

Annual Report

Roadside Flower Plantings in Virginia: Plant Selection and Seeding Strategies

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I. Introduction

The Virginia Department of Transportation (VDOT) has a well-established roadside wildflower planting program. To date, the majority of roadside flower research in Virginia has focused on basic species selection trials and the development of establishment protocols. Three issues of the roadside flower program need further exploration: I) developing management strategies to prolong flower bed color or interest during the course of the season, II) developing seed specifications to be used in the contracting process, and III) developing practical no-till planting techniques that will reduce weed competition while promoting successful stand establishment. This report will discuss each of those issues in turn based upon our first year of exploratory work on this project.

II. Prolonging the Period of Color/Interest in a Planting

A. Rationale

A goal of this phase of the roadside flower program is to create year-round interest for the enjoyment of the traveling public. Interest is defined as something unusual or attractive to draw the attention of travelers; these may not be flowers *per se* but could be ornamental grasses or other plants with interesting colors, textures, or growth forms. This goal is a particular challenge for Virginia because of the Commonwealth's variable climate and soil conditions. It is especially difficult to find species that will, in a single planting, provide color and/or interest over the course of the growing season, let alone the entire year.

The roadside-planting management strategies most often used in Virginia consist of a solely perennial or annual planting. The annuals often provide a higher rating on the ornamental scale, but they require more attention and typically have a relatively short period of peak color. The perennials that have been shown to do well in Virginia generally fall short of the annuals on

the ornamental scale, but they may provide a longer duration of flowering and require less attention and hence less money. Several approaches have been taken to extend color over spring and summer, 1) planting successive crops of annuals, 2) planting a mixture of perennials, or 3) planting a mixture of annuals and perennials.

Weed control can be a problem for both the annuals and perennials; but, because the annual flowerbeds are reworked yearly, the perennial weeds in these beds are not as problematic as in the perennial flowerbeds. Neat beds are more appealing; thus, annuals are often used. However, due to the tillage in the annual beds, annual weeds eventually become a problem.

B. Goals and Objectives

Our primary goal for this year was to investigate management strategies that would add year-round interest to the roadside beds and to do it in ways that minimize inputs of fertilizer, herbicide, labor, and equipment. Our other goal was to look for combinations of perennials with and without annuals that would provide interest for at least two years. Plant materials that have performed well in the past on Virginia roadsides were used, with care taken to avoid aggressive species that can threaten native species.

C. The Two Mixture Studies

1. Spring 1999 Study- Blacksburg

Objective: The goal was to evaluate annual and perennial species mixtures for their ability to provide a continuous succession of flowering during the growing season.

Procedures for Establishment, Maintenance and Data Collection: On April 18, two field studies (Short Species and Tall Species) were seeded on a level site in Blacksburg, Virginia. The combinations of annuals and perennials with and without grasses were an attempt to extend the

season of interest. The area was sprayed with glyphosate (2 gal/Ac) two times in early March prior to tillage. The soil was tilled to 3 inches. After hand-sowing (moist sand was used as a bulking agent with the seed) into the individual 100 ft² plots, the entire area was rolled to increase soil-seed contact. Each combination was replicated four times, and the plots were arranged in a randomized block design. The seeded species are listed in Table 1.

Results and Discussion: The flower seedlings germinated along with a dense stand of lambsquarter (*Chenopodium album*) in early May. On May 4, glyphosate (2 gal/Ac) in a wick applicator was applied to the whole field of lambsquarters. The effect on the weed was not significant enough to contain the weed growth. By the end of May, when the weeds were about 8 to 10 inches tall, 4 oz/Ac of Plateau™ was applied to the plots. Some of the planted species were known to be sensitive to the chemical, but the severity of the weed contamination gave us little choice. The chemical did little to control the weeds, since they were too large at the time of spraying. The herbicide burned the terminal growing points of the roadside flowers, possibly because the ambient air temperature was in the high 80's and the soil was dry. By June, the weeds were 3 feet or taller and the planted species were no longer visible upon casual inspection. It was clear at this point that the planting was not salvageable. We experienced the frustration that many roadside managers and contractors face. In early July, the field was mowed and then sprayed with two applications of glyphosate.

2. Fall 1999 Study- Blacksburg

Objective: The goal was to evaluate fall-sown annual and perennial species for their ability to provide a continuous succession of flowering in one or more growing seasons.

