Evaluation and Management of Turfgrass on Virginia Roadsides

Annual Report

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ABSTRACT

Turfgrass Cultivar Evaluations

The trial data in this report is reflected in the VDOT Seed Specifications for Grasses and Legumes (Form RD-4) [see appendices]. New cultivar trials of Kentucky bluegrass, tall fescue, and fine fescue were planted November 2001. Older cool-season grass trials were installed in the fall of 1999 at Blacksburg and Orange. Preliminary data gathered in from 1999 to 2001 will be used to formulate recommendations after fall 2002. Bermudagrass, zoysiagrass, centipedegrass, as well as low growing warm season native grass trials, were installed at Hampton Roads and Blacksburg in the summer of 2001.

Management Studies

The 1997 mowing studies on fine and tall fescue were continued to observe weed invasion and some changing dynamics caused by lodging on the plots that were never mowed. The plots that have never been mowed are starting to show signs of density reduction.

Native Grass Studies

The studies on native warm and cool-season grasses in the past several years have demonstrated that the establishment dynamics of the warm-season native grasses are different from those of the familiar cool-season grasses. Establishment of the shorter native grasses [buffalograss, blue grama, and little bluestem] is very difficult because these grasses are slow to germinate and/or spread and do not produce much top growth during their first year of development. This makes weed and erosion control paramount in the first three years of establishment. Our research shows that the natives start to establish a strong stand after the second year. The shorter natives [buffalograss, blue grama and little bluestem] established better on a roadside cut than on an area where the previous vegetation was removed with glyphosate. The overwhelming reason for the difference was competition from annual grassy weeds on the previously vegetated plots and the lack of competition on the roadside cut slope. The use of companion plants and/or weed control is crucial to effective erosion-free establishment of the warm-season species on slopes. Several experiments investigating the use of companion plants or weed control for successful native grass establishment are currently in progress. Attempts in establishing the shorter native grasses in three climatic regions of Virginia reinforce the observations above. The established sites [1998 Smart Road sites] are performing well and are a model to the ability of the natives to persist and control erosion once they are established. Plateau (imazapic), an herbicide

that is labeled for use with warm-season native grasses to control annual grassy and some broadleaf weeds remains an effective chemical. However, results from several VDOT areas show that the results can be inconsistent. It is recommended that Plateau not be used if air temperatures are above 85 ^{o}F and/or the soil is droughty. In these instances, use of Plateau may result in injury or death of target plants. Since this product is used in very low amounts per unit area, over-application can result in plant injury and the product will persist in soils for extended periods of time. This product has produced mixed results and **caution** is advised. The results of the experiment in section 10.3 of this report indicate that several other pre-emergent herbicides could be used to suppress annual grassy weeds and enhance establishment success of some native grasses.

Web site for Virginia Roadside Vegetation Research

The web site has been established to post annual reports, research updates, photographs, and to be a vehicle for communication between the researchers and the VDOT personnel in the field.
The web address is:

http://filebox.vt.edu/cals/cropsci/roadside.vegetation/

This site is under continual development and improvement because it is changed based on the user's needs and comments.

1. INTRODUCTION

The current roadside research program continues to fulfill two missions: (1) *to evaluate turfgrass cultivars and other species to ascertain their suitability for use on Virginia roadsides [soil stabilization and persistence]* and (2) *vegetation management studies to determine the optimum methods for successfully establishing and maintaining vegetation for stabilization and aesthetic purposes under variable conditions found on Virginia highway soils.*

Cool season, warm season and native cultivars (varieties) are continually evaluated in trials lasting for three or more years after seeding. This process ensures that new cultivars introduced into the market are evaluated in Virginia environments and the ones selected are best suited to roadside conditions and maintenance protocols. This testing procedure is designed so that the cultivars that the VDOT Seed Specifications for Grasses and Legumes (Form RD-4) document may be periodically updated.

The cultivars that are recommended for inclusion in Form RD-4 have achieved and maintained 70% or greater ground coverage three or more years after being sown. The selected cultivars are designated as “strongly recommended” or “marginally recommended”. Even though all the recommended cultivars meet the 70% density minimum, some cultivars consistently have a higher percentage of ground cover than others in separate tests, and thus are given “strongly recommended” status. Even though the “marginally recommended” cultivars meet the 70% threshold, their performance is not as consistent or vigorous across trial locations as that of the “strongly recommended” cultivars. Therefore, the “marginally recommended” cultivars should only be used after supplies of the strongly recommended cultivars are exhausted. Cultivars that meet a 75% threshold after two years may be designated as “promising”. These cultivars are for emergency use only and are not be included in the recommended list because they have not been tested for the full three years.

Fescue grasses have been the focus of our management research for many years. A strong role on Virginia roadsides exists for this group of adapted grasses because of many years of successful performances. Virginia has several climatic zones and the fescues are used successfully is most areas; however, there are some areas and conditions where certain species and/or combination of species work best. In western regions, [ridge and valley, northern piedmont] with higher elevations and cooler average temperatures, hard fescues consistently dominate mixed stands. Tall fescues establish and persist better in the middle piedmont region to the coastal plain. In these regions the standard mix is 50% tall fescue and 50% hard fescue. This mixture can be used on

over 90+ percent of Virginia for successful erosion control and the maintenance of an aesthetically pleasing ground cover.

Our warm-season native grass research is currently focused on proper establishment methods and variety selection. There are several species of native grasses that could be potentially used successfully on Virginia roadsides. Blue grama establishes rapidly and has shown the ability to compete successfully with annual grassy weeds. Further research regarding blue grama establishment methodology and ecotype adaptability to various climatic regions is underway or planned.

2. DATA RECORDING AND MANIPULATION

Data reported here are visual estimates of percent density **(% of ground covered**) and overall performance of each experiment and demonstration. The use of the overall performance (OP) rating system reflects the general quality of the stand. Most of the data are shown as percent density. Our observation is that plots with a density of 70% generally provide adequate coverage to exclude weeds and control soil erosion. Therefore, plots with 70% or greater density will be considered acceptable for roadside use. The term “70% threshold” will be used to indicate this concept.

The trial and management studies were evaluated in both the fall (late September to November, after the first frost), in late spring (April to May) and in mid summer (late June to late July). These dates allow for observation during a full range of growing conditions.

When statistical analyses were performed, methods from SAS Institute and means separation with Duncan’s Multiple Range Test were employed.

3. GENERAL ESTABLISHMENT AND MANAGEMENT INFORMATION

All of the sites are prepared in the same general manner unless specified. The original vegetation is killed with glyphosate; the site is disked or rototilled, and then seeded and rolled. The site may be mulched with hydro-mulch or straw to control erosion. The cultivars or treatments are arranged in a randomized block design, replicated at least three times. Plot sizes vary but generally are 1.82 m by 2.4 m (6'x8'). The cool season grasses are sown at a rate of 100 lb/A and the warm season grasses are sown at 50 - 60 lb/A. Lime is applied as dictated by a pre-establishment soil test. The fertilizer rates follow VDOT protocol of 300 lb/A of 15-30-15 fertilizer and are mowed four to six times a year depending on location. Herbicides are used only when necessary. All cool-season grass studies are planted in the Fall (September - October) or Spring (Feb -March) unless noted differently. Warm-season grasses are established in the spring (March - May).

4. TURFGRASS CULTIVAR EVALUATIONS - Tall Fescue

Tall fescue has been one of the main turfgrasses of VDOT's plantings. Tall fescue has proven to be a low cost, consistent germinator that persists under difficult conditions and has very good drought survival once fully mature. This combination has proven successful for several decades and the new cultivars are providing improved tolerances to insects and diseases. In the western regions, tall fescue persistence has not been as good as fine fescue persistence, as evidenced by the invasion of "grease grass" *Tridens flavus* into stands of tall fescue throughout Virginia.

4.1. 1999 BLACKSBURG TALL FESCUE TRIALS

Procedure: Thirty-nine cultivars were planted on 17 September 1999 at the Turfgrass Research Center in Blacksburg. The standard planting protocol was followed.

Results and Discussion: The mild winter [1999] and relatively cool and wet summers [2000 -1] provided a nearly stress free period which resulted in all the tall fescue cultivars averaging between 67 -76% ground cover. The data are preliminary [therefore no data presented] and cannot be used for recommendations but helps demonstrate that initial growing conditions have a large influence on establishment.

