Evaluation and Management of Turfgrass on Virginia Roadsides

Annual Report

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ABSTRACT

Turfgrass Cultivar Evaluations

Since the fall of 1993, fine and tall fescue trials have been sown in alternating years. As of May 1996, 70 tall and 73 fine fescue cultivars in four different trials had been established in the Coastal Plain of Virginia. The most promising fine fescue cultivars from the 1993 trial have been identified in this report.

Management Studies

The use of fine fescues continues to be the focus of our research program. The final results of these studies will be available in the next report (1996-97); however, the following observations are of value.

1) The fine fescues sown in combination with tall fescue or alone have performed favorably in the Ridge and Valley and the Piedmont of Virginia.

2) The hard fescue in the Coastal Plain has performed better than tall fescue on the cool and warm slopes. However, neither species has done well on the warm slope. Warm-season grasses should be used on this specific site. There is no benefit to sowing hard and tall fescue as a mix when compared to sowing hard fescue as a pure stand.

3) Birdsfoot trefoil in combination with the tall or fine fescue appears to persist for at least two and one-half years in all regions of Virginia, even the warm slopes in the Coastal Plain. The fine fescue does well with the trefoil.

4) For the establishment of tall fescue, a seeding rate of 95-140 kg/ha (85-125 lb/A) is recommended. The seeding rate of 73-95 kg/ha (65-85 lb/A) for all four types of fine fescue was adequate for establishment. The upper range is recommended only for more difficult sites. Long term persistence of these fescues sown at the different seeding rates will be evaluated in the 1996-97 project year.

Demonstration

Virginia is dotted with cut-slopes that are difficult to revegetate. Many of these slopes typically have a pH of 2-3 in the initial 10 cm of soil due to the weathering of newly exposed strata that are high in sulfur and iron. This demonstration was designed to establish vegetation on a barren acid-producing slope in the spring of 1996 in the Coastal Plain. This site-specific protocol's main ingredients include: the appropriate soil test, adequate lime application, the use of composted organic yardwaste and the sowing of salt- and acid-tolerant plant species. Establishment was a success; vegetative persistence will be carefully examined in the 1996-97 project year.

I. INTRODUCTION

Since 1993, our research has focused on fine fescue management stratagies and on evaluation of turfgrass cultivars. This year, two studies were added, a barren acid-producing slope was revegetated and new tall and fine fescue trials were installed. The fine fescue trials and management studies proved valuable in light of of this year's tall fescue shortage. The tall fescue shortage in the U.S. has driven the cost of tall fescue beyond that of the fine fescues. Contractors have been forced to shift from the traditional use of tall fescue to the less familiar fine fescue cultivars. Fortunately, the information generated from our recent fine fescue trial and management study provided VDOT personnel with the technical information which validated the use of fine fescue on roadsides. Our research studies will continue to examine the use of fine fescues and to address management concerns such as revegetating barren acid-producing slopes.

Turfgrass Cultivar Evaluations

Tall fescue and fine fescue cultivars (varieties) have been evaluated for roadside use by Virginia Tech for years. However, with the yearly introduction of new cultivars into the market, (as of fall 1996, 128 tall fescue cultivars are to be evaluated by the National Turfgrass Evalation Program) and the removal of older cultivars, it is important to keep the evaluation process up to date. Our goal this year was to add the newest tall and fine fescue cultivars to our testing program in order to update the 1999 VDOT Roadside Development Sheet. As of May 1996, 70 tall and 73 fine fescue cultivars were being evaluated.

Vegetation Management Studies

Fine fescue establishment and long term performance under various site conditions was again the focus of this year's effort. The adaptability of fine fescue to sloping sites, to north and south aspects, and to the various soil conditions present across Virginia was evaluated. Fine and tall fescue in pure and mixed systems was compared in order to identify an acceptable management scheme.

A fine fescue seeding rate study was initiated the fall of 1994. The four types of fine fescue, hard, Chewings, sheep and creeping red, are morphologically different enough to warrant a seeding rate study. It may be possible that less seed of a certain fine fescue type would be required to obtain adequate coverage. The previous year's hard fescue and tall fescue seeding rate study was continued. The goal of this study was to compare how the seeding rates of fine and tall fescue affect initial establishment and long-term persistence.

A study to demonstrate how to revegetate sulfuric acid-producing soils was completed in the early spring of 1996. This type of soil frequently occurs in Virginia and requires unique site-specific treatments. It appears that now that the general revegetation process has been identified and honed for VDOT's purpose, the future roadside research will be partially geared to reviewing site-specific

revegetation problems.

Data Recording and Manipulation

The data collected were an estimate of percent density (% of ground covered) and overall performance of each plot. The visual estimate of percent density has been used in turfgrass and roadside research for years. The use of the overall performance rating system is relatively new.

The overall performance (OP) rating system is based on allocating each plot a score of one to five, with five estimating an exceptional stand and one estimating a dead or poor stand. A rating of three indicates an acceptable stand for controlling soil erosion and excluding weeds. Color comes into play with this system; three indicates that the turf is a healthy green or blue green color, five indicates superior color, and one indicates a brown color. When compared to the percent density data, there was a highly significant positive correlation, confirming the validity of the rating system.

The data were reported as means and statistical tests were performed only when applicable. Statistics were not reported for the trials because the treatments (different cultivars) are too numerous to provide a fair test. Instead of using statistics, a percent density threshold has been assigned. Our observation is that plots with a density of 70% provide adequate coverage to exclude weeds and control soil erosion. Therefore, plots with 70% density will be considered acceptable for roadside use. The term "70% threshold" will be used to indicate this concept. A rating of three for the overall performance data is also an indication that the stand is of acceptable quality for a roadside environment. With these two systems used in combination, the trial can be fairly judged.

When the data were statistically analyzed, the Friedman Test (Ipe, 1987) was employed. The percent density and OP ratings generate non-continuous data; therefore, the data is not normally distributed. The nonparametric Friedman test takes into account that the data is not normal and the calculations are adjusted. The Least Significant Difference (LSD) is used to separate means as appropriate.

The trial and management studies were evaluated in both the fall (late September to mid-October) and in late spring (May to late June). These dates allow the grasses to recover from summer and winter injury prior to evaluation.

General Establishment and Management Information

All of the sites were prepared in the same manner unless specified differently. The original vegetation was killed with glyphosate. The site was then disked, seeded and mulched with hydro-mulch or straw. The cultivars/treatments were arranged in a randomized block design, replicated three times, and each plot was 1.82 m by 2.4 m (6'x8'). The cultivars were sown at a rate of 112.5 kg/ha (100lb/A). Fertilizer and lime were applied as dictated by a pre-establishment soil test (Appendix C).

Rates follow VDOT protocol of 682 kg/ha (600lb/A) of 15-30-15 fertilizer and 2,240 kg/ha (1 T/A) of lime. The sites were mowed once or twice a year so that they could be evaluated fairly. Herbicide was used only when necessary. All the studies were implemented in the fall with the exception of two fescue trials. Fall establishment was selected because in Virginia this is the ideal time to ensure successful stand development.

II. TURFGRASS CULTIVAR EVALUATIONS

Tall Fescue

Chester Tall Fescue Trial, Fall 1994

Procedure: This trial of 29 cultivars was installed September 28, 1994, on a typical Coastal Plain soil on route 288 East, near Chester. At the time of establishment fertilizer was applied[1]. Lime was not applied because the pH of the site was adequate. An application of Garlon 3A™ (28 l/ha,3 gal/A) was applied in September 1995 and July 1996 to control the broadleaf weeds. The site was mowed in July 1995 and 1996. Percent density and overall performance (OP) for each cultivar were recorded in October 1995 and May 1996 (Table 1a).

As a side project, 8 other various grasses were also sown at this same site. These include salty alkaligrass (*Puccinelia distans,* seeding rate of 146 kg/ha), a dwarf orchardgrass (*Dactylis glomerata*), a slender creeping red fescue (*Festuca rubra trichophylla*), a red fescue (*Festuca rubra rubra*), two sheep fescues (*Festuca ovina*) and two hard fescues (*Festuca longifolia*) (Table 1b). Percent density and OP for each cultivar were recorded in October 1995 and May 1996.

Results and Discussion: One year after sowing, the tall fescue density ranged between 62 and 88 percent with the majority of the cultivars exceeding the 70% density threshold (Table 1a). Twenty months following sowing (May 1996), the density range had not significantly changed, with 23 out of 29 varieties covering 70 percent or more of the ground. The mean of both the 12 and 20 month data were 75-74%, respectively.

A review of the miscellaneous grass species in Table 1b reveals that several of these grasses performed equally as well as the best tall fescue (Table 1a). Twenty months after sowing, Reliant, Azure Blue and Shademaster II covered 83 to 88 percent of the ground. The other fine fescues exceeded the 70% threshold except for Seabreeze, a slender creeping red fescue. The Salty Alkali grass fell from its initial density rating of 88% to 6.7% by the 20th month. It is speculated that the soil pH of 7.2 was not alkali enough to support continued growth. More evaluation of this grass is needed before it can be recommended.

The dwarf orchardgrass has performed fairly well in the Coastal Plain and should do well in the regions of Virginia which do not allow the use of tall fescue. The grass has not been tested against other orchardgrass cultivars, but the use of a dwarf on the roadside could be beneficial in reducing mowing frequency. The data presented here were preliminary and final judgement must be reserved until the fall 1997. However, if a cultivar is selected for only short term use, the information presented could be helpful.

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

Petersburg Tall Fescue Trial, Spring 1996

Procedure: This trial of 42 cultivars was installed April 18, 1996, on a typical Coastal Plain soil at the interchange of I95 and Rt. 295 (Site 1), near Petersburg. At the time of establishment, fertilizer was applied[2]. Lime was not applied because the pH of the site was adequate (Appendix C). An application of Garlon 3A™ (28 l/ha,3 gal/A) was applied in July 1996 to control the broadleaf weeds. The site was mowed in July 1996. Percent density and overall performance (OP) for each cultivar was recorded in May 1996 (Table 2).

Results and Discussion: One month after sowing, the tall fescue density ranged between 13 and 57 percent with none of the cultivars attaining the 70% density threshold (Table 2). The mean density coverage of all the cultivars was poor, 34%. The OP also reflects the poor performance. The low density and OP ratings are not surprising, and if this spring sown trial follows the example of other spring sown trials, the density will improve with time.

Fine Fescue

In the fall of 1993 and the spring of 1994, identical fine fescue trials were installed next to each other on Route 288 east, near Chester. The objective of establishing a fall and spring trial is to identify varieties which can be successfully established in the less than ideal spring season as compared to the fall season. Identifying varieties which are adaptable to different sowing dates is important in roadside establishment since grasses are often sown at less than optimum times of the year.

Fine fescue is a term which includes four species or sub-species: hard fescue (HF), Chewings fescue (CF) (*Festuca rubra* var. *commutata* Gaud.), creeping red fescue (CRF), also referred to as strong creeping fescue), sheep fescue (SF) and slender creeping red fescue (SCRF). Authorities consider them genetically different, but it is often difficult to tell them apart. However, this study noted differences in cultivars within one fine fescue type. The following two Chester trials include an assortment of these five types of fine fescue (Table 3 and 4).

Chester, Fine Fescue Trial, Fall 1993

Procedure: This trial was established on September 29, 1993 on the north facing side of route 288, close to the Chester exit. Sixty cultivars of various fine fescue were sown on a typical Coastal Plain sandy clay loam. Fertilizer was applied prior to seeding[3], but lime was not applied as dictated by the soil test (Appendix C). An application of Garlon 3A™ (28 l/ha) was applied in September

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[2]Fertilizer, 15-30-15, at rate of 341kg/ha (300 lb/A), and 0-46-0 at rate of 273 kg/ha (244 lb/A)

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

1995 and July 1996 to control the broadleaf weeds. The site has been mowed annually in July. Percent density and OP were recorded for each cultivar in October 1995 and May 1996 (Table 3).

Results and Discussion: The density two years after sowing, fall of 1995, ranged between 25 and 95 percent with 38 out of 60 cultivars obtaining a greater than 70 percent density rating. By the spring of 1996, the percent density was between 13 to 92%. Only 28 out of 60 cultivars made the 70% threshold.

Two and half years after sowing, definite performance patterns were evident. At this time cultivars of promising performance were selected as indicated in Table 3. The promising cultivars have consistantly exhibited 70% or greater density for at least 3 recording dates. These 12 cultivars can be tentatively recommend for use if there is a shortage of seed of other recommended cultivars. It is interesting to note that 10 out of the 12 promising cultivars are hard fescue, with only one Chewings fescue and the only sheep fescue that was included in this trial.

Chester, Fine Fescue Trial, Spring 1994

Procedure: This trial was established on April 15, 1994 on the north facing side of route 288, close to the Chester exit. Fifty-nine cultivars of various fine fescue types were sown on a typical Coastal Plain sandy clay loam. Fertilizer was applied prior to seeding[4], but lime was not applied as dictated by the soil test (Appendix C). An application of Garlon 3A™ (28 l/ha) was applied in September 1995 and July 1996 to control the broadleaf weeds. The site has been mowed annually each July. Percent density and OP were recorded for each cultivar in October 1995 and May 1996 (Table 4).

Results and Discussion: One and half years after sowing (fall 1995), the stand density ranged between 12 and 83 percent, with 15 varieties reaching the acceptable 70% threshold. By May 1996, two years after sowing, the density range was between 28 and 78 percent. Ten out of the 59 cultivars hit or exceeded the 70% threshold. Six out of the 10 cultivars that made the threshold were hard fescue. The only sheep fescue that was tested was the top performer. Three Chewings fescue were also on that top performance list.

When comparing the Chester fall and spring trials, we can only draw inferences because these data sets cannot be compared statistically. The following comments are only observations about the data:

1) Two years after sowing, the average percent density for all the cultivars in the fall sown trial was 70%. The spring sown trial average was 61%, a 9% difference.

2) Thirty-eight cultivars in the fall trial matched or exceeded the 70% density threshold; however, only 10 of the spring sown cultivars hit the threshold mark.

3) When compared to the fall sown trial, the spring trial required six months longer before any

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

of the cultivars reached the 70% threshold level.

4) Table 5 is a data compilation from the two trials, two years after each trial's sowing date. The information from this table indicates that some cultivars could be sown in the spring, fall or either season. The cultivars that can be sown anytime of the year are referred to as "sow-date-neutral". The majority of the cultivars should be sown in the fall; however, there are 12 cultivars that are sow-date-neutral. The use of these cultivars would be appropriate if the seeding date for a re-vegetation project is not known.

5) The important concept is that fine fescues, like tall fescues, will generally perform best if sown in the fall. However, like the tall fescue, the fine fescue will perform adequately if sown in the spring.

Petersburg Fine Fescue Trial, Spring 1996

Procedure: This trial of 20 cultivars was installed on April 18, 1996, on a typical Coastal Plain soil at the interchange of I95 and Rt. 295 (Site 1), near Petersburg. Fertilizer was applied[5] at the time of establishment. Lime was not applied because the pH of the site was adequate (Appendix C). Garlon 3A™ (28 l/ha, 3 gal/A) was applied in July 1996 to control the broadleaf weeds. The site was mowed in July 1996. Percent density and overall performance (OP) for each cultivar was recorded in May 1996.

Results and Discussion: One month after sowing, the fine fescue density ranged between 10 and 57 percent with none of the cultivars attaining the 70% density threshold (Table 6). The 25% mean density coverage of all the cultivars was poor.

The Petersburg tall and fine fescue trails were sown at the same site so that the tall fescue can be compared to the fine fescue. One month after sowing, the tall fescue's percent density was 34% and the fine fescue's average density was 25%. In spite of the low average, a few fine fescue cultivars performed as well as the tall fescue. The interesting note is that the Chewings and creeping red fescue performed better than the hard and sheep fescue. This trend was also noted in the Fine Fescue Trial at Chester that was sown the spring of 1994.

At this time, no cultivar changes are recommended for the VDOT Development Sheet. However, some fine fescues have been added to the promising catagory (Appendix A). In order to make it easier to monitor which cultivars are presently being tested, please consult Appendix A and B.

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[5]Fertilizer, 15-30-15, at rate of 341 kg/ha (300 lb/A), and 0-46-0 at rate of 273 kg/ha (244 lb/A)

III. MANAGEMENT STUDIES

Adaptation Study - Fine Fescue

Title: Performance of Fine Fescue and Fine Fescue with Tall Fescue as Influenced by Various Climatic and Soil Conditions Across Virginia.

Objective: To determine the soil and site tolerance of fine fescue sown in three prominent regions of Virginia: Coastal Plain, Piedmont and Ridge & Valley.

Procedure for Establishment, Maintenance and Data Collection: This study was successfully established in the fall of 1993 on three slightly sloping to flat sites in the Coastal Plain (Chester), Piedmont (Lynchburg) and Valley & Ridge (Blacksburg). Two cultivars of each type of fine fescue, hard (HF), Chewings (CF), and creeping red (CRF), were sown with or without tall fescue. The following cultivars were sown: Reliant (HF), Valda (HF), Cindy (CRF), Ensylva (CRF), Banner II (CF), Victory (CF), and tall fescue 'Falcon II'.

All of the sites that were established the fall of 1993 were prepared in the same manner as discussed in the introduction. In this study, the fine fescue cultivars that were sown alone were broadcast at a rate of 112.5 kg/ha (100 lb/A). When sown in combination with tall fescue, 56 kg of fine and 56 kg of tall fescue were sown per ha. The sites were sown on the following dates: Coastal Plain-Sept. 29, 1993, Piedmont-Oct. 1, 1993 and Ridge &Valley-Oct 14, 1994. Fertilizer was applied[6], but lime was not applied because the pH of each site was adequate (appendix C). Garlon 3A™, a broadleaf post-emergent herbicide, was applied at a rate of 28 l/ha, in March and September 1995 and July 1996 to the Coastal Plain site. Broadleaf weed competition was especially intense on this site. Trimec™ broadleaf post-emergent herbicide was applied at a rate of 5 l/ha, in March 1996 to the Piedmont site. All of the sites were mowed in July. This study has been monitored each spring and fall. The study will be terminated after October 1996.

Results and Discussion: Coastal Plain - Two years after sowing, only two out of the twelve fine fescue treatments exceeded the 70% density threshold and rated a three or greater OP (Figure 1a and 1b). However, two and a half years after sowing (Figure 2a), five of the fine fescue treatment combinations exceeded the 70% threshold. Some of the fine fescues fared better with the addition of the tall fescue and some varieties performed better without the tall fescue. The pure stand of tall fescue was significantly the same as the majority of the fine fescues alone and in combination with the tall fescue.

The spring data brings to light recurring trends in this study. The most obvious is the superior performance of 'Reliant' hard fescue alone or in combination with tall fescue. The performance of the pure stands of the two creeping red fescues has consistently been poor when compared to the

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

other varieties. Yet, the spring performance is always better than the fall's. The two creeping red fescues seem to "bounce back" in the spring. This may reflect this species' intolerance of summer heat.

Piedmont - Two years after sowing, eight out of the twelve fine fescue treatments as well as the tall fescue control exceeded the 70% density threshold and rated 3 or greater OP (Figure 3a and 3b). Two and a half years after sowing (Figure 4a and 4b), nine of the fine fescue treatment combinations exceeded the 70% threshold and rated above the acceptable OP limit of 3. As observed in the Coastal Plain study, the performance of the two creeping red fescues did not rival the performance of the other fine fescues in both the fall and spring data. However, both creeping red fescue varieties "bounced back" in the spring.

Ridge & Valley - The results from this site were different from the Coastal Plain and Piedmont sites for both fall and spring data. There were no significant differences in the percent density and OP among the fine fescue cultivars with and without tall fescue (Figure 5a, 5b, 6a and 6b). For both the fall and spring data, the fine fescue without tall fescue equaled or exceeded the tall fescue control treatment's density. The Ridge and Valley climate is generally cooler in the summer than the Coastal Plain and Piedmont sites. This may account for the good performance of the creeping red fescues.

Overview of the Three Regions - Experimental design prohibits statistical comparisons among the three regions; however, trends can be identified. In general, the Coastal Plain is less hospitable for the establishment of the fine and tall fescues that were used in this research in comparison to the Piedmont and Ridge & Valley (Figure 7a and 7b). Two years after sowing seed in the Coastal Plain, the performance of some of the fine fescues, with or without the tall fescue, varied from poor to superior as compared to the tall fescue control. Only one of the treatments, 'Reliant' hard fescue, covered 70% of the plot the second year. The implication is that this environment is not hospitable to even the tall fescue.

The "bouncing back" response of the creeping red fescue varieties from fall to spring is an admirable trait of these grasses; however, grasses that exhibit wide performance swings from season to season should not be used in roadside revegetation. When the density declines in the fall, there is a greater chance of weed invasion which could eventually eradicate the desired grass species.

The use of fine fescue in the three distinct regions of Virginia will be determined upon the collection of the fall 1996 data. Ridge & Valley and Piedmont areas at this time appear to be suitable for the use of fine fescues with or without the incorporation of tall fescue. However, the final judgement on their use in the Coastal Plain region is still on hold.

Slope Study - Fine Fescue

Title: Performance of Fine Fescue on a Slope in the Coastal Plain Region.

Objective: To determine if fine fescue can be established and maintained on a slope in the Coastal Plain Region.

Procedure for Establishment, Maintenance and Data Collection: Four cultivars of fine fescue, (hard fescue 'Reliant', Chewings fescue 'Banner II', creeping red fescue 'Cindy', sheep fescue 'FO-143'), one cultivar of birdsfoot trefoil 'AuDewey' (*Lotus corniculatus* L.) and one cultivar of tall fescue, 'Falcon II' were established September 29, 1993 on route 288 East, near Chester on a north facing 34% slope. The tall fescue was sown to provide a comparison with the fine fescue.

Even though this site was strongly sloping, the site was lightly tilled prior to seeding. All establishment procedures were similar to those used in the Fine Fescue Adaptation Study that was previously mentioned. The cultivars were arranged in a randomized block design and replicated four times. The grasses were sown at a rate of 112.5 kg/ha (100 lb/A), and the inoculated birdsfoot trefoil (BT) was sown at 5.7 kg/ha. The site has not been mowed due to the steep slope. Fertilizer was applied[7], but lime was not applied because the pH was above 6.4 (Appendix C). The study will be monitored each spring and fall until 1996.

Results and Discussion: The site was evaluated in October 1995 and May 1996, 24 and 32 months, respectively, after sowing. Percent density and overall performance of the four fine fescue species when evaluated at both dates, were not significantly different when analyzed (Figure 8). All grasses were well above the 70% density threshold. The tall fescue density was significantly less than all the fine fescues for both fall and spring. There are no adverse effects of not mowing the stand to date.