Procedures for Establishment, Maintenance and Data Collection: On October 8, this study was seeded in the same location as the failed Spring 1999 Study, but only after extensive field renovation. After the terminated spring study was mowed to the ground in July, the stubble was raked off the site. Glyphosate was applied on July 28, and again on September 1, (2 gal/Ac). On September 9, Basimid™ (350 lb/Ac), a type of soil sterilant, was broadcast over the field,

disked-in 3 inches and rolled. The field was then kept moist for 7 days. The site was lightly disked (1 to 2 inches) to break the surface layer of crust that had formed prior to seeding. Because the fertility and pH of the field was adequate, no amendments were added.

The spring and summer flowering species were divided into two separate blocks. This will allow us to evaluate the species as units and will reduce the problem of evaluating plots that contain declining species. However, in the future, the spring flowering species will be seeded with the summer flowering perennials.

Tables 2 and 3 list the species used. All the species were seeded at 15 lb. pure live seed/Ac. Note that little bluestem (*Schizachyrium scoparium*) was seeded with some of the summer-flowering perennials. This is not the usual time of the year to seed this warm-season grass. It was added to the mix to determine if this grass could be introduced at this time of the year. Fall is generally a more favorable time of the year to sow the perennials that perform the best in Virginia's climate, but it is not the preferred time for seeding the warm-season grasses. The introduction of little bluestem into the perennial mix can provide interest in the late spring, early summer, and onto into the fall, when summer perennials are not at their best ornamentally. Thus, little bluestem would serve as a "backbone" plant for the design.

All the species were sown on October 8 into the individual 100 ft² plots by hand after being mixed with moist sand. The entire area was rolled following seeding to increase soil-seed contact. The mixture combinations in each plot were replicated four times, and the plots were arranged in a randomized block design. Data on establishment, height, date of flowering, flower impact, and density will be collected in the 2000 growing season.

Results and Discussion: Two weeks after sowing, only the *Rudbeckia hirta* (blackeyed Susan), *Coreopsis tinctoria* (golden tickseed), and *Ratibia columnifera* (upright prairie coneflower) summer-flowering perennials were visible. However, all of the spring-flowering species were readily visible. One month after sowing, all of the summer-flowering perennials were visible except for *Coreopsis lanceolata* (lanceleaf coreopsis) and little bluestem. By December, however, only little bluestem was not visible. Figure 2 provides an indication of how

the addition of tickseed and *Rudbeckia* improved the density of cover by three months after planting. All of the other species were very small, and thus could easily be smothered by a moderate weed infestation. These data illustrate why flower mixes must be designed so that there is a balance in plant growth habit in the initial stage of the planting. Some desired species must germinate quickly and cover the ground quick enough to compete well with weeds. The mix must also allow slower germinating and maturing species to develop without shading them.

Figure 1 illustrates the percent ground cover density of the spring-flowering species one month after sowing. Both the *Papaver rhoeas* (poppy) and *Cherianthus allionii* (English wallflower) when combined with either *Centaurea cyanus* (bachelor's buttons) or *Hesperis matronalis* (dames rocket) provided more cover than *Silene armeria* (sweet William silene) or *Fagopyrum esculentum* (buckwheat). Two months after sowing, the density of vegetation had increased in all the plots. The poppy and wallflower plots were denser than the others when combined with either *Centaurea* or *Hesperis*. Poppy is very aggressive, and in the end may dominate the plots. If smothering weeds is an objective, use poppy. Wallflower is almost as aggressive as the poppy, and provided good coverage as well. If poppy and wallflower are used in a seeding mixture with slower developing perennials, we estimate that seeding rates should be no more than 5 lb/Ac to avoid single species dominance. The *Silene*, *Centaurea*, and *Hesperis* do not appear to dominate at least two months after seeding in the fall. The little bluestem was not visible at the time these data were collected. However, it may appear in the spring of 2000.

III. Developing Seed Specifications

A. Rationale

Roadside flower and native grass seeds are usually sold on a pure live seed (PLS) basis, because they often do not have high percentages of the desired seed or a high percentage of germination. The vendors are willing to sell the seed on a pure live seed basis if requested. It is strongly recommended that VDOT order seed on the PLS basis. However, information on minimum percent purity and germination is important when preparing seeding mixture specifications by VDOT.

B. Objective

The objective is to collect purity and germination information on various roadside flowers and native grasses so that these values can be assigned to assist with seed selection and purchase.

C. Procedure, Results and Discussion

In the summer of 1999, at least 20 seed companies were contacted and asked to assign minimum percent purity and germination to each species. The following seed companies returned information: Sharp Bros. Seed, Inc¹; Applewood Seed Co²; Wildseed Farms, LTD³; Prairie Restoration, Inc⁴; Bamert Seed Co⁵. Some information was also gleaned from a Wildflower Seed Specification document from the State of Florida Department of Transportation and the Guidelines in Recommended Uniform State Seed Law (RUSSL). Tables 4 and 5 are a compilation of the data collected. These data can be used to update the VDOT form RD-4.

