.6 |
| Phoenix | 5.7 | 4.7 | 4.8 | 5.0 | 5.0 | 5.0 | 4.7 | 5.0 | 5.3 | 4.0 | 3.5 | 4.6 |
| Safari | 6.3 | 4.7 | 4.8 | 5.7 | 4.3 | 5.0 | 4.7 | 5.3 | 5.7 | 3.7 | 3.5 | 4.6 |
| PSTF-401 | 5.3 | 4.3 | 4.4 | 6.0 | 4.0 | 5.0 | 4.0 | 4.8 | 5.7 | 4.0 | 3.8 | 4.5 |
| Astro 2000 | 5.0 | 4.0 | 4.5 | 5.0 | 4.3 | 5.0 | 4.0 | 5.0 | 5.3 | 3.7 | 3.5 | 4.4 |
| ISI-ATK | 5.0 | 4.0 | 4.4 | 5.7 | 4.3 | 4.7 | 4.0 | 4.5 | 5.3 | 3.7 | 3.5 | 4.3 |
| ISI-CRC | 5.7 | 4.3 | 4.3 | 5.7 | 4.7 | 5.3 | 4.0 | 4.2 | 5.0 | 3.7 | 3.3 | 4.3 |
| Pick CII | 5.7 | 4.3 | 4.5 | 6.0 | 4.0 | 4.7 | 4.0 | 4.5 | 5.0 | 3.7 | 3.5 | 4.2 |
| PSTF-200 | 5.0 | 4.0 | 4.5 | 5.7 | 4.0 | 5.3 | 3.7 | 4.5 | 5.0 | 3.3 | 3.3 | 4.2 |
| Kittyhawk | 5.3 | 3.3 | 4.5 | 6.0 | 3.7 | 4.7 | 4.0 | 4.5 | 5.3 | 3.3 | 3.3 | 4.1 |
| M-2 | 5.3 | 3.3 | 4.6 | 5.7 | 4.0 | 4.7 | 4.0 | 4.3 | 5.0 | 3.7 | 3.3 | 4.1 |
| Rebel Jr. | 6.3 | 5.0 | 4.5 | 5.7 | 4.3 | 4.7 | 3.3 | 4.2 | 5.7 | 3.3 | 3.5 | 4.1 |
| Shenandoah | 5.7 | 4.3 | 4.5 | 5.3 | 4.0 | 4.7 | 4.0 | 4.0 | 5.0 | 3.7 | 3.7 | 4.1 |
| BAR Fa 0855 | 5.7 | 3.7 | 4.4 | 5.3 | 4.0 | 4.3 | 4.0 | 4.0 | 5.0 | 3.3 | 3.3 | 4.0 |
| Falcon | 4.7 | 3.3 | 4.7 | 5.0 | 3.7 | 4.3 | 4.0 | 4.3 | 4.7 | 3.3 | 3.3 | 4.0 |
| SR 8200 | 5.7 | 4.0 | 4.4 | 5.7 | 3.7 | 4.0 | 4.0 | 4.5 | 5.3 | 3.3 | 3.3 | 4.0 |
| Avanti | 5.0 | 4.0 | 4.4 | 5.7 | 4.0 | 4.3 | 4.0 | 3.7 | 4.7 | 3.7 | 3.2 | 3.9 |
| Eldorado | 5.0 | 4.3 | 4.4 | 5.7 | 3.7 | 4.3 | 4.0 | 4.2 | 4.7 | 3.3 | 3.3 | 3.9 |
| Finelawn 88 | 4.7 | 3.3 | 4.5 | 5.7 | 3.7 | 4.3 | 4.0 | 4.5 | 4.7 | 3.0 | 3.2 | 3.9 |
| ISI-AFE | 5.3 | 3.0 | 4.4 | 6.0 | 3.7 | 4.0 | 3.7 | 4.2 | 5.3 | 3.0 | 3.2 | 3.9 |
| Micro DD | 4.7 | 4.0 | 4.7 | 6.3 | 3.3 | 4.3 | 3.7 | 4.2 | 5.0 | 3.3 | 3.2 | 3.9 |
| OFI-TF-601 | 5.3 | 4.0 | 4.5 | 6.0 | 3.7 | 4.7 | 4.0 | 3.8 | 5.0 | 3.0 | 3.2 | 3.9 |
| PSTF-LF | 5.0 | 4.0 | 4.5 | 5.7 | 3.7 | 4.3 | 4.0 | 4.2 | 5.0 | 3.0 | 3.2 | 3.9 |
| SR 8210 | 5.3 | 4.3 | 4.4 | 6.0 | 3.3 | 4.7 | 4.0 | 4.2 | 4.7 | 3.0 | 3.3 | 3.9 |
| SR 8400 | 5.3 | 3.7 | 4.4 | 5.3 | 3.3 | 4.3 | 3.7 | 4.0 | 5.0 | 3.3 | 3.3 | 3.9 |
| 403 | 4.7 | 3.3 | 4.4 | 6.0 | 3.7 | 4.0 | 3.7 | 4.0 | 5.0 | 3.3 | 3.2 | 3.8 |
| Austin | 4.7 | 3.7 | 4.5 | 6.0 | 4.0 | 4.0 | 4.0 | 3.5 | 4.7 | 3.3 | 3.3 | 3.8 |
| FA-19 | 5.0 | 4.7 | 4.4 | 6.0 | 3.7 | 4.0 | 3.7 | 4.0 | 4.7 | 3.3 | 3.2 | 3.8 |
| GEN-91 | 5.7 | 4.3 | 4.6 | 6.3 | 3.7 | 4.0 | 3.7 | 3.8 | 5.3 | 3.0 | 3.3 | 3.8 |
| KWS-DSL | 5.0 | 3.0 | 4.6 | 5.7 | 3.3 | 4.0 | 4.0 | 3.8 | 5.0 | 3.0 | 3.2 | 3.8 |
| Cochise | 4.7 | 3.7 | 4.4 | 6.0 | 3.0 | 3.7 | 3.3 | 4.2 | 5.0 | 3.3 | 3.3 | 3.7 |
| Guardian | 5.0 | 4.7 | 4.5 | 6.0 | 3.7 | 4.0 | 3.3 | 4.2 | 5.0 | 3.0 | 3.0 | 3.7 |
| SR 8300 | 5.3 | 4.0 | 4.3 | 6.0 | 3.7 | 4.3 | 3.0 | 4.0 | 4.7 | 3.3 | 3.2 | 3.7 |
| Aztec | 4.7 | 3.7 | 4.6 | 5.7 | 3.7 | 4.3 | 3.0 | 3.8 | 4.7 | 3.0 | 3.0 | 3.6 |
| FA-22 | 5.0 | 4.0 | 4.3 | 5.3 | 3.7 | 4.0 | 3.3 | 3.8 | 4.3 | 3.0 | 3.0 | 3.6 |
| MB-21-92 | 5.0 | 3.3 | 4.3 | 6.0 | 3.3 | 4.0 | 3.0 | 4.0 | 5.0 | 3.0 | 3.0 | 3.6 |
| MB-23-92 | 5.7 | 3.7 | 4.4 | 6.0 | 3.0 | 3.7 | 3.3 | 4.0 | 4.7 | 3.3 | 3.2 | 3.6 |
| Montank | 5.3 | 3.3 | 4.7 | 6.0 | 3.3 | 4.0 | 3.3 | 4.0 | 4.3 | 3.0 | 3.2 | 3.6 |
| Pixie | 5.0 | 4.3 | 4.2 | 6.0 | 3.3 | 3.7 | 3.3 | 4.0 | 4.7 | 3.0 | 3.0 | 3.6 |
| Trailblazer II | 6.0 | 3.7 | 4.5 | 6.0 | 3.3 | 4.0 | 3.3 | 3.8 | 4.7 | 3.0 | 3.2 | 3.6 |
| ATF-006 | 5.0 | 4.0 | 4.2 | 6.0 | 3.3 | 3.7 | 3.0 | 3.8 | 4.3 | 3.0 | 3.0 | 3.5 |
| BAR Fa 214 | 4.7 | 2.7 | 4.1 | 5.7 | 3.3 | 4.0 | 3.3 | 3.2 | 4.7 | 3.0 | 3.0 | 3.5 |
| Duke | 4.3 | 3.3 | 6.0 | 3.3 | 4.3 | 3.7 | 3.3 | 3.7 | 4.3 | 3.0 | 3.0 | 3.5 |
| ISI-AFA | 5.0 | 3.3 | 4.3 | 6.0 | 3.3 | 4.0 | 3.0 | 3.8 | 4.3 | 3.0 | 3.0 | 3.5 |
| MB-25-92 | 5.0 | 3.3 | 4.4 | 6.3 | 2.7 | 4.0 | 3.0 | 3.7 | 4.7 | 3.3 | 3.2 | 3.5 |
| PST-5DX w/e | 5.0 | 3.3 | 4.3 | 6.0 | 3.3 | 3.7 | 3.0 | 3.8 | 4.3 | 3.3 | 2.8 | 3.5 |
| SIU-1 | 6.3 | 4.0 | 5.7 | 3.3 | 4.4 | 3.7 | 3.3 | 4.0 | 4.0 | 3.3 | 3.2 | 3.5 |
| Tomahawk | 4.0 | 3.7 | 4.4 | 6.3 | 3.3 | 3.7 | 3.3 | 3.8 | 4.3 | 3.0 | 3.2 | 3.5 |
| Twilight | 4.3 | 3.0 | 4.4 | 7.0 | 3.0 | 3.7 | 3.3 | 3.5 | 4.3 | 3.3 | 3.0 | 3.5 |

(continued)

TABLE 1: (continued) Seedling vigor, spring ground cover, canopy height, genetic color, and turf quality evaluations of tall fescue cultivars planted in September, 1992. Ground cover was visually rated on a scale of 0 to 10, where 0=0% cover and 10=100% cover. Seedling vigor, genetic color and turf quality were visually rated on a scale of 1 to 9, where 1=dead, or brown turf and 9=ideal. Canopy height was measured 21 days after mowing. Each value is the mean of three replications.