Even though the AuDewey BT did not grow much until the spring of 1995, 20 months after sowing, the density had stabilized between 63 and 74%. The amount of cover offered by the BT is amazing considering that only 5.7 kg/ha of seed was sown. We would suggest that BT be sown with a cover crop to guard against possible erosion. Both tall or fine fescue appear to be suitable cover crops.

North & South Slope Aspect Study- Fine Fescue

Title: Performance of Fine Fescue in Pure and Mixed Stands as Influenced by Slope Aspect (Cool and Warm) in the Coastal Plain.

Objective: To compare the performance of fine fescue with and without the addition of tall fescue or birdsfoot trefoil when established on south and north facing slopes.

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

Procedure for Establishment, Maintenance and Data Collection: Reliant hard fescue alone and in combination with Falcon II tall fescue and the birdsfoot trefoil cultivar, AuDewey, were established Sept 29, 1993 on route 288 East, near Chester on a south (20%) and north (34%) facing slope on opposite sides of the road.

Even though both the north and south sites were strongly sloping, they were tilled prior to seeding. After the site was prepared in the same manner as the Fine Fescue Adaptation study, the fescue sown alone were sown at a rate of 112.5 kg/ha (100 lb/A). If sown in combination with another fescue, 57 kg of fine and 57 kg of tall fescue were sown per ha. If sown in combination with birdsfoot trefoil, 57 kg of fescue with 5.7 kg of trefoil were sown per ha. The birdsfoot trefoil was inoculated prior to sowing. The five treatments (Figure 9a) were arranged in a randomized block design and replicated three times. Fertilizer was applied to both sites, and lime was applied to only the south site[8] (Appendix C). The south site was mowed in July 1995 and July 1996 to control weeds. Because of the birdsfoot trefoil, post-emergence broadleaf weed control could not be used. The study will be monitored each spring and fall until 1996.

Results: The site was evaluated in October 1995 and May 1996. On the south aspect, percent density of the five treatments when evaluated 2 and 2 ½ years after sowing was not significantly different (Figure 9a). None of the grass or BT treatments approached the 70% density threshold. The data for the fall was uniformly depressed, thus reflecting the effect of the hot stressful summer. By spring, all but the BT "bounced back" (Figure 10a). All plant combinations doubled in density during the winter months, except for the hard fescue that was mixed with the tall fescue.

The north side of the highway presented a different picture. The percent density of the treatments on this side were significantly different for both fall and spring data (Table 9 a and 10a). For the fall data, all treatments, except for tall fescue and BT, reached or exceeded the 70% threshold. The three hard fescue treatments covered 90% of the plots, exceeding the tall fescue. In the spring, all of the hard fescue treatments exceeded the 90% again. The tall fescue with and without BT, as well as the BT alone, fell short of the 70% threshold. For both recording periods, the tall fescue alone was significantly less dense than the hard fescue alone.

Discussion: Because of the nature of the experiment, the south and north side cannot be statistically compared, but inferences can be drawn. Two and one-half years after sowing, (Figure 10a) the hard and tall fescue that were sown on the south aspect did not reach the 70% threshold. Only the hard fescue that was sown on the north aspect reached and exceeded this threshold. This finding may support the argument that hard fescue is more adapted to the north, cooler slopes, than the tall fescue and that the hard fescue is as equally adapted as tall fescue on a harsh south site in the Coastal Plain.

The combination of hard and tall fescue, when sown on either the south or north aspect, provided no advantage or disadvantage when compared to the pure stand of fine fescue. However,

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[8]Fertilizer, 15-30-15, at rate of 682 kg/ha (600 lb/A) and lime at rate of 2,240 kg/ha (1T/A)

when the hard and tall fescue combination was compared to a pure stand of tall fescue, the combination performed better on both aspects.

If slope aspect is contemplated in initial revegetation design, this research indicates than only warm-season grasses should be used on southern aspects in the Coastal Plain, because neither the tall or hard fescues performed well (bermudagrass, buffalograss or weeping lovegrass would be suitable for this type of site.) However, if the aspect is cool, either a pure stand of hard fescue or a mixture of tall and hard can be used with success.

If slope aspect is ignored as an establishment criteria, the use of a pure stand of hard fescue is recommended. The addition of tall fescue may not increase the percent density of the stand. If species diversity is desirable, the addition of birdsfoot trefoil can be recommended.

Birdsfoot Trefoil Study - Fine Fescue And Tall Fescue

Title: Performance of Fine Fescue and Tall Fescue in Combination with Three Cultivars of Birdsfoot Trefoil in Two Regions of Virginia, Piedmont and Ridge & Valley.

Objective: To determine if fine and tall fescue's performance can be enhanced with the addition of a nitrogen fixing legume, birdsfoot trefoil.

Procedure for Establishment, Maintenance and Data Collection: This experiment was established October 1, 1993 in Lynchburg (Piedmont) and October 14, 1993 in Blacksburg (Ridge & Valley) on flat sites. Three cultivars of birdsfoot trefoil, Empire, Norcen and AuDewey were sown with a hard fescue 'Eureka' in Lynchburg and with both a hard fescue 'Eureka' and tall fescue 'Falcon II' in Blacksburg. The Au-Dewey cultivar of birdsfoot trefoil is reported to be more heat tolerant than the other two cultivars.

After the site was prepared in the same manner as the Fine Fescue Adaptation Study, the fescue was sown alone at a rate of 112.5 kg/ha (100 lb/A). If sown in combination with birdsfoot trefoil, 56.7 kg of fescue with 5.7 kg of trefoil were sown per ha. The birdsfoot when sown alone was seeded at 5.7 kg/ha. The birdsfoot trefoil was inoculated prior to sowing. The Lynchburg site has a total of five treatments (Figure 11a), whereas the Blacksburg site has a total of eleven treatments (Figure 13a).

The fescue with and without trefoil were arranged in a randomized block design and replicated three times. Fertilizer was applied after sowing; however, lime was applied to only the Ridge & Valley site because the pH was less than 6.2 [9] (Appendix C). The Lynchburg site was mowed in June and September 1995 and in June 1996, and the Blacksburg site was mowed in July 1995 and 1996. The study will be monitored until the fall of 1996.

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[9]Fertilizer, 15-30-15, at rate of 682 kg/ha (600 lb/A) and lime at rate of 2,240 kg/ha (1T/A)

Results and Discussion: Lynchburg - No differences in percent density and overall performance of the fine fescue with the different varieties of BT were observed 24 and 32 months after sowing (Figure 11a/b and 12a/b). However, the 'Norcen' and 'AuDewey' BT were present in a greater amount than 'Empire' at this time. The hard fescue in combination with 'Empire', 'Norcen' and 'AuDewey' BT performed equally as well when compared to hard fescue alone. All of the hard fescue treatments performed as well as the tall fescue with 'AuDewey'.

Blacksburg - As observed in the Lynchburg study, there were few significant differences in percent density for each of the fine or tall fescue grown with the three different BT varieties, 24 and 32 months after sowing (Figure 13a and 14a). However, the hard fescue alone or in combination with the BT out-performed the tall fescue. All but one tall fescue treatment reached the 70% density threshold. The 'Empire' BT, when grown alone, was not as prolific as the other two cultivars. The OP ratings also reflect the same trends seen in the density data (Figure 13b and 14b).

Piedmont - BT reseeding was evident the spring of 1996 when it was found in a plot not initially seeded with BT. The BT has recovered from the early summer mowing in both Blacksburg and Lynchburg to date. The height of BT at the Blacksburg site was measured on June 3, 1996 prior to mowing. The average height of AuDewey was 37 cm; Norcen, 29 cm; and Empire, 32 cm.

Seeding Rate Study - Fine and Tall Fescue

Title: Performance of Fine and Tall Fescue Established at Four Seeding Rates.

Objective: To determine if seeding rates affect the performance of fine and tall fescue on the roadside.

Procedure for Establishment, Maintenance and Data Collection: Hard fescue 'Eureka' and the tall fescue 'Falcon II' seed were sown at 95, 112, 140, 168 kg/ha (85, 100, 125, 150 lbs/A) on a south facing 34 % slope on Route 288, near Chester, a Coastal Plain site, on September 29, 1993. The same establishment procedures that were used in the Fine Fescue Adaptation Study were used in this study. The treatments were arranged in a randomized block design and replicated three times. Fertilizer and lime were applied after sowing[10]. The site was mowed July 1995 and 1996 and post-emergent herbicide Garlon 3A™ (28 l/ha) was applied in September 1995 and July 1996. The study will be monitored in the fall of 1996.

Results and Discussion: The study was rated in October 1995 and May 1996, and at both times no significant differences in percent density and overall performance were indicated (Figure 15 a/b and 16 a/b). None of the seeding rate treatments approached the 70% density threshold.

The harsh soil and temperature conditions at this site represent one of the most severe

[10]Fertilizer, 15-30-15, at rate of 682 kg/ha (600 lb/A) and lime at rate of 2,240 kg/ha (1T/A)

conditions that can be found in Virginia. Along with the 34% slope on sandy loam Coastal Plain soil, this site is situated on a southern aspect which is quickly parched in the summer. The theory in selecting this site for the seeding rate study was to tax the grasses so that differences in rates could be observed if they occur. To date, statistical differences have not been observed. There has been a general trend of decline of all the seeding rates. This maybe due to the lack of N as well as the continued summer stress. Nitrogen has not been re-applied since the fall of 1993. When the final data are recorded in the fall of 1996, the total picture should be evident.

Seeding Rate Study - Fine Fescue

Title:Performance of Hard, Sheep, Creeping Red and Chewings Fescue Established at Four Seeding Rates.

Objective: To determine if seeding rates affect the performance of fine fescue on the roadside.

Procedure for Establishment, Maintenance and Data Collection: Pure stands of hard, sheep, creeping red and Chewings fescue were sown at 73, 95, 112, 168 kg/ha (65, 85, 100, 150 lbs/A respectively) on a north facing gentle sloping Coastal Plain site on Route 288, near Chester, on September 28, 1994. Establishment procedures were the same used in the Fine Fescue Adaptation Study. The treatments were arranged in a randomized block design and replicated four times. Fertilizer was applied after sowing[11]. Lime was not applied as dictated by the soil test (Appendix C). The site was mowed July 1995 and 1996 and post-emergent herbicide Garlon 3A™ (28 l/ha) was applied in September 1995 and July 1996. The study will be monitored each spring and fall until 1997.

Results and Discussion: The study was rated in October 1995 and May 1996. For each fescue species, there were no significant differences observed in percent density and overall performance (Figure 17 a/b and 18 a/b). All of the species, except for creeping red fescue, approached or exceeded the 70% density threshold at all rates. The performance of creeping red fescue as a group does not rival the performance of the other fescue types two years following sowing. As the stand matures, differences may become more evident. The data from the next year will hopefully reveal how rates affect persistence.

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

Demonstration

Title: Renovation of a Barren Acid-Producing Slope

Objective: To revegetate a slope with exposed sulfidic soils with the addition of lime and composted yardwaste.

Procedure for Establishment, Maintenance and Data Collection: A cut slope (30%) with exposed sulfur-producing soil was identified on the Mechanicsville exit, Route 360, from interstate 295. The north-east facing slope was off on the left of the off-ramp. The slope was completely void of vegetation and the drain at the base of the slope had about 270 cm of eroded sediment. According to the Mechanicsville Headquarter's crew leader, the drain had been cleaned several years prior to the spring of 1996. This provides an idea as to the amount of erosion that can occur from one of these slopes.

The soil was carefully collected from a depth of 10cm (4") and then at 20-25cm (8-10"). The general soil tests were performed (Table 7) as well as a specialized potential acidity test (peroxide acidity test). From this test it was determined that 22,400 kg/ha (10 tons/A) of agricultural lime would be required to raise the pH to close to 6 as long as only the first 10 cm of soil was disturbed. The deeper the soil, the greater the magnitude in potential acidity. For example, the potential acidity test of a subsurface soil sample (20-25cm) from a different site indicated that 60,000 kg/ha (27 tons/A) of lime would be required. Thus, it is best to not expose the deeper subsoil if possible.

On March 7, 1996, the slope was covered with half of the lime (11,200 kg/ha), 672 kg/ha (600 lb/A) of phosphorus, and 13,440 kg/ha (12,000 lb/A) of fiber mulch with the use of a hydroseeder. The high P addition would potentially slow down the acidifying reaction of the sulfur in the soil.

On April 17, 1996 the site was seeded in the following manor:
1) The 0.03 ha (3,000 sq ft) site was divided in half, length wise (Figure 19). The bottom portion was regraded with a gradeall-type machine. Only the 10-15cm (4-6") of the soil profile was disturbed. The top portion of the site was left undisturbed and the rills were left intact.

2) Four-year-old sifted yardwaste compost from 623 Landfill Inc. was piled (lengthwise) in the middle of the slope by the gradeall. The compost was applied at the rate of 8.4 cu meter (11 cu yd) wet or 112,000 kg/ha (50 ton/A) dry.

3) The hydroseeder then applied 11,200 kg/ha of lime to the entire area which included the side area adjacent to the area that was covered with compost.

4) The compost was then raked up and down the slope by hand. The compost contained 50% solids but was still easy to rake. After the raking, 0.03 ha of slope was covered with compost. The middle 3 meters of the slope was covered with 13-20 cm of compost and only received half of the lime

application (11,200 kg/ha). The rest of the slope was covered to a thickness of 5-10 cm. For an indication of cost, 2 loader buckets of compost were used at a cost of $150. This included the cost of delivery.

5) The legumes were sown by hand after they were inoculated. They were not added to the hydroseeder slurry in fear that the high salts would harm the bacterial inoculum. To inoculate the seed, the seed was first poured into a large grocery-style paper bag and then sprayed with a sugar water solution of 1:4 sugar to water. The dusty inoculum sticks to the seed if the sugar water is used. The inoculum was added to the bag, and the bag was given a few shakes. The seed was distributed with a hand-held spinner spreader. The following legumes were seeded:

a. Annual lespedeza 'Kobe' , *Lespedeza stipulacea*, 5 kg/ha (4 lb/A)
b. Sericea lespedeza, *Lespedeza cuneata*, 5 kg/ha (4 lb/A)
c. Birdsfoot trefoil, *Lotus corniculatus* 'AuDewey', 5 kg/ha (4 lb/A)

6) The hydroseeder applied a seed mix, 15-30-15 fertilizer 672 kg/ha (600lb/A), and 1,680 kg/ha (1,500 lb/A) of wood fiber mulch to the compost and non-compost covered areas. The seed mixture consisted of the following species:

a. Hard fescue 'Relliant II' and 'Arora'- 130 kg/ha (116 lb/A)
b. Sheep fescue 'Azure'- 90 kg/ha (80 lb/A)
c. Alkaligrass - *Puccinellia distans* - 8 kg/ha (7 lb/A)

7) Figure 19 provides a diagram of the four treatments. The area at the top of the hill, "L-C", was not tilled; however, the site was amended with surface applied lime and compost. The area at the bottom of the slope, "L-C-T", was tilled and amended with surface applied lime and compost. The area between these two areas, "1/2L-C", received only half an application of lime, the area was not tilled but compost was applied to the surface. The control area, "L", was limed. No other amendments were applied nor was the area tilled.

This site will be monitored yearly until the fall of 1999. An application of lime and fertilizer will be surface applied in September 1996.

Results and Discussion: As of May 10, 1996, the seed germination of the slope looked very good. The birdsfoot trefoil and annual lespedeza were in the 4-leaf stage and the hard fescue was in the 3-blade stage. Germination was fairly uniform for the area that was regraded. On the non-regraded area, most of the vegetation was in the valleys of the rills. This was not a surprise. There was a definite boundary difference in vegetation between the compost-applied area and the area that was not amended with compost. The compost area appeared to be greener and more dense. At the base of the slope the sediment was stained a rust color from the iron sulfates that leached from the slope. This was indicative that chemical reactions with the sulfur were still occurring. One of the goals in revegetating this type of slope is to slow the chemical reactions so that the vegetation's roots can live in an environment free of sulfuric acid and aluminum ions.

On May 30, 1996, six weeks after sowing, the site was evaluated for vegetation establishment

and growth. Percent density, plant number, and OP were recorded for 21 observations (using a randomly tossed 48 by 19 cm frame) for each of the four distinct areas on the slope (Table 8). The compost amended areas out-performed the control for all three measured parameters. The use of tillage did not appear to be better than the non-tilled area, but the data is deceiving. In the non-tilled area both valley and peaks of the rill were equally sampled. The percent density and plant counts were higher in the valleys, which in turn skew the data. The plant populations were higher in the valleys because the soil moisture was more favorable to germination and/or the water washed the seed into the rills. The tilled area's germination was more uniform than the non-tilled areas. At this time there appears to be little difference between the area that received the full amount of lime as compared the strip that received only half the lime.

The height of birdsfoot trefoil was measured for 9 randomly selected plants from a composted and non-composted site. The mean of the trefoil from the compost amended area was 97 cm and the mean of the plant form the non-compost amended area was 67 cm. The height difference may be due to either or both enhanced soil-moisture or added fertility from the compost. Both areas were fertilized with the same amount of fertilizer at date of sowing. However, the compost offers a small amount of nitrogen (Appendix D).

The use of compost appears to be a key in successful revegetation of this type of slope. The summer weather following sowing was ideal. The temperatures did not exceeded 38 ^{0}C, and the rainfall was ample. Persistence of the vegetation will be carefully monitored in the next few years.

CONCLUSIONS

I. Turfgrass Cultivar Evaluations

The new generation of tall and fine fescue trials that have been planted in the Coastal Plain are not mature enough to provide cultivar recommendations for the VDOT Development Sheet. However, some fine fescues have been designated as "promising". These cultivars can be used in a pinch, but with some reservation. The 1996-97 report will contain the final list of fine fescue cultivars that have been tested for three years and can, therefore, be recommended for use in Virginia.

II. Management Studies

The fine fescue studies that were installed in the fall of 1993 are close to completion. Apparently, fine fescues as a general group can be successfully grown in the Ridge and Valley and Piedmont of Virginia, either alone or in a mixed stand with tall fescue. We would like to watch the Coastal Plain site for another season before making a final judgement. As of now, the fine fescues did as well as or better than the tall fescue on cool slopes; however, both the tall and fine fescues have exhibited a decrease in density on the warm slope. In light of this observation, warm-season grasses, such as bermudagrass, buffalograss and weeping lovegrass, should be considered logical candidates for warm aspect slopes.

The establishment of birdsfoot trefoil, a "mowable" N-fixing legume, was successful in the Coastal Plain, Piedmont and Ridge & Valley regions of Virginia. More information on persistence, which should be available in the next few months, is needed before trefoil can be recommended for roadside or median use. This plant could help to expand roadside planting diversity without dominating a stand.

The tall and fine fescue seeding rate experiment has demonstrated that 95 kg/ha (85 lb/A) fine fescue and 149 kg/ha (125 lbs/A) of tall fescue (sown as a pure stand) are adequate for establishment on even the most difficult sites encountered in Virginia. If the site is not harsh, then a lower seeding rate can be used, especially if percent purity and germination of the seed are high. Please note that these preliminary recommended rates are based on establishment data. The final recommendation will be presented when the persistence data are available.

Barren acid-producing slopes can be revegetated, as proven in coal strip mine areas; however, site-specific protocols must be used. The main ingredients to success are soil testing, adequate lime applications, the use of composted organic matter such as yardwaste, and the application of seed-mixes which are adapted to low pH and high salts. Vegetation on our test site, which was successfully established in the spring of 1996, will be monitored for persistence over time.

Acknowledgments

Steven M. Nagle, Cathy Atkinson, Dickey Shepherd, and Charlie McCoy have made considerable contributions to this research:

Special thanks goes to the Lynchburg and Richmond districts for all their help in preparing the research sites, with special gratitude to Brian Waymack for his help in orchestrating the installation of the plots in Chester and of the barren acid-producing slope demonstration in Mechanicsville.