¹ 396 SW Davis St, Clinton, Mo., 64735-9058

² 5310 Vivian St, Arvada, CA 80002

³ 425 Wildflower Hills, Fredericksburg, TX 78624

⁴ P.O. Box 327, Princeton, MN 55371

⁵ Rt. 3, Box 1120, Muleshoe, TX 79347

IV. Adapting No-Till Techniques to Roadside Flower Plantings - Fall 1999 Demonstration - Piedmont

A. Rationale

A common complaint from Virginia roadside managers is weed infestation. In neighboring states, soil fumigants have been used with great success to decrease weed infestations in roadside flowerbeds. This method works well to eliminate first-year weed competition; but soil sterilants are harmful to beneficial soil microbes, and the technique is expensive. The use of soil fumigants is not part of the Virginia Roadside Program, so alternative weed control techniques must be used.

Weeds have been a major concern for farmers for many years. Adoption of no-till planting systems can help to control weeds in crops such as alfalfa, corn, and soybeans when combined with an herbicide program. More recently no-till planting has been adapted to sowing native warm-season grasses. In the no-till system, seed is drilled into herbicide-killed vegetative stubble by a special seed drill. In this way, weed seed is not brought to the surface, as it would be in conventional tillage and planting. Therefore, annual weeds are less of a problem. Another advantage of no-till is that the soil is not left bare and exposed to erosion. No-till methods can also provide an establishment advantage in both wet and dry years. A no-till planting can typically be done sooner after a rain than can the full set of operations associated with conventional planting. When soil moisture is at a premium (droughty years), the no-till approach conserves soil water and assists in seed germination and growth if seeds are properly planted. Another important advantage for roadside flowers is that the decomposing vegetation left in no-till planting will provide organic matter as well as help to retain soil moisture. The disadvantages of no-till methods can include increased numbers of some perennial weeds and the necessity of planting in rows (albeit very narrow rows). With proper management, the perennial weeds can be killed prior to seeding. Multiple applications of glyphosate may be required to kill all the weeds. If planting in rows is a visual concern, pulling the seeder at different angles across the field can solve the problem. Sowing swaths of seed by hand over the no-till-seeded area will also create a

more natural looking stand. By the time many of the species attain full stature, there will be no indication they are growing in rows.

B. Goals and Objectives

The objective of this experiment was to examine the feasibility of using a no-till seeder for planting roadside flower species into killed sod, and to determine which species could be planted with this method.

C. Procedures for Establishment, Maintenance and Data Collection

On September 15, 1999, *Papaver rhoeas*, *Echinaceae purpurea* (purple coneflower), *Coreopsis lanceolata* and *Ratibia columnifera* were sown with a Tye Pasture Pleaser Drill on an essentially level site located at the Northern Piedmont Agricultural Research and Extension Center in Orange, Virginia. The existing vegetation of mostly tall fescue with some weeping lovegrass was sprayed twice in one day with glyphosate (2 gal/Ac) on September 8. This unusual glyphosate application method was used because of weather constraints. This is not ideal and is not recommended, but it seemed to work. The seeds were planted at a rate of approximately 20 lbs. PLS / Ac. On an adjacent site, the same species were planted (at the same rate) on an area with conventional tillage. Both sites were assessed on November 16, and all species had germinated and were performing well with minimal weed competition in the no-till area. In the conventional area, the weeds were more prevalent than the no-till site. Because the no-till seeded plants were planted in rows, the number of plants per linear foot was counted to estimate stand density. Our target linear density, based on our observations, is 2 to 4 plants per foot. The mean for the *Coreopsis*, *Ratibia*, and *Papaver* 2 months after sowing was two plants/foot; however, the mean for *Echinaceae* was only one plant/foot. The *Echinaceae* leaves appeared to be chewed by unidentified insects, slugs, or snails. We will apply pesticides in the spring to try to curtail further damage. The area will be observed for at least a year. Density, time of flower, flower ratings, and height will be measured in the spring of 2000.

V. Conclusions

The first year of this contract has provided many insights into the difficulty in establishing roadside flowers with spring planting. There are many factors that work against this process. The summer-annual weeds appeared to be the worst problem. The fall planting has been much more successful for two reasons. 1) The cool and moist weather in the fall was more conducive to germination and establishment of perennial roadside flowers, and 2) Basimid™ was effective in reducing the weed population. Although the effect of the weed-control chemical has been positive, the amount of weed contamination in the spring of 2000 will be the decisive marker. Basimid™ is not the perfect tool for cleaning up severely weed-infested soils, but it is the only soil sterilant that does not require special equipment for application. We hope that this project will be continued so that data can be collected for a few years. It is important to follow this new planting to determine if it meets the objective of creating successive ornamental interest over at least one year.