| Entry | Seedling Vigor Oct 15 | Ground Cover Apr 20 | Canopy Height Jun 2 | Genetic Color Jun 11 | Turf Quality May 11 | Jun 11 | Jul 31 | Aug 24 | Sep 29 | Nov 5 | Dec 2 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1-9) | (0-10) | ( in ) | (1-9) | (--------------------------------1-9 | | | | | | | ----------------------------------------) |
| Virtue | 5.0 | 4.0 | 6.0 | 3.3 | 4.6 | 4.3 | 3.0 | 3.8 | 4.0 | 3.0 | 3.0 | 3.5 |
| ZPS-J3 | 4.3 | 3.3 | 6.0 | 3.0 | 4.6 | 4.0 | 3.0 | 3.8 | 4.3 | 3.0 | 3.3 | 3.5 |
| BAR Fa 2AB | 4.3 | 3.7 | 4.1 | 6.3 | 3.3 | 3.3 | 3.3 | 3.2 | 4.3 | 3.3 | 3.0 | 3.4 |
| Finelawn Petite | 5.0 | 3.7 | 4.3 | 6.0 | 2.7 | 3.7 | 3.3 | 3.7 | 4.7 | 3.0 | 2.8 | 3.4 |
| ITR-90-2 | 5.0 | 3.3 | 4.2 | 6.0 | 3.3 | 3.7 | 3.0 | 3.8 | 4.0 | 3.0 | 3.0 | 3.4 |
| Monarch | 4.7 | 3.3 | 4.4 | 6.0 | 3.0 | 4.0 | 3.0 | 3.7 | 4.3 | 3.0 | 3.0 | 3.4 |
| Pick 90-10 | 4.3 | 3.7 | 4.3 | 6.7 | 3.0 | 3.3 | 3.3 | 3.8 | 4.3 | 3.0 | 3.0 | 3.4 |
| PST-5PM | 5.0 | 3.3 | 4.6 | 6.0 | 2.7 | 3.7 | 3.3 | 3.8 | 4.3 | 3.0 | 3.0 | 3.4 |
| Rebel-3D | 4.3 | 3.3 | 4.5 | 6.0 | 3.0 | 3.7 | 3.3 | 3.7 | 4.3 | 3.0 | 2.8 | 3.4 |
| SFL | 4.0 | 2.7 | 6.0 | 3.0 | 4.3 | 3.7 | 3.3 | 3.3 | 4.0 | 3.3 | 2.8 | 3.4 |
| Bonanza II | 4.3 | 3.0 | 4.4 | 5.7 | 3.0 | 3.7 | 3.0 | 3.7 | 4.3 | 2.7 | 2.8 | 3.3 |
| Bonsai Plus | 4.3 | 3.3 | 4.6 | 6.3 | 2.7 | 3.7 | 3.0 | 3.5 | 4.3 | 3.0 | 3.0 | 3.3 |
| Lancer | 5.0 | 3.3 | 6.0 | 3.0 | 4.4 | 3.7 | 3.0 | 3.5 | 4.0 | 3.0 | 2.8 | 3.3 |
| Leprechaun | 5.0 | 2.3 | 4.2 | 6.0 | 2.7 | 3.7 | 3.0 | 3.5 | 4.3 | 3.3 | 2.7 | 3.3 |
| PRO-9178 | 5.0 | 3.3 | 4.4 | 6.0 | 3.0 | 3.7 | 3.0 | 3.5 | 4.0 | 3.0 | 3.0 | 3.3 |
| PST-59D | 4.7 | 3.7 | 4.3 | 6.0 | 3.0 | 3.7 | 3.0 | 3.5 | 4.3 | 3.0 | 2.8 | 3.3 |
| PST-5LX | 4.3 | 3.7 | 4.3 | 6.3 | 2.7 | 3.7 | 3.0 | 3.7 | 4.0 | 3.0 | 2.8 | 3.3 |
| PST-5STB | 5.3 | 2.3 | 4.4 | 5.7 | 3.0 | 3.7 | 3.0 | 3.3 | 4.0 | 3.3 | 3.0 | 3.3 |
| Silverado | 4.7 | 3.7 | 4.3 | 6.0 | 3.3 | 3.7 | 3.0 | 3.5 | 4.0 | 2.7 | 2.8 | 3.3 |
| ZPS-E2 | 4.3 | 3.0 | 4.2 | 6.3 | 2.7 | 3.3 | 3.3 | 3.8 | 4.3 | 3.0 | 2.5 | 3.3 |
| Bonanza | 4.7 | 2.3 | 4.3 | 5.0 | 2.7 | 3.3 | 3.0 | 3.5 | 4.3 | 3.0 | 2.8 | 3.2 |
| PST-RDG | 4.7 | 3.0 | 4.4 | 7.0 | 2.7 | 3.7 | 3.0 | 3.5 | 4.0 | 2.7 | 2.7 | 3.2 |
| Vegas | 3.7 | 3.3 | 6.0 | 2.7 | 4.3 | 3.3 | 3.0 | 3.0 | 4.3 | 3.0 | 3.0 | 3.2 |
| WXI-208-2 | 4.7 | 3.0 | 4.3 | 6.0 | 3.0 | 3.0 | 3.0 | 3.2 | 4.0 | 3.0 | 3.2 | 3.2 |
| ATF-007 | 4.3 | 2.7 | 4.3 | 6.3 | 3.0 | 3.3 | 2.7 | 3.5 | 3.7 | 2.7 | 2.8 | 3.1 |
| MB-24-92 | 4.7 | 3.0 | 4.3 | 6.0 | 2.0 | 3.3 | 3.0 | 3.5 | 4.0 | 3.0 | 3.0 | 3.1 |
| PST-5VC | 5.0 | 3.7 | 4.1 | 6.0 | 3.3 | 3.3 | 2.3 | 3.2 | 3.7 | 3.0 | 2.8 | 3.1 |
| ZPS-VL | 4.7 | 3.3 | 4.2 | 6.7 | 3.0 | 3.3 | 2.7 | 3.5 | 3.7 | 2.7 | 3.0 | 3.1 |
| CAS-MA21 | 4.3 | 3.3 | 4.4 | 6.0 | 2.3 | 3.3 | 2.7 | 3.3 | 3.7 | 3.0 | 3.0 | 3.0 |
| Lexus | 4.3 | 2.7 | 6.3 | 2.3 | 3.8 | 3.3 | 2.7 | 3.0 | 3.7 | 3.0 | 2.8 | 3.0 |
| MB-22-92 | 4.7 | 2.7 | 4.3 | 6.0 | 2.7 | 3.0 | 2.7 | 3.3 | 3.7 | 3.0 | 2.7 | 3.0 |
| Pick 90-12 | 4.7 | 2.3 | 4.1 | 6.3 | 2.3 | 3.0 | 3.0 | 3.3 | 4.0 | 2.3 | 2.8 | 3.0 |
| CAS-LA20 | 4.3 | 2.0 | 4.3 | 5.7 | 2.7 | 3.0 | 2.7 | 3.2 | 3.7 | 2.7 | 2.7 | 2.9 |
| ZPS-ML | 4.3 | 3.0 | 4.0 | 6.0 | 2.7 | 3.0 | 2.7 | 3.2 | 3.7 | 2.7 | 2.7 | 2.9 |
| J-1048 | 3.7 | 2.3 | 5.3 | 2.3 | 4.5 | 3.0 | 2.7 | 3.0 | 3.7 | 2.3 | 2.5 | 2.8 |
| Bonsai | 5.0 | 1.7 | 6.0 | 2.0 | 4.2 | 3.0 | 2.7 | 3.0 | 3.3 | 2.7 | 2.3 | 2.7 |
| Pick 90-6 | 3.7 | 2.0 | 3.9 | 6.3 | 2.0 | 2.7 | 2.7 | 3.0 | 3.3 | 2.7 | 2.3 | 2.7 |
| Sig. Level (p) | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| LSD (p=0.05) | 1.3 | 1.4 | 0.4 | 0.6 | 1.1 | 0.9 | 0.9 | 0.8 | 1.0 | 0.7 | 0.5 | 0.6 |

# PERFORMANCE OF KENTUCKY BLUEGRASS CULTIVARS UNDER LOW MAINTENANCE CONDITIONS

## INTRODUCTION

As part of the National Turfgrass Evaluation Program 1990 Low Maintenance Kentucky Bluegrass test, 63 cultivars of Kentucky bluegrass were seeded to be evaluated under low maintenance conditions. The maintenance level of this test could be described as a low maintenance turf, in contrast to a conservation planting, which would be a more appropriate description of a roadside. Kentucky bluegrass is not often considered a suitable species for low maintenance conditions, but positive performance of this species in other trials conducted by this project warranted the initiation of this test.

## MATERIALS AND METHODS

Cultivars of Kentucky bluegrass were drop seeded to 4 by 6 ft plots arranged in a randomized complete block design with three replications on October 5, 1990. Starter fertilizer was applied at 30, 44, and 9 lbs/ac of N, $P_2O_5$, and $K_20$, respectively. Additional fertilizer applications have included applications of urea (46-0-0) at 22 lb N/ac on May 23 and October 23, 1991, an application of urea at 44 lb N/ac on October 19, 1992, and an application of sulfur-coated urea (39-0-0) at 44 lb N/ac on October 4, 1993. The entire study area was treated with 2,4-D plus dicamba at 0.48 plus 0.25 lb ai/ac on May 29, 1991 to remove broadleaf weeds. The study area has never been irrigated. The study is mowed at a height of 4 inches, when needed. During 1993, a relatively dry year, the study was mowed five times; April 28, May 12, June 16, August 24, and October 5. The primary weed species present in the test are common dandelion (*Taraxacum officinale*) and quackgrass (*Elytrigia repens*). Data collected in 1993 included spring greenup on April 20; genetic color on June 15; and turf quality on May 11, June 15, August 13, October 4, and December 1. Spring greenup was rated as percent cover by green tissue, where '0' indicates 0% green and '10' indicates 100% green. Genetic color and turf quality were visually rated on a scale of 1 to 9, where '1' indicates dead or brown turf and '9' indicates ideal turf. The five turf quality ratings were averaged to determine a mean quality rating, and the cultivars are sorted in descending order based on mean quality, and reported in Table 1.

## RESULTS

Victa was the cultivar rated best for mean quality at 3.9, which was significantly higher than all but the next eight cultivars in the mean quality ranking. There has been a decline in Kentucky bluegrass performance from the previous season, as 50 of the cultivars ranked better than 3.9 in 1992. Compared to the fine fescue cultivars being evaluated under the same conditions in the same field, the Kentucky bluegrass cultivars provide a thinner stand with more weeds.

## CONCLUSIONS

Under the conditions of this trial, the Kentucky bluegrass cultivars have declined in performance after three full growing seasons, and are inferior to fine fescues tested under the same conditions. None of the cultivars tested are showing promise for use in roadside plantings, compared to most fine fescue cultivars.