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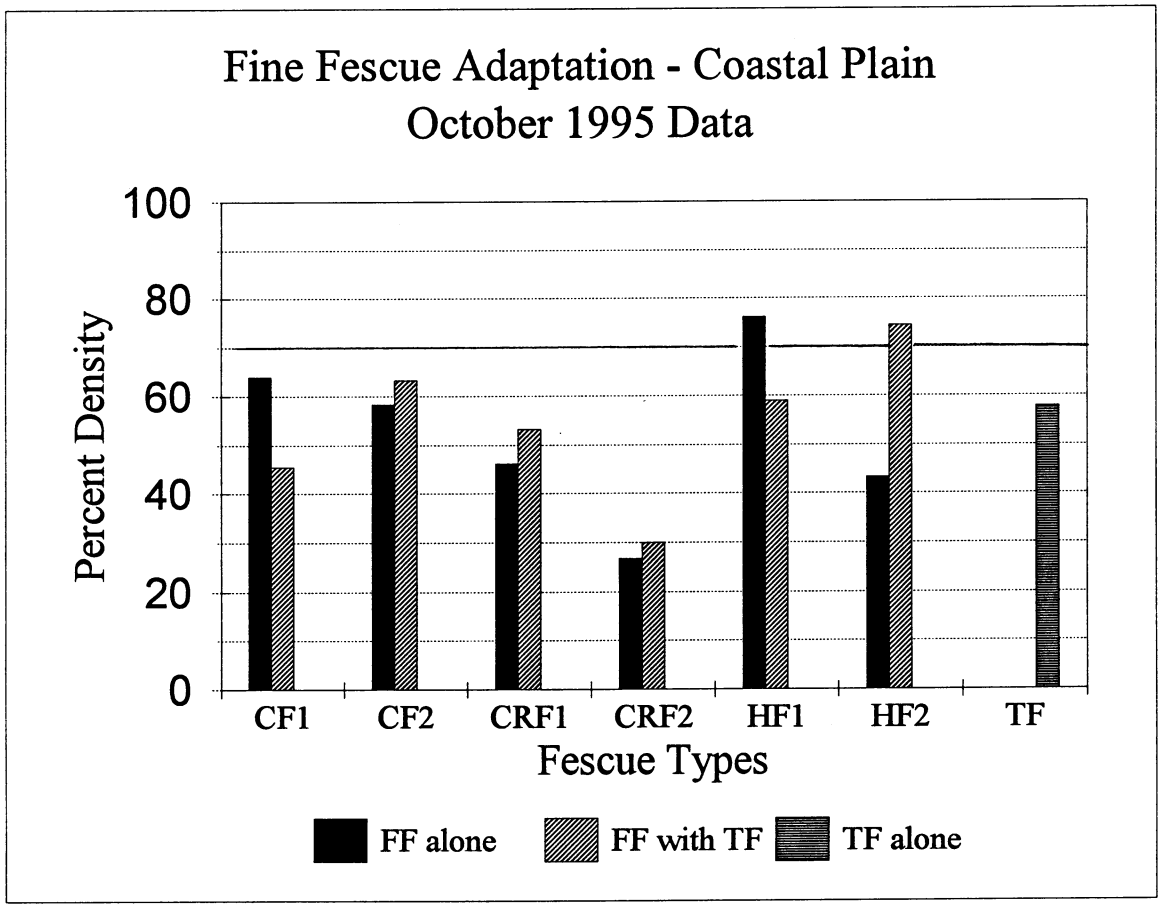
Figure 1a. Fine Fescue Adaptation - Coastal Plain

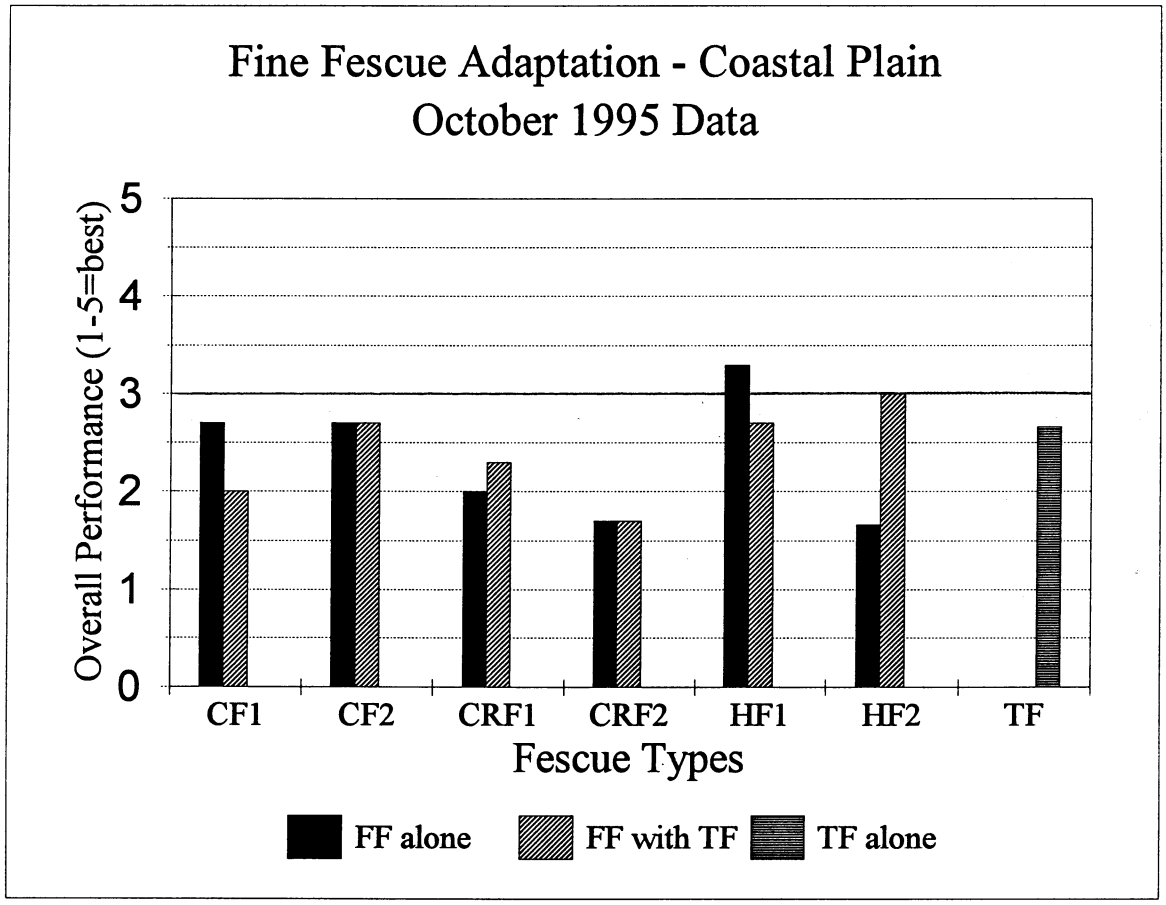
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control. The data were recorded in October 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 1b. Fine Fescue Adaptation - Coastal Plain

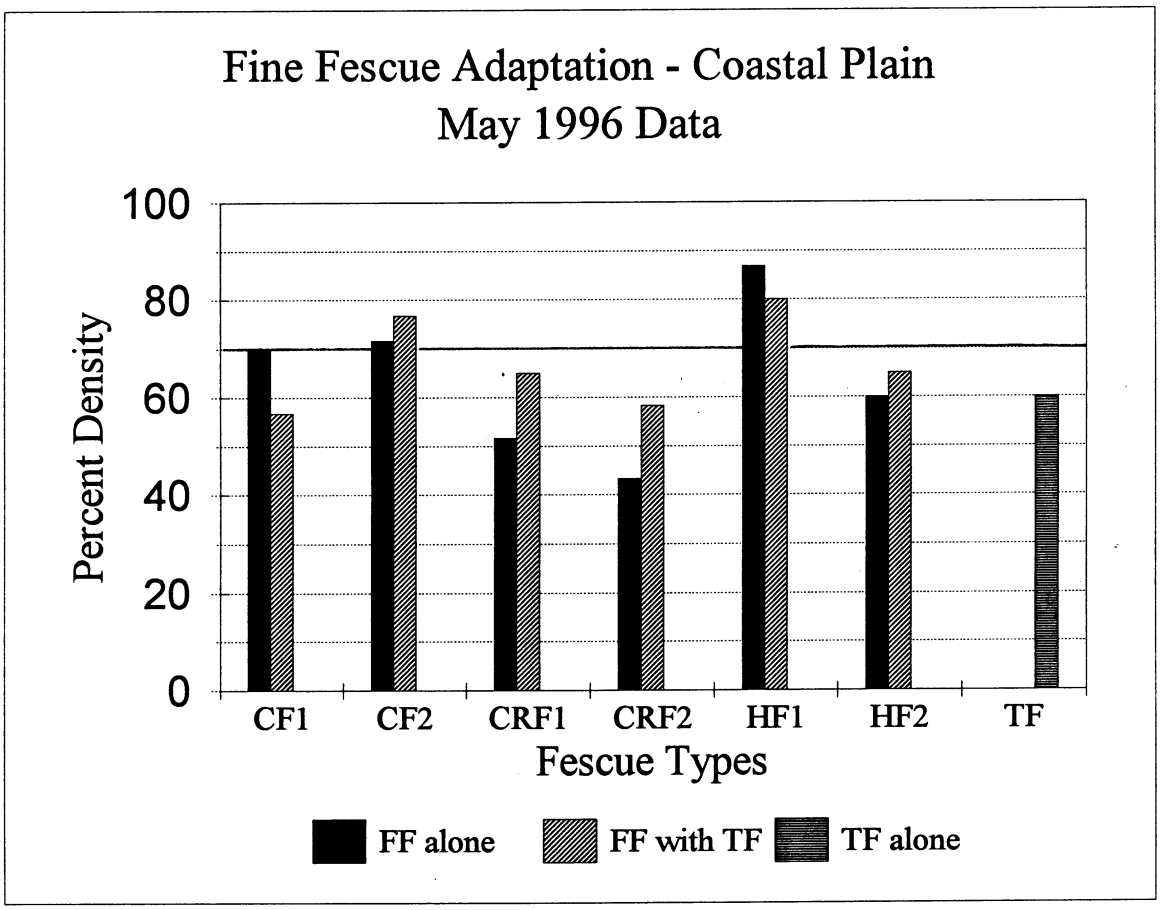
Overall Performance (1-5=best) of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control. The data were recorded in October 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 2a. Fine Fescue Adaptation - Coastal Plain

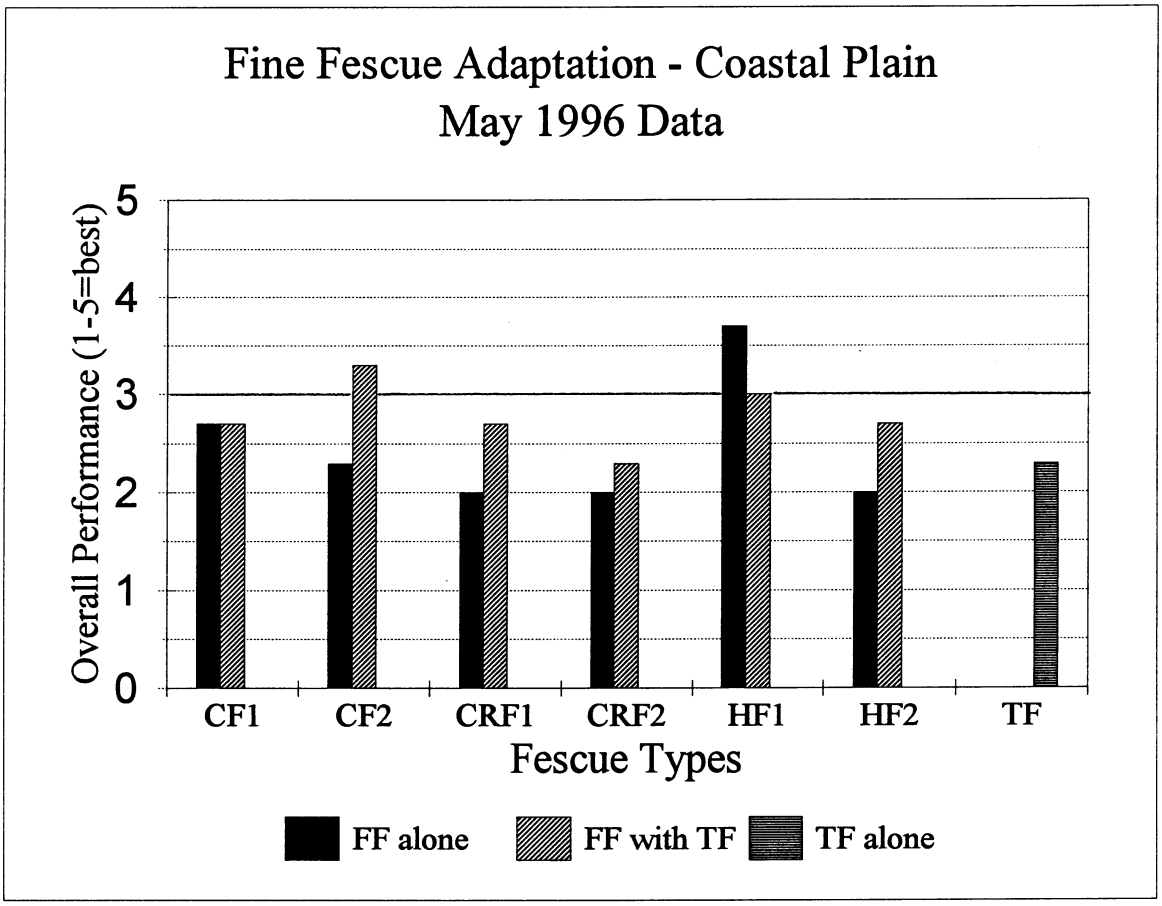
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control.The data were recorded in May 1996.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 2b. Fine Fescue Adaptation - Coastal Plain

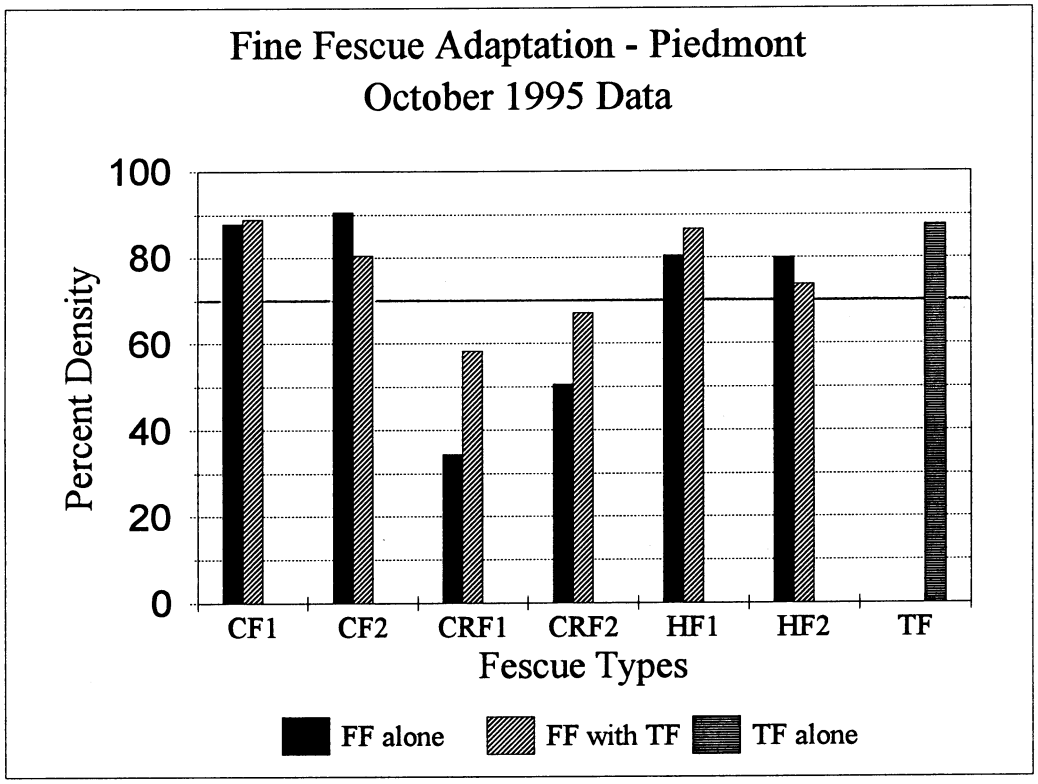
Overall Performance (1-5=best) of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control. The data were recorded in May 1996.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 3a. Fine Fescue Adaptation - Piedmont

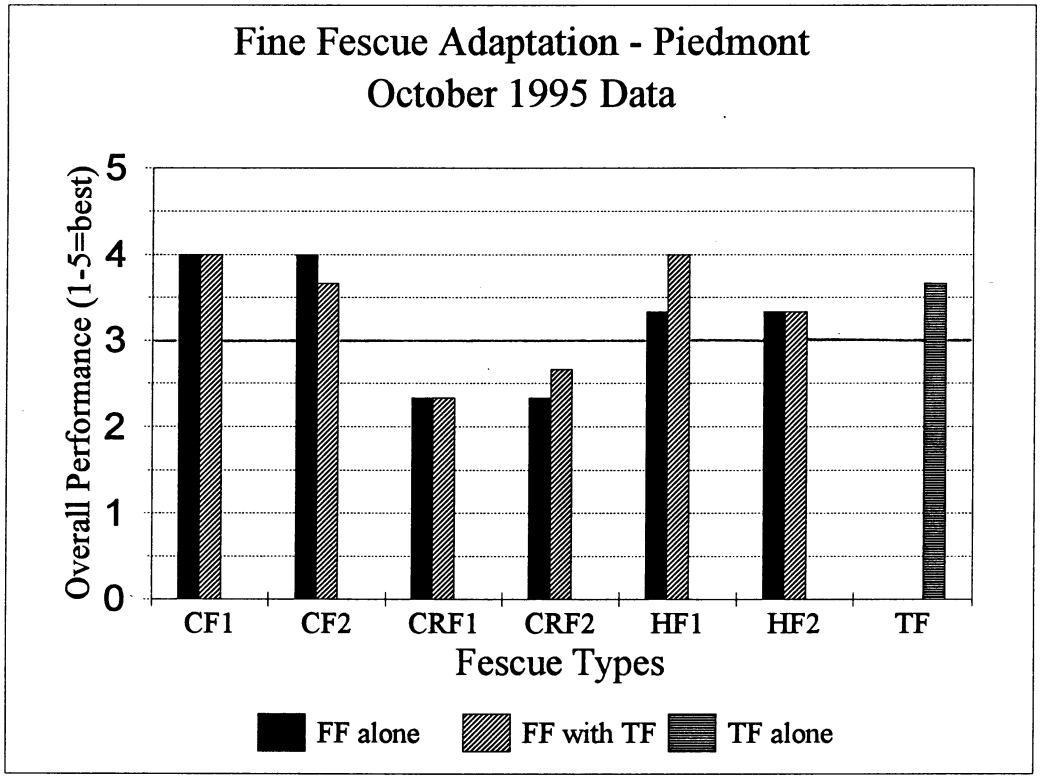
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control. The data were recorded in October 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 3b. Fine Fescue Adaptation - Piedmont

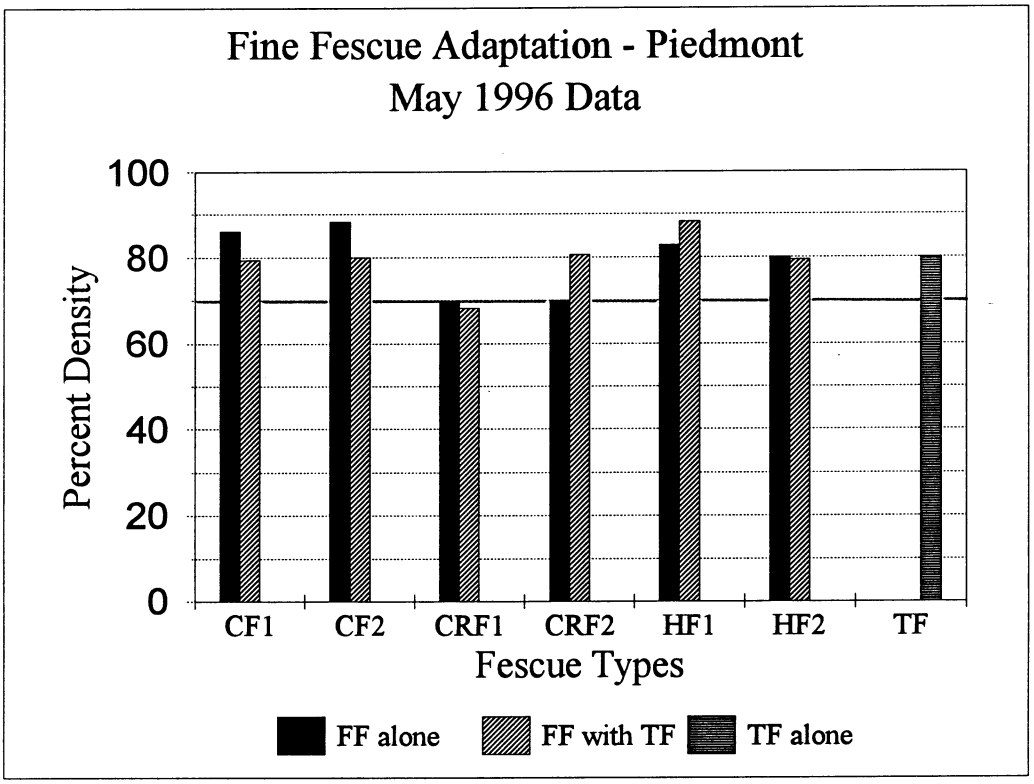
Overall Performance (1-5=best) of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control. The data were recorded in October 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 4a. Fine Fescue Adaptation - Piedmont

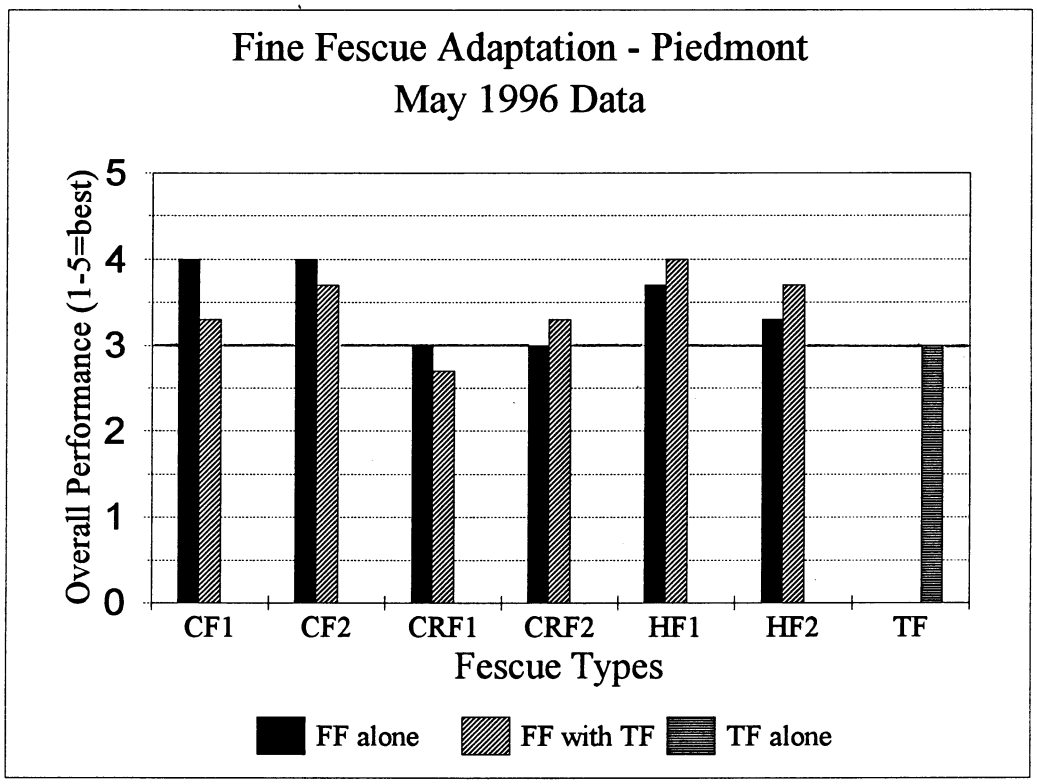
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control. The data were recorded in May 1996.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 4b. Fine Fescue Adaptation - Piedmont