With every research problem there is often a counter problem-solving event that occurs. This is exactly what happened when the spring study was not successful because of the lambsquarter invasion. Farmers have faced weed problems, and one response has been to use no-till management techniques. Thus, we decided to try this technique with several of the species of roadside flowers. To date we have a nice stand of no-till planted roadside flowers in Orange, Virginia. We will explore this technique further, because we feel that it could prove a valuable tool for the Virginia VDOT roadside manager.

Table 1. Roadside Flower Study (seeded in the spring of 1999, Blacksburg)

Treatment #	Annual				Grass				Perennial			
	Seeding rate (lb/A)	Seeding rate (lb/100 sq ft)	Seeding rate (g/100 sq ft)	plant	Seeding rate (lb/A)	Seeding rate (lb/100 sq ft)	Seeding rate (g/100 sq ft)	plant	Seeding rate (lb/A)	Seeding rate (lb/100 sq ft)	Seeding rate (g/100 sq ft)	plant
1	Cos sulf	15	0.034	15.62			0.00					
2	Cos sulf	10	0.023	10.41	WW	15	0.034	15.62				
3	Cos sulf	10	0.023	10.41	WW	15	0.034	15.62	Lanc	10	0.023	10.42
4	Cos sulf	10	0.023	10.41	WW	15	0.034	15.62	Rud	2	0.005	2.08
5	Cos sulf	10	0.023	10.41	WW	15	0.034	15.62	Rat Df	2	0.005	2.08
6	Cos sulf	10	0.023	10.41	SF	20	0.046	20.82				
7	Cos sulf	10	0.023	10.41	SF	20	0.046	20.82	Lanc	10	0.023	10.42
8	Cos sulf	10	0.023	10.41	SF	20	0.046	20.82	Rud	2	0.005	2.08
9	Cos sulf	10	0.023	10.41	SF	20	0.046	20.82	Rat Df	2	0.005	2.08
10	Cos sulf	10	0.023	10.41								
11	Cos sulf	15	0.034	15.62					Lanc	10	0.023	10.42
12	Cos sulf	15	0.034	15.62					Rud	2	0.005	2.08
13	Cos sulf	15	0.034	15.62					Rat Df	2	0.005	2.08

Key: Cos sulf=Cosmos sulfureus, WW=western wheatgrass, SF= sheep fescue, Lanc= Coreopsis lanceolata, Rud=Rudbeckia hirta, Rat Df=Ratibia columnifera dwarf cv.

Tall Species

Treatment #	Annual				Grass				Perennial			
	Seeding rate (lb/A)	Seeding rate (lb/100 sq ft)	Seeding rate (g/100 sq ft)	Plant	Seeding rate (lb/A)	Seeding rate (lb/100 sq ft)	Seeding rate (g/100 sq ft)	Plant	Seeding rate (lb/A)	Seeding rate (lb/100 sq ft)	Seeding rate (g/100 sq ft)	Plant
1	Cos bi	15	0.034	15.62								
2	Cos bi	10	0.023	10.41	LB	10	0.023	10.41				
3	Cos bi	10	0.023	10.41	LB	10	0.023	10.41	Max	8,000	0.018	8.34
4	Cos bi	10	0.023	10.41	LB	10	0.023	10.41	Glory	2,000	0.002	1.04
5	Cos bi	10	0.023	10.41	LB	10	0.023	10.41	Rat	2,000	0.005	2.08
6	Cos bi	10	0.023	10.41	Can	15	0.034	15.62				
7	Cos bi	10	0.023	10.41	Can	15	0.034	15.62	Max	8,000	0.018	8.34
8	Cos bi	10	0.023	10.41	Can	15	0.034	15.62	Glory	2,000	0.002	1.04
9	Cos bi	10	0.023	10.41	Can	15	0.034	15.62	Rat	2,000	0.005	2.08
10	Cos bi	15	0.034	15.62								
11	Cos bi	10	0.023	10.41					Max	8,000	0.018	8.34
12	Cos bi	10	0.023	10.41					Glory	2,000	0.002	1.04
13	Cos bi	10	0.023	10.41					Rat	2,000	0.005	2.08

Key: Cos bi=Cosmos bipinnatus, LB= little bluestem, Can=Canadian wildrye, Max=Helianthus maximiliani, Glory=Rudbeckia hirta 'Gloriosa', Rat=Ratibia columnifera.

