

**Jamie L. Whitten Plant Materials Center**

**Coffeeville, MS**

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Vol. 12 No. 5

Technical Note

September 1996

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**EVALUATION OF ESTABLISHMENT METHODS FOR CERTAIN HERBACEOUS NATIVE  
PLANT SPECIES**

B. B. Billingsley and Janet Grabowski

**ABSTRACT**

Initial stand establishment and stand retention and development of twelve species of native grasses and forbs (natives) was compared following seeding under varied planting dates, mulch treatments, and planting procedures. Tests were conducted on one site with full sunlight exposure, and on another in partial shade. Both stand establishment and retention varied from species to species. When considering the twelve species as a group, (1) plots in full sunlight had 27 percent better stands than those in partial shade, (2) plots seeded with a seed mixture of natives/cover crops onto a clean tilled site produced 26 percent better stands than those overseeded into previously established cover crops, and (3) August was the best seeding date followed by June, April, and October. Germination and establishment of some species was delayed by wheat straw mulch as compared to wood excelsior mulch or no-mulch, but stand differences due to mulches varied little at the conclusion of this test.

**INTRODUCTION**

Presently, there is a great deal of interest in planting native wildflowers and other herbaceous plant species which add beauty and provide a more natural appearance to the landscape. Such plants add vegetative diversity which may provide wildlife food and cover, and can help control soil erosion directly or by enhancing the growth of other cover crop species. A lack of knowledge about planting methods and techniques which provide good seed germination and stand establishment hinders the increased use of natives. Under the provisions of a cooperative agreement between the National Park Service (NPS) and the Natural Resources Conservation Service (NRCS), a test was conducted to gain more knowledge of the planting methods and techniques needed to establish natives. This test was designed to evaluate the effect of different planting dates (4), mulch treatments (3), and seeding regimes (2) on seed germination and stand establishment and retention of twelve species of natives. Some treatments and soil amendments-application rates used in this test reflect needs by the NPS to establish vegetation in sometimes severe conditions and are not necessarily recommended for all sites.

B. B. Billingsley is the Plant Materials Project Leader and Janet M. Grabowski is a Biologist at the Jamie L. Whitten Plant Materials Center, Route 3, Box 215-A, Coffeeville, Mississippi 38922-9263, Tele: (601) 675-2588, FAX: (601) 675-2588, Email: janet@ms.nrcs.usda.gov.

Natural Resources Conservation Service

Homer L. Wilkes, State Conservationist  
Jackson, MS

## EXPERIMENTAL PROCEDURES

### I. Site Selection and Preparation:

Two separate areas were selected for testing because of the variation which occurs at construction sites along the Natchez Trace Parkway. These areas, with description were:

Open area - A sloping hillside with reasonably good soil uniformity and full sun exposure.

Forest edge - An area adjacent to a pine-hardwood forest with mostly west to south exposure to the sun. The percent of slope, soil type, and previous soil erosion is quite variable. Any given test replication was located on a reasonably uniform situation, but variations between replications was considerable.

The test areas were mowed in June 1992, and the plant residue was burned off. In July 1992, plant regrowth was sprayed with Roundup® (glyphosate) at a rate of two quarts per acre. After vegetation died, approximately two inches of soil surface was removed in order to reduce the number of weed seeds present.

### II. Experimental Design:

Randomized complete block, with four replications at each test area. Three variables were considered:

- A. Planting dates
- B. Mulch treatments
- C. Seeding regimes (seeding natives and cover crops together vs. overseeding natives to previously established cover crops).

### III. Materials and Methods:

#### A. Plant Materials:

##### 1. Native Plants

Winter bentgrass, *Agrostis hyemalis*  
Virginia wildrye, *Elymus virginicus*  
Little bluestem, *Schizachyrium scoparium*  
Purpletop, *Tridens flavus*  
Little barley, *Hordeum pusillum*  
Calliopsis, *Coreopsis tinctoria*  
Lance-leaf coreopsis, *Coreopsis lanceolata*  
Black-eyed Susan, *Rudbeckia hirta*  
Lyre-leaf sage, *Salvia lyrata*  
Partridge pea, *Chamaecrista fasciculata*  
Philadelphia fleabane, *Erigeron philadelphicus*  
Clasping coneflower, *Dracopis amplexicaulis*

Seeding Rate - 12 pure live seed of each species per sq. ft.

Planting rate (lb/acre)

2. <u>Cover crops</u>	<u>and month planted</u> April, June, August
Common bermudagrass ( <i>Cynodon dactylon</i> ) (hull removed)	20
Redtop ( <i>Agrostis gigantea</i> )	15
Annual ryegrass ( <i>Lolium perenne</i> ssp. <i>multiflorum</i> )	20
'KY 31' tall fescue ( <i>Festuca arundinacea</i> )	10
	October
Common bermudagrass (unhulled)	10
Redtop	15
Annual ryegrass	20
'KY 31' tall fescue	20

B. Plot Size: 8' X 10'

C. Plot Preparation: Plots were roto-tilled two inches deep, hand raked, then rolled with a hand roller immediately prior to being seeded.