TABLE 1: Spring greenup, genetic color, and turf quality evaluations for Kentucky bluegrass cultivars during 1993, and season end mean quality ratings from 1992 and 1991. Greenup was visually rated on a scale of 0 to 10 where 0=0% green and 10=100% green. Genetic color and turf quality were visually rated on a scale of 1 to 9 where 1=dead, or brown turf and 9=ideal. Each value is the mean of three replications.

| Entry | Spring Greenup Apr 20 | Genetic Color Jun 15 | Turf Quality 1993 May 11 | Jun 15 | Aug 13 | Oct 4 | Dec 1 | Mean | 1992 Mean | 1991 Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | (0-10) | (1-9) | (----- 1-9 | | | | | | | -----) |
| Victa | 3.7 | 6.0 | 4.3 | 3.7 | 3.7 | 4.0 | 4.0 | 3.9 | 4.2 | 5.2 |
| GEN-RSP | 2.0 | 5.0 | 3.0 | 3.3 | 3.7 | 4.3 | 4.3 | 3.7 | 4.4 | 4.8 |
| BAR VB 852 | 2.7 | 4.3 | 3.7 | 3.7 | 3.3 | 3.7 | 3.8 | 3.6 | 5.7 | 4.7 |
| ISI-21 | 2.7 | 5.3 | 3.0 | 3.0 | 3.7 | 4.0 | 4.5 | 3.6 | 4.9 | 4.4 |
| Fortuna | 3.0 | 6.3 | 3.7 | 3.7 | 3.3 | 3.3 | 3.7 | 3.5 | 5.1 | 4.7 |
| BAR VB 7037 | 1.7 | 5.3 | 3.0 | 3.0 | 3.3 | 4.0 | 4.0 | 3.5 | 4.4 | 5.0 |
| Ba 74-017 | 3.3 | 6.3 | 4.3 | 3.3 | 3.0 | 3.0 | 3.5 | 3.4 | 4.7 | 4.4 |
| PST-YQ | 2.7 | 4.7 | 3.3 | 3.7 | 3.0 | 3.0 | 4.0 | 3.4 | 4.8 | 4.0 |
| Gnome | 3.0 | 6.0 | 4.0 | 3.3 | 3.0 | 3.3 | 3.5 | 3.4 | 4.3 | 4.2 |
| MN 2405 | 1.7 | 6.3 | 2.3 | 2.7 | 3.3 | 4.0 | 4.2 | 3.3 | 3.6 | 4.2 |
| Crest | 2.7 | 6.0 | 4.0 | 3.3 | 2.7 | 3.0 | 3.7 | 3.3 | 4.6 | 4.7 |
| NJIC | 2.3 | 5.3 | 3.0 | 2.7 | 3.0 | 3.7 | 4.0 | 3.3 | 4.3 | 4.5 |
| Miracle | 1.7 | 6.3 | 2.7 | 3.0 | 3.0 | 4.0 | 4.0 | 3.3 | 4.2 | 4.3 |
| Cynthia | 2.0 | 6.0 | 2.7 | 2.7 | 3.0 | 4.3 | 3.8 | 3.3 | 5.0 | 4.4 |
| EVB 13.703 | 2.0 | 6.0 | 3.3 | 3.3 | 3.0 | 3.3 | 3.3 | 3.3 | 5.7 | 3.9 |
| Unknown | 2.7 | 6.0 | 3.7 | 3.3 | 3.3 | 3.0 | 3.3 | 3.3 | 4.2 | 4.3 |
| PST-A7-111 | 2.7 | 5.0 | 2.3 | 2.7 | 3.3 | 4.0 | 4.0 | 3.3 | 3.1 | 4.2 |
| Washington | 3.0 | 5.3 | 3.3 | 3.0 | 3.3 | 3.7 | 3.3 | 3.3 | 3.8 | 3.5 |
| Baron | 2.7 | 6.7 | 4.0 | 3.0 | 2.3 | 3.0 | 3.7 | 3.2 | 4.7 | 3.9 |
| Belmont | 2.3 | 7.0 | 3.3 | 4.0 | 3.0 | 2.3 | 3.3 | 3.2 | 5.2 | 4.4 |
| Unique | 2.0 | 6.0 | 3.3 | 3.3 | 3.0 | 3.0 | 3.3 | 3.2 | 5.1 | 3.5 |
| Destiny | 3.7 | 6.0 | 4.0 | 3.7 | 2.7 | 2.3 | 3.5 | 3.2 | 4.6 | 4.0 |
| SR 2000 | 3.3 | 6.3 | 4.0 | 3.0 | 2.7 | 2.7 | 3.7 | 3.2 | 4.7 | 3.7 |
| Park | 2.3 | 5.0 | 3.0 | 3.0 | 2.7 | 3.7 | 3.3 | 3.1 | 3.4 | 4.0 |
| Kyosti | 2.0 | 6.0 | 3.0 | 3.3 | 3.0 | 2.7 | 3.7 | 3.1 | 4.7 | 3.9 |
| Bronco | 2.3 | 5.7 | 3.0 | 3.0 | 3.0 | 3.3 | 3.2 | 3.1 | 4.2 | 4.9 |
| Sophia | 1.0 | 6.3 | 2.3 | 3.0 | 3.0 | 3.7 | 3.5 | 3.1 | 4.2 | 3.8 |
| Voyager | 2.0 | 5.7 | 2.7 | 2.7 | 3.0 | 3.7 | 3.7 | 3.1 | 3.9 | 4.8 |
| Banjo | 3.0 | 6.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.5 | 3.1 | 2.9 | 4.2 |
| Merion | 3.3 | 5.3 | 4.0 | 3.7 | 2.7 | 2.3 | 2.7 | 3.1 | 4.1 | 2.0 |
| J-386 | 2.3 | 6.0 | 3.0 | 3.0 | 2.3 | 3.3 | 4.0 | 3.1 | 4.2 | 4.2 |
| Cobalt | 2.7 | 5.3 | 3.7 | 3.0 | 3.0 | 2.7 | 3.0 | 3.1 | 4.8 | 4.0 |
| Merit | 2.7 | 6.0 | 3.7 | 3.0 | 2.7 | 2.7 | 3.0 | 3.0 | 5.0 | 4.0 |
| Barzan | 0.0 | 6.3 | 1.7 | 2.0 | 3.0 | 4.0 | 4.3 | 3.0 | 3.8 | 4.3 |
| NE 80-47 | 1.7 | 6.0 | 3.0 | 3.0 | 2.3 | 3.0 | 3.7 | 3.0 | 5.4 | 4.0 |
| EVB 13.863 | 2.3 | 6.0 | 3.3 | 3.0 | 2.3 | 3.0 | 3.5 | 3.0 | 5.1 | 3.9 |
| Suffolk | 2.0 | 5.0 | 3.0 | 3.0 | 2.7 | 3.0 | 3.3 | 3.0 | 4.8 | 4.5 |
| NuStar | 1.7 | 5.3 | 3.0 | 3.0 | 2.7 | 3.0 | 3.3 | 3.0 | 4.4 | 4.0 |
| J-335 | 2.3 | 5.7 | 3.3 | 3.0 | 2.7 | 3.0 | 3.0 | 3.0 | 4.6 | 3.9 |
| Haga | 2.3 | 5.3 | 3.3 | 3.3 | 2.3 | 2.3 | 3.5 | 3.0 | 4.8 | 4.3 |
| Opal | 2.0 | 6.0 | 2.7 | 3.0 | 3.0 | 3.0 | 3.5 | 3.0 | 5.0 | 4.4 |
| Chelsea | 1.7 | 6.7 | 2.7 | 2.7 | 3.0 | 3.3 | 3.3 | 3.0 | 3.4 | 4.4 |
| KWS Pp 13-2 | 2.3 | 6.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.4 | 3.5 |
| South Dakota Certified | 1.3 | 5.7 | 2.3 | 3.0 | 3.0 | 3.0 | 3.5 | 3.0 | 2.7 | 4.5 |
| Ba 78-376 | 2.0 | 5.0 | 2.3 | 2.7 | 3.0 | 3.3 | 3.2 | 2.9 | 3.3 | 3.4 |
| PST-C-303 | 2.3 | 5.0 | 3.0 | 3.0 | 2.3 | 2.7 | 3.5 | 2.9 | 4.8 | 4.9 |
| Amazon | 1.0 | 6.3 | 2.7 | 3.3 | 2.7 | 2.7 | 3.3 | 2.9 | 5.4 | 3.2 |
| BAR VB 1169 | 2.0 | 5.7 | 3.3 | 2.7 | 2.7 | 2.7 | 3.3 | 2.9 | 5.3 | 4.5 |
| Barcelona | 2.0 | 6.0 | 2.3 | 3.0 | 3.0 | 3.0 | 3.3 | 2.9 | 4.9 | 4.5 |

continued

TABLE 1: (continued) Spring greenup, genetic color, and turf quality evaluations for Kentucky bluegrass cultivars during 1993, and season end mean quality ratings from 1992 and 1991. Greenup was visually rated on a scale of 0 to 10 where 0=0% green and 10=100% green. Genetic color and turf quality were visually rated on a scale of 1 to 9 where 1=dead, or brown turf and 9=ideal. Each value is the mean of three replications.

| Entry | Spring Greenup Apr 20 | Genetic Color Jun 15 | Turf Quality 1993 May 11 | Jun 15 | Aug 13 | Oct 4 | Dec 1 | Mean | 1992 Mean | 1991 Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | (0-10) | (1-9) | (------------------------------------------ | | | 1-9 | | | | -----------------------------------------) |
| Alene | 2.0 | 5.3 | 2.0 | 2.3 | 3.0 | 3.3 | 3.8 | 2.9 | 2.9 | 4.3 |
| Barsweet | 1.7 | 6.3 | 2.7 | 3.0 | 2.3 | 2.7 | 3.2 | 2.8 | 5.2 | 4.0 |
| BAR VB 895 | 2.3 | 5.3 | 3.7 | 3.0 | 2.3 | 2.0 | 2.8 | 2.8 | 4.4 | 4.9 |
| ZPS-84-749 | 1.7 | 6.0 | 2.0 | 2.0 | 3.0 | 3.7 | 3.3 | 2.8 | 4.0 | 4.2 |
| Kenblue | 1.3 | 6.0 | 2.0 | 2.0 | 3.0 | 3.3 | 3.7 | 2.8 | 3.0 | 4.4 |
| Monopoly | 1.7 | 5.3 | 2.3 | 2.7 | 2.7 | 3.0 | 3.0 | 2.7 | 4.2 | 5.0 |
| Ram-1 | 1.0 | 6.3 | 2.0 | 2.7 | 2.7 | 3.0 | 3.3 | 2.7 | 4.7 | 4.3 |
| Livingston | 2.3 | 5.7 | 2.7 | 2.3 | 2.7 | 2.7 | 3.3 | 2.7 | 4.6 | 4.2 |
| PST-C-391 | 2.3 | 5.3 | 3.0 | 3.0 | 2.3 | 2.3 | 2.8 | 2.7 | 4.8 | 3.7 |
| Freedom | 2.3 | 5.0 | 3.0 | 3.0 | 2.0 | 2.7 | 2.8 | 2.7 | 4.6 | 3.7 |
| Midnight | 2.3 | 7.3 | 3.0 | 2.3 | 2.0 | 2.3 | 3.2 | 2.6 | 5.3 | 3.7 |
| Liberty | 2.3 | 5.7 | 3.0 | 3.0 | 2.0 | 2.0 | 3.0 | 2.6 | 4.8 | 3.7 |
| Nublue | 2.3 | 5.3 | 3.3 | 2.7 | 2.0 | 2.3 | 2.8 | 2.6 | 4.7 | 4.7 |
| Bartitia | 1.7 | 6.0 | 2.3 | 2.7 | 2.0 | 2.7 | 2.8 | 2.5 | 5.1 | 4.0 |
| Significance Level (p) | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | - - - | - - - |
| LSD (p=0.05) | 0.8 | 0.7 | 0.8 | 0.7 | 0.8 | 0.9 | 0.8 | 0.6 | - - - | - - - |

## EVALUATION OF TURF SPECIES AND MIXTURES UNDER LOW MAINTENANCE CONDITIONS

### INTRODUCTION

The objectives of this study are to evaluate the utility of previously untried grass species under low maintenance conditions, and evaluate the effect on establishment of varying proportions of perennial ryegrass or Kentucky bluegrass when mixed with the Department's Formula L seeding mixture (60% hard fescue, 40% creeping red fescue).