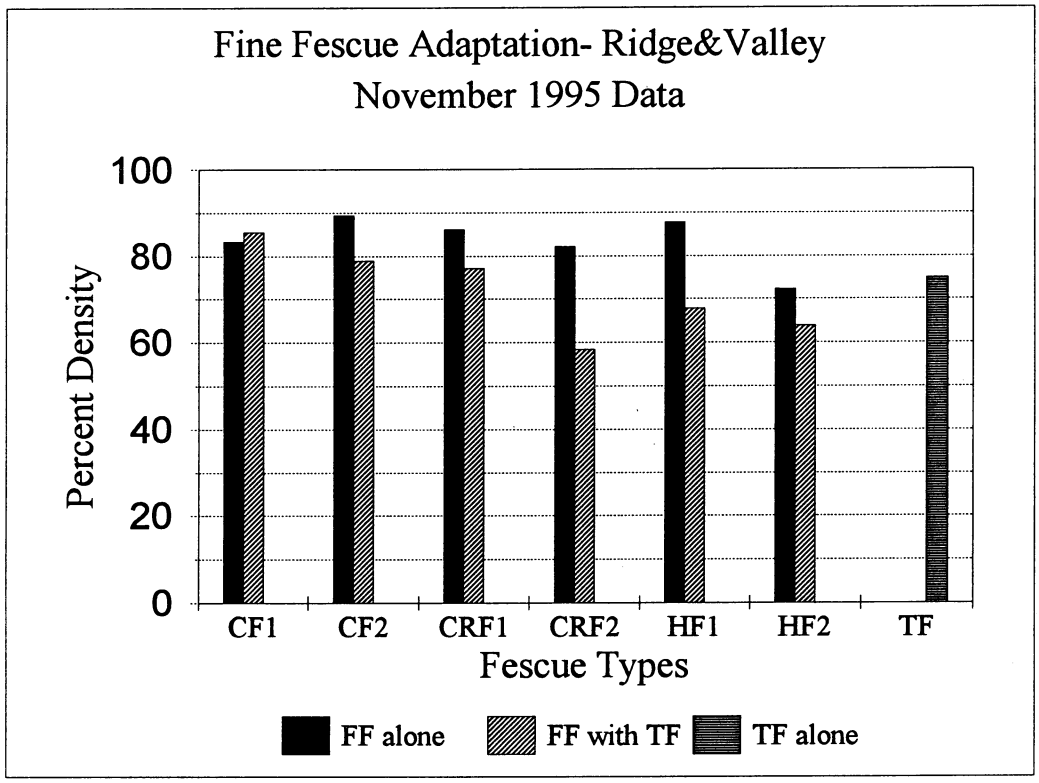
Overall Performance (1-5=best) of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in September 1993. TF alone was sown as a control. The data were recorded in May 1996.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 5a. Fine Fescue Adaptation - Ridge & Valley

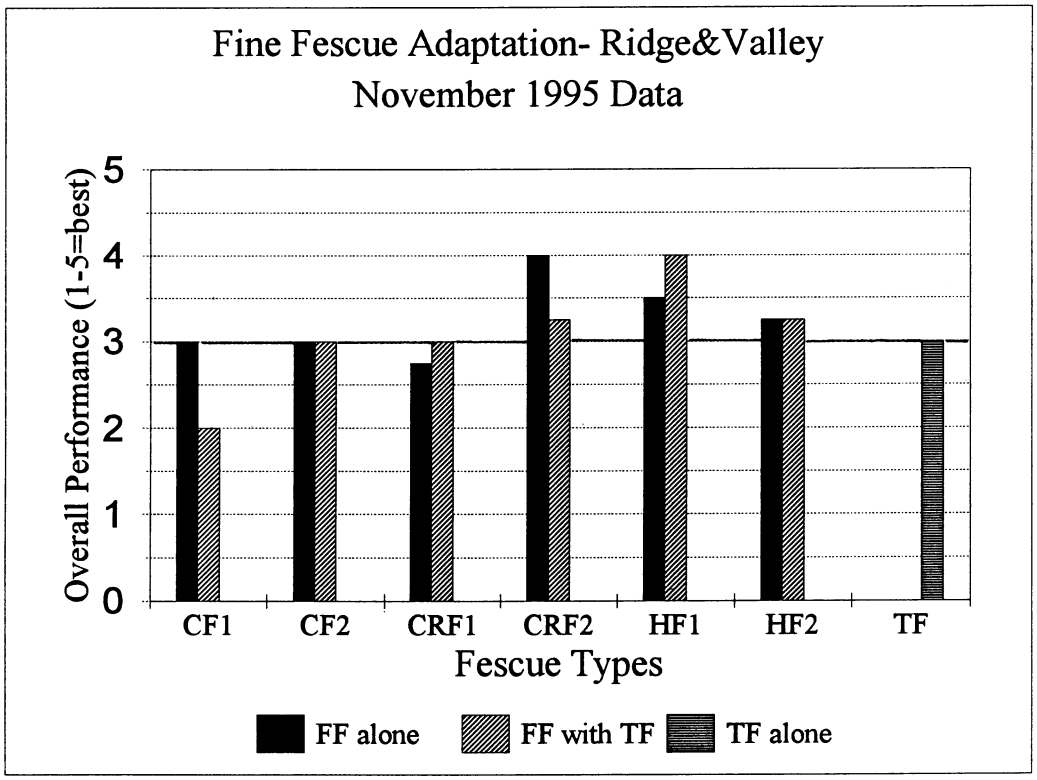
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in October 1993. TF alone was sown as a control. The data were recorded in November 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Faclon II

Figure 5b. Fine Fescue Adaptation - Ridge & Valley

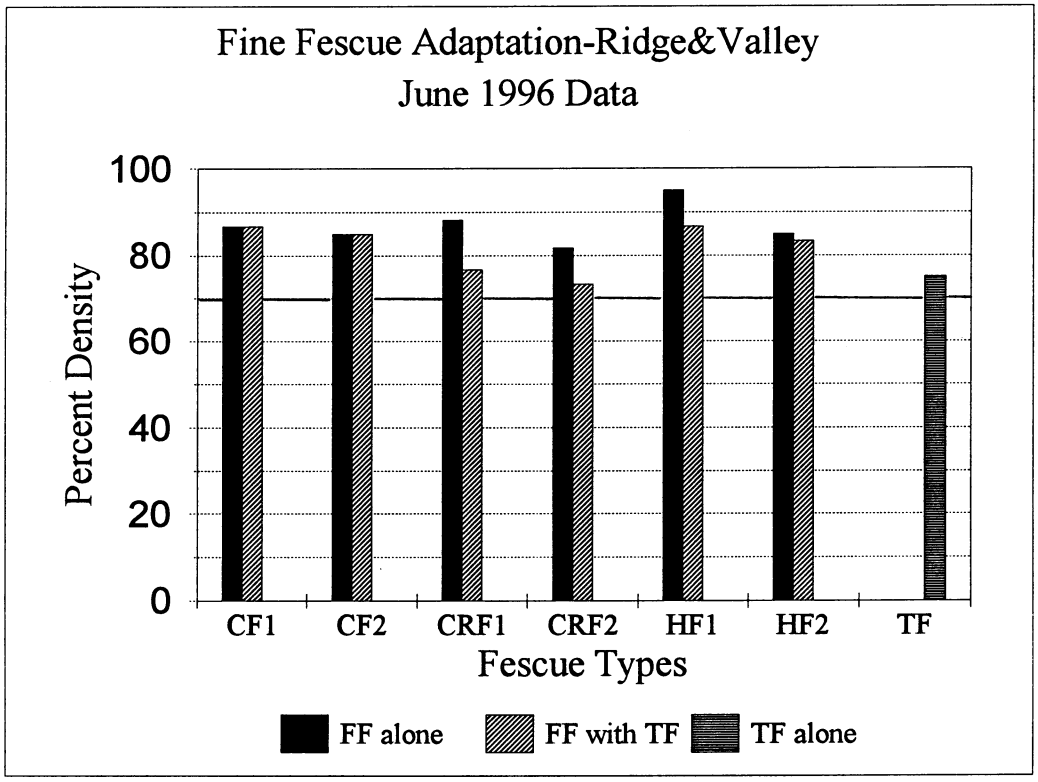
Overall Performance (1-5=best) of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in October 1993. TF alone was sown as a control. The data were recorded in November 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Faclon II

Figure 6a. Fine Fescue Adaptation - Ridge & Valley

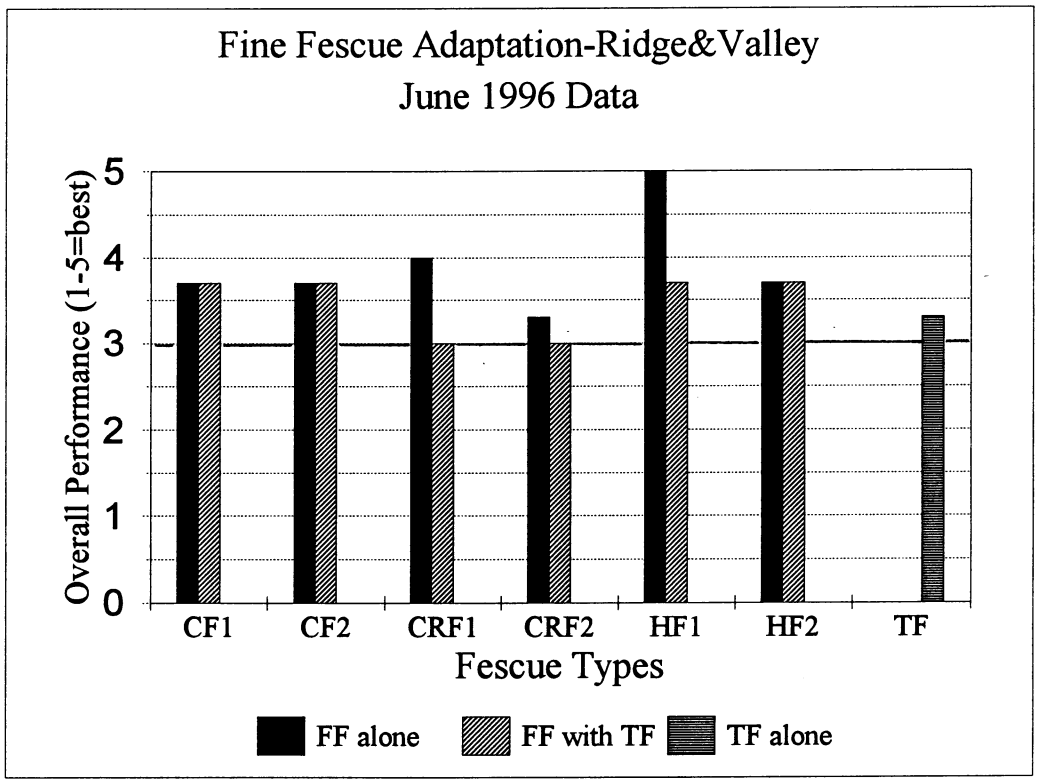
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in October 1993. TF alone was sown as a control. The data were recorded in June 1996.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Figure 6b. Fine Fescue Adaptation - Ridge & Valley

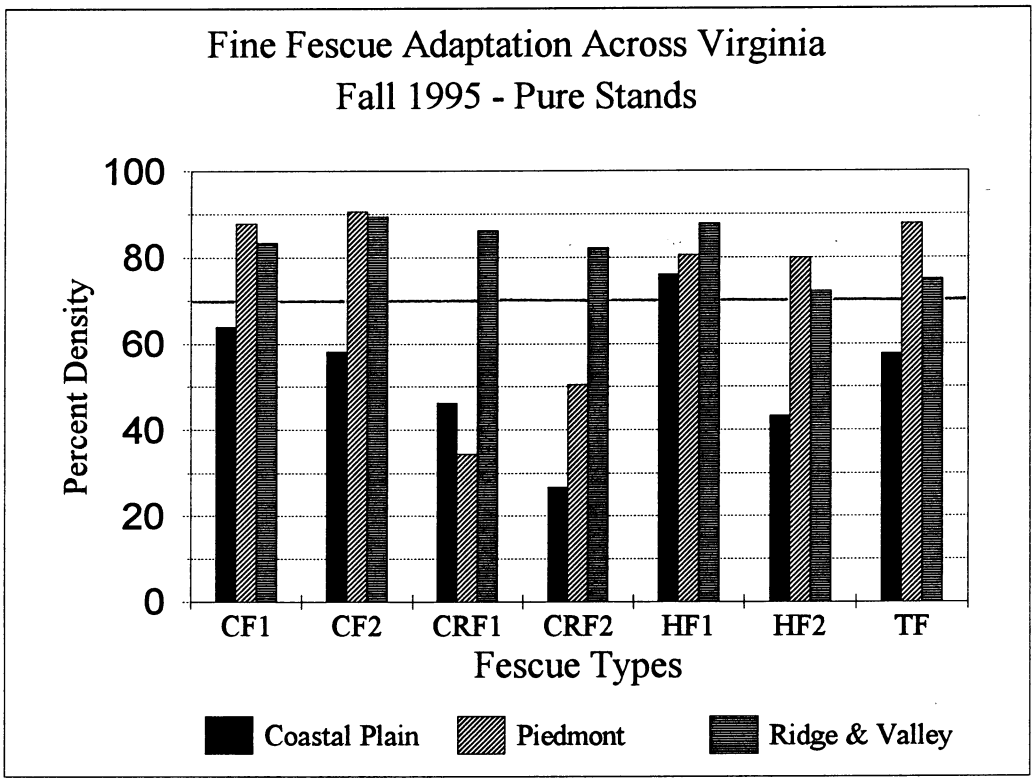
Overall Performance (1-5=best) of two varieties of each Chewings (CF), Creeping Red (CRF) and Hard (HF) fescue, with and without tall fescue (TF). The site was sown in October 1993. TF alone was sown as a control. The data were recorded in June 1996.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Table 7a. Fine Fescue Adaptation - Summary of Three Regions

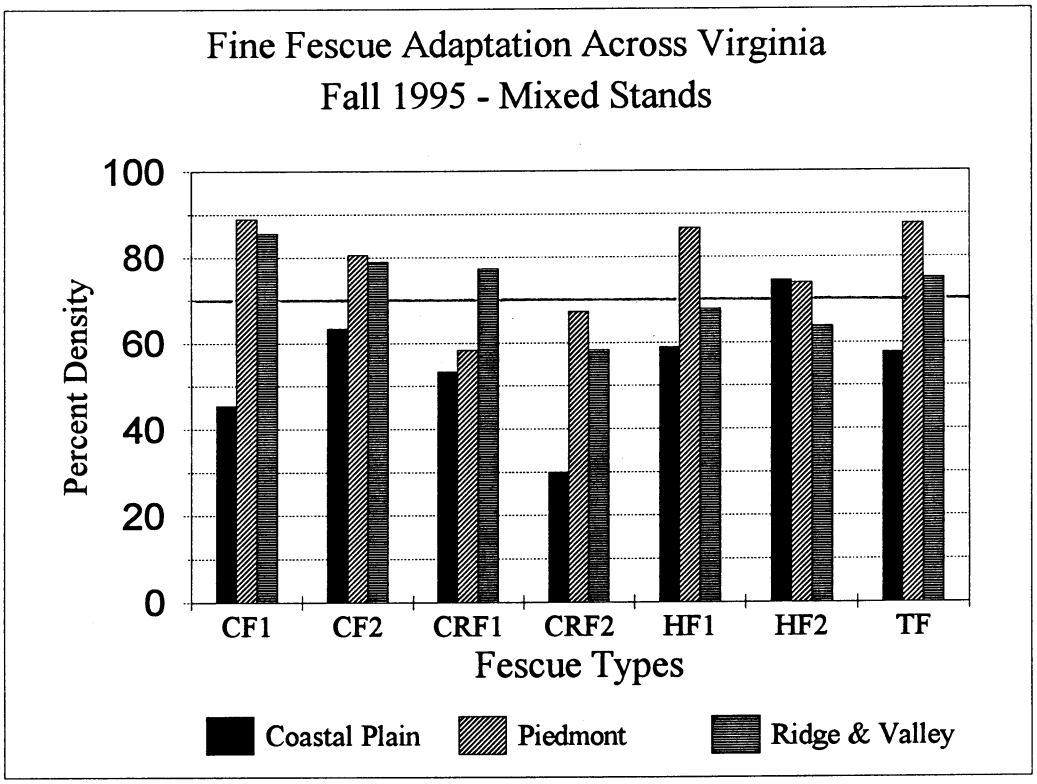
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF), and Hard (HF) fescue in pure stands is presented. The sites were sown in the fall of 1993. The tall fescue was sown as a control. The data were recorded in the fall of 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda
TF=Falcon II

Table 7b. Fine Fescue Adaptation - Summary of Three Regions

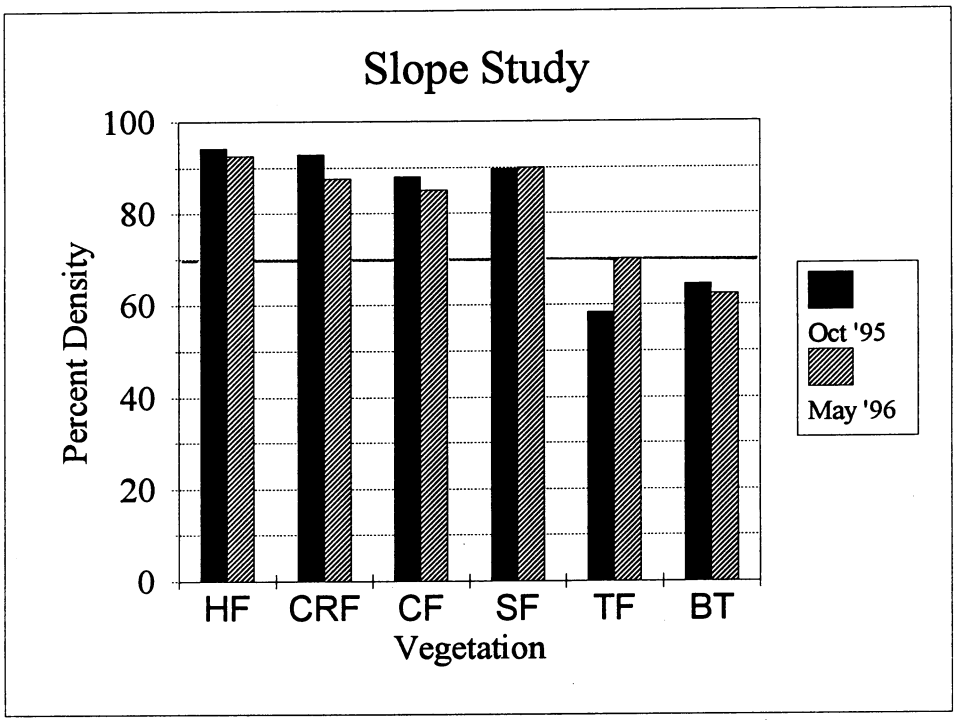
Percent density of two varieties of each Chewings (CF), Creeping Red (CRF), and Hard (HF) fescue mixed with tall fescue is presented. The sites were sown the fall of 1993. A pure stand of tall fescue was sown as a control. The data were recorded in the fall of 1995.



CF1=Banner II, CF2=Victory, CRF1=Cindy, CRF2=Ensylva, HF1= Reliant, HF2=Valda TF=Falcon II

Figure 8. Slope Study

Percent density and overall performance of hard fescue (HF), creeping red fescue (CRF), Chewings fescue (CF), sheep fescue (SH), tall fescue (TF), and birdsfoot trefoil (BT) is provided. The seed was sown on a north facing, 34% slope in the fall of 1993 in Chester, Virginia.



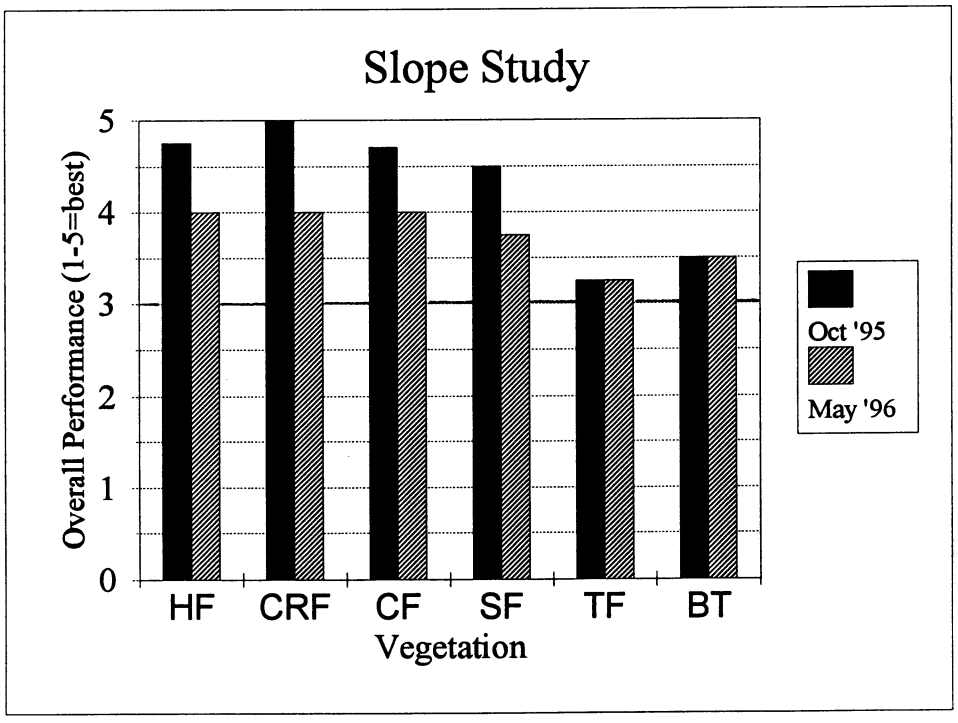
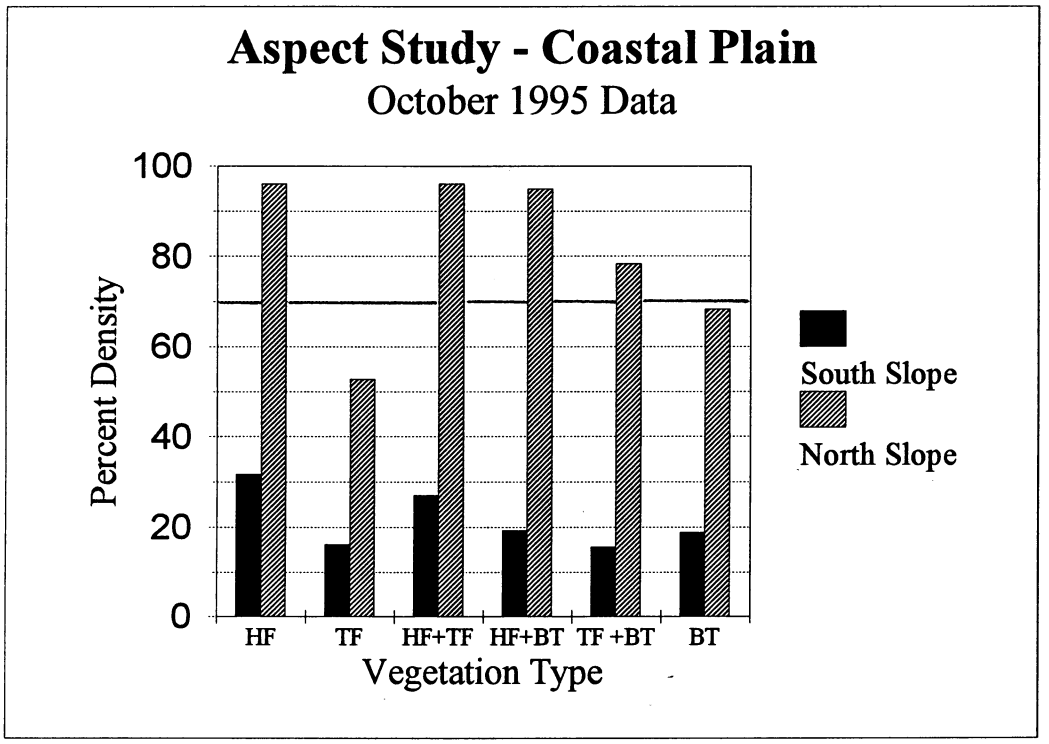


Figure 9a and b - Aspect Study - Fine and Tall Fescue - Chester

Percent density and overall performance of hard fescue (HF) and tall fescue (TF) with and without birdsfoot trefoil (BT) are presented. The seed was sown on a south and north aspect in the fall of 1993. The data were recorded in October 1995.