Table 4.1 Tall Fescue varieties in 1999 Trials

Seed Name	Supplier	Seed Name	Supplier
		TOMAHAWK	Pure Seed Testing
MC2	TMI	JT-3	Jacklin Seed
BRAVO	LESCO	HOUNDDOG 5	CEBECO - Int'l Seed
LARAMIE	LESCO	BRANDY	Jacklin Seed
ADVENTURE II	TMI	PRIDE	CEBECO - Int'l Seed
LANCER	LESCO	KITTYHAWK SST	Smith Seed
AVANTI	TMI	WOLFPACK	Pure Seed Testing
COMSTOCK	Smith Seed	ARID 3	Jacklin Seed
DL / SP	ABT - Zajac	AZTEC II	TMI
STETSON	LESCO	TSD	TMI
JT-1	Jacklin Seed	APACHE II	Pure Seed Testing
R594E - 97	Pure Seed Testing	ANTHEM 11	TMI
JT -2	Jacklin Seed	MILLENNIUM	TMI
CORONADO GOLD	Pure Seed Testing	SR 8300	Seed Research
SCORPION	ABT - Zajac	GRANDE	Seed Research
ARID II	Jacklin Seed	REGIMENT	Seed Research
CISI - TF23	CEBECO - Int'l Seed	ARABIA	Jacklin Seed
JT -4	Jacklin Seed	TULSA	Seed Research
TARHILL	Pure Seed Testing	BONANAZA II	Seed Research
PIXIE	Jacklin Seed	CREWCUT	Seed Research

4.2. 1999 ORANGE TALL FESCUE TRIALS

Procedure: Thirty-nine cultivars were planted on 14 September 1999 at the Orange County Research Center. This experiment is identical to the Blacksburg planting and is designed to determine if the cultivar's performance would differ between two Virginia climatic regions.

Results and Discussion: The mild winter [1999] and relatively cool and wet summers [2000-1] caused all the tall fescue cultivars to increase from between 77 - 90% to 82 - 100% ground coverage. The data are preliminary [therefore no data are presented] and cannot be used for recommendations but helps demonstrate the initial growing conditions have a large influence on establishment.

4.3 2001 PETERSBURG TALL FESCUE TRIALS

Procedure: Thirty-one cultivars were planted on 14 November 2001 at the Petersburg research site. This experiment is identical to the Roanoke planting and is designed to determine if the cultivar's performance would differ between two Virginia climatic regions.

Table 4.3 Tall Fescue varieties in 2001 Trials

Seed Name	Supplier	Seed Name	Supplier
Arabia	Simplot - Jacklin	Millennium	TMI, Inc.
Arid 3	Simplot - Jacklin	Mustang 3	
Arid II	Simplot - Jacklin	Olympic Gold	Turf Seed
Aurora Gold	Turf Seed	Pure Gold	Turf Seed
Barlexas	Barenbrug USA	Quest	Simplot - Jacklin
Barrera	Barenbrug USA	Southeast	Landmark Seed
Barrington	Barenbrug USA	SR 8210	Seed Research
Bravo	Lesco, Inc	SR 8250	Seed Research
Coronado Gold	Turf Seed	SR 8500	Seed Research
Coyote	Landmark Seed	SR 8600	Seed Research
Crewcut II	Seed Research	Stetson	Lesco, Inc
Dynasty		Tar Heel	Turf Seed
Endeavor	Turf Seed	TF 66	Barenbrug USA
Focus	TMI, Inc.	Tracer	Barenbrug USA
Grande	Seed Research	Wolfpack	Turf Seed
Maximize	Turf Seed		

5. TURFGRASS CULTIVAR EVALUATIONS - Fine Fescue

Fine fescues combined with tall fescue have been a standard seeding mixture used by VDOT for many years. The fine fescues tend to work best in the cooler regions of Virginia while the tall fescues perform best in the

piedmont and upper coastal plain. The combination of both species provides a wider range of adapted areas [soil, climate and light] than either single component. Fine fescue is a term which includes four species or subspecies within the genus Festuca: hard fescue (HF) (*Festuca longifolia*), Chewings fescue (CF) (*Festuca rubra* var. *commutata* Gaud.), creeping red fescue (CRF) (*Festuca rubra rubra*, also referred to as strong creeping fescue), sheep fescue (SF) (*Festuca ovina*) and slender creeping red fescue (SCRF) (*Festuca rubra trichophylla*). Authorities consider them genetically different, but it is often difficult to tell them apart. However, our studies reveal that the hard fescues tend to outperform the other fine fescue species in Virginia.

5.1. 1999 BLACKSBURG FINE FESCUE TRIALS

Procedure: Fifteen fine fescue cultivars were planted at the turfgrass research center in Blacksburg on 17 September 1999. The area received an application of pelletized lime [20 lb per 1000 ft^2] and 300 lbs of 15-30-15 fertilizer per VDOT standards.

Results and Discussion: The mild weather resulted in all but one cultivar being above the 70% threshold. This is an improvement over last year when four cultivars were below 70%. The soil at the Blacksburg site is a loam with good depth, which also contributed to the good establishment. The data are preliminary [therefore no data are presented] and cannot be used for recommendations.

Table 5.1 Fine Fescue varieties in 1999 Trials

MX86AE	SHEEP	Jacklin Seed	BRITTANY	CRF	LESCO
QUATRO	SHEEP	CEBECO - Int'l Seed	SHADEMARK	CRF	LESCO
OSPREY	HF	Seed Research	TRAPEZE	CRF	ABT - Zajac
ATTLIA E	HF	TMI	SR 5200 E	CRF	Seed Research
DEFIANT	HF	LESCO	DAWSON	SCRF	Seed Research
MINOTAUR	HF	TMI	INTRIGUE	CHEW	TMI
RESCUE	HF	Jacklin Seed	SANDPIPER	CHEW	Seed Research
SCALDIS	HF	Seed Research			

5.2. 1999 ORANGE COUNTY FINE FESCUE TRIALS

Procedure: Fifteen fine fescue cultivars were planted on 14 September 1999 at the Orange Agriculture Research Center. The seed was planted according to the protocol outlined in section 3. No lime was applied to this site with a clay loam soil. This experiment uses the same cultivars and seeding methods as the fall 1999

Blacksburg fine fescue trial and the combined data will show if the cultivars perform differently in two climatic regions of Virginia.

Results and Discussion: All cultivars are above the 70% threshold. The weather after seeding was very favorable for germination and the mild winter combined with the cool wet summer provided outstanding growing conditions. The data are preliminary [therefore none are presented] and cannot be used for recommendations but helps demonstrate that initial growing conditions have a large influence on establishment. This result illustrates why trials are also needed on roadside sites.

5.3. 2001 PETERSBURG FINE FESCUE TRIALS

Procedure: Nineteen cultivars were planted on 14 November 2001 at the Petersburg research site. This experiment is identical to the Roanoke planting [Spring 2002] and is designed to determine if cultivar performance would differ between two Virginia climatic regions.

Table 5.3 Fine Fescue varieties in 2001 Trials

Bridgeport	CHF	Barenbrug USA	Shademaster II	CRF	Turf Seed
Brittany	CHF	Lesco, Inc	SR 5210	CRF	Seed Research
Intrigue	CHF	TMI, Inc.	Defiant	HF	Lesco, Inc
Sandpipers	CHF	Seed Research	Discovery	HF	Turf Seed
SR 5100	CHF	Seed Research	Hardtop	HF	Barenbrug USA
Tiffany	CHF	Turf Seed	Minotaur	HF	TMI, Inc.
SR 7100	COB	Seed Research	Osprey	HF	Seed Research
BAR CF 8 FUS1	CRF	Barenbrug USA	Rescue 911	HF	Simplot - Jacklin
Jasper II	CRF		Scaldis II	HF	Seed Research
Shademark	CRF	Lesco, Inc	SR 3100	HF	

6. TURFGRASS CULTIVAR EVALUATIONS - Kentucky Bluegrass

6.1. 1999 BLACKSBURG KENTUCKY BLUEGRASS TRIALS

Procedure: Fifteen Kentucky bluegrass cultivars were planted on 17 September 1999 at the Turfgrass Research Center in Blacksburg.

Results and Discussion: This location yielded second year results that ranged from 70 - 90 % ground cover. The end of the second year found all cultivars over the threshold. The weather for the first two years after seeding was very favorable for germination and the mild winters combined with the cool wet summers provided outstanding growing conditions. The data are preliminary [therefore none are presented] and cannot be used for recommendations but helps demonstrate that favorable initial growing conditions have a large influence on establishment success.