Table 2. Spring-flowering mixtures (seeded in the fall 1999, Blacksburg)

Base Species	Added Species
<i>Centaurea cyanus</i> (bachelor's buttons)	<i>Papaver rhoeas</i> (corn poppy)
<i>Centaurea cyanus</i>	<i>Silene armeria</i> (sweet William silene)
<i>Centaurea cyanus</i>	<i>Cherianthus allionii</i> (English wallflower)
<i>Centaurea cyanus</i>	<i>Fagopyrum esculentum</i> (buckwheat)
<i>Hesperis matronalis</i> (dames rocket)	<i>Papaver rhoeas</i>
<i>Hesperis matronalis</i>	<i>Silene armeria</i>
<i>Hesperis matronalis</i>	<i>Cherianthus allionii</i>
<i>Hesperis matronalis</i>	<i>Fagopyrum esculentum</i>

Table 3. Summer-flowering mixtures (seeded in the fall 1999, Blacksburg)

Base Species	Added Species
<i>Coreopsis tinctoria</i> (golden tickseed)	<i>Helianthus maximiliani</i> (Maximilian sunflower)
<i>Coreopsis tinctoria</i>	<i>Ratibia columnifera</i> (upright prairie coneflower)
<i>Coreopsis tinctoria</i>	<i>Rudbeckia hirta</i> (blackeyed Susan)
<i>Coreopsis tinctoria</i>	<i>Helenium autumnale</i> (common sneezeweed)
<i>Coreopsis lanceolata</i> (lanceleaf coreopsis)	<i>Helianthus maximilliani</i>
<i>Coreopsis lanceolata</i>	<i>Ratibia columnifera</i>
<i>Coreopsis lanceolata</i>	<i>Rudbeckia hirta</i>
<i>Coreopsis lanceolata</i>	<i>Helenium autumnale</i>
<i>Echinaceae purpurea</i> (eastern purple coneflower)	<i>Helianthus maximilliani</i>
<i>Echinaceae purpurea</i>	<i>Ratibia columnifera</i>
<i>Echinaceae purpurea</i>	<i>Rudbeckia hirta</i>
<i>Echinaceae purpurea</i>	<i>Helenium autumnale</i>
<i>Schizachyrium scoparium</i> (little bluestem)	<i>Helianthus maximilliani</i>
<i>Schizachyrium scoparium</i>	<i>Ratibia columnifera</i>
<i>Schizachyrium scoparium</i>	<i>Rudbeckia hirta</i>
<i>Schizachyrium scoparium</i>	<i>Helenium autumnale</i>

Table 4. VDOT Roadside Flower Plant List

The list of commercially available species includes all that VDOT might use in the Virginia Roadside Flower Program. Percent minimum germination and purity are from information provided by the following the seed companies or sources: 1=Sharp Bros, 2=Florida, #3=Wildseed Farms, #4=Applewood Seed, #5=Guidelines in Recommended Uniform State Seed Law (RUSSEL)

Genus and Species	% Min. Germination					% Purity			
	#1	#2	#3	#4	#5	#1	#2	#3	#4
<i>Achillea millefolium</i>			65	75	50			98	98
<i>Achillea filipendulina</i>			60	75	50			98	98
<i>Agropyron cristatum</i>									
<i>Alyssum saxatile</i>				75	60				98
<i>Anthemis tinctoria</i>									
<i>Asclepias tuberosa</i>			60	75				97	98
<i>Aster divaricatus</i>									
<i>Aster grandiflorus</i>									
<i>Aster novae-angliae</i>			55	75				95	98
<i>Aster pilosus</i>				75					98
<i>Aster ptarmicoides</i>									
<i>Bidens aristosa</i>									
<i>Bidens frondosa</i>									
<i>Calendula officinalis</i>				75					98
<i>Castilleja coccinea</i>									
<i>Castilleja indivisa</i>			60					90	
<i>Centaurea cyanus</i>			65	75	60			99	98
<i>Cheiranthus allionii</i>			65	75	65			99	98
<i>Chrysanthemum carinatum</i>			60	75	40			99	98
<i>Chrysanthemum leucanthemum</i>	90		60	75		60		99	98
<i>Chrysanthemum maximum</i>	90		60	75	65	60		99	98
<i>Chrysopsis mariana</i>									
<i>Cichorium intybus</i>	95		60	75		50		99	98
<i>Clarkia concinna</i>									
<i>Clarkia unguiculata</i>			60	75				99	98
<i>Clarkia amoena</i>			60	75				99	98
<i>Cleome serrulata</i>				70					98
<i>Cosmos bipinnatus</i>		65	60				90	95	90
<i>Coreopsis lanceolata</i>	90	60	60	75	40	70	90	98	98
<i>Cosmos sulphureus</i>			65	75	65			98	98
<i>Coreopsis tinctoria</i>	95		65	75	65	60		99	98
<i>Daucus carota</i>	50			75		75			90
<i>Delphinium ajacis</i>			60	75	60			99	98
<i>Desmodium canadense</i>									
<i>Dianthus barbatus</i>			70	75	70			99	98
<i>Dimorphotheca aurantiaca</i>			60	75				97	98
<i>Echinacea angustifolia</i>	90		60	75	60	60		98	98
<i>Echinacea pallida</i>	60		50	75		70		98	95
<i>Echinacea purpurea</i>	65		50	75		85		98	90
<i>Erigeron speciosus</i>				75					95
<i>Eschscholzia californica</i>			65	75	60			99	98
<i>Gaillardia aristata</i>		60	60	65	45		90	94	95
<i>Gaillardia pulchella</i>		60	60	65	45		90	94	95
<i>Gilia capitata</i>				75	65				98