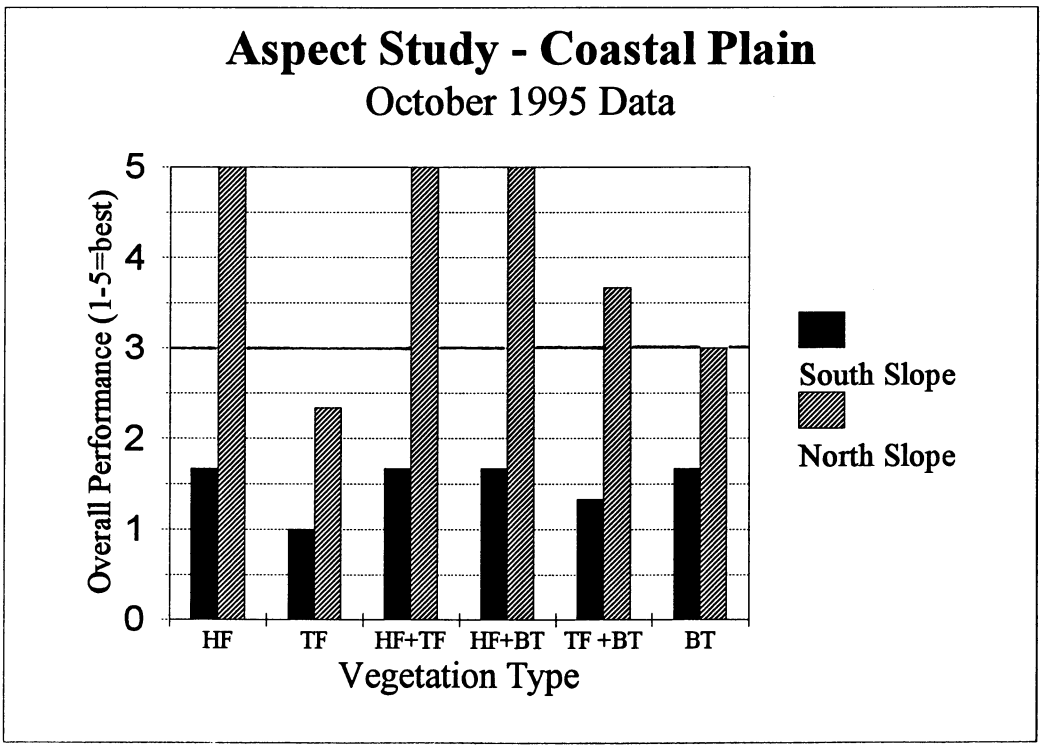
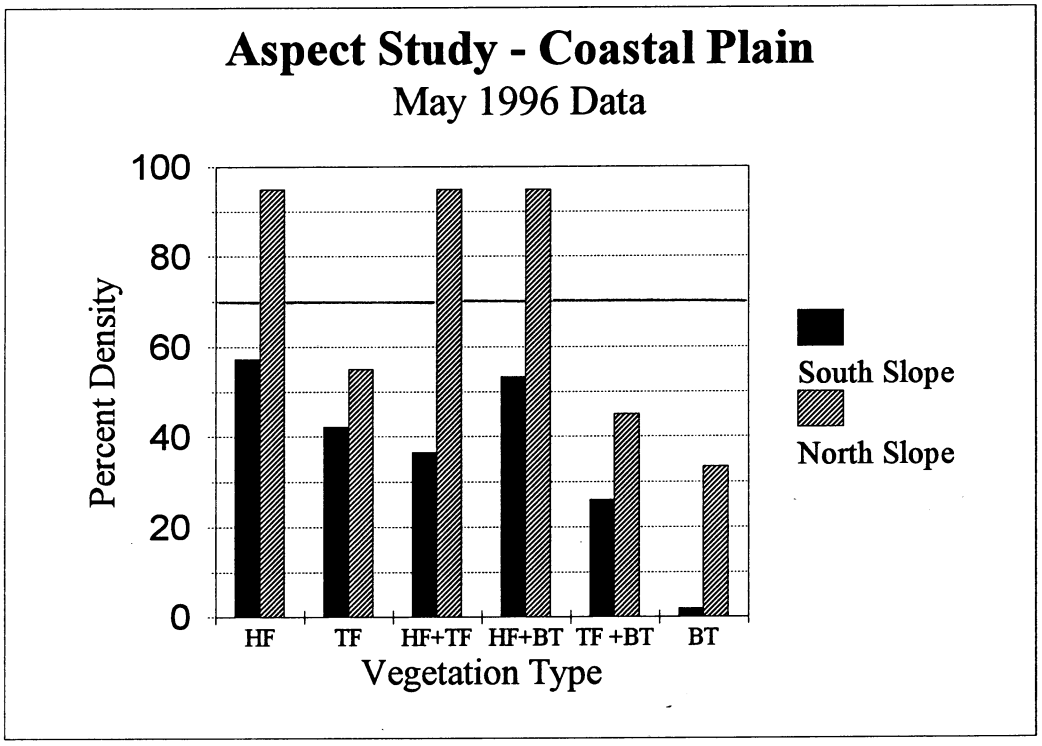


Figure 10a and b - Aspect Study - Fine and Tall Fescue - Chester
Percent density and overall performance of hard fescue (HF) and tall fescue (TF) with and without birdsfoot trefoil (BT) are presented. The seed was sown on a south and north aspect in the fall of 1993. The data were recorded in May 1996.



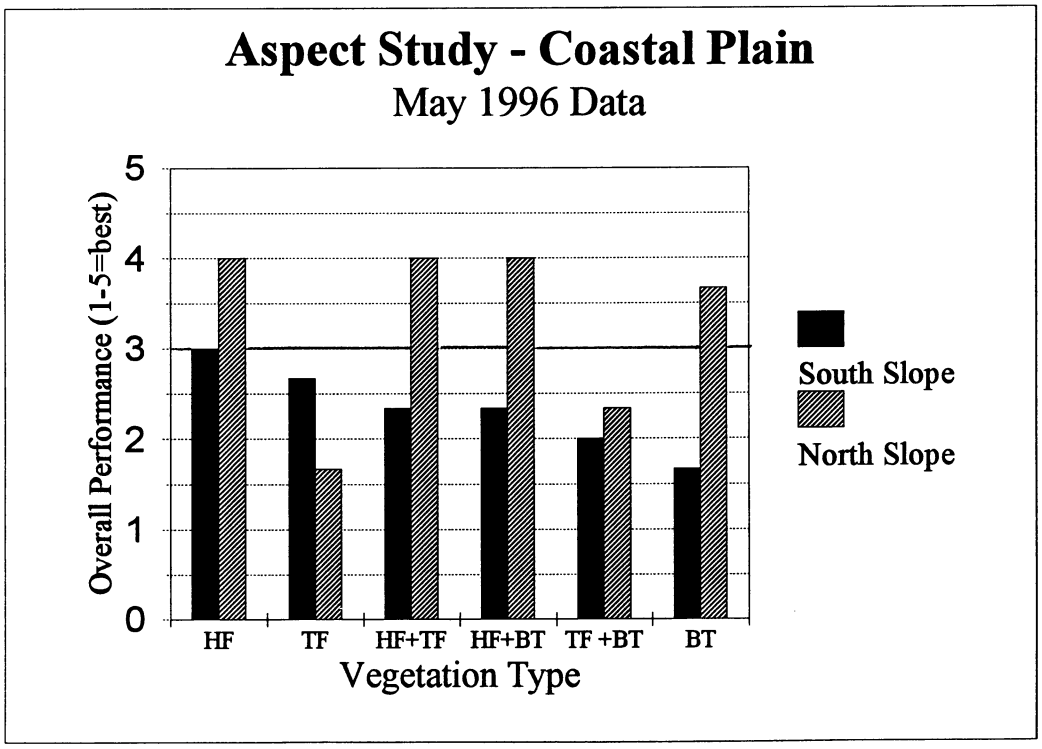
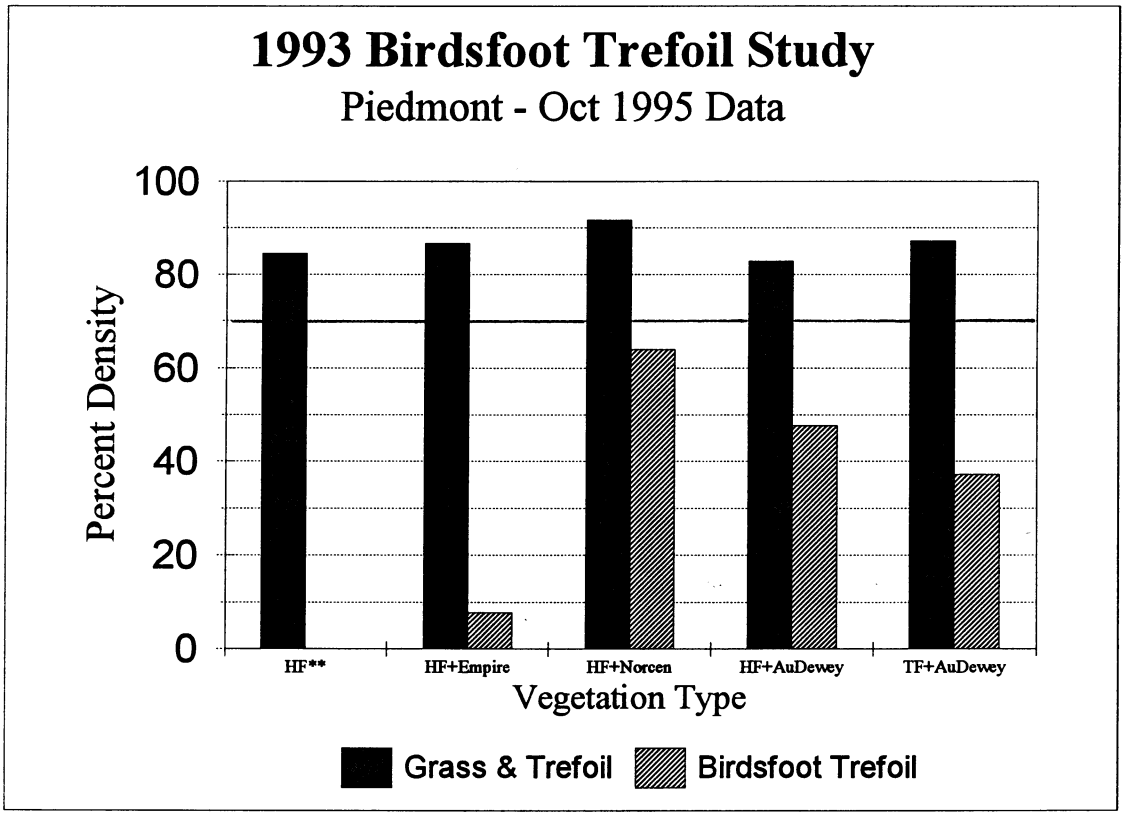


Figure 11a and b. - Birdsfoot Trefoil Study - Piedmont

Percent density and overall performance of hard fescue (HF) and tall fescue (TF) with three cultivars of birdsfoot trefoil (BT) are presented. The seed was sown in the fall of 1993 in Lynchburg. The data were recorded in October 1995.
BT cultivars used were Empire, Norcen and AuDewey.



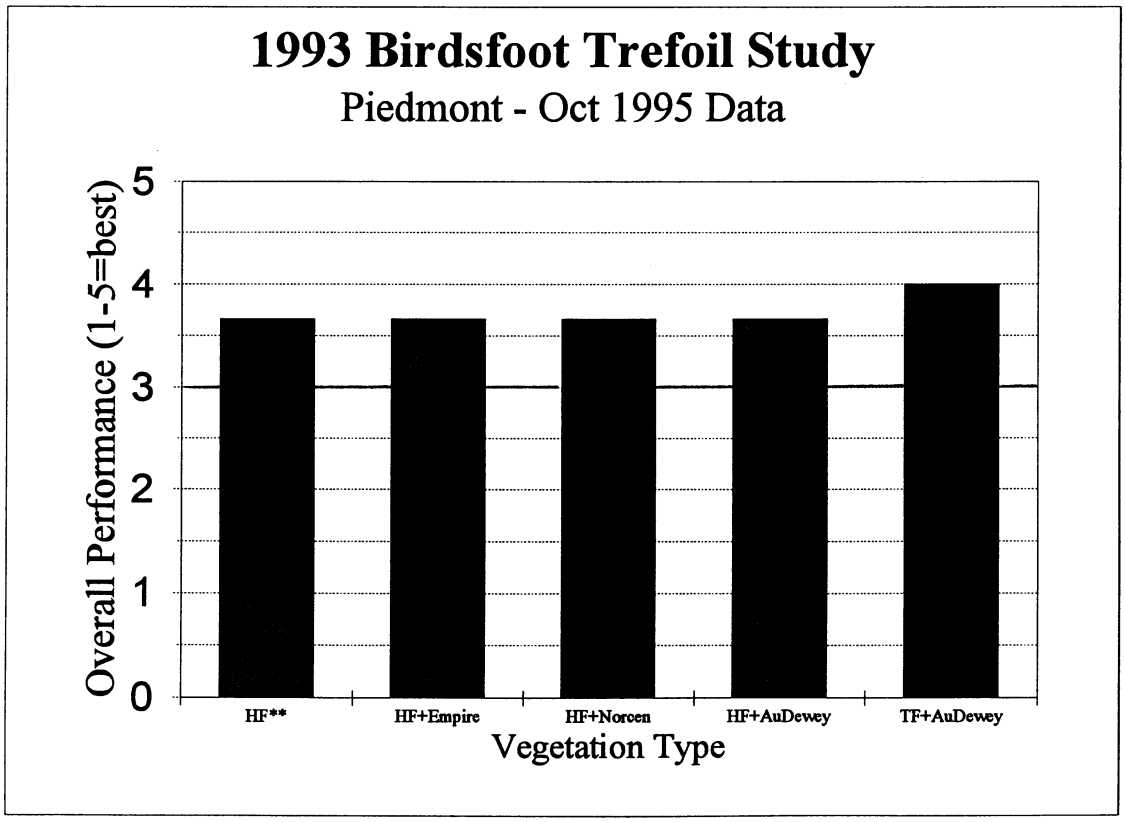
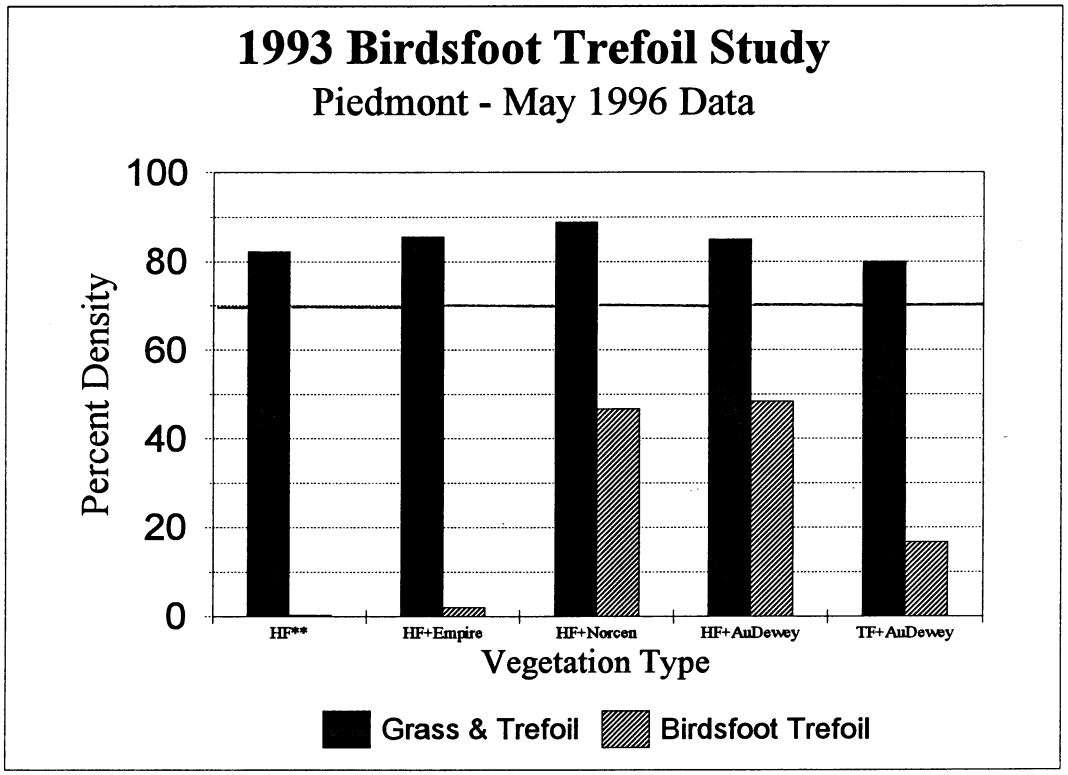


Figure 12a and b. - Birdsfoot Trefoil Study - Piedmont

Percent density and overall performance of hard fescue (HF) and tall fescue (TF) with three cultivars of birdsfoot trefoil (BT) are presented. The seed was sown in the fall of 1993 in Lynchburg. The data were recorded in May 1996.
BT cultivars used were Empire, Norcen and AuDewey.



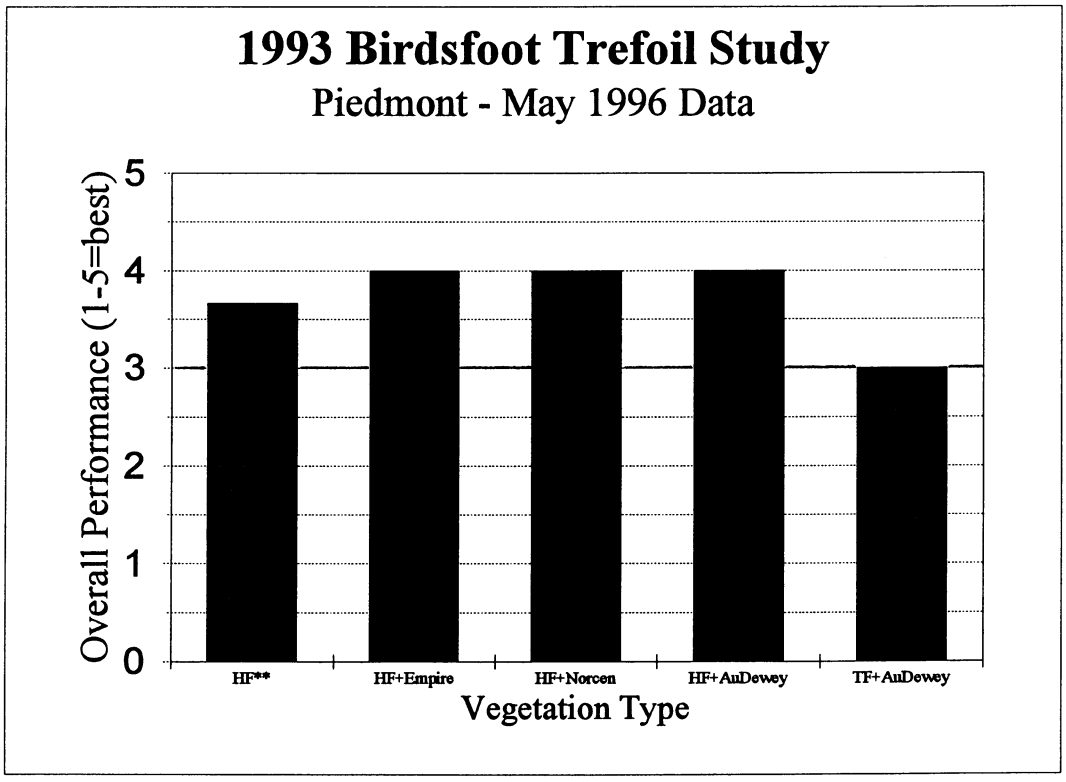
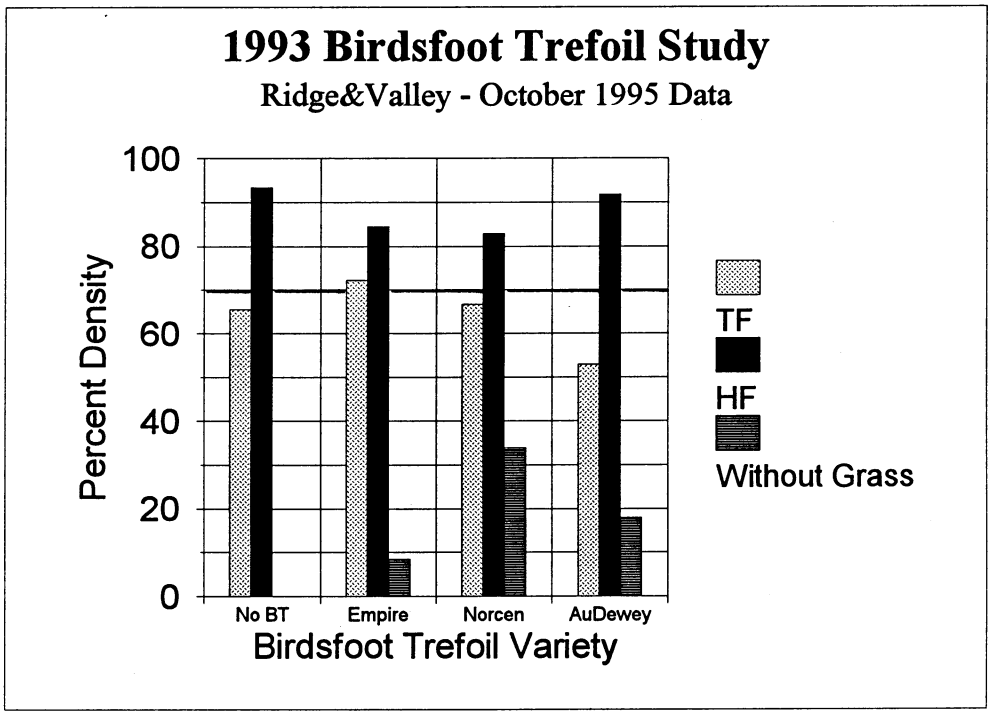


Figure 13a and b. - Birdsfoot Trefoil Study - Ridge and Valley

Percent density and overall performance of hard fescue (HF) and tall fescue (TF) with three cultivars of birdsfoot trefoil (BT) are presented. The seed was sown in the fall of 1993 in Blacksburg. The data were recorded in October 1995.