Table 6.1 Kentucky bluegrass varieties in 1999 Trials

DRAGON	ABT - Zajac
LIVINGSTON	Pure Seed Testing
BLUESTAR	Pure Seed Testing
GINGER	Dye Seed
BLUEMOON	Jacklin Seed
VOYAGER	Pure Seed Testing
DELLWOOD	ABT - Zajac
CHICAGO II	Jacklin Seed
FREEDOM II	Jacklin Seed
NOTTINGHAM	ABT
DENIM	Pure Seed Testing
MERIT	Seed Research
SR 2100	Seed Research
CANON	Seed Research
CYNTHIA	Seed Research

6.2. 1999 ORANGE COUNTY KENTUCKY BLUEGRASS TRIALS

Procedure: Fifteen Kentucky bluegrass cultivars were planted on 14 September 1999 at the Orange county AREC using the standard protocol described in section 3 of this report. This experiment is identical to the Blacksburg planting and is designed to determine if the cultivars perform differently between two different Virginia climatic regions.

Results and Discussion: This location yielded second year results that ranged from 55 - 88 % ground cover with 5 cultivars above the 70% threshold. The mild winter of 1999 and the relatively cool and wet summer of 2000 produced nearly stress free conditions. The data are preliminary [therefore no data are presented] and

cannot be used for recommendations but helps demonstrate that favorable initial growing conditions have a large influence on establishment success.

6.3. 2001 PETERSBURG KENTUCKY BLUEGRASS TRIALS

Procedure: Twenty-seven cultivars were planted on 7 October 1998 at the Petersburg VDOT site located at the intersection of route 460 and interstate 295. This trial was established following the standard protocol described in section 3 of this report This experiment is identical to the Roanoke planting [Spring 2002] and is designed to determine if cultivar performance would differ between two Virginia climatic regions.

Table 6.3 Kentucky bluegrass varieties in 2001 Trials

Baritone	Barenbrug USA	PST B4 246	Turf Seed
Baron	Barenbrug USA	PST B9 35	Turf Seed
Baronie	Barenbrug USA	PST B5 89	Turf Seed
Barzan	Barenbrug USA	PST-A6-214	Turf Seed
BlueStar	Turf Seed	PST-B5-43	Turf Seed
Brooklawn	TMI, Inc.	Shamrock	Lesco, Inc
Canon	Seed Research	SR 2100	Seed Research
Denim	Turf Seed	Unique	
Langara		Voyager	Turf Seed

7. PERENNIAL RYEGRASS TRIALS AND MISCELLANEOUS COOL SEASON VARIETY TRIALS

7.1. 2001 PETERSBURG PERENNIAL RYEGRASS TRIALS

Procedure: Twenty-seven cultivars were planted on 7 October 1998 at the Petersburg VDOT site located at the intersection of route 460 and interstate 295. This trial was established following the standard protocol described in section 3 of this report. This experiment is identical to the Roanoke planting [Spring 2002] and is designed to determine if the cultivar's performance would differ in to two Virginia climatic regions.

Table 7.1 Perennial ryegrass varieties in 2001 Trials

Allsport	Lesco, Inc	Pinnacle II	Barenbrug USA
ASAP	Simplot -Jacklin	Pirouette	Barenbrug USA
Barlennium	Barenbrug USA	Pizzazz	TMI, Inc.

Goalkeeper	Simplot - Jacklin	Premeir II	Barenbrug USA
Legacy II	Lesco, Inc	Prospect	Lesco, Inc
Linedrive	Lesco, Inc	Prosport	Lesco, Inc
Peak	Barenbrug USA		

7.2. 2001 MISC COOL SEASON TRIALS

Procedure: Eleven cultivars of various cool season grasses were planted on 7 October 1998 at the Petersburg VDOT site located at the intersection of route 460 and interstate 295. This trial was established following the standard protocol established by VDOT and designed to evaluate non-standard grasses. This experiment is identical to the Roanoke planting [Spring 2002] and is designed to determine if the cultivar performance would differ between two Virginia climatic regions.

Table 7.2 Misc. Cool Season varieties in 2001 Trials

Barkoel	Barenbrug USA	Praire Junegrass [Koleria macrantha]
Barleria	Barenbrug USA	Praire Junegrass [Koleria macrantha]
Elsie	Turf Seed	Orchardgrass [Dactylis glomerata]
Megabite	Turf Seed	Orchardgrass [Dactylis glomerata]
Pro Am	Lesco, Inc	Rough bluegrass [Poa trivalias]
Barpressa	Barenbrug USA	Canadian Bluegrass [Poa compressa]
SR 7100	Seed Research	Colonial Bentgrass [Agrostis capillaris]
Golfstar	Simplot -Jacklin	Idaho Bentgrass [Agrostis idahoensis]
Barcampsia	Barenbrug USA	Tufted Hairgrass [Deschampsia caespitosa]
SR 7200	Seed Research	Velvet Bentgrass [Agrostis canina]
Bar WB01	Barenbrug USA	Velvet grass [Holcus lanatus]

8. WARM SEASON VARIETY TRIALS

8.1. 2001 Warm season grass trials in Hampton Roads

Warm season grass trials [2000] in Hampton Roads and Culpeper were initiated and some preliminary germination data were gathered. The Hampton Roads experiment was terminated because of existing bermudagrass infestation and the area was sprayed with glyphosate several times during August and September to kill the existing bermudagrass. New trials were planted on May 1, 2001 with 15 bermudagrass, 5 zoysiagrass, 7 buffalograss, 1 centipedegrass and 2 bahiagrass cultivars. The buffalograss was planted at 40 lb PLS (pure live seed) per acre and all others were planted at 50 lb (bulk) per acre. The grasses established well in the wet mild summer. All but one bermudagrass were above the 70% level with most in the 90% range. Two of the zoysia grasses reached the 70% range with the others less than 63%. None of the buffalograss was above 60% with most below the 40% level; this result was not unexpected because buffalograss is known for its slow germination and spread. A surprise is the outstanding performance of the centipedegrass with a cover of 90%, while both of the bahiagrasses were below 22% cover.

Table 8.1 Warm Season varieties in 2001 Trials

AU Sand Mtn	SRO	Bahia	Cody-pb-c	Pawnee-Buttes	Buffalo
Riba	SRO	Bahia	Sharp Shooter	Sharp Bros	Buffalo
Barmuda	Barenbrug	Berm.	Sharp's Imp2	Sharp Bros	Buffalo
Sahara	Barenbrug	Berm.	PennBuf	SRO	Buffalo
Majestic-c	Bermuda Ind.	Berm.	Bison	Stock Seed	Buffalo
U-3	Bermuda Ind.	Berm.	Cody-st-c	Stock Seed	Buffalo
Jackpot	Jacklin	Berm.	Texoka	Stock Seed	Buffalo
Southern Star	Jacklin	Berm.	Centipede	Patten Seed	Centipede
Sun Devil 2	Jacklin	Berm.	Cathay	Jacklin	Zoysia
Sunstar	Lesco	Berm.	Zenith	Patten Seed	Zoysia
Mohawk	Seeds West	Berm.	Campanion	SRO	Zoysia
Sydney	Seeds West	Berm.	Del Sol	TMI	Zoysia
990210H	SRO	Berm.	Zen 300	TMI	Zoysia
SR9554	SRO	Berm.			
Yukon	SRO	Berm.			
Savannah-c	Turf-Seed	Berm.			
Sungrazer		Berm.			

8.2. 2001 Warm season grass trials in Culpeper

The 2000 warm season grass trials in Hampton Roads and Culpeper were initiated and some preliminary germination data were gathered. Inconsistent establishment was caused by poor germination conditions immediately following seeding and the 2000 trial was terminated. New trials were planted on April 18, 2001 with 14 bermudagrass, 5 zoysiagrass, 7 buffalograss, 1 centipedegrass, 2 bahiagrasses and 1 blue grama cultivar. The preliminary results are similar to the Hampton Roads experiment. The bermudagrasses were generally in the 80% range except one at the 37% level. Overall the coverage was less than HR, which is expected in the cooler Culpeper [upper piedmont] region. One zoysiagrass did very well [95%] while the others were less than 15%. The centipede managed a respectable 66% while the blue grama averaged 94% coverage.

9. MANAGEMENT STUDIES

9.1 The Effect of Mowing Regimes on the Establishment and Persistence of Fine Fescue - Fall 1997

Objective: To determine the effect of mowing frequency on the persistence of hard, Chewings and tall fescue.

Procedure: A relatively flat site in Blacksburg at the Turfgrass Research Center was selected in the fall of 1997. The previously established vegetation was destroyed with glyphosate. The site was disked, rototilled and fertilized in the fall of 1997[1]. Lime was not required (pH 7.2). Monostands of hard, Chewing's and Tall fescue were sown at 100 lb/A on 8 September 1997. The treatments were arranged in a randomized split block design and replicated four times using 10' X 8' plots. Garlon 3A™ (2.7 qt/A) was applied in the spring of 1998 to control broadleaf weeds. Beginning in the spring of 1998, the designated plots were mowed either once, twice, or thrice a year with the residue left on the plots. Some plots were not mowed until after the first, second or third year. Data were recorded prior to the initial mowing and recorded in the fall and spring each year.