### METHODS AND MATERIALS

Twelve seeding combinations were drop seeded to 10 by 20 ft plots, arranged in a randomized complete block with three replications, on September 25, 1992, at the Penn State Landscape Management Research Center. The treatments included 'Supra' *Poa supina*, seeded alone at 10, 20, and 40 lbs seed/ac, and in combination with 'Aurora' hard fescue at 20 lb/ac, at 10 and 20 lb/ac; combinations of Formula L (60% 'Aurora' hard fescue, 40% 'Pennlawn' creeping red fescue) plus 'Pennfine' perennial ryegrass at 80 plus 20, 85 plus 15, and 90 plus 10 lbs/ac, respectively; Formula L plus 'Merit' Kentucky bluegrass at 75 plus 25, and 85 plus 15 lb/ac, respectively; 'Bardot' colonial bentgrass at 11 lb/ac; and a blend of 'Penncross', 'Pennlinks', and 'Penneagle' creeping bentgrass at 11 lb/ac. Seedbed preparation consisted of two passes with a disk, secondary tillage with a Gill pulverizer, and hand raking. After seeding, the area was rolled, and mulched with approximately 2500 lb/ac of straw. Perennial ryegrass was seeded at 44 lb/ac into 1 ft alleyways between all plots.

The study area was treated with Garlon 3A plus Transline, at 48 oz plus 6 oz on May 11; and mowed at a height of 4 inches on June 16, 1993. A visual rating of percent ground cover was taken June 17, 1993. Plots seeded to Formula L in combination with either Kentucky bluegrass or perennial ryegrass were evaluated for stand composition by removing five, 4-inch diameter core samples and counting the number of tillers of each species on December 17, 20 and 21, 1993. Results from ground cover ratings and tiller counts are reported in Table 1.

### RESULTS

Establishment of *Poa supina* was poor, regardless of seeding rate. Plots seeded to *P. supina* alone were dominated by annual weeds, particularly giant foxtail (Setaria faberi); and no *P. supina* was observed when seeded in combination with hard fescue. The five treatments including Formula L were rated significantly higher for ground cover than all other treatments. The ratio of perennial ryegrass or Kentucky bluegrass to Formula L did not affect ground cover ratings, or stand composition based on tiller counts. In all Formula L treatments, Formula L was the dominant component. The colonial bentgrass and creeping bentgrass treatments provided similar cover to hard fescue on June 17. All treatments except those seeded to *P..supina* alone filled in well, and provided excellent cover by season's end.

### CONCLUSIONS

Under the conditions of this experiment, *P. supina* established poorly, and does not seem to offer utility for low maintenance or conservation plantings. Hard fescue, Formula L combinations, and the bentgrasses became well established and provided excellent, low-growing ground cover by the end of the first growing season. Adding perennial ryegrass or Kentucky bluegrass did not enhance or hinder establishment of Formula L. We expect the perennial ryegrass that did establish in the Formula L combination plots to disappear in the next two growing seasons. The longevity of Kentucky bluegrass in combination with Formula L, and the bentgrasses remains to be seen.

TABLE 1: Visual ratings of percent ground cover taken June 17, 1993, for 12 seeding treatments established September 25, 1992. Tiller counts were taken December 17-21, from five, 4-inch diameter cores taken from each plot seeded to a Formula L combination, and percent stand composition was calculated.

| Seeding Mixture | Seeding Rate | Ground Cover Jun 17 | Tiller Density Dec 21 | Stand Composition Formula L | Other Species |
|---|---|---|---|---|---|
| | (lbs) | ( % ) | (tillers/12.6 in$^2$) | ( % ) | ( % ) |
| 1. 'Supra' *Poa supina* | 10 | 4 | - - | - - | - - |
| 2. 'Supra' *Poa supina* | 20 | 5 | - - | - - | - - |
| 3. 'Supra' *Poa supina* | 40 | 5 | - - | - - | - - |
| 4. 'Supra' *Poa supina* + | 10 | 33 | - - | - - | - - |
| 'Aurora' hard fescue | 20 | | | | |
| 5. 'Supra' *Poa supina* + | 20 | 35 | - - | - - | - - |
| 'Aurora' hard fescue | 20 | | | | |
| 6. Formula L[1/] + | 80 | 52 | 118 | 89 | |
| 'Pennfine' perennial ryegrass | 20 | | 14 | | 11 |
| 7. Formula L + | 85 | 45 | 98 | 89 | |
| 'Pennfine' perennial ryegrass | 15 | | 12 | | 11 |
| 8. Formula L + | 90 | 53 | 102 | 90 | |
| 'Pennfine' perennial ryegrass | 10 | | 11 | | 10 |
| 9. Formula L + | 75 | 55 | 99 | 92 | |
| 'Merit' Kentucky bluegrass | 25 | | 9 | | 8 |
| 10. Formula L + | 85 | 58 | 90 | 93 | |
| 'Merit' Kentucky bluegrass | 15 | | 6 | | 7 |
| 11. 'Bardot' colonial bentgrass | 11 | 38 | - - | - - | - - |
| 12. creeping bentgrass[2/] | 11 | 35 | - - | - - | - - |
| Significance Level (p) | | 0.0001 | - - | 0.9 | 0.9 |
| LSD (p=0.05) | | 12 | - - | n.s. | n.s. |

[1/] Formula L contains 60% 'Aurora' hard fescue and 40% 'Pennlawn' creeping red fescue.

[2/] A 1:1:1 blend of 'Penncross', 'Pennlinks', and 'Penneagle' creeping bentgrasses.

# EFFECT OF APPLICATION DATE ON RESPONSE OF TALL AND FINE FESCUES TO APPLICATIONS OF ESCORT OR TELAR

## INTRODUCTION

The herbicides Escort and Telar are commonly used for broadleaf weed control along Pennsylvania roadsides. They may be used in tank mixes with other herbicides to improve the spectrum of broadleaf weeds controlled, or they may be used in combination with turf growth regulators. Both herbicides have growth regulator-like activity, and are particularly suppressive to tall fescue (*Festuca arundinacea*) when applied with mefluidide in the vegetative to early reproductive phases of spring growth. A trial was initiated to determine if time of application of Escort or Telar affected the response of tall fescue or fine fescues to these herbicides.

## MATERIALS AND METHODS

Treatments including an untreated check; Escort alone at 0.5 and 1.0 oz/ac, and at 0.5 oz/ac plus 48 oz/ac of Garlon 3A; and Telar alone at 0.5 and 1.0 oz/ac, and 0.5 lb oz/ac plus 48 oz/ac of Garlon 3A were applied to stands of tall fescue and fine fescue at the Landscape Management Research Center on May 4, June 1, June 30, August 7, and September 2, 1992. The tall fescue area was a stand of 'Transition Blend' tall fescue, previously maintained at 3.5 in. The fine fescue area was a mixture of hard fescue (*Festuca longifolia*), creeping red fescue (*Festuca rubra*), and chewings fescue (*Festuca rubra* ssp. *commutata*) maintained at 3.0 in. The experimental design for both grasses was a randomized complete block with a split-plot treatment arrangement and three replications. Application date was the whole-plot factor, and herbicide treatment was the sub-plot factor. Individual plots were 3 by 15 ft. The treatments were applied with a $CO_2$-powered, hand-held sprayer delivering 15.8 gal/ac at 24 psi with Spraying Systems 8002 spray tips. Prior to each application, each study area was mowed at 3.0 in, with clippings collected. All treated plots in the tall fescue test were harvested May 29, June 30, July 31, September 1, and September 30, 1992; and May 11, 1993. Treated fine fescue plots were harvested May 29, June 30, July 31, September 1, and October 6, 1992; and May 12, 1993. Harvests were taken with a 20 in rotary mower cutting at 3.0 in.

## RESULTS

There was a significant interaction between application date and herbicide treatment for both grasses, and the yields following the herbicide treatments are reported for each application date in Tables 1 and 2. Yields of tall fescue were reduced by the herbicide treatments at the first harvest following the May 4, June 1, Aug. 7, and Sept. 2 applications, with the greatest suppression occurring following the May 4 application. Following the June 30 application, only Telar at the high rate, or in combination with Garlon 3A, caused a reduction in growth. The growth of the herbicide treated tall fescue recovered from the initial suppression, and there was no reduction in the yields compared to the untreated check at the second harvest following application for any of the application dates. The herbicide treatments caused discoloration of the tall fescue after each application. By the time of the second harvest the discoloration was not apparent, as the growth in the herbicide treated plots was from new tillers and had better color than the grass in the untreated areas.

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

## CONCLUSIONS

These results indicate that applications of conservative rates of Escort or Telar with Garlon 3A should only cause short-term injury to turf. The most severe discoloration and reduction in growth of both the tall and fine fescues occurred when the grasses were growing most actively in early spring. There were no treatment effects observed the following season. The transferal of these results to the roadside is only possible when the rates of application are similar. Any increase in the rates of application, due to errors in equipment calibration or variation due changing target terrain along roadside, may result in more severe injury or death to the turf. Herbicide combinations are available that control broadleaf weeds and have a wider margin of safety on grasses.