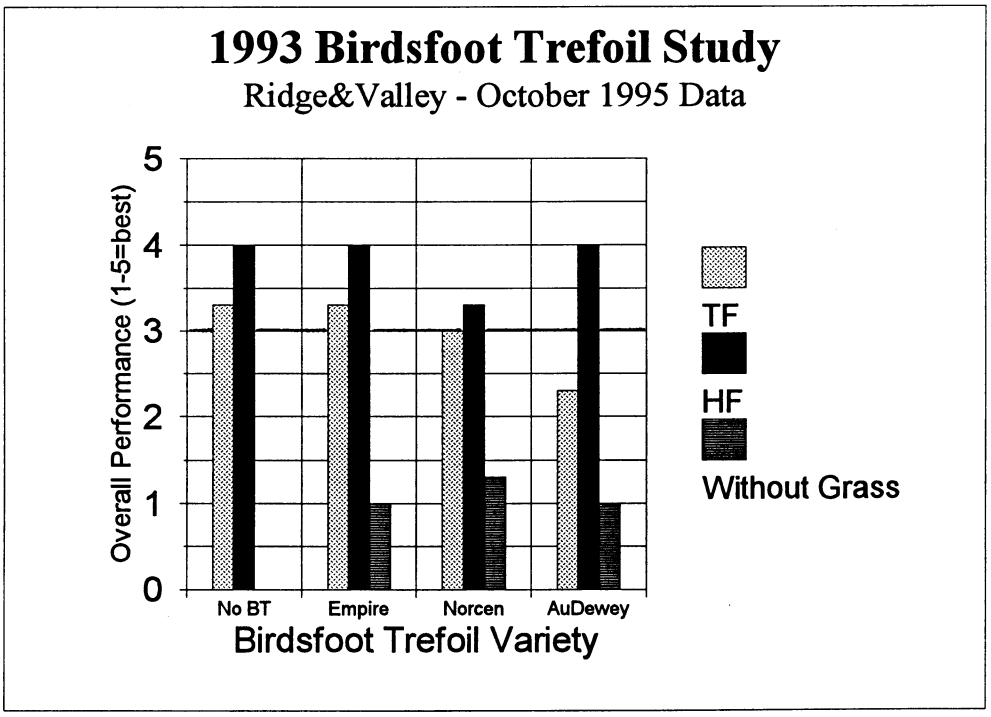
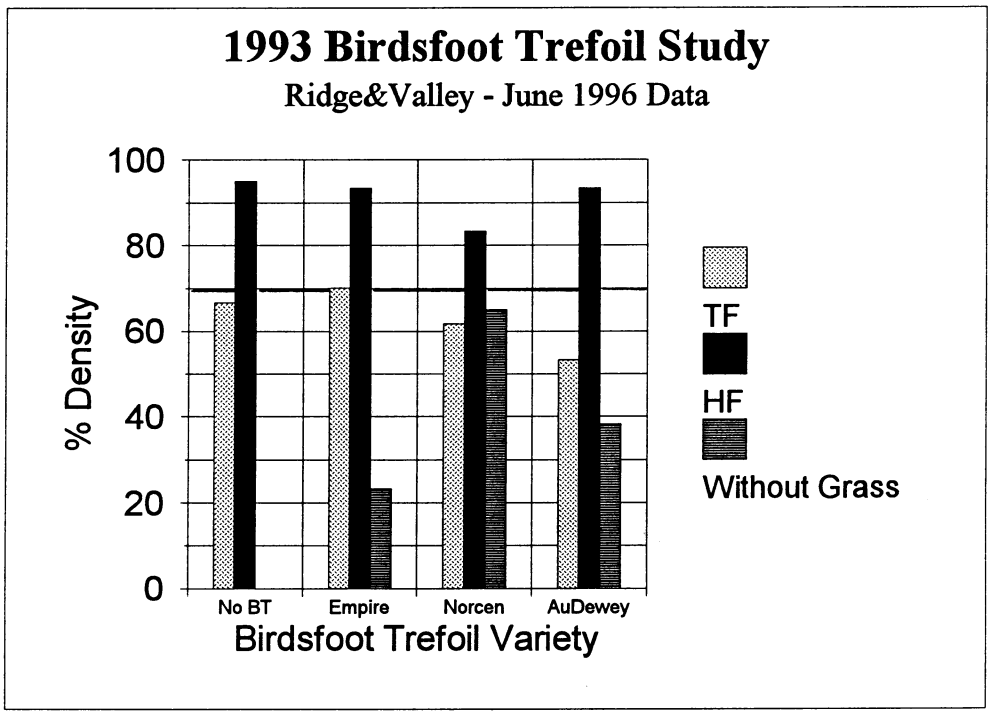


Figure 14a and b. - Birdsfoot Trefoil Study - Ridge and Valley

Percent density and overall performance of hard fescue (HF) and tall fescue (TF) with three cultivars of birdsfoot trefoil (BT) are presented. The seed was sown in the fall of 1993 in Blacksburg. The data were recorded in June 1996.



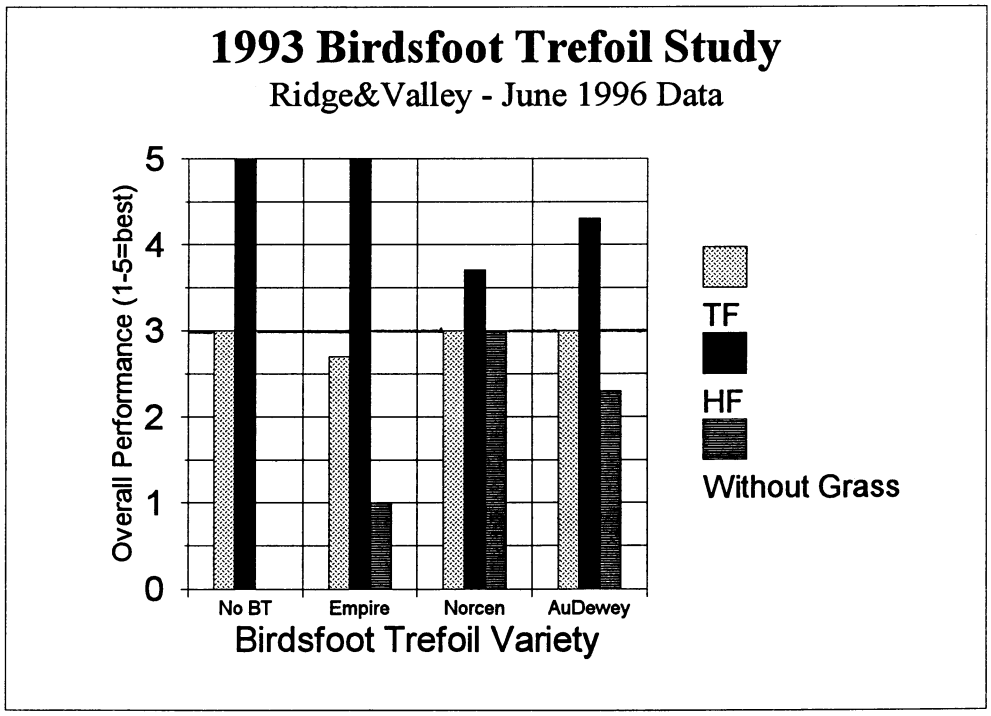
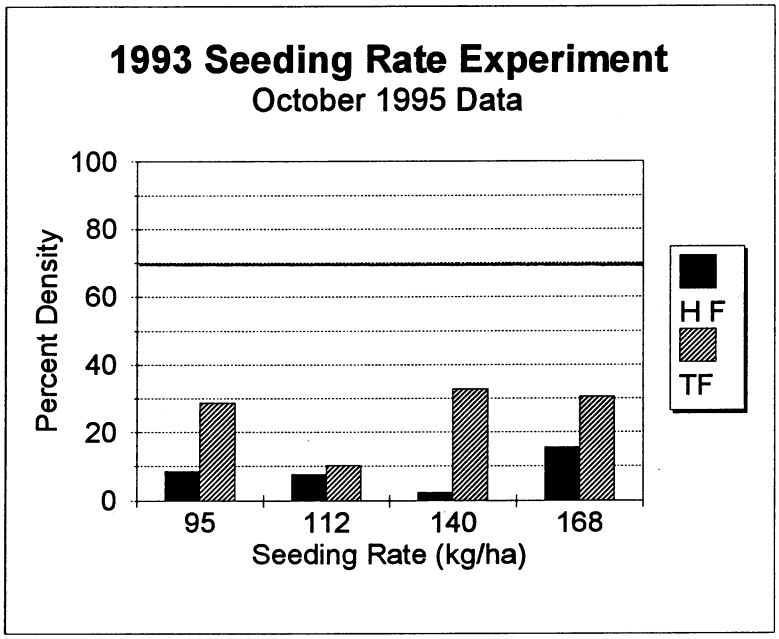


Figure 15a and b. 1993 Seeding Rate Study - Hard and Tall Fescue

Percent density and overall performance of four seed rates of hard and tall fescue that were established in the fall of 1993 in Chester are presented. Data were recorded in October 1995.



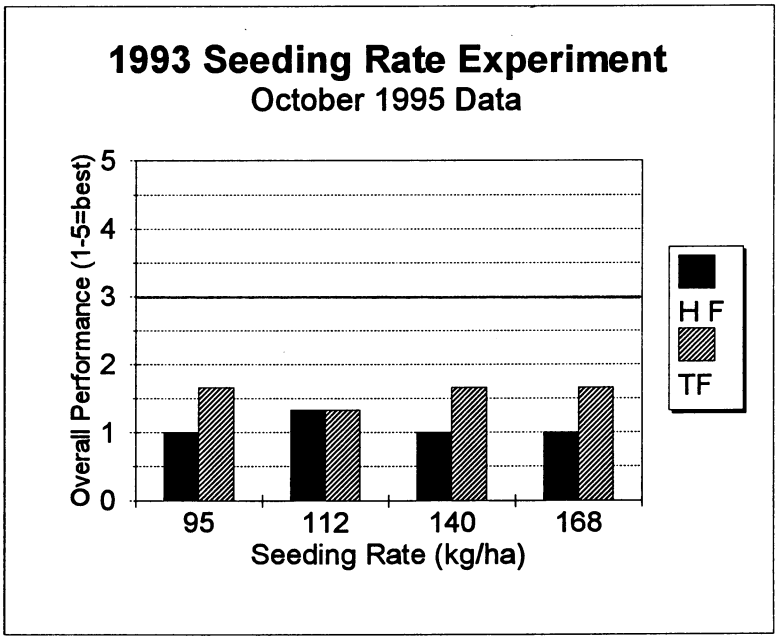
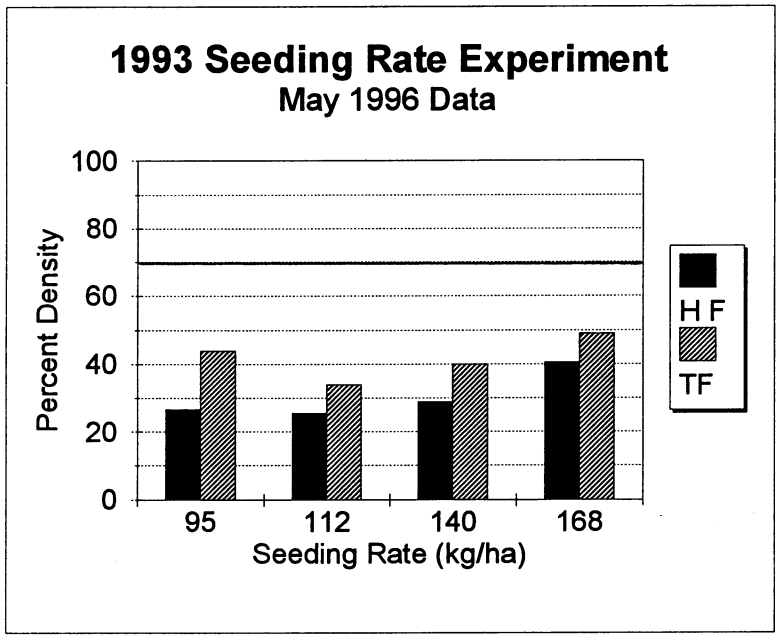


Figure 16a and b. 1993 Seeding Rate Study - Hard and Tall Fescue

Percent density and overall performance of four seed rates for hard and tall fescue that were established in the fall of 1993 in Chester are presented. Data were recorded in May 1996.



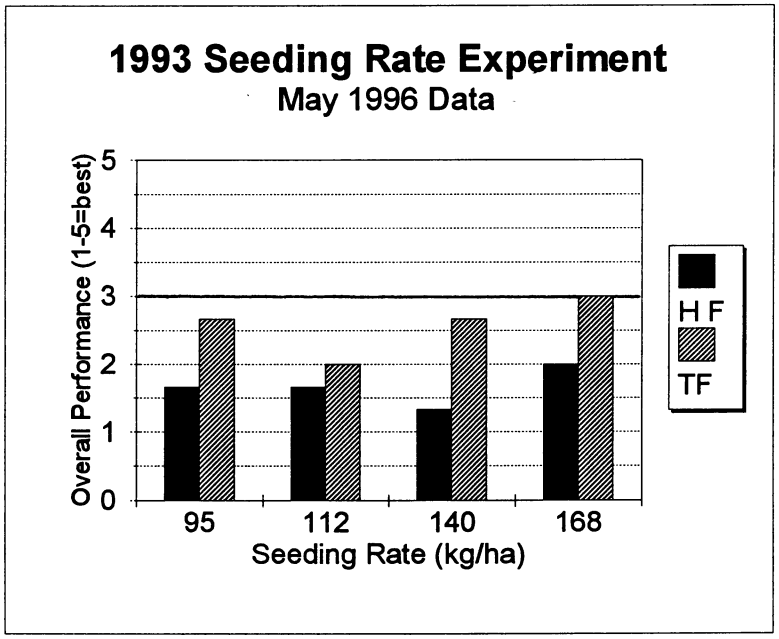
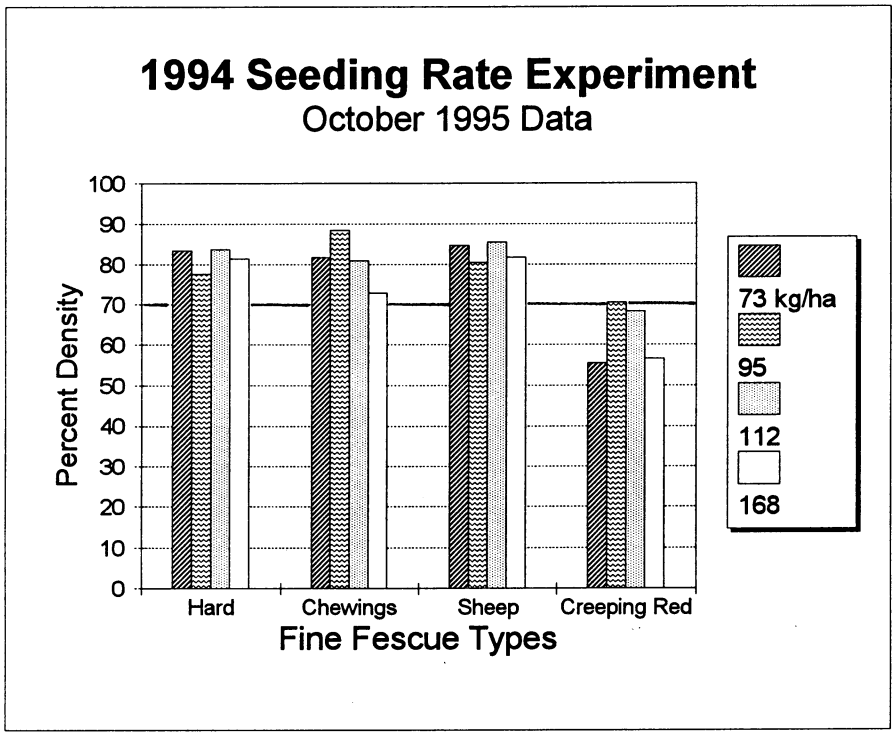


Figure 17a and b. 1994 Seeding Rate Study - Fine Fescue

Percent density and overall performance of four seeding rates for Hard, Chewings, Sheep and Creeping Red Fescue are presented. The seeds were sown in the fall of 1994 in Chester. Data were recorded October 1995.



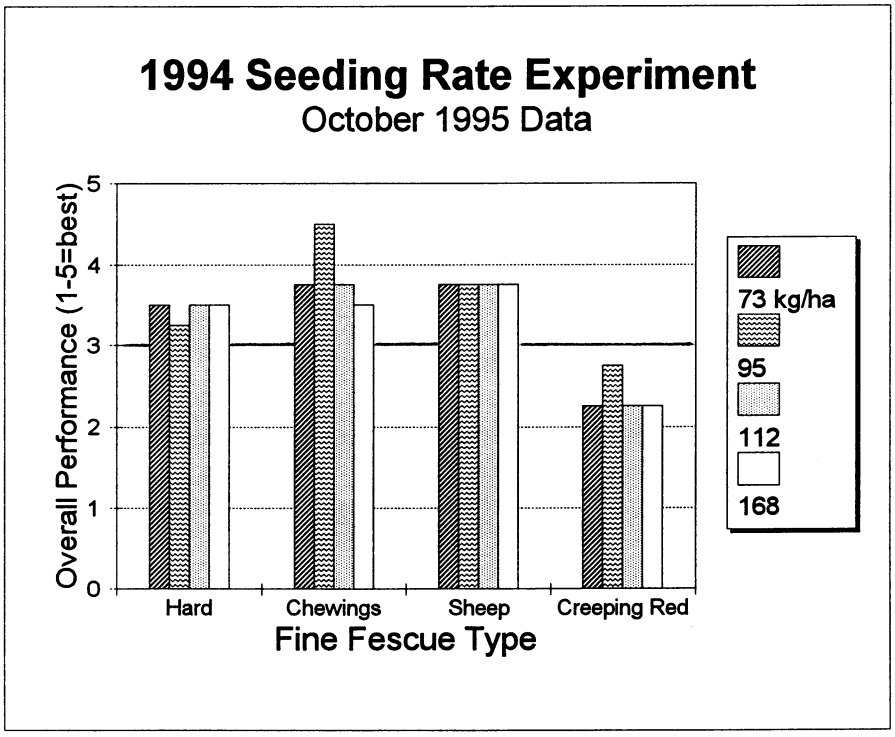
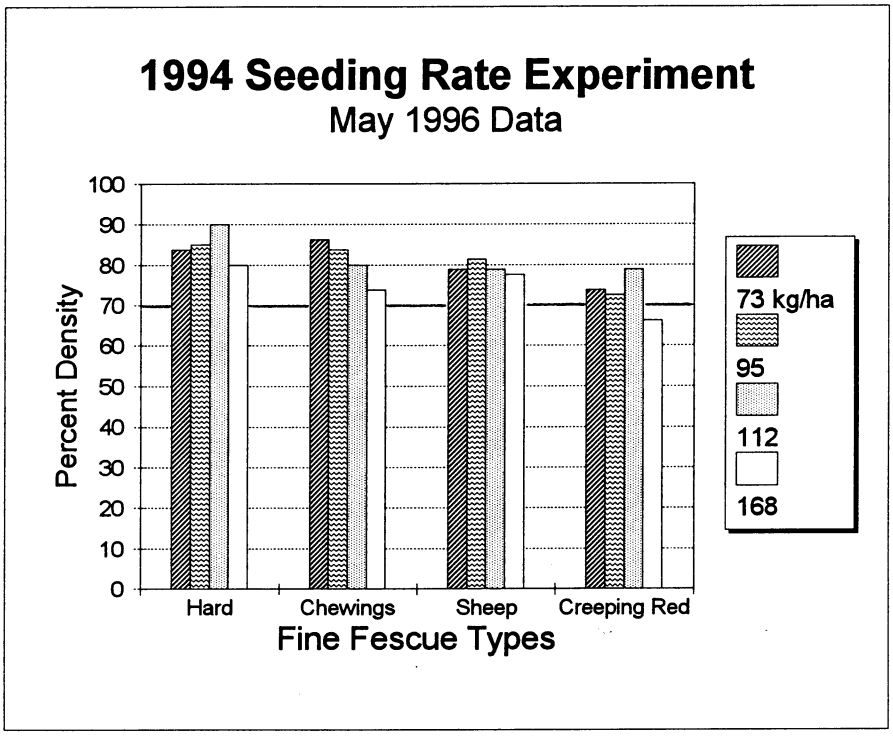


Figure 18a and b. 1994 Seeding Rate Study - Fine Fescue

Percent density and overall performance of four seeding rates for Hard, Chewings, Sheep and Creeping Red Fescue are presented. The seeds were sown in the fall of 1994 in Chester. Data were recorded May 1996.