Results and Discussion: All the grasses were well established by the first mowing in the spring of 1998. The data are presented in Table 9.1. The density of all the species increased over the summer. By the winter of 1998 all of the fine fescue plots attained a density greater than 90% and all of the tall fescue plots had a density greater than 86%. Mowing regime had little affect on the turfgrass density. Two observations are of interest: 1) the turfgrasses that were mowed on May 15 and again on July 15 were relatively free of seedheads in September 1998 (reconfirming Dr. Blaser's past recommendations to let the tall fescue go to seed in the spring before mowing which results in removal of the apical meristem from the reproductive tiller; the result being a stand of vegetative (clean-looking) tillers for the remainder of the season); and 2) in July of 1999 after an extended drought and temperatures in the 80-90's, the Chewings fescue foliage color was rated a 3 while the two other species rated 6 (1-9, 9=best color). The turf that was never mowed, especially the Chewings fescues, showed weed infestations during the summer of 2000. The clippings left on the mowed plots may have provided enough fertilizer value to encourage new growth and help maintain density so as to have prevented weeds from taking hold. Additional data on weed density will be taken in 2002 to confirm this observation.

[1]Fertilizer, 15-30-15, at rate of 682 kg/ha (600 lb/A)

<u>TABLE 9.1</u> Mowing Study - Blacksburg, planted 8 September 1997 at a rate of 100 lb per acre and mowing treatments started the following spring. The data represents the percentage of ground cover [density] and average of four replications The mowing regime shows when the plots were mowed or not mowed.

			% Ground Cover					
	Treat #	**Mowing Regime**	**April '98**	**Sept '98**	**Dec '98**	**Dec '99**	**Jun '00**	**Jun 01**
Chewings Fescue	**1**	**May '98 & '99**	**70**	**95**	**95**	**88**	**88**	**85**
	2	**May + Sept '98 & '99**	**74**	**98**	**95**	**89**	**89**	**87**
	3	**May, July + Sept '98 & '99**	**73**	**95**	**95**	**95**	**87**	**88**
	4	**May '99**	**69**	**96**	**95**	**91**	**78**	**81**
	5	**Never Mowed**	**70**	**94**	**95**	**95**	**81**	**88**
		Average per time	71	95	95	92	88	86
Hard Fescue	**1**	**May '98 & '99**	**68**	**95**	**95**	**100**	**89**	**91**
	2	**May + Sept '98 & '99**	**79**	**94**	**94**	**95**	**90**	**91**
	3	**May, July + Sept '98 & '99**	**71**	**98**	**95**	**98**	**95**	**90**
	4	**May '99**	**74**	**98**	**95**	**98**	**90**	**90**
	5	**Never Mowed**	**74**	**96**	**95**	**94**	**79**	**90**
		Average per time	73	96	95	97	90	90
Tall Fescue	**1**	**May '98 & '99**	**61**	**93**	**89**	**84**	**82**	**90**
	2	**May + Sept '98 & '99**	**63**	**91**	**89**	**80**	**86**	**89**
	3	**May, July + Sept '98 & '99**	**60**	**93**	**90**	**83**	**91**	**87**
	4	**May '99**	**56**	**89**	**86**	**85**	**83**	**87**
	5	**Never Mowed**	**64**	**89**	**88**	**79**	**79**	**85**
		Average per time	61	91	88	82	81	88

Average per time = average of all data per observation date

9.2 The Influence of several commercial biostimulants, seaweed and humic acid extracts and molasses on tall fescue establishment

Objective: To determine if certain biostimulants and supplements would increase germination or early stand survival using a simulated hydro seeding application.

Procedure: A poor soil [clay B-horizon with little available P] at the turfgrass research center in Blacksburg was used for this experiment. The area was glyphosated and roto-tilled twice prior to the experiment. The design was a randomized complete block with 4 replications and plots 6' X 6'. Coyote tall fescue was the grass seed used. The followed a standard VDOT protocol: 100 lb/A seed, 300 lb/A of 15-30-15 fertilizer and 1500 lb/A of fiber mulch. To simulate a hydro seeder the seed, fertilizer, biostimulant and water for each plot were mixed in a 2-liter container and allowed to stand for 30 minutes before application. A measured amount of pre-moistened paper/wood fiber mulch was applied over each plot by rubbing it through a hardware cloth screen over each plot to assure even distribution. The experiment was planted on 15 July 2001 and weeds were controlled manually. The plots received irrigation to allow germination and to prevent wilting of the seedlings. The treatments were: seaweed extract, humic acid extract, seaweed plus humic acid, molasses, an untreated control and four commercial biostimulants.

The plots were visually rated for germination and chlorophyll activity was measured with a dual wavelength florometer. Plugs [6" diameter and 6" deep] were pulled in September, placed in plastic pots and allowed to dry under a rainout shelter to measure early stand tolerance to drought.

Results and Discussion

No treatment significantly improved the germination or the chlorophyll activity of tall fescue. There were no differences in wilting among the treatments or control when the cores were allowed to dry or when re-watered and allowed to dry a second time.

Conclusion:

None of the treatments improved the germination or enhanced the drought tolerance of tall fescue when planted in mid summer.

10. NATIVE GRASS RESEARCH

10.1 Demonstration - Preliminary Evaluation of Native Grasses for Roadside Use - Spring 1997

Procedure: Twenty types of native grasses were sown in 10' X 10' blocks as a demonstration. These grasses were established in the Valley & Ridge (Blacksburg) region in the late spring of 1997. All varieties examined were seeded and established according to information gathered from the literature and seed sources.

Results and Discussion:

The Blacksburg demonstration continues to perform well. At end of 2001 all of the plots were had 80-95% cover. The growth of the warm-season grasses in the first year was generally sparse, but by the second year, the mature grasses produced seed. By the third year several of the stands had some invasion from seeds blown in from neighboring plots. The largest invaders were little bluestem and Indiangrass. This may restrict the use of these species to areas where their spread is acceptable. During the early spring of 2000 and 2001 the entire demonstration area was mowed to a 5" height and the residue removed. An observation was that by the middle of the summer all the varieties were back to full height with the lone exception of 'Blaze' little bluestem [18" tall] and which produced only 10 % of the seedheads that another cultivar in this demonstration produced.

Seasonal changes for the warm-season grasses were observed in Blacksburg, with the grasses going dormant [turned brown] in late November and beginning to sprout new leaves by the middle of April. In the winter of 1998-99 and 99-00 the dead foliage was not removed. Only the big bluestem's stalks lodged under the ice and snow. The little bluestem, Indiangrass and switchgrass foliage stood up the entire winter. The spring growth the following year quickly covered the decaying biomass so that by mid-May the old growth was evident.

The native cool-season grasses were generally easier than the warm season grasses to seed and establish. The *Koleria* grows to 5" high, is dark green and was adapted to dry sites and would be a good selection for the clear areas adjacent to the roadside but the establishment rates are very slow. The wildryes and western wheatgrass are too tall for the clear areas next to the roadside but may be good candidates for use in areas beyond the clear zone. The Canada and Virginia wildrye reach 4-5' tall and offer showy seedheads. They may also do well in flower plantings as a companion and offer winter interest. The Virginia wildrye did not tolerate the drought in 1999 as well at the Canada wildrye, but literature indicates that Virginia wildrye would be a good plant in wet areas.

Western wheatgrass becomes 3' tall, upright, wire-like and very blue-green/silver in color. The pubescent western wheatgrass 'Manska' established easily and has persisted well in the Blacksburg region, but

it should not be used on the roadside. Previous observations indicated that 'Manska' seeded readily and might be invasive; however, in the year following a spring mowing, few seedheads were evident. An area for future research would be to test the persistence of some of the 'taller' native grasses under a mowing regime to determine if they may be suitable for use closer to the roadway if mowed regularly.

The buffalograss and blue grama, the shortest of the native warm-season short-grass group, are strong candidates for use in the clear zone because of their short growth habit. They both have a very similar appearance and will grow up to 1 foot tall on a good site. The blue grama can germinate in four to six days and provide a quick cover under ideal conditions. The buffalograss will germinate in ten to fourteen days and produces stolons after the plant is established. They are found together in nature and make good companions. In Blacksburg, during the cool wet summer of 2000 the buffalograss and blue grama never reached the point where new growth covered the old to produce a 100% green stand. In 2001 both stands were reduced by the wet conditions and disease. These 'shorter' natives are more difficult to establish because their slow and low growth in the first year allows weeds to effectively out-compete them. An herbicide, mowing and companion crop protocol is under development to find a combination that will allow these native grasses to consistently establish and provide erosion control.