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

| Application Date | Treatment | Application Rate | Harvest Date May 29 | Jun 30 | Jul 31 | Sep 1 | Sep 30 | May 11 |
|---|---|---|---|---|---|---|---|---|
| | | (oz/ac) | (--------------------lb dry matter/M | | | | --------------------) | (lb fresh/M) |
| May 4 | untreated check | - - - | 19.1 | 9.8 | 6.2 | 11.0 | 7.3 | 38.7 |
| May 4 | Escort | 0.5 | 3.5 | 8.3 | 8.5 | 8.6 | 6.1 | 31.8 |
| May 4 | Escort | 1.0 | 4.5 | 8.1 | 13.0 | 12.4 | 7.9 | 40.1 |
| May 4 | Escort + Garlon 3A | 0.5 + 48 | 4.1 | 10.6 | 9.8 | 9.2 | 6.4 | 34.4 |
| May 4 | Telar | 0.5 | 4.5 | 11.1 | 9.9 | 12.9 | 8.2 | 42.8 |
| May 4 | Telar | 1.0 | 5.0 | 8.6 | 8.5 | 11.9 | 8.5 | 42.7 |
| May 4 | Telar + Garlon 3A | 0.5 + 48 | 5.6 | 11.7 | 8.1 | 10.6 | 7.3 | 36.2 |
| Significance Level (p) | | | 0.0001 | 0.5054 | 0.1646 | 0.4615 | 0.1630 | 0.4525 |
| LSD (p=0.10) | | | 2.7 | n.s. | n.s. | n.s. | n.s. | n.s. |
| Jun 1 | untreated check | - - - | | 8.1 | 6.4 | 8.8 | 6.3 | 34.4 |
| Jun 1 | Escort | 0.5 | | 2.7 | 7.2 | 9.5 | 6.4 | 28.7 |
| Jun 1 | Escort | 1.0 | | 4.9 | 9.4 | 10.2 | 7.6 | 34.4 |
| Jun 1 | Escort + Garlon 3A | 0.5 + 48 | | 4.6 | 10.2 | 12.2 | 8.0 | 38.8 |
| Jun 1 | Telar | 0.5 | | 4.1 | 8.7 | 8.1 | 7.9 | 34.8 |
| Jun 1 | Telar | 1.0 | | 3.3 | 7.4 | 9.6 | 7.5 | 36.3 |
| Jun 1 | Telar + Garlon 3A | 0.5 + 48 | | 2.3 | 4.7 | 8.7 | 6.8 | 29.0 |
| Significance Level (p) | | | | 0.0075 | 0.0094 | 0.3230 | 0.1252 | 0.2556 |
| LSD (p=0.10) | | | | 2.1 | 1.4 | n.s. | n.s. | n.s. |
| Jun 30 | untreated check | - - - | | | 5.8 | 8.2 | 6.4 | 33.1 |
| Jun 30 | Escort | 0.5 | | | 5.3 | 11.7 | 7.3 | 36.5 |
| Jun 30 | Escort | 1.0 | | | 4.7 | 11.1 | 7.4 | 33.8 |
| Jun 30 | Escort + Garlon 3A | 0.5 + 48 | | | 5.3 | 12.6 | 7.9 | 37.7 |
| Jun 30 | Telar | 0.5 | | | 4.0 | 9.8 | 7.9 | 37.7 |
| Jun 30 | Telar | 1.0 | | | 2.2 | 8.9 | 8.2 | 36.7 |
| Jun 30 | Telar + Garlon 3A | 0.5 + 48 | | | 3.4 | 8.9 | 8.0 | 33.6 |
| Significance Level (p) | | | | | 0.0468 | 0.1291 | 0.7101 | 0.9784 |
| LSD (p=0.10) | | | | | 1.8 | n.s. | n.s. | n.s. |
| Aug 7 | untreated check | - - - | | | | 12.2 | 8.7 | 43.5 |
| Aug 7 | Escort | 0.5 | | | | 7.9 | 10.4 | 40.0 |
| Aug 7 | Escort | 1.0 | | | | 6.2 | 8.0 | 41.5 |
| Aug 7 | Escort + Garlon 3A | 0.5 + 48 | | | | 6.9 | 9.1 | 36.9 |
| Aug 7 | Telar | 0.5 | | | | 6.7 | 8.7 | 39.1 |
| Aug 7 | Telar | 1.0 | | | | 6.3 | 7.1 | 40.2 |
| Aug 7 | Telar + Garlon 3A | 0.5 + 48 | | | | 6.5 | 7.1 | 42.1 |
| Significance Level (p) | | | | | | 0.0751 | 0.1978 | 0.9797 |
| LSD (p=0.10) | | | | | | 3.3 | n.s. | n.s. |
| Sep 2 | untreated check | - - - | | | | | 9.5 | 39.9 |
| Sep 2 | Escort | 0.5 | | | | | 4.4 | 43.1 |
| Sep 2 | Escort | 1.0 | | | | | 4.6 | 42.1 |
| Sep 2 | Escort + Garlon 3A | 0.5 + 48 | | | | | 4.6 | 43.0 |
| Sep 2 | Telar | 0.5 | | | | | 4.5 | 39.6 |
| Sep 2 | Telar | 1.0 | | | | | 3.3 | 39.4 |
| Sep 2 | Telar + Garlon 3A | 0.5 + 48 | | | | | 4.9 | 46.7 |
| Significance Level (p) | | | | | | | 0.0001 | 0.8367 |
| LSD (p=0.10) | | | | | | | 1.1 | n.s. |

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

| Application Date | Treatment | Application Rate | Harvest Date May 29 | Jun 30 | Jul 31 | Sep 1 | Oct 6 | May 12 |
|---|---|---|---|---|---|---|---|---|
| | | (lb ai/a) | (---------------------lb dry matter/M | | | | --------------------) | (lb fresh/M) |
| May 4 | untreated check | - - - | 16.6 | 9.1 | 5.0 | 5.9 | 7.6 | 34.6 |
| May 4 | Escort | 0.5 | 7.7 | 7.5 | 6.1 | 6.2 | 8.1 | 31.5 |
| May 4 | Escort | 1.0 | 6.2 | 7.7 | 6.2 | 6.7 | 8.5 | 36.2 |
| May 4 | Escort + Garlon 3A | 0.5 + 48 | 9.1 | 7.0 | 6.6 | 6.8 | 9.1 | 32.0 |
| May 4 | Telar | 0.5 | 11.8 | 6.0 | 6.6 | 7.2 | 9.0 | 34.3 |
| May 4 | Telar | 1.0 | 10.0 | 7.1 | 6.8 | 7.4 | 8.8 | 35.0 |
| May 4 | Telar + Garlon 3A | 0.5 + 48 | 10.4 | 7.7 | 5.6 | 7.1 | 9.9 | 34.5 |
| Significance Level (p) | | | 0.0001 | 0.5004 | 0.3365 | 0.4031 | 0.3705 | 0.8914 |
| LSD (p=0.05) | | | 1.8 | n.s. | n.s. | n.s. | n.s. | n.s. |
| Jun 1 | untreated check | - - - | | 8.8 | 5.2 | 6.1 | 8.4 | 34.6 |
| Jun 1 | Escort | 0.5 | | 7.0 | 5.0 | 7.0 | 10.1 | 34.9 |
| Jun 1 | Escort | 1.0 | | 7.6 | 6.6 | 7.3 | 10.7 | 40.5 |
| Jun 1 | Escort + Garlon 3A | 0.5 + 48 | | 8.6 | 6.4 | 7.3 | 9.4 | 35.3 |
| Jun 1 | Telar | 0.5 | | 9.7 | 6.9 | 8.4 | 10.0 | 39.5 |
| Jun 1 | Telar | 1.0 | | 7.4 | 6.4 | 8.2 | 11.4 | 40.2 |
| Jun 1 | Telar + Garlon 3A | 0.5 + 48 | | 7.6 | 6.2 | 7.9 | 9.6 | 40.7 |
| Significance Level (p) | | | | 0.3060 | 0.0592 | 0.0572 | 0.1741 | 0.7845 |
| LSD (p=0.05) | | | | n.s. | n.s. | n.s. | n.s. | n.s. |
| Jun 30 | untreated check | - - - | | | 7.0 | 7.4 | 10.2 | 45.5 |
| Jun 30 | Escort | 0.5 | | | 6.6 | 8.2 | 11.3 | 38.8 |
| Jun 30 | Escort | 1.0 | | | 5.2 | 8.6 | 12.7 | 46.4 |
| Jun 30 | Escort + Garlon 3A | 0.5 + 48 | | | 7.8 | 9.9 | 14.1 | 55.9 |
| Jun 30 | Telar | 0.5 | | | 6.7 | 7.7 | 12.3 | 45.4 |
| Jun 30 | Telar | 1.0 | | | 6.6 | 8.5 | 12.1 | 50.4 |
| Jun 30 | Telar + Garlon 3A | 0.5 + 48 | | | 6.1 | 8.0 | 11.3 | 39.9 |
| Significance Level (p) | | | | | 0.0871 | 0.0975 | 0.0748 | 0.2029 |
| LSD (p=0.05) | | | | | n.s. | n.s. | n.s. | n.s. |
| Aug 7 | untreated check | - - - | | | | 7.1 | 9.0 | 35.9 |
| Aug 7 | Escort | 0.5 | | | | 5.4 | 10.0 | 35.3 |
| Aug 7 | Escort | 1.0 | | | | 6.1 | 12.6 | 54.2 |
| Aug 7 | Escort + Garlon 3A | 0.5 + 48 | | | | 5.8 | 11.4 | 44.7 |
| Aug 7 | Telar | 0.5 | | | | 7.2 | 10.5 | 47.2 |
| Aug 7 | Telar | 1.0 | | | | 6.4 | 9.4 | 39.8 |
| Aug 7 | Telar + Garlon 3A | 0.5 + 48 | | | | 9.1 | 10.4 | 39.9 |
| Significance Level (p) | | | | | | 0.4189 | 0.1280 | 0.2374 |
| LSD (p=0.05) | | | | | | n.s. | n.s. | n.s. |
| Sep 2 | untreated check | - - - | | | | | 8.4 | 29.5 |
| Sep 2 | Escort | 0.5 | | | | | 6.6 | 41.6 |
| Sep 2 | Escort | 1.0 | | | | | 4.6 | 31.8 |
| Sep 2 | Escort + Garlon 3A | 0.5 + 48 | | | | | 5.9 | 35.2 |
| Sep 2 | Telar | 0.5 | | | | | 8.4 | 39.4 |
| Sep 2 | Telar | 1.0 | | | | | 6.6 | 33.2 |
| Sep 2 | Telar + Garlon 3A | 0.5 + 48 | | | | | 4.7 | 25.3 |
| Significance Level (p) | | | | | | | 0.0103 | 0.1069 |
| LSD (p=0.05) | | | | | | | 2.2 | n.s. |

## EVALUATION OF THE HERBICIDE ACCENT FOR USE IN ROADSIDE SETTINGS

### INTRODUCTION

The herbicide Accent is a relatively new compound that has use potential for roadside settings. Investigation in agronomic settings has indicated that Accent has activity on Canada thistle (*Cirsium arvense*), and is safe to crownvetch (*Coronilla varia*). Accent is labelled for use in corn and soybeans, which would provide a margin of error should roadside treatments be misapplied near crops. Three tests were conducted to evaluate the efficacy of Accent on Canada thistle; a backpack application and a replicated plot test comparing two rates applied in fall or spring, and a truck-based handgun operation to evaluate application rate and method. Additional tests were also conducted to evaluate the activity of Accent on tall fescue (*Festuca arundinacea*), giant foxtail (*Setaria faberi*), and black raspberry (*Rubus* spp.).