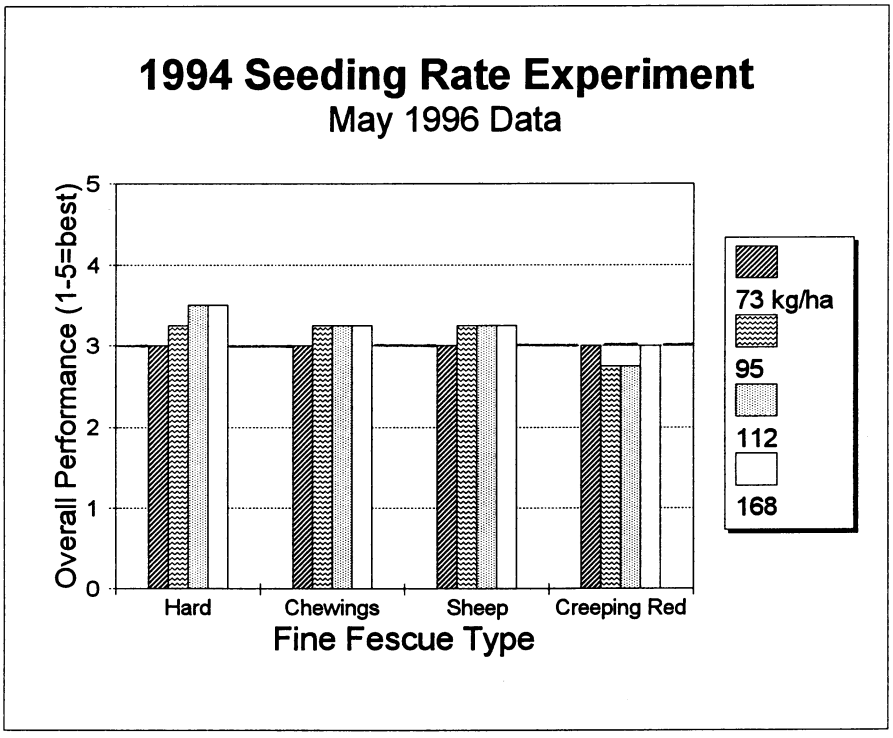
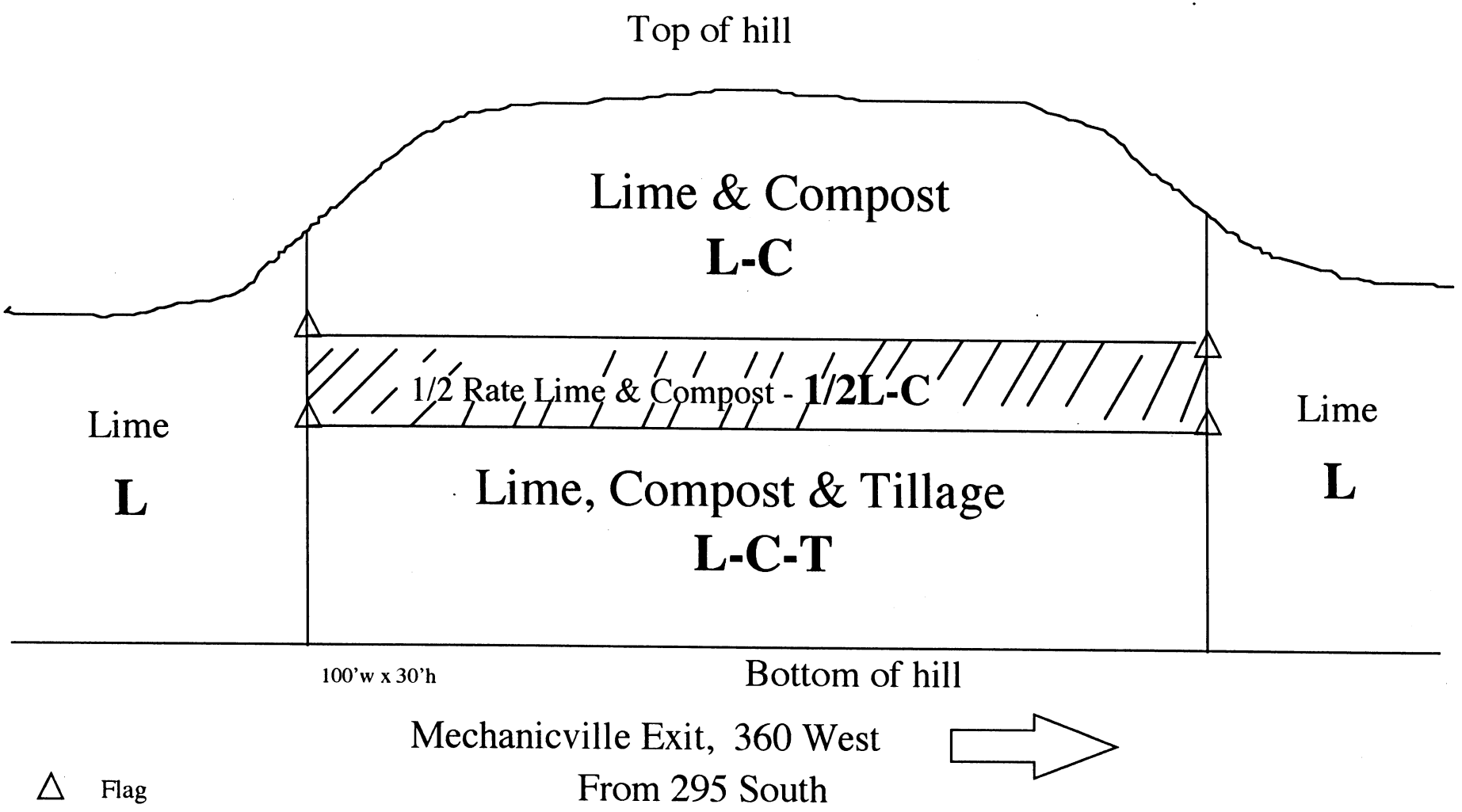


Figure 19. Barren Acid-Producing Slope Revegetation Demonstration

The map of the slope that was revegetated on April 17, 1996 is presented. On this date, the rills at the bottom of the slope were smoothed, and compost, lime, fertilizer and seed were added to the surface.



Appendix A

Fine Fescue Trials - May 1996 Data

The percent density (PD) and overall performance (OP, 1-5=best) of the current fine fescue trials is presented. The data was collected in May of 1996. Cultivars with endophyte are designated by (E).
Cultivars that are identified with an asterisk are designated as "Promising".

		Location and Age of Trial							
		Chester 2.5 yr		Chester 2 yr		Chester 1.5 yr		Petersburg 1 month	
Cultivar	Type**	PD	OP	PD	OP	PD	OP	PD	OP
67135	SF	76.7	3.0	61.7	2.7				
Aruba	CRF	13.3	1.0	43.3	1.7				
Aurora (E)	HF	66.7	2.7	60.0	2.7				
Aurora	HF							13.3	1.3
Azure Blue	SF					86.7	3.7	15.0	1.0
BAR Frr 4ZBD	CRF	46.7	1.7	38.3	1.7				
BAR UR 204	CRF	60.0	1.7	60.0	2.3				
Banner II	CF	70.0	2.7	63.3	3.0				
Boreal	CRF							41.7	2.7
Bridgeport	CF	58.3	2.3	61.7	2.7				
* Brigade	HF	76.7	3.3	73.3	3.3				
Brittany	CF	68.3	2.7	63.3	3.0			41.7	2.3
CAS-FR13	CRF	58.3	2.3	58.3	2.3				
Cascade	CF	75.0	2.7	33.3	1.3				
Common creep.	CRF	66.7	2.7	45.0	2.0				
Darwin	CF	60.0	2.7	41.7	2.0				
Dawson	SCRF	40.0	1.3	63.3	3.0				
Discovery	HF	91.7	4.0	58.3	2.7	76.7	3.0	21.7	1.7
* Ecostar	HF	78.3	3.0	73.3	3.3				
* FO 143	SF	78.3	2.7	78.3	3.3				
Flyer	CRF	55.0	2.3	48.3	2.0				
Herald	CRF							30.0	2.3
ISI-FC-62	CF	45.0	1.7	50.0	1.7				
Jamestown	CF	50.0	2.0	60.0	2.7				
Jamestown II	CF	71.7	3.0	61.7	2.7				
Jasper (E)	CRF	68.3	2.7	63.3	2.7				
* MB 61-93	CF	73.3	3.0	65.0	3.0			25.0	1.3
MB 63-93	CF	63.3	2.7	66.7	3.0				
MB 64-93	CF	66.7	3.0	70.0	2.7				
MB 65-93	CF	65.0	2.7	66.7	3.0			30.0	1.7
MB 66-93	CF	56.7	2.0	50.0	2.0				
* MB 81-93	HF	83.3	3.3	58.3	2.7			10.0	1.0
MB 82-93	HF	73.3	3.0	63.3	2.3				
* MB 83-93	HF	81.7	3.0	61.7	2.7				
* MED 32	HF	76.7	3.0						
Medina	CF	46.7	2.0	28.3	1.3				
Molinda	CF	55.0	2.3	65.0	2.7				
NJ F-93	CF	60.0	2.7	56.7	2.3				
* Nordic	HF	81.7	3.3	73.3	3.3				
PRO 92/20	CF	73.3	2.7	68.3	3.0				
* PRO 92/24	HF	78.3	3.3	71.7	2.7				
PST-44D	CF	66.7	2.7	60.0	2.3				

Appendix A continued

Cultivar	Type	Chester 2.5 yr PD	Chester 2.5 yr OP	Chester 2 yr PD	Chester 2 yr OP	Chester 1.5 yr PD	Chester 1.5 yr OP	Petersburg 1 month PD	Petersburg 1 month OP
PST-4DT	CRF	50.0	2.0	63.3	2.7				
PST-4ST	CRF	53.3	2.3	66.7	3.0				
PST-4VB (E)	CRF	66.7	2.3	63.3	2.7				
Pamela	HF	58.3	2.3	63.3	2.7				
Pick 4-91W	CF	65.0	2.7	68.3	3.0				
Quatro	SF					73.3	3.0		
Reliant	HF					88.3	3.7		
* Reliant II	HF	78.3	3.3	61.7	2.7			23.3	2.0
Rondo	CRF	36.7	1.3	61.7	2.7				
Rudax	CF							23.3	2.0
Saxon	HF							13.3	1.3
SR 3100	HF	78.3	3.0	56.7	2.3				
SR 5100	CF	66.7	2.7	68.3	3.0				
* Scaldis	HF	90.0	4.0	75.0	3.0				
Seabreeze	SCRF	55.0	2.0	60.0	2.7	56.7	2.3	25.0	1.7
Shademark	CRF							26.7	2.0
Shademaster II	CRF	45.0	2.0	50.0	2.3	83.3	3.3	56.7	3.3
Shadow (E)	CF	50.0	2.0	58.3	3.0				
Southport	CF							25.0	2.3
* Spartan	HF	90.0	4.3	71.7	3.7				
Teal	SF							21.7	1.7
TMI-3CE	CF	75.0	2.7	70.0	3.0				
Tiffany	CF	50.0	2.3	70.0	3.0			28.3	2.0
Victory (E)	CF	60.0	2.3	68.3	3.0				
Waldina	HF							15.0	1.3
Warwick	HF							10.0	1.3
WVPB-STCR-101	CRF	50.0	2.3	63.3	3.0				
WX3-FF54	CF	51.7	2.3	53.3	2.0				
WX3-FFG6	CRF	66.7	2.7	65.0	3.0				
ZPS-4BN	CRF	63.3	3.0	58.3	2.3				
ZPS-MG	CF	66.7	2.7	65.0	2.7				

** Creeping Red Fescue (CRF), Slender Creeping Red Fescue (SCRF), Hard Fescue (HF) Sheep Fescue (SF), Chewings Fescue (CF)

Appendix B

Tall Fescue Trials - May 1996 Data

The percent density (PD) and overall performance (OP, 1-5=best) of the current tall fescue trials is presented. The data was collected in May of 1996. Cultivars with endophyte are designated by (E).

	Location and Age of Trial			
	Chester/ 1.5 yr		Petersburg/1 month	
Cultivar	PD	OP	PD	OP
989			33.3	2.7
5LMR-94			20.0	1.7
983			28.3	1.7
A91			38.3	2.3
AFA (E)	75.0	3.0		
Adventure II			33.3	2.7
Anthem			35.0	2.7
Apache II			26.7	2.0
Apache III			25.0	1.7
Austin	66.7	2.7		
Avalon			25.0	2.3
B4ENTF	63.3	2.3		
B4WSTF	71.7	3.0		
Barcel	76.7	3.0		
Benton	68.3	3.0		
Benton Turf			36.7	2.7
Bonsai Plus			38.3	2.3
Bullet			40.0	2.3
CRC (E)	75.0	2.7		
Cimarron			33.3	2.7
Coronado			31.7	2.0
Coyote	70.0	2.7		
Crossfire	80.0	3.3		
Crossfire II			36.7	2.7
Earthsave			40.0	2.7
Emperor II	76.7	3.3		
Era	70.0	3.0		
FDM-91	66.7	2.7		
Finelawn 1	70.0	3.0		
Finelawn Petite	71.7	2.7		
Genesis (Gen-91)			28.3	1.7
Georgia 5	88.3	3.7		
Houndog 5 (E)	78.3	3.3		
Jaguar 3	80.0	3.7		
Kitty Hawk			30.0	2.3
LG-93			35.0	2.0
Lancer			26.7	2.3
Lexus	73.3	3.0		
MB 21			36.7	2.3
MB 22			46.7	2.7
MB 24			28.3	2.3
MB 25			23.3	2.0
MB 23			26.7	1.7
Micro			35.0	2.7
Mini-Mustang	88.3	3.7		
Mohawk			53.3	3.0
Mustang II			45.0	3.0
Mustang II-RTF	75.0	3.0		

Appendix B continued

	Chester/ 1.5 yr		Petersburg/1 month	
	PD	OP	PD	OP
Orygun	80.0	3.3		
Palisades			56.7	3.3
Phoenix	80.0	3.3		
Poly N91			40.0	3.0
Pyramid			31.7	2.0
RD-31			30.0	2.7
RG-93			36.7	2.7
Rebel 3D	71.7	3.0		
Rebel III	63.3	2.7		
Safari			43.3	3.0
Safe			13.3	1.3
Shortstop	68.3	3.0		
Shortstop II (90-6)	71.7	3.0	16.7	1.3
Silverado	71.7	2.7		
Tar Heel			28.3	1.7
Titan			35.0	2.7
Titan II			41.7	3.0
Tomahawk			46.7	2.7
Tradition	71.7	3.0		
Trailblazer II			36.7	2.3
Twilight II+fertilizer			31.7	2.0
Vegas	78.3	3.3		

Appendix C

Soil Test Results
Annual Report 1995-1996

Study	Location	Soil Test Date	pH	PPM			
				Phosphorus	Potassium	Calcium	Magnesium
Fine Fescue Trial - Fall '93	Chester	9/93	6.4	28	67	492	117
Fine Fescue Trial -Spring '94	Chester	5/94	5.9	33	72	468	120
Tall Fescue Trial - Fall '94	Chester	9/94	7.2	21	63	780	120
Tall & Fine Fescue Trial -Spring '96	Petersburg	4/96	7.5	10	59	828	120
ADAPTATION-Fine Fescue	Chester	9/93	6.4	28	67	492	117
ADAPTATION-Fine Fescue	Lynchburg	9/93	6.9	14	36	912	120
ADAPTATION-Fine Fescue	Blacksburg	9/93	6.6	14	74	120	120
TREFOIL-Fine Fescue	Lynchburg	9/93	6.9	14	36	912	120
TREFOIL-Fine Fescue	Blacksburg	9/93	5.8	4	49	696	120
SLOPE - Fine Fescue	Chester	9/93	6.4	50	44	612	120
ASPECT- South	Chester	9/93	5.5	25	45	216	103
ASPECT- North	Chester	9/93	6.4	50	44	612	120
SEEDING RATE-FF & TF	Chester	9/93	5.5	25	45	216	103
SEEDING RATE - Fine Fescue	Chester	9/94	6.8	20	55	432	116

Appendix D

Analysis of the yardwaste compost from 623 Landfill, Inc.
March 1996

REPORT NUMBER

R062-160

A & L EASTERN AGRICULTURAL LABORATORIES INC.
7621 WHITEPINE RD. RICHMOND VA. 23237 804-743-9401

SEND TO: 623 LANDFILL, INC
2415 GRENOBLE RD.
RICHMOND, VA 23294

CUSTOMER: 623 LANDFILL, INC.

SAMPLES SUBMITTED BY:

623 LANDFILL INC

DATE OF REPORT 3/12/96 PAGE 1

POTTING MEDIA ANALYSIS REPORT

SAMPLE IDENT.	Lab No.	pH	Conductivity mmhos/cm	Ammonia Nitrogen ppm N	Nitrate Nitrogen ppm N	Phosphorus ppm P	Potassium ppm K	Sulfur ppm S	Calcium ppm Ca	Magnesium ppm Mg	Sodium ppm Na	Iron ppm Fe	Aluminum ppm Al	Manganese ppm Mn	Copper ppm Cu	Zinc ppm Zn	Boron ppm B
	40980	6.8	0.31	4	<1	2	78	4	46	12	17						

Please consult the enclosed table for nutrient ratings.
Overall fertility level is low. More nitrogen and phosphorus is needed.
This material can be used as growth media as long as nitrogen and phosphorus are added.
Addition of perlite or vermiculite to improve drainage would be beneficial.

F. G. PRUITT, INC.
MAR 15 1996
RECEIVED

Paul C.H. Chu, Ph.D.

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

A & L AGRICULTURAL LABORATORIES, INC.
By C. Norman Jones
C. NORMAN JONES

Table 1a. Tall Fescue Trial - Chester, Fall 1994.
Mean percent density and overall performance (OP) of twenty-nine cultivars were recorded in the fall of 1995 and spring of 1996. The trial was established on September 28, 1994. Cultivars with endophyte are designated by (E).

	Percent Density				OP (1-5=best)			
Cultivar	Dec '94	May '95	Oct '95	May '96	Dec '94	May '95	Oct '95	May '96
Georgia 5	81.7	81.7	88.3	88.3	4.3	3.7	4.3	3.7
Mini-Mustang	75.0	78.3	76.7	88.3	3.7	4.0	3.0	3.7
Crossfire	70.0	76.7	83.3	80.0	3.3	3.3	3.7	3.3
Jaguar 3	76.7	75.0	88.3	80.0	3.0	3.0	4.0	3.7
Orygun	80.0	85.0	88.3	80.0	4.0	4.0	3.7	3.3
Phoenix	78.3	81.7	90.0	80.0	4.3	3.7	3.7	3.3
Houndog 5 (E)	75.0	71.7	75.0	78.3	3.3	3.3	3.3	3.3
Vegas	71.7	71.7	78.3	78.3	3.3	3.0	3.3	3.3
Barcel	88.3	81.7	78.3	76.7	4.7	4.0	3.7	3.0
Emperor II	68.3	73.3	85.0	76.7	3.7	3.3	3.7	3.3
AFA (E)	70.0	60.0	73.3	75.0	3.0	2.7	3.0	3.0
CRC (E)	68.3	65.0	80.0	75.0	3.0	2.7	3.7	2.7
Mustang II-RTF	78.3	78.3	70.0	75.0	3.7	3.7	2.3	3.0
Lexus	68.3	68.3	70.0	73.3	3.0	2.7	2.7	3.0
90-6	68.3	63.3	61.7	71.7	3.3	3.0	2.7	3.0
B4WSTF	75.0	80.0	53.3	71.7	3.3	3.3	2.3	3.0
Finelawn Petite	73.3	73.3	78.3	71.7	3.3	3.0	3.0	2.7
Rebel 3D	70.0	68.3	61.7	71.7	3.0	2.7	2.3	3.0
Silverado	66.7	65.0	58.3	71.7	3.0	2.7	2.3	2.7
Tradition	68.3	73.3	83.3	71.7	3.3	3.3	4.0	3.0
Coyote	81.7	78.3	81.7	70.0	3.7	3.3	3.3	2.7
Era	80.0	75.0	75.0	70.0	4.0	3.3	3.3	3.0
Finelawn 1	83.3	83.3	80.0	70.0	4.0	4.0	3.3	3.0
Benton	75.0	71.7	75.0	68.3	3.7	3.0	3.3	3.0
Shortstop	80.0	73.3	73.3	68.3	3.7	3.0	3.3	3.0
Austin	80.0	73.3	71.7	66.7	3.7	3.0	2.7	2.7
FDM-91	76.7	68.3	56.7	66.7	3.7	3.3	2.3	2.7
B4ENTF	68.3	68.3	71.7	63.3	3.3	3.0	3.0	2.3
Rebel III	80.0	70.0	61.7	63.3	3.3	3.0	2.0	2.7

Table 1b. Miscellaneous Grass Trial - Chester, Fall 1994.
Mean percent density and overall performance (OP) of eight cultivars were recorded in the fall of 1995 and spring of 1996. The trial was established on September 28, 1994.

Entry	Grass Type	Cultivar	Percent Density				OP (1-5=best)			
			Dec 94	May '95	Oct '95	May '96	Dec '94	May '95	Oct '95	May '96
31	HF*	Reliant	38.3	71.7	91.7	88.3	1.0	3.3	4.3	3.7
33	SF	Azure Blue	50.0	71.7	73.3	86.7	1.7	3.0	3.3	3.7
37	CRF	Shademaster II	88.3	80.0	83.3	83.3	4.3	4.0	3.3	3.3
38	HF	Discovery	63.3	68.3	70.0	76.7	2.3	2.7	2.7	3.0
36	SF	Quatro	68.3	61.7	71.7	73.3	3.0	2.3	3.0	3.0
1	DOG	LG-3	85.0	76.7	83.3	73.3	4.7	3.7	3.7	2.7
35	SCRF	Seabreeze	73.3	70.0	55.0	56.7	3.7	3.0	2.3	2.3
32	SAG	-	88.3	76.7	0.0	6.7	4.3	2.7	1.0	1.0

* Creeping Red Fescue (CRF), Salty Alkaligrass (SAG), Dwarf Orchardgrass (DOG), Hard Fescue (HF), Slender Creeping Red Fescue (SCRF), Sheep Fescue (SF)

Table 2. Tall Fescue Trial - Spring 1996
Mean percent density and overall performance (OP) for cultivars that were recorded one month after sowing. The trial was sown on April 18, 1996 in Petersburg, Virginia.