The taller grasses of the short-grass category are sideoats grama and little bluestem. The sideoats has a plain appearance, grows to 12 to 24", and is a good companion with little bluestem. The little bluestem has vertical stems, which are silver-blue in the summer and bronze in the fall, and grows to 18 to 36 inches.

The tall grass warm-season species that have done well at the Blacksburg site are big bluestem and Indiangrass. They both are about 6' tall with attractive seedheads and should be used in areas away from the roadside because of the large amount of aboveground foliage produced, which is dry during the late fall through late spring, creating an unacceptable fire hazard. Indiangrass seed heads are distinctive when they turn golden/red in the fall. Switchgrass is a “sleeper” in establishment behavior. The first year it is difficult to distinguish from the weeds, but the next year it becomes obvious.

During the first two years Plateau (4oz/A) was applied yearly [in spring] to the warm-season grasses and 2,4-D (4 oz/1000 ft. sq.) was applied to both cool- and warm-season grasses to control broadleaves and crabgrass. The tall species shaded out the weeds fairly well by the end of the second year. The success of establishment of the native warm-season grasses depends on the severity of weed pressure. In Blacksburg, no herbicides were used during 2000 or 2001 and the only control measures taken were some hand cutting of the big bluestem and indiangrass out of the short grass species. There was very little broadleaf weed growth (less than 5 plants in a 10' X 10' plot) and all of it was in the sideoats grama or buffalograss plots.

10.2 Screening of Pure and Mixed Stands of Short and Tall Native Grasses

Objective: The goal of this study was to determine the adaptation and persistence of selected native grasses to the Valley and Ridge region of Virginia when seeded on a newly constructed slope in Montgomery County, Virginia.

Methods and materials: Pure and mixed stands of short [Table 10.2A] and tall [Table.10.2C] warm-season native grasses were sown on April 28, 1998 on a newly cut roadside slope of the Smart Road Project. Located in Montgomery County, just east of Blacksburg, Virginia the rocky north-eastern facing 2:1 slope with an elevation of 638 meters and a soil pH of 8.0 was divided into 10' by 10' plots. The experiment used a randomized block design with 3 replications. The seed was sown by hand. A companion plant, *Coreopsis tinctoria,* was seeded into designated plots at 2.25 lbs/A. Fertilizer, 44 lb nitrogen/A from a sulfur coated urea, 600 lb phosphorus/A from 0-46-0, and 87 lb potash/A from 0-0-60 were applied. The site was then covered with hydromulch (1500 lb/A). By late spring the site had developed several deep rills due to the steep slope, inadequate vegetative cover and the frequent severe storms that plagued the area soon after the seed was sown. **Thus, extra measures were taken to retard soil erosion**. In July 1998, 2,000 lbs/A of straw was blown onto the plots and 20 lbs/A of German millet (*Setaria italica*), 300 lbs/A of 15-30-15 and 1000 lbs/A of paper mulch were applied with a hydraulic seeder. In the spring of 1999 and 2000 glyphosate was applied to selectively control the few large broadleaf weeds. In July 1999 sulfur coated urea (45 N lb/A) was applied. The data collected were the percentage of ground covered by the different species.

Table 10.2A ***Native Warm Season Grass Screening Trial in Blacksburg, VA. The SHORT native grasses seeding rates. PLS means the seeding rate is based on pure live seed and BULK means seeding rate is based on bulk rate.***

	Bulk Lbs Per Acre	Lbs PLS Per Acre
Buffalograss 'Cody'		44.00
Blue grama		11.00
Sideoats grama		23.00
Little bluestem 'Little Camper'		17.00
Hard and Tall Fescue (1:1)	100.00	
Buffalograss 'Cody' + little bluestem 'Little Camper'		44.00 8.00
Buffalograss 'Cody' + blue grama		44.00 5.00
Buffalograss 'Cody' +sideoats grama		44.00 11.00
Little bluestem 'Little Camper' + blue grama		17.00 5.00
Little bluestem 'Little Camper' +sideoats grama		17.00 11.00
Buffalograss 'Cody' + little bluestem 'Little Camper' + blue grama		44.00 8.00 3.00
Buffalograss 'Cody' + little bluestem 'Little Camper' +sideoats grama		44.00 8.00 11.00

Results of the short native grass: The northeast-facing site that was used for this study was a very rocky 2:1 slope. Additional factors contributed to the difficulty of establishing vegetation on this site. Montgomery County experienced a drought from August to October in 1998 and a severe drought in the summer of 1999. The short native grass percentage ground cover [density] on the slopes was slower to develop than the standard tall/hard fescue plots. [Table 10.2B]. A year after sowing [May 99], all of the short-grass entries exceeded 50% cover with 7 of 12 exceeding 70%; however, density declined after the severe drought in the summer of 1999 [Dec 99]. All of the entries, except sideoats grama, rebounded by the next year to be close to or exceed previous high densities [Jun 00]. The little bluestem and sideoats grama plots only had coverage in the 40% range, significantly less than the other species. The standard mix [hard and tall fescue] was superior to the native species until the second year. Two years after seeding the buffalograss/blue grama mix had the most cover of any short grass species; in fact, any mix that included either buffalo and/or blue grama was statistically and numerically similar to the fescue mix plots with 73.3% ground cover. The third year showed

increases in percentage cover in all plantings except the little bluestem/sideoats grama plots. Also, after three years the buffalograss plots average cover [86.7%] was numerically superior to the fescue mix [85.0%]. The sideoats grama, little bluestem and side oats/little bluestem average ground cover were less than 70% and statistically less than the other short grass species tested.

Table 10.2B Screening of warm season SHORT native grasses in Blacksburg, Va. Seeded 28 April 1998 on a NW facing cut slope. The data presented are the percentage of ground cover, the average of three replications.

	Percent of Ground Cover				
Plants	**Nov-98**	**May-99**	**Dec-99**	**Jun-00**	**Jul-01**
Buffalograss 'Cody'	**48.3BD**	**65.0CE**	**66.7A**	**73.3A**	**86.7A**
Blue grama	**56.7AB**	**83.3AB**	**66.7A**	**73.3A**	**76.7AB**
Sideoats grama	**35.0D**	**56.7DE**	**50.0AC**	**41.7C**	**53.3B**
Little bluestem 'Little Camper'	**38.3CD**	**51.7E**	**33.3C**	**46.7BC**	**66.7AB**
Hard and Tall Fescue (1:1)	**68.3A**	**86.7A**	**70.0A**	**73.3A**	**85.0AB**
Buffalograss /L bluestem	**51.7BC**	**65.0CE**	**60.0AB**	**66.7A**	**70.0AB**
Buffalograss /blue grama	**55.0AB**	**75.0AC**	**60.0AB**	**73.3A**	**80.0AB**
Buffalograss/sideoats	**53.3AC**	**73.3AC**	**53.3AB**	**73.3A**	**71.7AB**
Little bluestem/blue grama	**58.3AB**	**70.0BD**	**63.3AB**	**73.3A**	**75.0AB**
Little bluestem /sideoats	**35.0D**	**65.0CE**	**43.3BC**	**53.3AC**	**53.3B**
Buffalograss/L bluestem/blue grama	**58.3AB**	**83.3AB**	**63.3AB**	**63.3A**	**73.3AB**
Buffalograss/L Bluestem/sideoats	**48.3BD**	**81.7AB**	**63.3AB**	**56.7AC**	**70.0AB**

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

Table 10.2C Native Warm Season Grass Screening Trial in Blacksburg, VA. The TALL native grasses seeding rates. PLS means the seeding rate is based on pure live seed and BULK means seeding rate is based on a bulk rate.

Plants	Bulk Lbs per Acre	Lbs PLS seeds per Acre	
Big bluestem 'Niagara'		13.20	
Indiangrass		12.40	
Switchgrass 'Blackwell'		5.60	
Deertongue 'Tioga'		5.60	
Big bluestem 'Niagara' + Indiangrass		6.60 6.20	
Switchgrass 'Blackwell' + deertongue 'Tioga'		2.80 2.80	
Hard fescue 'Nordic'	100.00		
Tall fescue 'Eldorado'	100.00		

Results of the tall native grass species: The first year ended with only the two standards, hard fescue and tall fescue, achieving a ground cover of greater that 70% [TABLE 10.2D]. The best tall native species was big bluestem/indiangrass [50%]. The density of the tall native grass improved the second year. As expected, the switchgrass and big bluestem were the best native species at the end of second year with averages of 33% and 50%. However, all species did not rival the density of the tall or hard fescue at 60% and 83%. The third year ended with only one native, big bluestem, having a ground cover over 60%. Hard fescue density increased to 90% while the tall fescue decreased to 52%.