### MATERIALS AND METHODS

Roadside Backpack Application to Canada Thistle

Single plots measuring 90 by 250 ft were laid out in the median of SR 222, about 1 mile north of the Ephrata interchange, to compare two rates of Accent applied in fall or spring. The plot area was an unmowed stand of crownvetch and tall fescue, with Canada thistle occurring throughout. The were also scattered specimens of bull thistle (*Cirsium vulgare*). All thistle species within each plot were spot treated using a lever-actuated piston pump backpack equipped with a spray wand using a single OC-04 spray tip, operating at about 20 psi. The treatments were originally intended to be applied at 1.0 and 1.5 oz Accent/ac, at 10 gal/ac, with Clean Cut added at 0.25% v/v.. A more realistic estimate would be that the treatments were applied at 20 to 25 gal/ac, and were applied at 2.0 to 2.5, and 3.0 to 3.75 oz/ac, respectively. The fall applications were made October 16, 1992, to vegetative stems; and the spring applications were made May 17, 1993, when thistle was in the late vegetative to early bud stage. The fall treatments were evaluated May 17, and the spring treatments on June 24.

Replicated Small Plot Application to Canada Thistle

A study comparing fall or spring applications of Accent at 0.66 and 1.32 oz/ac, and Velpar L at 2 qts/ac; was established at the Penn State Valentine Turfgrass Research Center. The fall treatments were applied October 28, 1992, and the spring treatments were applied May 24, 1993. The treatments were applied using a $CO_2$-powered, hand-held boom delivering 16 gal/ac at 20 psi, using Spraying Systems 8002 flat fan tips. All herbicide treatments included Clean Cut at 0.25% v/v. At the time of the fall application, Canada thistle stems were 6 to 18 in tall, and crownvetch was 6 to 10 in tall. At the spring application, Canada thistle was in bud stage, 12 to 24 in tall; and crownvetch was vegetative, 10 to 18 in tall. Prior to the fall application, the number of Canada thistle stems was counted in each plot. Canada thistle stem counts were taken again May 21, to determine stand reduction in the fall treated plots, and to obtain an initial count for the spring treatments. Counts of dead thistle stems were taken June 30 to determine stand reduction from the spring treatments.

Truck-Mounted Handgun Canada Thistle Treatments

A truck-mounted sprayer was used to spot treat Canada thistle along a 2.5 mile length of SR 45, between SR 322 and SR 26, on June 25, 1993. The sprayer was equipped with a Spraying Systems GunJet 43 with a D6 orifice, delivering 1.1 gal/min at 30 psi. The spray solution consisted of Accent at 4 oz/100 gal, Clean Cut at 0.25% v/v, and SanAg 41 drift control agent at 5 oz/100 gal. At total of 12 gallons was applied to the west bound shoulder.

Vehicle speed during application ranged from 2 to 5 mph, depending on thistle density. Most treated stems were within 10 ft of the shoulder. Canada thistle was in the early bloom stage at application. The most common species in the treated areas were crownvetch and smooth brome (*Bromus inermis*). Much of the treatment area was adjacent to agricultural areas planted to soybeans or corn. The treated and untreated sides of the road were evaluated September 21.

Evaluation of Accent Activity on Tall Fescue and Giant Foxtail

Two experiments were established at the Penn State Landscape Management Research Center to determine the activity of Accent on tall fescue and giant foxtail, to determine if Accent could provide selective control of foxtail in roadside tall fescue. The treatments included Accent at 0.5, 1.0, or 2.0 oz/ac; Horizon at 32 oz/ac; Poast at 40 oz/ac; Assure II at 7 oz/ac; and an untreated check. The treatments were applied to each test with a $CO_2$-pressurized, hand-held sprayer delivering 16 gal/ac at 20 psi with Spraying Systems 8002 flat fan tips. The experimental design of each test was a randomized complete block, with three replications and 3 by 15 ft plots. The treatments were applied to both studies on June 30, 1993. The tall fescue was a six-year old stand of 'Transition Blend'[1/], maintained at 3.5 inches. The giant foxtail was in the 3 to 5 leaf stage when treated. The giant foxtail plots had been treated with Roundup in mid-May, and consisted almost entirely of annual species. Other species in the test area were giant crabgrass (*Digitaria sanguinalis*), and common lambsquarters (*Chenopodium album*). Visual ratings of injury were taken in both experiments on July 15.

Evaluation of Accent Activity on Brambles

Accent at 2 or 4 oz/ac, and Escort at 1 oz/ac, were applied to a stand of brambles consisting primarily of black raspberry, and a few plants of blackberry, on July 1, 1993, near the University Park Aiport. The treatments were applied with a $CO_2$-pressurized sprayer equipped with a Radiarc, delivering 29 gal/ac at 20 psi, to 9 by 80 ft plots. Second year canes were bearing fruit, and were 5 to 6 ft long, with a canopy height of 4 ft. First year canes were 3 to 4 ft long. Each treatment included Penevator 9 at 0.25% v/v. The treatments were evaluated for injury September 21, 1993.

## RESULTS

Roadside Backpack Application to Canada Thistle

There was no visible sign of activity on Canada thistle, or any other species, from the fall applied treatments on May 17. The development, and density of the thistle was no different from untreated thistle in adjacent areas. The spring applied treaments were very effective on Canada thistle, when rated 36 DAT, with no visible difference between the two application rates. Nearly all treated stems of Canada thistle in each distinct patch were dead, indicating that the application technique was effective. There was no visible injury to any crownvetch, whether at the edge of a thistle patch, or in a mixed stand. Accent had little or no activity on the second-season bull thistle that was treated. Some patches of Canada thistle showed very little effect from the treatment, with no differences apparent within a patch. These unaffected were often adjacent to patches that were effectively controlled, so it seems unlikely that they were missed. Because of the operational nature of the application, it is difficult to determine the reason for this apparent inconsistency. If the patches were actually treated, perhaps there is a biotype differences among Canada thistle. This has been demonstrated as a cause for differential response of Canada thistle to the fungicide anilizine, which is extremely lethal to some biotypes, but has no effect on others.

---

[1/] A blend of 'Cimmaron', 'Olympic', and 'Bonanza' tall fescues.

## Replicated Small Plot Application to Canada Thistle

None of the fall applied treatments had any observable effect on Canada thistle, based on visual symptoms or stem counts. Stem counts were higher on May 21 than in October for all plots, treated or untreated. When the spring treatments were rated 37 DAT, there was almost no thistle mortality in the Accent plots. The spring Accent treatments did cause terminal chlorosis of thistle, and inhibited or delayed bloom. Thistle in the untreated check was at about 50 percent bloom, while some thistle in the 0.66 oz/ac Accent plots were just beginning to bloom. Most of the visible buds in plots treated with either Accent rate were stunted, and may not have been viable. Velpar L caused much less mortality than anticipated, but did cause noticeable defoliation, prevented flower bud formation, and did stunt the plants.

## Truck-Mounted Handgun Canada Thistle Treatments

The effects the Accent treatment applied with a handgun were inconclusive. There were areas where the thistle stems were dead, but in these particular locations, there were no nearby untreated thistle patches. In other areas, the treated stems were very similar to untreated, with axillary regrowth. The application timing was late for a material like Accent, which is an enzyme-inhibitor, and requires several weeks for full activity on well established plants. There was no sign of injury to crownvetch, or any other species in the treatment areas. None of the corn or soybeans adjacent to treated areas showed any injury. This was a relatively low volume application, probably in the 20 to 30 gal/ac range, so the rate of 4 oz Accent/100 gal was probably weak. A different handgun would be more effective for this type of application, as the relatively small D6 orifice and the low pressure setting produced a cone that could not be thrown very far, so much of the application was done with a solid stream. A fixed pattern device such as a Radiarc would work very well if the treatment area was a fixed with, but the ROW on this roadway was 80 ft, and the distance between the thistle and the truck varied from about 5 ft, to out of reach. The handgun could effectively reach 15 to 20 ft maximum, depending on vehicle and wind speed, and spray pattern orientation.

## Evaluation of Accent Activity on Tall Fescue and Giant Foxtail

Results of color ratings of tall fescue, and injury ratings of giant foxtail taken July 15, 15 DAT, are reported in Table 1. All herbicide treatments received color ratings significantly lower than the check. The 2 oz/ac rate of Accent, and Poast caused the most discoloration. Increasing the rate of Accent from 0.5 to 2.0 oz/ac reduced color ratings from 7.7 to 6.3. The discoloration of tall fescue was temporary for all treatments, as the treatments were not distinguishable six weeks after treatment.

All treatments caused significant injury to giant foxtail, compared to the check; and Horizon, Poast, and Assure II caused significantly more injury than the Accent treatments. When rated 15 DAT, Horizon, Poast, and Assure II provided almost complete control of giant foxtail, but within a few weeks later germinating giant foxtail had become well established, and by season's end, these treatments looked very much like the check. All three Accent treatments continued to act on treated foxtail after the July 15 rating, and prevented additional germination. However, Accent had very little activity on large crabgrass, which eventually produced an almost pure stand in the Accent plots.

TABLE 1: Color ratings of tall fescue, and injury ratings for giant foxtail, taken July 15, for treatments applied June 30, 1993. Each value is the mean of three replications.

| Treatment | Application Rate | Tall Fescue[1/] Color | Giant Foxtail[2/] Injury |
|---|---|---|---|
| | (oz product/ac) | (1-9) | (0-10) |
| 1. Accent | 0.5 | 7.7 | 5.7 |
| 2. Accent | 1.0 | 7.0 | 6.3 |
| 3. Accent | 2.0 | 6.3 | 7.2 |
| 4. Horizon | 32 | 8.0 | 9.3 |
| 5. Poast | 40 | 6.3 | 9.2 |
| 6. Assure II | 7 | 7.3 | 9.3 |
| 7. Untreated Check | - - - | 9.0 | 0.0 |
| Significance Level (p) | | 0.0001 | 0.0001 |
| LSD (p=0.05) | | 0.8 | 1.0 |

Evaluation of Accent Activity on Brambles

The treatments were evaluated, September 21, 83 DAT. The second year canes had already set fruit and died. None of the treatments had killed brambles, but all three produced at least chlorosis, and some necrosis of the tips of treated plants. Accent at 4 oz/ac produced the most injury, and there was no axillary regrowth observed on treated canes, as there was in canes treated with 2 oz/ac Accent or Escort at 1 oz/ac. The Accent treatments caused symptoms on pokeweed (*Phytolacca americana*), ranging from marginal chlorosis, to leaf necrosis and stem chlorosis. Followup observations in 1994 will indicate whether these treatments are slow-acting, or simply ineffective at the rates used.