<i>Gilia tricolor</i>			65	75	65			99	98
<i>Gypsophila elegans</i>			65	75	70			99	98
<i>Gypsophila paniculata</i>				75	70				98
<i>Helenium amarum</i>									
<i>Helenium autumnale</i>					40				
<i>Helianthus angustifolius</i>									
<i>Helianthus annuus</i>				75	65				95
<i>Helianthus debilis</i>	90		60	75	65	60		98	98
<i>Helianthus maximilliani</i>									
<i>Heliopsis helianthoides</i>	85			60		55			95
<i>Hesperis matronalis</i>			65	75	65			99	98
<i>Iberis sempervirens</i>				75	55				98
<i>Iberis umbellata</i>			65	75				99	98
<i>Ipomopsis rubra</i>			60	75				99	98
<i>Lathyrus latifolius</i>				75					98
<i>Liatris spicata</i>			60	70				97	98
<i>Linaria maroccana</i>			65	75	65			99	98
<i>Linaria vulgaris</i>					65				
<i>Linum grandiflorum rubrum</i>			60	75	60			99	98
<i>Linum lewisii</i>			60	75	60			99	98
<i>Linum perenne</i>			60					99	
<i>Lobelia cardinalis</i>			50					98	
<i>Lobelia siphilitica</i>				75					90
<i>Lobularia maritima</i>			65	75				98	98
<i>Lupinus perennis</i>			65	75	65			99	98
<i>Lychnis chalcedonica</i>			65	75	70			99	98
<i>Machaeranthera tanacetifolia</i>			55	75				94	95
<i>Mentzelia lindleyi</i>				60					98
<i>Mirabilis jalapa</i>				75	60				98
<i>Monarda citriodora</i>									
<i>Monarda didyma</i>	85			70		50			90
<i>Monarda fistulosa</i>	90		65	60		70		99	95
<i>Myosotis sylvatica</i>				75	50				98
<i>Nemophila maculata</i>			60	75	60			99	98
<i>Nemophila menziesii</i>			70	75				97	98
<i>Oenothera biennis</i>									
<i>Oenothera fruticosa</i>									
<i>Oenothera hookeri</i>			60	60				98	95
<i>Oenothera missouriensis</i>			60	75				98	98
<i>Oenothera speciosa</i>			60	75				98	98
<i>Papaver rhoeas</i>			60	75	60			98	98
<i>Penstemon palmeri</i>				75					98
<i>Penstemon strictus</i>			60	75				98	98
<i>Phacelia campanularia</i>			60	75	65			97	98
<i>Phlox carolina</i>									
<i>Phlox drummondii</i>		60	60	75	55		90	98	98
<i>Ratibida columnifera</i>			60	75				95	90
<i>Ratibida pinnata</i>	85			75		80			98
<i>Rudbeckia amplexicaulis</i>		50	60	75			90	98	98
<i>Rudbeckia fulgida</i>									
<i>Rudbeckia hirta</i>	95	65	60	75	60	70	90	98	98
<i>Rudbeckia hirta 'Gloriosa'</i>			60	75				98	98
<i>Rudbeckia subtomentosa</i>	80					60			

<i>Salvia azurea</i>	80			60		60			90
<i>Salvia coccinea</i>			65	75				99	98
<i>Saponaria ocymoides</i>				75	60				98
<i>Silene armeria</i>			70	75	60			99	98
<i>Silene pendula</i>				75					98
<i>Silene virginica</i>									
<i>Solidago rigida</i>	60					50			
<i>Solidago speciosa</i>									
<i>Trifolium incarnatum</i>			80					98	
<i>Verbena tenuisecta</i>			55	50				97	95
<i>Vernonia noveboracensis</i>									
<i>Zinnia elegans</i>				75					98