Table 10.2D Screening of warm season TALL native grasses in Blacksburg, Va. Seeded 28 April 1998 on a NW facing road cut slope. The data presented are the percentage of ground cover, average of three replications.

Percent of Ground Cover

Plants	Jul-98	Aug-98	May-99	Dec-99	Jun-00	July-01
Big bluestem 'Niagara'	40.0CD	36.7BC	55.0B	36.7B	50.0BC	61.7AB
Indiangrass	30.0DE	35.0BC	45.0B	23.3B	16.7E	25.0B
Switchgrass 'Blackwell'	30.0DE	43.3BC	48.3B	36.7B	33.3CE	46.7B
Deertongue 'Tioga'	28.3DE	30.0C	50.0B	23.3B	16.7E	28.4B
Big bluestem/indiangrass	50.0BC	51.7B	45.0B	36.7B	43.3BD	56.7AB
Switchgrass 'Blackwell'/deertongue	20.0E	26.7C	56.7B	30.0B	26.7DE	43.3B
Hard fescue 'Nordic'	66.7A	71.7A	78.3A	80.0A	83.3A	90.0A
Tall fescue 'Eldorado'	60.0AB	75.0A	83.3A	63.3A	60.0B	51.7B

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

Discussion: The short native species developed a greater percentage of ground cover much quicker than the tall native species. The taller grass species generally take a longer time to develop above ground biomass than the shorter species. The native species developed ground cover slower than would be acceptable for soil stabilization and would require additional erosion control measures. Companion plants or fiber blankets would be necessary on erodable sites when native plants are to be established. A companion plant, *Coreopsis tinctoria*, was sown at establishment, but the drought conditions did not allow sufficient numbers of the Coreopsis or the German millet to mature and provide any real measure of soil stabilization.

The percentage ground cover of the short native mixtures was dominated by either blue grama or buffalograss by the end of the third year. The sideoats grama persisted only in the pure stands and contributed less than 5% in all other combinations. The buffalograss was starting to invade adjacent plots, especially the plots down slope. The tall grass mixtures were dominated by big bluestem or switchgrass with both starting to seed into other experimental plots. The mixture of hard and tall fescue was 95% hard fescue by the end of the third year. Additional indications of hard fescue adaptation are the increase in density in the pure hard fescue plots and the decline in the pure tall fescue plots. **The establishment of the short native species was helped by the lack of competition from annual grassy weeds. This situation would be expected in newly created "cut" slopes, but would not hold true for "fill" or sites with existing vegetation**.

Table 10.2E Scientific names of the native grass species used in this experiment

Buffalograss *Buchloe dactyloides* VAR. 'Cody'
Blue grama *Bouteloua gracilis*
Sideoats grama *Bouteloua curtipendula*
Little bluestem *Schizachyrium scoparium* VAR. 'Little Camper'
Big bluestem *Andropogon gerardii* VAR. 'Niagara'
Indiangrass *Sorghastrum nutans* Switchgrass *Panicum virgatum* VAR. 'Blackwell'
Deertongue *Dichanthelium clandestinum* Hard fescue *Festuca longifolia 'Nordic*
Tall fescue *Festuca arundinacea* VAR. 'Eldorado'

10.3 The Effects of Pre-emergent Herbicides on Six Species of Native Grasses.

Objective: To determine the best pre-emergent herbicide to use in the successful establishment of several different native grasses

This experiment was conducted to test the effects of eight pre-emergent annual grass herbicides on establishment of six native grass species over two years. Competition from annual grassy weeds for light, water and nutrients is a major obstacle in the successful establishment of slower establishing native grass species in the first two years following seeding. This situation is particularly important when the native grasses are planted where existing vegetation has been eliminated. The herbicides used were Imazapic-Plateau®, Quinclorac-Drive 75®, Dithiopyr-Dimension®, Pendimethalin-Pendulum®, Oxadiazon-Ronstar®, Prodiamine-Barricade®, Metsulfuron-Escort® and an untreated control. The label rates were used.

The eight pre-emergence treatments applied on 15 May 2000 were: [Table 10.3A]

Plateau -2 oz product per acre	Drive 75 - 1 lb product per acre
Pendulum 60 DF - 1.5 lb ai per acre	Dimension 1 EC - 0.25 lb ai per acre
Ronstar 2 G - 1.5 lb ai per acre	Barricade 65 DF - 0.375 lb ai per acre
Escort 60 DF - 0.1 oz product per acre	Control or check

The native grass species planted were Buffalograss (*Buchloe dactyloides*), Blue grama (*Bouteloua gracilis*), Sideoats grama (*Bouteloua curtipendula*), Little bluestem (*Schizachyrium scoparium*), Big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*) and Switchgrass (*Panicum virgatum*).
A site in Blacksburg Virginia with poor soil was used for this replicated experiment. The initial treatments were applied on 15 May 2000 with seeding on 16 May 2000. Herbicides only were applied in the second year on 17 April 2001. This experiment uses a split block design. The experimental area was randomly divided into 18 **blocks** of 12' X 48' with each block subdivided into 8 **plots** of 12' X 6'. Each grass species was replicated three times using three randomly selected blocks. Each herbicide treatment was replicated three times per grass species using a randomly selected plot within a species block. The treatments were applied and the grasses seeded the next day. The area received 0.75 inches of rain within 5 days of application. The experiment did not receive any supplemental irrigation; however, the summers of 2000 and 2001 **were exceptionally wet and cool**. The area used has a very clayey soil that is phosphorus poor. The area was fertilized with 2.0 lb P/1000 ft^2 from 0-46-0 and 2 lb/1000 ft^2 of potassium from 0-0-50. No nitrogen was applied because it would benefit the existing weed more that the slower growing native grasses.

Results:

Tables 10.3B, 10.3C and 10.3D

Plateau® generally maintained control of the weed population longer than the other herbicides and allowed the highest percentage of **little bluestem**, **big bluestem** and **indiangrass** groundcover by the end of one year. Plateau also significantly helped **blue grama** and **buffalograss**. It also aided the establishment of **blue grama** and **indiangrass.** Data from the end of the second year changed slightly with only the **little bluestem** and **blue grama** plots with the highest percentage of cover. However, imazapic treated **big bluestem, indiangrass** and **buffalograss** stands were significantly helped in the second year. The data shows a negative impact on the establishment of **switchgrass**.

Ronstar® helped in the establishment of almost all the native grass species in this experiment. Oxadiazon treated plots had the highest ground cover percentage of **blue grama** and **switchgrass** in the 2000. In 2001 this trend continued and the Ronstar treated plots of **switchgrass, indiangrass** and **big bluestem** had more cover that other treatments. Stands of **buffalograss** and **blue grama** improved with application of oxadiazon. The only native grass that Ronstar 2G did not substantially help was **little bluestem**.

Drive 75® generally provided the second longest control of the weeds and helped establish **buffalograss, blue grama, little bluestem** and **indiangrass**.

The third most effective herbicide in the control of weeds in this experiment was Pendulum®. It helped in the establishment of **buffalograss** and hindered **blue grama, little bluestem** and **indiangrass** in both years of the Dimension® provided good weed control at the end of each year but did not statistically help any species and greatly hindered the germination of most native grass species tested.

Barricade® improved **switchgrass** establishment [in percentage only] and was little or no help to the rest of the native grasses tested.

Escort® had the shortest control time of the weeds and allowed germination of all the native grasses. After 12 weeks there was no noticeable weed control and all but **blue grama** species had a reduction in density as a result of weed competition.

The control initially had the best percentage of germination but the native grasses were quickly reduced by the weed competition.

Table 10.3A Native Warm Season Grass Screening Trial in Blacksburg, VA. The SHORT native grasses seeding rates. PLS means the seeding rate is based on pure live seed and BULK means seeding rate is based on bulk rate.

Six grasses	VARIETIES		SEED RATES	CULTIVARS		Pre-emergent Herbicides			
			PLS / A			Treatments:			RATE
A	Buffalograss		30	Cody		**1**	Plateau SC		2 oz product per acre
B	blue grama		15	Hachita		**2**	Drive 75 DF		1 lb product per acre
C	little bluestem		15	Niagara		**3**	Pendulum 60 DF		1.5 lb ai per acre
D	Switchgrass		10	Blackwell		**4**	Dimension 1 EC		0.25 lb ai per acre
E	Indiangrass		12	Tomahawk		**5**	Ronstar 2 G		1.5 lb ai per acre
F	big bluestem		18	Aldous		**6**	Barricade 65 DF		0.375 lb ai per acre
						7	Escort 60 DF		0.1 oz product per acre

This site will be maintained with the native grasses to provide materials for future research

Table 10.3B Native Warm Season Grass Screening Trial in Blacksburg, VA. The SHORT native grasses seeding rates. PLS means the seeding rate is based on pure live seed and BULK means seeding rate is based on bulk rate.