## CONCLUSIONS

Based on the results from the spring applications at Ephrata, Accent does hold promise for selective removal of existing Canada thistle stems. There is no indication from fall or spring treatments that Accent will actually act on the root system to a noticeable extent. Accent could provide a treatment with less injury potential to crownvetch, and particularly to grass. Properly applied Velpar L treatments are safe to crownvetch, but quite active on cool season grasses. One limitation of Accent compared to Velpar L, is the lack of activity on biennial thistles. Velpar will control these species, while Accent does not seem to have any effect, at least on second-season plants. Although Accent does have soil activity, it does not appear that over-applications will produce the bare ground that Velpar applications have in the past. Accent does not appear to have the broad spectrum of Velpar to allow it to be an all purpose spot treatment, so tank mixes will need to be developed to be able to control species that often occur with Canada thistle, such as poison hemlock (*Conium maculatum*), and pokeweed, in addition to biennial thistles.

## CONTROL OF CANADA THISTLE WITH TRANSLINE OR GARLON APPLIED WITH CHEMICAL SHEARS

### INTRODUCTION

A study was established to determine if chemical shears could provide selective weed control with Transline and Garlon 3A based on height differential between the crop and weed species. This system was evaluated on a roadside stand of crownvetch (*Coronilla varia*) infested with Canada thistle (*Cirsium arvense*), near State College, PA.

### MATERIALS AND METHODS

The crownvetch and thistle plots were either cut above the crownvetch (thistle tops only), or at a height of 2 to 3 inches. Herbicide treatments included none, a 25 percent solution (0.75 lb ae/gal) of Transline, and a 25 percent solution (0.75 lb ae/gal) of Garlon 3A. The plots were 5 by 10 ft, arranged in a completely random design. The treatments were applied June 23, 1993. The herbicide solution was applied to the cutter bar of the hedge clippers by gravity feed to a tube running the length of the bar with several outlet ports to wet the bar. The bar was cleaned between the two herbicide treatments by cutting vegetation outside the treatment area while water was running through the system. Prior to initiating chemical shearing, the shears were run until the bar was visibly moistened, then briefly used outside the treatment area to reduce excess solution. The high cut and low-cut plots were treated at the same time, therefor we are only able to report average volume per herbicide treatment, rather than solution volume differences between the two cutting treatments. If we estimate that 90 ml of the total solution used was not applied to treated foliage due to the initial wetting the bar and removing solution from the bar at the conclusion of treatment, the gallons/acre of herbicide solution was 9.2 (6.9 lb ai) for Transline, and 7.1 (5.3 lb ai) for Garlon 3A. These amounts could be reduced in this setting by using different shears. Crownvetch stems are quite fibrous, and did not cut well, requiring repeated movement over the same area to complete the cut.

Total Canada thistle stems were counted in each plot June 30, 7 days after treatment (DAT), and the number missed by the cutter was determined. A visual rating of crownvetch percent crownvetch injury, and counts of dead thistle stems were taken August 11 (49 DAT). Counts of living thistle stems were taken October 19, and were categorized as surviving (axillary and basal sprouts) or new shoots. Canada thistle stem counts were used to calculate percent mortality of treated stems, and percent regrowth expressed relative to initial stem counts. Results are reported in Table 1.

### RESULTS

Despite the extreme application rates, Garlon 3A was not effective on Canada thistle at either cutting height. Crownvetch mortality was lower at 49 DAT with the high cut, but crownvetch had recovered in all Garlon 3A treated plots by 118 DAT. Transline was not selective to crownvetch based on cutting height. The application rate apparently resulted in residual soil activity, as plots that originally consisted of only Canada thistle and crownvetch were bare at 118 DAT, while seedlings of plumeless thistle (*Carduus acanthoides*) were common in plots receiving no herbicide or Garlon 3A.

### CONCLUSIONS

The chemical shears evaluated in this test are an early prototype, and many improvements are necessary before the utility of this application system can be effectively evaluated. This type of system will not provide selective control in crownvetch areas due to highly variable height differentials between crownvetch and Canada thistle. A working herbicide applicator/mower system could be useful in the control of taller broadleaf weeds in turf, and would provide whole plant control as well as eliminating brown-out by cutting the plant tops. There are efforts in the industry to develop rotary, as well as sickle bar type mowing equipment to apply herbicides.

TABLE 1: Response of crownvetch and Canada thistle to herbicide treatments applied with chemical shears June 23, 1993. Crownvetch injury was visually rated August 11. Canada thistle mortality was calculated from counts of still-living treated stems taken August 11 and October 19. Thistle regrowth was calculated from counts of newly emerged shoots taken October 19.

| | | Crownvetch | Canada Thistle | | |
|---|---|---|---|---|---|
| Product | Cutting Height | Injury Aug 11 | Mortality Aug 11 | Mortality Oct 19 | Regrowth Oct 19 |
| | | (----------------------------------%----------------------------------) | | | |
| 1. Check | High | 3 | 50 | 87 | 42 |
| 2. Check | Low | 17 | 43 | 70 | 32 |
| 3. Transline | High | 86 | 100 | 89 | 7 |
| 4. Transline | Low | 99 | 100 | 100 | 0 |
| 5. Garlon 3A | High | 25 | 68 | 83 | 48 |
| 6. Garlon 3A | Low | 93 | 71 | 39 | 60 |
| Significance Level (p) | | 0.0001 | 0.1064 | 0.0108 | 0.0055 |
| C.V. (%) | | 30 | 38 | 22 | 53 |
| LSD (p=0.05) | | 28 | n.s. | 30 | 30 |

## RESPONSE OF TALL FESCUE TO FALL OR SPRING APPLICATIONS OF PLANT GROWTH REGULATOR TREATMENTS

### INTRODUCTION

A trial was established to compare the response of tall fescue to plant growth regulator treatments applied in the late fall or spring. If effective, fall applications would increase the application window of growth regulators.

### MATERIALS AND METHODS

The test was conducted at the Landscape Management Research Center, on a six-year old stand of 'Transition Blend' tall fescue (*Festuca arundinacea*). The experimental design was a randomized complete block with three replications. The treatment combinations were Embark plus Event, a commercial pre-mix of Pursuit and Arsenal› at 8 plus 4 (0.044 plus 0.0016) oz/ac, respectively; Embark plus Telar at 12 plus 0.25 oz/ac; Embark plus Arsenal at 8 plus 3 oz/ac; Escort at 0.5 oz/ac; and an untreated check. All plant growth regulator treatments included dicamba at 1.0 lb ai/a, and Clean Cut at 0.25% v/v. Fall treatments were applied November 10, 1992, and spring treatments were applied May 10, 1993, using a $CO_2$-powered, hand-held sprayer delivering 18.5 gal/ac at 19 psi using Spraying Systems 8002 flat fan spray tips. The experimental design was a randomized complete block with three replications. Tall fescue injury observations were made May 28. Seedhead density counts, as well as measurements of seedhead and vegetative canopy height were taken June 18. Clipping harvests were taken using a rotary mower with a cutting height of 3.0 in on June 28 and August 16. A visual estimate of percent turf cover on a green tissue basis was taken August 12.

### RESULTS

There was little visual difference between the fall treatments and the untreated check on May 28. The spring treatments were all noticeably discolored compared to the check, with the Embark combinations slightly more discolored than the Escort treatment. After the June 28 harvest, the Embark plus Arsenal treatment stood out due to a thinner stand, though the turf color was not different than the other treatments.

The fall and spring treatment data were analyzed separately, each with the untreated check (Tables 1 and 2). The only significant response to the fall treatments compared to the untreated check was a reduction in seedhead density for the Embark plus Event, Embark plus Telar, and Embark plus Arsenal treatments. All spring treatments caused a reduction in seedhead density and height, canopy height, and June 28 clippings yields, with the Embark combinations providing more suppression than Escort. Tall fescue treated with Embark plus Arsenal had significantly less turf cover on August 12, and lower clippings yields on August 16 than all other treatments.

### CONCLUSIONS

The fall applications only had an impact on seedhead density, but not enough to be useful. The late application date may have contributed to this, and leaves the question of the utility of these applications unanswered. Embark plus Arsenal applied in the spring provided activity longer than is desirable on tall fescue, and caused unacceptable stand thinning.

TABLE 1: Response of tall fescue to growth regulator treatments applied November 10, 1992. Seedhead density and height, and canopy height were measured June 18, 1993. Dry matter clipping yields were measured June 28 and August 16, and are reported in lbs/1000 sq. ft (lb/M). Green turf cover was visually rated August 12. Each value is the mean of three replications.

| | Application Rate | Seedhead Density | Seedhead Height | Canopy Height | Dry Matter Yield Jun 28 | Green Turf Cover | Dry Matter Yield Aug 16 |
|---|---|---|---|---|---|---|---|
| | (oz/ac) | (#/ft$^2$) | ( in ) | ( in ) | ( lb/M ) | ( % ) | ( lb/M ) |
| Embark + | 8 | 8.3 | 24.7 | 9.4 | 20.7 | 47 | 5.7 |
| Event | 4 | | | | | | |
| Embark + | 12 | 6.6 | 24.8 | 10.0 | 21.4 | 45 | 6.3 |
| Telar | 0.25 | | | | | | |
| Embark + | 8 | 7.7 | 24.1 | 9.0 | 16.2 | 45 | 5.2 |
| Arsenal | 3 | | | | | | |
| Escort | 0.5 | 12.5 | 25.3 | 9.9 | 20.6 | 45 | 6.4 |
| untreated check | - - - | 12.2 | 25.5 | 9.5 | 20.8 | 45 | 6.1 |
| Significance Level (p) | | 0.062 | 0.260 | 0.574 | 0.439 | 0.961 | 0.295 |
| LSD (p=0.10) | | 3.8 | n.s. | n.s. | n.s. | n.s. | n.s. |

TABLE 2: Response of tall fescue to growth regulator treatments applied May 10, 1993. Seedhead density and height, and canopy height were measured June 18, 1993. Dry matter clipping yields were measured June 28 and August 16, and are reported in lbs/1000 sq. ft (lb/M). Green turf cover was visually rated August 12. Each value is the mean of three replications.

| | Application Rate | Seedhead Density | Seedhead Height | Canopy Height | Dry Matter Yield Jun 28 | Green Turf Cover | Dry Matter Yield Aug 16 |
|---|---|---|---|---|---|---|---|
| | (oz/ac) | (#/ft$^2$) | ( in ) | ( in ) | (lb/M) | ( % ) | ( lb/M ) |
| Embark + | 8 | 0.0 | 0.0 | 6.8 | 9.8 | 47 | 5.9 |
| Event | 4 | | | | | | |
| Embark + | 12 | 0.9 | 8.9 | 7.1 | 9.8 | 42 | 6.2 |
| Telar | 0.25 | | | | | | |
| Embark + | 8 | 0.1 | 2.0 | 7.1 | 7.8 | 12 | 1.5 |
| Arsenal | 3 | | | | | | |
| Escort | 0.5 | 2.9 | 14.4 | 7.8 | 13.0 | 47 | 6.2 |
| untreated check | - - - | 12.2 | 25.5 | 9.5 | 20.8 | 45 | 6.1 |
| Significance Level (p) | | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| LSD (p=0.05) | | 1.5 | 8.9 | 0.8 | 4.2 | 7 | 1.4 |

# RESPONSE OF TALL FESCUE TO EMBARK IN COMBINATION WITH CUTLESS, PACLOBUTRAZOL, OR PRIMO

## INTRODUCTION

Embark is the most widely used PGR for roadside use in Pennsylvania. PGR's are categorized as Type I, cell division inhibitors, such as Embark; or Type II, cell elongation inhibitors. Combinations of Embark with the Type II PGR's Cutless, paclobutrazol, or Primo were evaluated to determine the utility of these combinations for growth and seedhead suppression of tall fescue (*Festuca arundinacea*).