Table 5. VDOT Native Grass Plant List

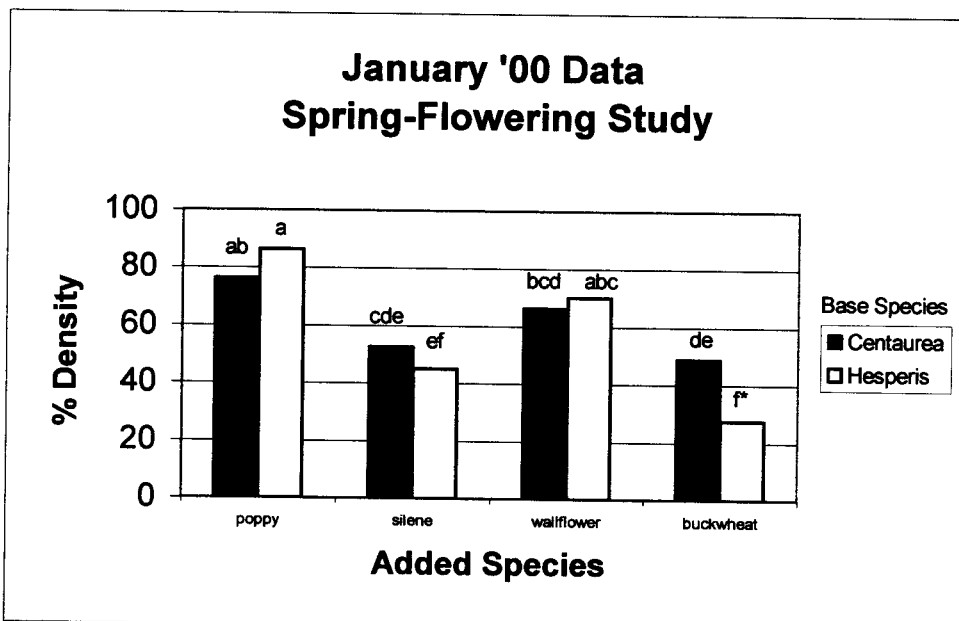
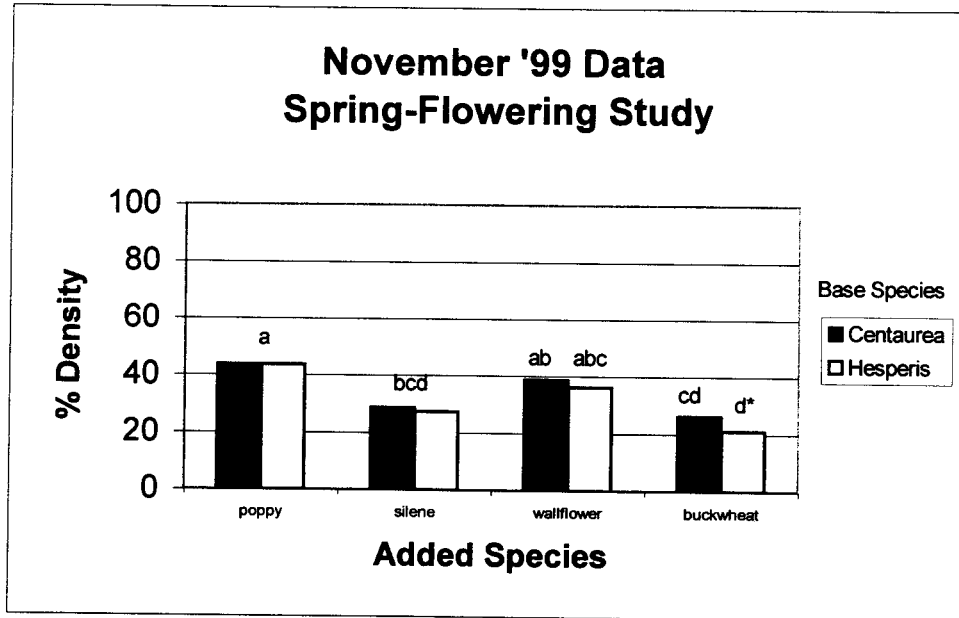
The list of commercially available grass species includes those that VDOT might use on Virginia roadsides. Percent minimum germination and purity are from information provided by the following seed companies:

#1 Prairie Restoration, #2 Applewood, #3 Bamert

Genus and Species	% Germination			% Purity		
	#1	#2	#3	#1	#2	#3
<i>Agropyron smithii</i> (western wheatgrass)			75			75
<i>Andropogon gerardii</i> (big bluestem)	67	50	75	67	70	75
<i>Andropogon glomeratus</i> (Bushy bluestem)						
<i>Andropogon elliottii</i> (beardgrass)						
<i>Andropogon virginicus</i> (broomsedge)						
<i>Bouteloua curtipendula</i> (sideoats grama)	60	75	70	85	90	75
<i>Bouteloua gracilis</i> (blue grama)	90	75	50	60	50	75
<i>Buchloe dactyloides</i> (buffalograss)		60	80		98	75
<i>Calamagrostis canadensis</i> (blue joint)	88			28		
<i>Deschampsia sp.</i> (tufted hairgrass)						
<i>Elymus canadensis</i> (Canada wildrye)	84	75		86	95	
<i>Elymus virginicus</i> (Virginia wildrye)						
<i>Eragrostis trichodes</i> (sand lovegrass)			85			75
<i>Koeleria cristata</i> (Junegrass)	86			50		
<i>Panicum virgatum</i> (switchgrass)	85	75	90	99	98	75
<i>Panicum clandestinum</i> (deertongue)						
<i>Schizachyrium scoparium</i> (little bluestem)	84	75	60	68	50	75
<i>Sorghastrum nutans</i> (Indiangrass)	93	75	70	97	80	75
<i>Tripsacum dactyloides</i> (eastern gamagrass)						

Figure 1. Spring Flowering Study - Fall 1999 - Blacksburg

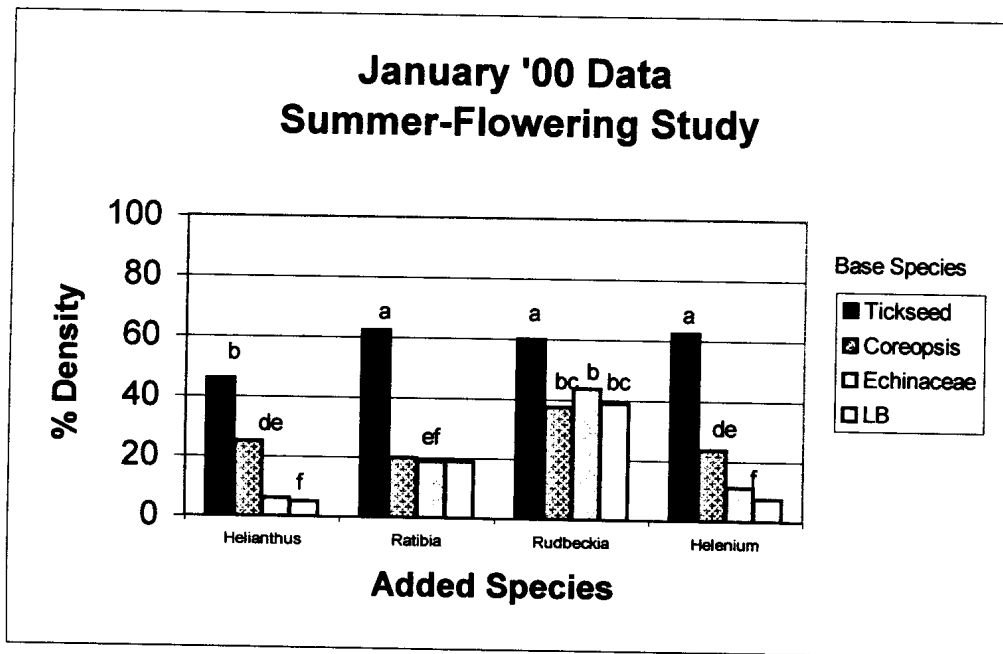
Seeds were sown on October 8, 1999 as two species mixes. Percent ground cover density was determined for each mix on November 8, 1999 and January 6, 2000.



poppy=*Papaver rhoeas* , Silene=*Silene armeria* , wallflower=*Cherianthus allionii*
 buckwheat=*Fagopyrum esculentum* , Centuarea=*Centaurea cyanus* , Hesperis=*Hesperis matronalis* .

* Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Figure 2. Summer-Flowering Study - Fall 1999 - Blacksburg
 Seeds were sown on October 8, 1999 as mixes. Percent ground cover density was determined for each mix on January 6, 2000.



Tickseed=Coreopsis tinctoria, Coreopsis=Coreopsis lanceolata, Echinaceae=Echinaceae purpurea,
 LB=little bluestem, Helianthus=Helianthus maximilliani, Ratibia=Ratibia columnifera,
 Rudbeckia=Rudbeckia hirta, Helenium=Helenium autumnale.

* Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.