BUFFALOGRASS												
Aug-00		***Treated on 16 May 2000***				**Sep-01**		***Retreated on 17 April - no seeding***			
		Seeded on 16 -17 May 2000									
	TARGET %	Treatment		WEED %			TARGET %	Treatment		WEED %	
	Mean	Number		Mean			Mean	Number		Mean	
A	10.00	2		8.67	E	A	26.67	3		40.00	D
B	7.33	1		3.33	E	A	23.33	5		38.33	C
AB	6.67	5		51.67	B	A	20.00	2		63.33	B
AB	1.67	3		25.00	CD	A	13.33	1		61.67	B
AB	0.33	4		33.33	BC	A	6.67	4		38.33	C
AB	0.33	6		46.67	B	A	5.00	7		93.33	A
AB	0.33	7		83.33	A	A	0.00	6		46.67	BC
B	0.00	8		100.00	A	A	0.00	8		95.00	A

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

BLUE GRAMA												
Aug-00		***Treated on 16 May 2000***				**Sep-01**		***Retreated on 17 April - no seeding***			
		Seeded on 16 -17 May 2000									
	TARGET %	Treatment		WEED %			TARGET %	Treatment		WEED %	
	Mean	Number		Mean			Mean	Number		Mean	
A	48.33	5		38.33	C	A	70.00	1		21.33	C
AB	43.33	1		7.33	D	A	70.00	5		13.33	C
AB	33.33	2		5.00	D	A	60.00	7		35.00	BC
ABC	28.33	8		67.67	AB	A	56.67	2		13.33	C
BCD	20.33	7		73.33	A	A	53.33	8		43.33	ABC
BCD	18.33	6		51.67	ABC	B	6.67	6		58.33	AB
CD	3.33	3		11.67	D	B	6.67	3		70.00	A
D	0.00	4		43.33	BC	B	0.00	4		58.33	AB

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

Table 10.3C ***Native Warm Season Grass Screening Trial in Blacksburg, VA. The SHORT native grasses seeding rates. PLS means the seeding rate is based on pure live seed and BULK means seeding rate is based on bulk rate.***

LITTLE BLUESTEM												
Aug-00		***Treated on 16 May 2000***				**Sep-01**		***Retreated on 17 April - no seeding***			
		Seeded on 16 -17 May 2000									
	TARGET %	Treatment		WEED %			TARGET %	Treatment		WEED %	
	Mean	Number		Mean			Mean	Number		Mean	
A	6.67	1		13.33	C	A	21.67	1		36.67	B
B	3.33	2		28.33	BC	AB	16.67	2		50.00	AB
C	0.00	3		18.33	C	AB	16.67	5		43.33	B
C	0.00	4		46.67	B	AB	5.00	8		90.00	A
C	0.00	5		45.00	B	B	3.33	7		93.33	A
C	0.00	6		48.33	B	B	1.67	6		66.67	AB
C	0.00	7		100.00	A	B	0.00	3		48.30	AB
C	0.00	8		86.67	A	B	0.00	4		43.30	B

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

SWITCHGRASS												
Aug-00		***Treated on 16 May 2000***				**Sep-01**		***Retreated on 17 April - no seeding***			
		Seeded on 16 -17 May 2000									
	TARGET %	Treatment		WEED %			TARGET %	Treatment		WEED %	
	Mean	Number		Mean			Mean	Number		Mean	
A	35.00	5		28.33	BCD	A	43.33	5		21.67	B
B	13.33	6		33.33	BC	B	23.33	6		40.00	AB
B	8.33	8		88.33	A	B	21.67	4		26.67	B
B	6.67	2		11.67	D	B	20.00	3		45.00	AB
B	6.67	4		36.67	B	B	18.33	7		71.67	AB
B	5.00	3		16.67	CD	B	15.00	8		80.00	A
B	3.33	7		76.67	A	B	13.33	2		51.67	AB
B	0.67	1		11.67	D	B	5.00	1		70.00	AB

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

Table 10.3D ***Native Warm Season Grass Screening Trial in Blacksburg, VA. The SHORT native grasses seeding rates. PLS means the seeding rate is based on pure live seed and BULK means seeding rate is based on bulk rate.***

INDIANGRASS												
Aug-00		Treated on 16 May 2000				Sep-01		Retreated on 17 April - no seeding			
		Seeded on 16 -17 May 2000									
	TARGET %	Treatment		WEED %			TARGET %	Treatment		WEED %	
	Mean	Number		Mean			Mean	Number		Mean	
A	41.67	1		10.00	D	A	66.67	5		13.33	D
B	10.00	2		20.00	D	A	63.33	1		20.00	CD
B	5.00	5		66.67	AB	B	30	2		33.33	BCD
B	5.00	8		91.67	A	B	28.33	8		53.33	AB
B	3.33	7		78.33	AB	B	23.33	7		66.70	A
B	1.67	6		50.00	BC	B	8.33	6		45.00	ABC
B	0.00	3		3.67	D	B	6.67	3		23.33	CD
B	0.00	4		28.33	CD	B	3.33	4		33.33	BCD

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

BIG BLUESTEM												
Aug-00		Treated on 16 May 2000				Sep-01		Retreated on 17 April - no seeding			
		Seeded on 16 -17 May 2000									
	TARGET %	Treatment		WEED %			TARGET %	Treatment		WEED %	
	Mean	Number		Mean			Mean	Number		Mean	
A	30.00	1		9.00	C	A	40.00	5		16.67	C
AB	20.00	2		6.67	C	A	38.33	1		30.00	BC
BC	10.00	5		48.67	B	A	36.67	2		21.67	C
BC	5.00	6		55.00	B	B	13.33	8		71.67	AB
BC	3.67	3		10.00	CD	B	10.00	7		75.00	A
C	0.33	4		45.33	BC	B	8.33	6		56.67	ABC
C	0.00	7		95.00	A	B	5.00	3		51.67	ABC
C	0.00	8		91.67	A	B	3.33	4		56.67	ABC

Within each column the values followed by the same letter do not significantly differ at the 5% level of probability using the Duncan's Multiple Range Test.
Means are the average of 3 replications in a randomized block design.

11. CONCLUSION

11.1 Turfgrass Cultivar Evaluations

The trial data in this report are reflected in the updated VDOT Seed Specifications for Grasses and Legumes (Form RD-4). The next update will occur in 2002 when new data are collected from tall fescue, fine fescue, perennial ryegrass and Kentucky bluegrass variety trials. As mentioned in other reports, it is noted that in the Coastal Plain Region of Virginia, fine fescue will establish best if sown in the fall. Fine fescue tends to establish and persist better in the higher and colder regions of the commonwealth. A blend of tall fescue and fine fescue produces a mix that is adaptable to a wider range of conditions that either component alone. It should be noted that orientation of slopes on a highway corridor often exhibit significantly different environments. The fine fescue and tall fescue have performed consistently and reliably for many years and the improved varieties should allow them to be successful under a broader range of conditions with less chemical input needed.

11.2 Native Grass Management Studies

The studies on native warm season grasses in the past several years have provided much insight. The culture of the native warm-season grasses is very different from the cool-season grasses and presents some challenges, i.e., the narrower window for seeding, speed of establishment, and weed control. Shorter native grasses like buffalograss, blue grama, and little bluestem have not established as well as the "adapted" or "introduced" species like tall and fine fescue on difficult sites during the first years of establishment. The use of companion plants is crucial to erosion-free establishment of these warm-season native grasses on slopes. Current research indicates that these shorter growing native grasses may be suitable for use along roadsides but the consistency and density of establishment must be greatly improved for them to even be considered as an option. The moderate height natives [little bluestem and sideoats grama] could be mixed with the shorter natives in areas that are outside the clear zone or inside if they will persist under a highway mowing schedule. More research will be needed on the mowing tolerance of native grasses. The taller native grasses like switchgrass and indiangrass should only be used in locations distant from the roadside because of the plant's mature height and the amount of above ground growth produced. Future research on the use of companion plants, seeding rates, release options and improved establishment methods should help move us closer to being able to establish the native grasses where these species will best perform under roadside management. **The overall goal is to use the optimum vegetation in a specific location [situation] to achieve the goals of soil stabilization, persistence and aesthetic quality**.

12. ACKNOWLEDGMENTS

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13. DISCLAIMER

“The contents of this report reflect the view of the Consultant who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the Virginia Department of Transportation. This report does not constitute a standard, specification or regulation.”