## MATERIALS AND METHODS

This trial was established at the Penn State Landscape Management Research Center, on a six year old stand of 'Transition Blend' tall fescue. The treatments included Embark at 16, 20, and 24 oz/ac; in combination with Cutless at 16 and 24 oz/ac; paclobutrazol at 16 and 24 oz/ac; and Primo at 32, 48, and 64 oz/ac; and an untreated check, for a total of 22 treatment combinations. The treatments were applied May 10, 1993, to 3 by 15 ft plots using a $CO_2$-powered, hand held sprayer delivering 18.4 gal/ac at 20 psi using 8002 flat fan spray tips. The experimental design was a randomized complete block with three replications. All treatments included a surfactant[1/] at 0.25% v/v. Prior to application, the study area was mowed to a height of 3.5 in. A visual evaluation of turf injury was made May 28. Measurements of seedhead density and height, and vegetative canopy height were taken June 18. Clippings yields were measured June 28 and August 16, using a 20 in rotary mower cutting at a height of 3.0 in. A visual rating of red clover (*Trifolium pratense*) cover was taken August 12.

## RESULTS

All treated plots showed some injury relative to the check, but there was no discernable difference between the treatments, and the injury was considered acceptable for a roadside-quality turf. In the initial analysis of all 22 treatments, the PGR treatments significantly reduced seedhead density and height, canopy height, and June 28 clippings yield compared to the untreated check. Values recorded in the check plots were 16.5 seedheads/$ft^2$, seedhead height of 15.0 in, canopy height of 7.9 in, and dry matter yields on June 28 and Aug 16 of 14.1 and 11.1 lb/1000 $ft^2$ (lbs/M), respectively. The data was then analyzed as a 3 by 7 factorial treatment arrangement (three Embark rates by seven Type II treatments) without the untreated check. Red clover cover was used as a covariate to adjust the dry matter yields taken August 16 for Type II treatments at the 16 oz/ac rate of Embark. There was no significant effect from Embark rate, Type II PGR, or the interaction on seedhead density counts. The effects of Embark rate and Type II PGR were significant for seedhead and canopy height. The results for each Embark rate-Type II combination are reported to illustrate an apparent antagonistic effect of the combinations (Table 1). For both seedhead and canopy height, the measured height increased with increasing Embark rate, except for combinations with Cutless at 16 oz/ac. It appears the combinations antagonized Embark activity more than the Type II PGR's, as increasing the rate of a given Type II material increased suppression, though the Type II rate differences decreased with increasing Embark rate. There was a significant interaction between Embark rate and Type II treatments for clippings yield on June 28 ($p=0.05$), and August 16 ($p=0.0001$). At both dates, the primary source of the interaction was the great difference in suppression between the 16 and 20 oz/ac rates of Embark with Cutless at 16 oz/ac, compared to the other Type II materials. As with the height measurements, increasing Embark rates did not increase suppression of clippings yields.

---

[1/] Aquatic Surfactant, Arborchem Products, Inc., Ft. Washington, PA.

## CONCLUSIONS

Combinations of Type II PGR's with Embark did provide suppression of tall fescue, without causing unacceptable discoloration. The combinations also provide longer suppression longer in the growing season, compared to Embark in combination with Event or Telar. Two drawbacks of combinations are the observed antagonism between the different PGR types; and perhaps more importantly, the high cost and lack of roadside labeling for the Type II materials. Despite the observed antagonism, effective combinations have been developed; but until there is a market demand for this type of chemistry on roadsides, Type II PGR's will remain a tool for high maintenance turf.

TABLE 1: Measurements of seedhead and vegetative canopy height taken June 18, 1993, for Type II growth regulator treatments applied in combination with three rates of Embark on May 10, 1993. Each value is the mean of three replications.

| Treatment | Application Rate | Seedhead Height Embark (oz/ac) 16 | 20 | 24 | Canopy Height Embark (oz/ac) 16 | 20 | 24 |
|---|---|---|---|---|---|---|---|
| | (oz/ac) | (---------------in ---------------) | | | (---------------in ---------------) | | |
| Cutless | 16 | 7.1 | 6.6 | 6.3 | 5.9 | 6.3 | 6.6 |
| Cutless | 24 | 5.3 | 5.5 | 5.9 | 6.1 | 5.5 | 6.2 |
| paclobutrazol | 16 | 6.3 | 5.8 | 5.9 | 5.7 | 6.3 | 6.2 |
| paclobutrazol | 24 | 4.8 | 5.4 | 5.6 | 5.6 | 5.7 | 6.3 |
| Primo | 32 | 5.3 | 5.3 | 6.7 | 5.9 | 5.6 | 5.8 |
| Primo | 48 | 4.9 | 4.4 | 5.3 | 5.1 | 5.5 | 5.9 |
| Primo | 64 | 4.5 | 4.0 | 5.3 | 5.3 | 5.4 | 5.4 |
| Significance Level (p) | | 0.0055 | 0.0016 | 0.4309 | 0.0228 | 0.2923 | 0.0723 |
| LSD (p=0.05) | | 1.1 | 1.0 | n.s. | 0.5 | n.s. | n.s. |

TABLE 2: Dry weight clippings yields for Type II growth regulator treatments applied in combination with three rates of Embark on May 10, 1993. Dry weight clippings yields were taken June 28 and August 16, 1993, and are reported in lbs/1000 $ft^2$ (lbs/M). Each value is the mean of three replications.

| Treatment | Application Rate | Clippings Yield June 28 Embark (oz/ac) 16 | 20 | 24 | Clippings Yield Aug. 16 Embark (oz/ac 16 | | 20 | 24 |
|---|---|---|---|---|---|---|---|---|
| | (oz/ac) | (-----lbs dry matter/M------) | | | (-------lbs dry matter/M -------) | | | |
| Cutless | 16 | 10.4 | 6.7 | 7.1 | 18.5 | a | 9.4 | 11.1 |
| Cutless | 24 | 6.0 | 5.2 | 4.8 | 10.7 | abc | 7.6 | 7.9 |
| paclobutrazol | 16 | 5.7 | 6.9 | 6.7 | 7.2 | c | 8.3 | 8.8 |
| paclobutrazol | 24 | 4.8 | 5.5 | 6.4 | 6.5 | c | 6.3 | 6.4 |
| Primo | 32 | 6.0 | 5.9 | 5.2 | 13.0 | ab | 9.1 | 9.3 |
| Primo | 48 | 4.8 | 4.1 | 5.2 | 12.2 | ab | 8.3 | 10.9 |
| Primo | 64 | 4.5 | 4.1 | 4.1 | 9.9 | bc | 10.3 | 7.9 |
| Significance Level (p) | | 0.0036 | 0.0847 | 0.0500 | | | 0.0954 | 0.4381 |
| LSD (p=0.05) | | 2.1 | n.s. | 1.9 | | | n.s. | n.s. |

## EFFECT OF NITROGEN FERTILIZER ON THE ESTABLISHMENT OF AN ANNUAL WILDFLOWER MIX

### INTRODUCTION

The objective of this experiment was to determine the effect of nitrogen fertilization on establishment of an annual wildflower mix, by observing growth of wildflower and weed species.

### MATERIALS AND METHODS

Prior to seedbed preparation, the study area was amended with 266 lbs/ac of 0-46-0, 122 lbs/ac of 0-0-50, and 1750 lbs/ac of lime, according to soil test recommendations. The seedbed was prepared by rototilling to a depth of 6 inches, and hand raking. The three nitrogen treatments were 0 lb N/ac, 40 lb N/ac from urea (46-0-0), and 40 lb N/ac from sulfur-coated urea (SCU) (39-0-0). The annual wildflower mix (Table 1) was seeded, and the nitrogen treatments were applied on April 20, 1993, to 5 by 15 ft plots, arranged in a randomized complete block with three replications. On August 13, plant counts were taken from two 0.25 $m^2$ samples from each plot, and the wildflowers and weeds were harvested and dried to determine dry matter yield. Weed species present included giant foxtail (*Setaria faberi*), yellow foxtail (*Setaria lutescens*), smooth pigweed (*Amaranthus hybridus*), common lambsquarters (*Chenopodium album*), and common yellow woodsorrel (*Oxalis stricta*).

### RESULTS AND CONCLUSIONS

There was no significant effect on wildflower or weed biomass due to nitrogen treatments. Under the conditions of this study, which included a well prepared seedbed and recommended soil levels of phosphorous and potassium, as well as pH; the addition of relatively low rates of nitrogen, whether quick or delayed release did not influence the growth of wildflowers or weeds. In a roadside setting, where soil organic matter and fertility levels may be low, addition of nitrogen may be useful, but in relatively fertile soils additional nitrogen is not necessary.

TABLE 1: Annual wildflower mix species and seeding rates.

| Common Name | Scientific Name | Seeding Rate |
|---|---|---|
| | | (lb/acre) |
| Cornflower | *Centaurea cyanus* | 1.00 |
| Tall Plains Coreopsis | *Coreopsis tinctoria* | 0.50 |
| Cosmos | *Cosmos bipinnatus* | 2.00 |
| Rocket Larkspur | *Delphinium ajacis* | 1.50 |
| Indian Blanket | *Gaillardia pulchella* | 1.50 |
| Corn Poppy | *Papaver rhoeas* | 0.50 |
| Total | | 7.00 |

TABLE 2: Wildflower and weed biomass in response to nitrogen fertilizer treatments. Wildflowers were seeded April 20,1993. Wildflower and weed dry weights were taken on August 16, 1993 from two 0.25 $m^2$ areas within each plot. Values are the mean of three replications.

| Fertilizer Treatment | Fertilizer Rate | Wildflower Dry Weight | Weed Dry Weight |
|---|---|---|---|
| | (lbs N/ac) | (g/0.25 $m^2$) | (g/0.25 $m^2$) |
| none | 0 | 113 | 150 |
| urea (46-0-0) | 40 | 107 | 149 |
| SCU (38-0-0) | 40 | 118 | 144 |
| Significance Level (p) | | 0.65 | 0.83 |
| LSD (p=0.05) | | n.s. | n.s. |