Cultivar	Percent Density	OP (1-5=best)
Palisades	56.7	3.3
Mohawk	53.3	3.0
MB 22	46.7	2.7
Tomahawk	46.7	2.7
Mustang II	45.0	3.0
Safari	43.3	3.0
Titan II	41.7	3.0
Bullet	40.0	2.3
Earthsave	40.0	2.7
Poly N91	40.0	3.0
A91	38.3	2.3
Bonsai Plus	38.3	2.3
MB 21	36.7	2.3
RG-93	36.7	2.7
Trailblazer II	36.7	2.3
Benton Turf	36.7	2.7
Crossfire II	36.7	2.7
Micro	35.0	2.7
Titan	35.0	2.7
Anthem	35.0	2.7
LG-93	35.0	2.0
989	33.3	2.7
Adventure II	33.3	2.7
Cimarron	33.3	2.7
Twilight II+fertilizer	31.7	2.0
Coronado	31.7	2.0
Pyramid	31.7	2.0
Kitty Hawk	30.0	2.3
RD-31	30.0	2.7
Genesis (Gen-91)	28.3	1.7
Tar Heel	28.3	1.7
983	28.3	1.7
MB 24	28.3	2.3
MB 23	26.7	1.7
Lancer	26.7	2.3
Apache II	26.7	2.0
Apache III	25.0	1.7
Avalon	25.0	2.3
MB 25	23.3	2.0
5LMR-94	20.0	1.7
Shortstop II	16.7	1.3
Safe	13.3	1.3

Table 3. Fine Fescue Trial - Chester, Fall 1993.
Mean percent density and overall performance (OP) for sixty fine fescue cultivars.
Data was recorded in October 1994, May 1995, October 1995 and May 1996. The trial was established September 29, 1993. Cultivars with endophyte are designated by (E).

Cultivar	Grass Type	Percent Density				OP (1-5=best)			
		Oct '94	May '95	Oct '95	May '96	Oct '94	May '95	Oct '95	May '96
Discovery	hard	61.7	68.3	86.7	91.7	2.7	2.7	3.7	4.0
Scaldis	hard	71.7	91.7	95.0	90.0	3.3	4.7	4.3	4.0
Spartan	hard	76.7	83.3	95.0	90.0	4.0	3.7	4.7	4.3
MB 81-93	hard	71.7	65.0	88.3	83.3	3.3	2.7	3.7	3.3
MB 83-93	hard	71.7	75.0	88.3	81.7	3.6	3.7	4.0	3.0
Nordic	hard	75.0	75.0	90.0	81.7	3.3	3.3	4.0	3.3
Ecostar	hard	66.7	80.0	85.0	78.3	3.3	3.7	4.0	3.0
FO 143	sheep	56.7	70.0	86.7	78.3	2.0	3.0	3.3	2.7
PRO 92/24	hard	65.0	80.0	80.0	78.3	2.7	3.0	3.7	3.3
Reliant II	hard	63.3	71.7	71.7	78.3	2.7	3.3	3.0	3.3
SR 3100	hard	40.0	55.0	76.7	78.3	1.7	2.0	3.0	3.0
67135	sheep	61.7	66.7	76.7	76.7	2.7	3.0	2.7	3.0
Brigade	hard	75.0	78.3	85.0	76.7	3.3	3.7	3.7	3.3
MED 32	hard	71.7	73.3	78.3	76.7	3.3	3.3	3.0	3.0
Cascade	chewings	58.3	58.3	78.3	75.0	2.7	2.0	3.3	2.7
TMI-3CE	chewings	56.7	61.7	75.0	75.0	2.3	2.3	3.3	2.7
MB 61-93	chewings	78.3	68.3	88.3	73.3	3.6	2.7	4.0	3.0
MB 82-93	hard	66.7	58.3	73.3	73.3	3.0	2.0	3.3	3.0
PRO 92/20	chewings	58.3	58.3	81.7	73.3	2.3	2.0	3.7	2.7
Jamestown II	chewings	53.3	60.0	75.0	71.7	2.3	2.3	3.3	3.0
Banner II	chewings	63.3	55.0	81.7	70.0	2.7	2.3	3.3	2.7
Brittany	chewings	68.3	55.0	81.7	68.3	2.7	2.0	3.7	2.7
Jasper (E)	strong creep.	56.7	56.7	71.7	68.3	2.3	1.7	2.7	2.7
Aurora (E)	hard	38.3	48.3	61.7	66.7	1.7	2.0	2.0	2.7
Common creep.	strong creep.	71.7	66.7	53.3	66.7	3.0	2.7	2.0	2.7
MB 64-93	chewings	51.7	60.0	73.3	66.7	1.7	1.7	3.3	3.0
PST-44D	chewings	46.7	53.3	75.0	66.7	2.0	2.0	3.0	2.7
PST-4VB (E)	strong creep.	60.0	48.3	66.7	66.7	2.3	1.3	2.7	2.3
SR 5100	chewings	56.7	50.0	83.3	66.7	2.7	2.0	4.0	2.7
WX3-FFG6	strong creep.	65.0	61.7	73.3	66.7	2.7	2.3	3.0	2.7
ZPS-MG	chewings	48.3	48.3	71.7	66.7	2.3	1.7	3.0	2.7
MB 65-93	chewings	58.3	41.7	71.7	65.0	2.7	1.3	3.0	2.7
Pick 4-91W	chewings	60.0	58.3	73.3	65.0	2.7	1.7	3.0	2.7
MB 63-93	chewings	58.3	56.7	76.7	63.3	2.7	2.0	3.3	2.7
ZPS-4BN	strong creep.	50.0	58.3	63.3	63.3	2.7	2.3	2.7	3.0
BAR UR 204	strong creep.	66.7	55.0	55.0	60.0	3.3	1.7	2.3	1.7
Darwin	chewings	61.7	61.7	75.0	60.0	2.7	2.3	2.7	2.7
NJ F-93	chewings	58.3	48.3	75.0	60.0	3.0	2.0	3.0	2.7
Victory (E)	chewings	53.3	58.3	71.7	60.0	2.7	2.7	2.3	2.3

Table 3 continued

Cultivar	Grass Type	Percent Density				OP (1-5=best)			
		Oct '94	May '95	Oct '95	May '96	Oct '94	May '95	Oct '95	May '96
Bridgeport	chewings	56.7	66.7	78.3	58.3	2.0	2.7	3.3	2.3
CAS-FR13	strong creep.	60.0	55.0	43.3	58.3	2.0	1.7	2.0	2.3
Pamela	hard	63.3	60.0	70.0	58.3	3.0	2.0	2.7	2.3
MB 66-93	chewings	66.7	51.7	66.7	56.7	3.0	1.3	2.7	2.0
Flyer	strong creep.	61.7	56.7	66.7	55.0	3.0	2.7	2.7	2.3
Molinda	chewings	78.3	56.7	71.7	55.0	4.0	2.7	2.7	2.3
Seabreeze	slender creep.	51.7	48.3	55.0	55.0	1.7	1.3	2.0	2.0
PST-4ST	strong creep.	43.3	31.7	56.7	53.3	1.7	1.0	2.0	2.3
WX3-FF54	chewings	58.3	48.3	63.3	51.7	2.3	2.0	2.3	2.3
Jamestown	chewings	31.7	38.3	41.7	50.0	1.3	1.7	1.7	2.0
PST-4DT	strong creep.	66.7	60.0	56.7	50.0	2.7	2.0	2.3	2.0
Shadow (E)	chewings	50.0	53.3	75.0	50.0	2.3	1.7	3.3	2.0
Tiffany	chewings	45.0	45.0	65.0	50.0	2.3	2.3	2.3	2.3
WVPB-STCR-101	strong creep.	55.0	50.0	56.7	50.0	2.0	2.0	2.3	2.3
BAR Frr 4ZBD	strong creep.	51.7	56.7	60.0	46.7	2.7	2.0	2.3	1.7
Medina	chewings	43.3	36.7	66.7	46.7	1.3	1.3	2.7	2.0
ISI-FC-62	chewings	38.3	23.3	40.0	45.0	1.3	1.0	2.0	1.7
Shademaster II	strong creep.	60.0	45.0	46.7	45.0	2.3	1.3	2.0	2.0
Dawson	slender creep.	38.3	38.3	48.3	40.0	1.3	1.3	1.7	1.3
Rondo	strong creep.	53.3	48.3	56.7	36.7	2.0	1.0	2.0	1.3
Aruba	strong creep.	65.0	46.7	25.0	13.3	3.0	1.0	1.0	1.0

Table 4. Fine Fescue Trial - Chester, Spring 1994.
Mean percent density and overall performance (OP) for fifty-nine fine fescue cultivars.
Data was recorded in December 1994, May 1995, October 1995, and May 1996. The trial was established on April 15, 1994. Cultivars with endophyte are designated by (E).

Cultivar	Grass Type	Percent Density				OP (1-5=best)			
		Dec '94	May '95	Oct '95	May '96	Dec '94	May '95	Oct '95	May '96
FO 143	sheep	51.7	63.3	82.7	78.3	2.7	2.3	3.3	3.3
Scaldis	hard	45.0	51.7	81.7	75.0	2.0	1.7	3.7	3.0
Brigade	hard	45.0	50.0	60.0	73.3	2.0	1.7	2.7	3.3
Ecostar	hard	58.3	66.7	80.0	73.3	2.0	2.3	3.3	3.3
Nordic	hard	61.7	56.7	83.3	73.3	2.3	2.3	3.7	3.3
PRO 92/24	hard	48.3	56.7	63.3	71.7	2.3	2.0	2.3	2.7
Spartan	hard	56.7	56.7	73.3	71.7	2.3	2.0	3.7	3.7
MB 64-93	chewings	68.3	60.0	70.0	70.0	3.0	2.3	3.3	2.7
TMI-3CE	chewings	46.7	55.0	73.3	70.0	2.0	2.0	3.3	3.0
Tiffany	chewings	60.0	58.3	75.0	70.0	2.7	2.0	3.3	3.0
PRO 92/20	chewings	60.0	55.0	65.0	68.3	2.7	2.0	2.7	3.0
Pick 4-91W	chewings	66.7	61.7	66.7	68.3	2.7	2.7	3.0	3.0
SR 5100	chewings	60.0	55.0	75.0	68.3	2.7	2.0	3.7	3.0
Victory (E)	chewings	70.0	65.0	80.0	68.3	3.7	2.3	3.7	3.0
MB 63-93	chewings	41.7	50.0	60.0	66.7	2.0	1.7	3.0	3.0
MB 65-93	chewings	50.0	51.7	63.3	66.7	2.3	2.0	2.7	3.0
PST-4ST	strong creep.	58.3	48.3	53.3	66.7	2.3	2.0	2.7	3.0
Falcon II	Tall Fescue	41.7	60.0	65.0	65.0	2.0	2.3	2.7	2.7
MB 61-93	chewings	65.0	55.0	68.3	65.0	2.7	1.7	3.3	3.0
Molinda	chewings	60.0	56.7	36.7	65.0	2.3	2.0	1.3	2.7
WX3-FFG6	strong creep.	51.7	53.3	60.0	65.0	2.7	2.0	2.7	3.0
ZPS-MG	chewings	53.3	61.7	55.0	65.0	2.7	2.0	2.3	2.7
Banner II	chewings	65.0	63.3	50.0	63.3	2.7	2.7	2.0	3.0
Brittany	chewings	58.3	53.3	75.0	63.3	2.7	2.0	3.0	3.0
Dawson	slender creep	48.3	60.0	47.3	63.3	2.0	2.0	1.7	3.0
Jasper (E)	strong creep.	43.3	46.7	55.0	63.3	2.7	1.7	2.3	2.7
MB 82-93	hard	55.0	53.3	70.0	63.3	2.0	2.3	3.0	2.3
PST-4DT	strong creep.	51.7	46.7	41.7	63.3	2.3	1.7	2.0	2.7
PST-4VB (E)	strong creep.	55.0	56.7	49.0	63.3	2.3	2.0	2.0	2.7
Pamela	hard	36.7	51.7	65.0	63.3	1.3	1.7	2.7	2.7
WVPB-STCR-101	strong creep.	38.3	43.3	38.3	63.3	2.0	1.7	1.3	3.0
67135	sheep	35.0	46.7	70.0	61.7	2.0	1.7	3.0	2.7
Bridgeport	chewings	66.7	68.3	61.7	61.7	3.0	2.7	2.7	2.7
Jamestown II	chewings	58.3	61.7	60.0	61.7	2.7	2.0	2.7	2.7
MB 83-93	hard	48.3	48.3	58.3	61.7	2.0	1.7	2.7	2.7
Reliant II	hard	36.7	46.7	58.3	61.7	2.0	1.7	2.7	2.7
Rondo	strong creep.	61.7	61.7	70.0	61.7	2.3	2.3	2.7	2.7
Aurora (E)	hard	41.7	53.3	48.3	60.0	1.3	1.7	2.0	2.7
BAR UR 204	strong creep.	55.0	55.0	46.7	60.0	2.7	2.0	2.0	2.3
Jamestown	chewings	46.7	53.3	53.3	60.0	2.3	1.7	2.7	2.7
PST-44D	chewings	65.0	63.3	70.0	60.0	3.0	2.7	3.3	2.3
Seabreeze	slender creep	40.0	53.3	56.7	60.0	2.0	2.3	2.0	2.7
CAS-FR13	strong creep.	45.0	45.0	50.0	58.3	2.0	1.7	1.7	2.3
Discovery	hard	51.7	45.0	65.0	58.3	2.3	1.7	3.0	2.7

Table 4 continued

Cultivar	Grass Type	Percent Density				OP (1-5=best)			
		Dec '94	May '95	Oct '95	May '96	Dec '94	May '95	Oct '95	May '96
MB 81-93	hard	43.3	45.0	53.3	58.3	2.0	1.7	2.3	2.7
Shadow (E)	chewings	61.7	61.7	55.0	58.3	2.7	2.3	1.7	3.0
ZPS-4BN	strong creep.	50.0	48.3	18.3	58.3	2.0	2.0	1.3	2.3
NJ F-93	chewings	60.0	55.0	65.0	56.7	2.7	1.7	2.7	2.3
SR 3100	hard	33.3	50.0	60.0	56.7	1.3	1.3	2.7	2.3
WX3-FF54	chewings	53.3	48.3	51.7	53.3	2.7	2.0	2.0	2.0
ISI-FC-62	chewings	35.0	50.0	48.3	50.0	2.0	2.0	2.0	1.7
MB 66-93	chewings	48.3	50.0	28.3	50.0	2.0	2.0	1.3	2.0
Shademaster II	strong creep.	53.3	58.3	30.0	50.0	2.0	2.3	1.3	2.3
Flyer	strong creep.	41.7	53.3	39.0	48.3	2.0	2.0	1.7	2.0
Common creep.	strong creep.	53.3	46.7	16.7	45.0	2.0	1.7	1.0	2.0
Aruba	strong creep.	46.7	38.3	16.7	43.3	2.0	1.0	1.3	1.7
Darwin	chewings	35.0	46.7	45.0	41.7	1.7	2.0	2.3	2.0
BAR Frr 4ZBD	strong creep.	48.3	48.3	11.7	38.3	2.3	1.7	1.0	1.7
Cascade	chewings	28.3	43.3	31.7	33.3	1.3	1.7	1.3	1.3
Medina	chewings	31.7	35.0	20.0	28.3	1.0	1.3	1.0	1.3

Table 5. Fine Fescue Trials - Fall 1993 & Spring 1994.
The percent density for fifty-nine fine fescue cultivars two years after sowing was presented.
The percent density data is transformed by subtracting 70% (threshold level) from the percent density.
The sow-date recommendations were derived from the fall and spring transformations.
The fall trial was established September 29, 1993 and the spring trial was established April 15, 1994.
Cultivars with endophyte are designated by (E).

Cultivar	Grass Type	Percent Density		Transformed (%-70)		Recommended Sow-date
		Fall Sown	Spring Sown	Fall	Spring	
Banner II	chewings	81.7	63.3	11.7	-6.7	Fall
Bridgeport	chewings	78.3	61.7	8.3	-8.3	Fall
Brittany	chewings	81.7	63.3	11.7	-6.7	Fall
Cascade	chewings	78.3	33.3	8.3	-36.7	Fall
Darwin	chewings	75.0	41.7	5.0	-28.3	Fall
Jamestown II	chewings	75.0	61.7	5.0	-8.3	Fall
MB 61-93	chewings	88.3	65.0	18.3	-5.0	Fall
MB 63-93	chewings	76.7	66.7	6.7	-3.3	Fall
MB 65-93	chewings	71.7	66.7	1.7	-3.3	Fall
MB 66-93	chewings	66.7	50.0	-3.3	-20.0	Fall
Medina	chewings	66.7	28.3	-3.3	-41.7	Fall
Molinda	chewings	71.7	65.0	1.7	-5.0	Fall
NJ F-93	chewings	75.0	56.7	5.0	-13.3	Fall
PRO 92/20	chewings	81.7	68.3	11.7	-1.7	Fall
PST-44D	chewings	75.0	60.0	5.0	-10.0	Fall
Pick 4-91W	chewings	73.3	68.3	3.3	-1.7	Fall
SR 5100	chewings	83.3	68.3	13.3	-1.7	Fall
Shadow (E)	chewings	75.0	58.3	5.0	-11.7	Fall
Victory (E)	chewings	71.7	68.3	1.7	-1.7	Fall
WX3-FF54	chewings	63.3	53.3	-6.7	-16.7	Fall
ZPS-MG	chewings	71.7	65.0	1.7	-5.0	Fall
Discovery	hard	86.7	58.3	16.7	-11.7	Fall
MB 81-93	hard	88.3	58.3	18.3	-11.7	Fall
MB 82-93	hard	73.3	63.3	3.3	-6.7	Fall
MB 83-93	hard	88.3	61.7	18.3	-8.3	Fall
Pamela	hard	70.0	63.3	0.0	-6.7	Fall
Reliant II	hard	71.7	61.7	1.7	-8.3	Fall
SR 3100	hard	76.7	56.7	6.7	-13.3	Fall
67135	sheep	76.7	61.7	6.7	-8.3	Fall
BAR Frr 4ZBD	strong creep	60.0	38.3	-10.0	-31.7	Fall
Common creep.	strong creep	53.3	45.0	-16.7	-25.0	Fall
Flyer	strong creep	66.7	48.3	-3.3	-21.7	Fall
Jasper (E)	strong creep	71.7	63.3	1.7	-6.7	Fall
WX3-FFG6	strong creep	73.3	65.0	3.3	-5.0	Fall
ZPS-4BN	strong creep	63.3	58.3	-6.7	-11.7	Fall
MB 64-93	chewings	73.3	70.0	3.3	0.0	Neutral
TMI-3CE	chewings	75.0	70.0	5.0	0.0	Neutral
Aurora (E)	hard	61.7	60.0	-8.3	-10.0	Neutral
Brigade	hard	85.0	73.3	15.0	3.3	Neutral

Table 5 continued

Cultivar	Grass Type	Percent Density		Transformed (%-70)		Recommended Sow-date
		Fall Sown	Spring Sown	Fall	Spring	
Ecostar	hard	85.0	73.3	15.0	3.3	Neutral
Nordic	hard	90.0	73.3	20.0	3.3	Neutral
PRO 92/24	hard	80.0	71.7	10.0	1.7	Neutral
Scaldis	hard	95.0	75.0	25.0	5.0	Neutral
Spartan	hard	95.0	71.7	25.0	1.7	Neutral
FO 143	sheep	86.7	78.3	16.7	8.3	Neutral
PST-4VB Endo.	strong creep	66.7	63.3	-3.3	-6.7	Neutral
Shademaster II	strong creep	46.7	50.0	-23.3	-20.0	Neutral
ISI-FC-62	chewings	40.0	50.0	-30.0	-20.0	Spring
Jamestown	chewings	41.7	60.0	-28.3	-10.0	Spring
Tiffany	chewings	65.0	70.0	-5.0	0.0	Spring
Dawson	slender cree	48.3	63.3	-21.7	-6.7	Spring
Seabreeze	slender cree	55.0	60.0	-15.0	-10.0	Spring
Aruba	strong creep	25.0	43.3	-45.0	-26.7	Spring
BAR UR 204	strong creep	55.0	60.0	-15.0	-10.0	Spring
CAS-FR13	strong creep	43.3	58.3	-26.7	-11.7	Spring
PST-4DT	strong creep	56.7	63.3	-13.3	-6.7	Spring
PST-4ST	strong creep	56.7	66.7	-13.3	-3.3	Spring
Rondo	strong creep	56.7	61.7	-13.3	-8.3	Spring
WVPB-STCR-101	strong creep	56.7	63.3	-13.3	-6.7	Spring

Table 6. Fine Fescue Trial - Spring 1996
Mean percent density and overall performance (OP) for cultivars that were recorded one month after sowing. The trial was sown on April 18, 1996 in Petersburg, Virginia.

Cultivar	Grass Type	Percent Density	OP (1-5=best)
Shademaster II	SCRF	56.7	3.3
Brittany	CF	41.7	2.3
Boreal	CRF	41.7	2.7
Herald	CRF	30.0	2.3
MB 65	CF	30.0	1.7
Tiffany	CF	28.3	2.0
Shademark	CRF	26.7	2.0
Seabreeze	SCRF	25.0	1.7
MB 61	CF	25.0	1.3
Southport	CF	25.0	2.3
Rudax	CF	23.3	2.0
Reliant II	HF	23.3	2.0
Discovery	HF	21.7	1.7
Teal	SF	21.7	1.7
Waldina	HF	15.0	1.3
Azure Blue	SF	15.0	1.0
Saxon	HF	13.3	1.3
Aurora	HF	13.3	1.3
Warwick	HF	10.0	1.3
MB 81 -Scotts	HF	10.0	1.0

Table 7. Barren Acid-Producing Slope - 1996
The soil analysis results from the barren acid-producing slope in Mechanicsville, Virginia.

Sample Description	Date	pH	ppm in soil						
			Soluble Salts	P	K	Ca	Mg	Fe	Al
Overall slope	03/15/96	2.8	666	19	70	300	56	248	143
Overall slope , 1 month after 1/2 lime & P applied	04/17/96	3.5	n/r*	27	42	360	105	176	138
Areas 1 month after treatment:									
Lime Only (L)	06/21/96	5.0	n/r	31	47	1200	120	191	148
Lime and Compost (L-C)	06/21/96	4.5	n/r	31	72	912	120	161	174
Lime, Compost and Tillage (L-C-T)	06/21/96	4.7	n/r	27	42	360	105	162	100
1/2 Lime and Compost (1/2L-C)	06/21/96	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r

* n/r=data not recorded

Table 8. Barren Acid-Producing Slope - 1996
The mean number of plants, percent density and overall performance (OP) for four treatments are reported. The data was recorded for 21 observations per treatment on May 10, 1996.

Treatment	Plant Count* Rating	Percent Density	OP (1-5=best) Rating
Lime Only (L)	1.0	15.0	1.0
Lime and Compost (L-C)	2.0	44.0	1.5
Lime, Compost and Tillage (L-C-T)	1.7	51.0	2.4
1/2 Lime and Compost (1/2L-C)	1.4	55.0	2.8

* Plant Count - <50=1, 51 to100=2, 101 to 150=3, 151 to 200=4, 201+=5