14. REFERENCES

Booze-Daniels, J.N., R.E. Schmidt, and D.R. Chalmers. 1998. Native Grasses on the Roadsides of Virginia - A Review of Literature. Virginia Dept. Trans., Environmental Div., 1401 East Broad Street, Richmond, Va. 23219.

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15. Addendum

RD 4 LIST VIRGINIA DEPARTMENT OF TRANSPORTATION -

SPECIFICATIONS FOR STANDARD AND NON-STANDARD SEED ITEMS

I. Specifications for Standard Seed Items
II. Specifications for Non-Standard Seed Items
III. Sampling and Testing Procedures for In State and Out of State Vendors

BOTANICAL NAME	**COMMON NAME**
RD 4 LIST *Coronilla varia*	Crownvetch
Cynodon dactylon	Bermudagrass
Dactylis glomerata	Orchardgrass
Eragrostis currula	Weeping Lovegrass
***Festuca arundinacea*	Tall Fescue
***Festuca longifolia*	Fine Hard Fescue
***Festuca ovina*	Fine Sheep Fescue
***Festuca rubra ssp. commutata*	Fine Chewings Fescue
***Festuca rubra ssp. rubra*	Fine Creeping Red Fescue
Hordeum vulgare	Barley
Lathyrus sylvestris	Flat Pea
Lepedeza cuneata	Serecia Lespedeza
Lolium multiflorum	Annual Ryegrass
Lotus corniculatus	Birdsfoot Trefoil
***Poa pratensis*	Kentucky Bluegrass
Secale cereale	Rye (Winter Rye)
Setaria italica	Foxtail Millet (German)
Triticum aestivum	Wheat
Trifolium repens	White Dutch Clover

***Certified Seed Required For These**

VIRGINIA DEPARTMENT OF TRANSPORTATION

1. SPECIFICATIONS FOR STANDARD SEED ITEMS

Kind and Cultivars	Min. Pure Seed %	Min. Germ. %	Min. Germ. Plus Hard Seed %	Weed Seed Not to Exceed %	LIMITATIONS
Tall Fescue Cultivars: Afa, Apache, Arid, Austin, Avanti, AZTEC, B4ENTF, IIIB4WSTF, Barcel, Rebel Jr., Safari, Shenandoah, Shortstop, Shortstop II, Silverado, Tradition, Vegas, Willamette, Winchester, Wrangler, Earthsave, Eldorado, Empress, Era, Falcon II, FDM-91, Finelawn, Finelawn 1, Finelawn 2, Finelawn, Benton, Bonanza, Bonzai, Bonzai II, Carefree, Chesapeake, Chieftain, Cimarron, Coyote, CRC, Crossfire, Monarch, Mustang, Mustang II, Orygun, Pacer, Phonex, Rebel II, Rebel, Rebel 3D, Petite, Georgia, Georgia 5, Guardian, Houndog5, Jaguar, Jaguar3, Kitty Hawk, Lexus, Micro, Mini-Mustang, Mojave	98	90	--	0.25	**RES. NOX. WEEDSEEDS** Same As VA Seed Law **PROH. NOX. WEEDSEEDS** Same As VA Seed Law **LAWN & TURF REST. NOX** 10 Per ounce or 160 Per Pound
Kentucky Bluegrass Cultivars: Adelphi, Caliber, Columbia, Eclipse, Georgetown, Glade, J1555, Kenblue, Monopoly, NJ-54, Nustar, South Dakota, Touchdown, Victa	98	85	--	0.25	
Fine Hard Fescue Cultivars: Aurora, Biljart, SR3100, Reliant II, Defiance, Vernon, Scaldis, Ecostar, MB 82-93, Brigade, Valda, Nordic, Discovery, Waldina, Pamela, Reliant, MED 32, Saxon, Osprey, Spartan	98	85	--	0.25	

Kind and Cultivars	**Min. Pure Seed %`**	**Min. Germ. %**	**Min. Germ. Plus Hard Seed %**	**Weed Seed Not to Exceed %**	**LIMITATIONS**
Fine Creeping Red Fescue Cultivars: BAR UR 204 Ensylva PST-4DT Cindy Jasper PST-4ST Dover Pennlawn WX3-FFG6	98	85	--	0.25	
Fine Chewings Fescue Cultivars: Banner Jamestown II Tiffany BannerII Koket Treazure Banner III K-2 (MB65-93) TMI-3CE Bridgeport MB61-93 Victory Brittany Molinda Victory II Cascade NJF-93 WX3-FF54 Clumbra Sandpiper ECO (MB 63-93) Shadow ISI-FC-62 Shadow II Jamestown SR 5100	98	85	--	0.25	
Fine Sheep Fescue Cultivars: Azay, Azure Blue, Bighorn, Quatro	98	85	--	0.25	
Bermudagrass **(2)**	98	85	--	0.25	
Foxtail Millet (German)	98	85	--	0.25	
Annual Ryegrass	98	90	--	0.25	
Rye (Winter Rye) Cultivars: Abruzzi, Balboa	98	85	--	0.25	
Triticum aestivum Wheat	98	85	--	0.25	
Hordeum vulgare (Barley)	98	85	--	0.25	
Weeping Love Grass	98	85	--	0.25	
Orchardgrass Cultivars: **(1)**, OG1A OG, Potomac, Shilo, Taos	90	85	--	0.50	
Sericea Lespedeza **(2), (3)**	98	40	75	0.50	

Kind and Cultivars	**Min. Pure Seed %`**	**Min. Germ. %**	**Min. Germ. Plus Hard Seed %**	**Weed Seed Not to Exceed %**	**LIMITATIONS** 
Crownvetch Cultivars: **(3)** Chemung, Emerald, Penngift	98	36	71	0.25	
Flat Pea **(3)**	99	38	75	0.25	
White Dutch Clover **(3)**	99	80	90	0.25	
Birdfoots Trefoil Cultivars: **(3)** AuDewey, Empire, Norcen	98	60	80	0.50	

(1) Virginia origin or approved cultivars.

(2) Spring-Hulled, Fall-Unhulled

(3) Seed must be inoculated with the appropriate strain and rate of bacteria. For hydroseeding, use a minimum of five times the dry seeding rate of inoculant.

III. SAMPLING PROCEDURE

A. Virginia Supplier

1. The supplier, prior to shipment, shall have the Virginia Department of Agricultural and Consumer Services seed inspector for the area draw samples for testing on all seed lots intended for purchase order deliveries to the Virginia Department of Transportation.

2. All seed lots shall be properly labeled and clearly identified by a lot number prior to sampling by the Virginia Department of Agriculture and Consumer Services seed inspector. The purchase order number, if known, shall be given to the inspector and shown on the test reports.

3. Test results on such samples will be reported to the Virginia Department of Transportation and to the supplier by the Virginia Department of Agriculture and Consumer Services.

4. Seed will not be accepted at any VDOT facility for delivery until the test results have been received and the seed is found to conform to the Virginia Seed Law, and the Virginia Department of Transportation's RD-4 seed specifications and bear a valid green tag. Seed in open bags, seed bags that do not have an attached and valid Green Tag, or bags with expired green tags will not be accepted.

B. Out-Of-State Suppliers

1. Seed will not be accepted for delivery until seed lots have been found to meet the Virginia Department of Transportation's seed specifications and bear the green tag.

2. At the time of shipment, the Virginia Department of Agriculture and Consumer Services, Seed Laboratory, One North 14th Street, Room 238, Telephone – (804) -786-8795, Richmond, Virginia, 23219, shall be notified. At the point of delivery to a non-VDOT facility, all lots will be subject to sampling and testing by the Virginia Department of Agriculture and Consumer Services. Seed will not be accepted at any VDOT facility for delivery until the test results have been received and the seed is found to conform to the Virginia Seed Law, and the Virginia Department of Transportation's RD-4 seed specifications and bear a valid green tag. Seed in open bags or bags with expired green tags will not be accepted.

3. The results of tests by the Virginia Department of Agriculture and Consumer Services will take precedence over tests performed by others. All seeds are subject to sampling and testing by the Virginia Department of Agriculture and
Consumer Services and/or certified VDOT personnel whose decision shall be final. Seed tests shall have been completed within a 9-month period, exclusive of the calendar month in which the test was completed, prior to the delivery date.

4. The labels and seed(s) must conform to these specifications and all Federal and State laws, rules and regulations. No prohibited noxious-weed seeds, as defined by the rules and regulations adopted for enforcement of the Virginia Seed Laws, will be permitted; i.e., Canada Thistle, Field Bindweed, Quackgrass, Johnsongrass, Plumeless Thistle, etc. Restricted noxious-weed seeds shall not exceed the number per ounce or per pound of such noxious-weed seeds specified in such rules and regulations.