D. Fertilizer:

1. Application procedure at time of initial plot seeding:

- a. 6000 pounds agricultural limestone per acre surface applied, plus
- b. 500 pounds 13-13-13 or equivalent fertilizer per acre, surface applied.

Both the agricultural limestone and the fertilizer were applied immediately preceding plot tillage as described in Section III., C. above.

2. Application procedure for top-dressing previously seeded plots:

Fertilizer at a rate of 500 pounds per acre 13-13-13 was applied to the surface of plots which were seeded with cover crops or a combination of cover crops/native plants the immediately preceding planting date. Only one top-dressing application was applied to any given plot.

E. Mulch Treatments:

1. 6000 lbs/acre wheat straw, or
2. Wood excelsior blanket, or
3. No-mulch

Mulch was applied only at the time of initial plot seeding, whether seeded to cover crops only or natives/cover crop seed mixture.

F. Planting Procedure:

1. For initial planting of all plots.
  - a. Gramoxone® (paraquat) herbicide was applied to plots 10-14 days prior to planting, if needed to control existing weeds.
  - b. Limestone and fertilizer were applied and then incorporated as described in Section III., D., 1.
  - c. Either cover crop seeds alone or a combination of cover crop/native seeds were planted as described in Section III., A.
  - d. Plots were then rolled with a hand roller to firm the soil and mulched according to the treatment assigned to each plot by randomization, either no mulch, wheat straw (6000 lbs/acre) or excelsior blanket. Wheat straw mulch was sprayed with an organic tackifier to help hold it in place.
  - e. Planting dates for native species were October 1 and 2, 1992; March 29 and 30, 1993 (for April 1 planting -- hereafter referred to as April); May 28-June 1, 1993; and August 2 and 3, 1993.
2. For overseeding of plots previously established to cover crops only.
  - a. Cover crops were mowed to a height of 4-6 inches.
  - b. Native seeds were overseeded by hand into the cover crop plots with no soil disturbance.

G. Mowing:

1. During the latter half of July or first half of August each year, a 42 inch wide strip was mowed to a 4-6 inch height across the 10 foot dimension of each plot.
2. The entire area of all plots was mowed to a height of 4-6 inches after a killing frost (November).

IV. Evaluation Methods:

Initial evaluations concerning the germination and establishment of both the cover crop and native species were made soon after germination could be determined. Either descriptive notes or evaluation tables or both were used to record evaluations. All plots were observed for plant growth and developmental changes at least monthly from April through October, and at least twice during the November through March period.

Ratings of the plant numbers-per-plot of each native species were made whenever such numbers could best be determined. Partridge pea, Little bluestem, Purpletop, and Virginia wildrye were primarily rated at the flowering or early seed production stage of growth. Overwintering rosettes or other vegetative structures made identification of the other eight species possible in spring before

other vegetative growth was large. Spring ratings were used for these species if large, competing vegetation made rating impossible when they were flowering. Plant numbers-per-plot for the twelve species of natives were rated on a scale of 1-5, based upon the number of clearly identified plants present. Accurate total counts were impossible in some instances.

## RESULTS AND DISCUSSION

The results of this test are shown in chronological order which best presents the development and/or decline of the cover crop species and natives.

### A. Cover Crops

Overall cover crop stand density and vigor was better in the open area test plots than in those along the forest edge. Both better soil conditions and a lack of shade may have contributed to the better performance of the cover crop species in the open area. Any given planting date/mulch treatment combination produced a similar pattern of germination in both test areas.

Tables 1 and 2 give cover crop ratings as recorded in December 1993. Ratings shown are for cover crops only, and do not include cover provided by mulch residue, clipping residue, or invading weedy species. Total cover was considerably greater than that provided by cover crops alone. No cover crop ratings were assigned in 1994 and 1995 when total cover on almost all plots was very close to 100 percent. Notes on individual cover crop species follows:

#### Redtop:

This species has provided far more cover than all other cover crop species planted. Somewhat slow to establish; produces dense stand; tends to reduce the establishment of most natives tested as well as weeds.

Best planting dates - October, August, April, June.

Best mulch - Excelsior blanket, none, wheat straw.

#### Annual ryegrass:

This species provided fair-good first year cover, but failed to become established in succeeding years.

Best planting dates - August, October, April, June

Best mulch - Wheat straw, excelsior blanket, no-mulch.

#### Bermudagrass:

This species has been suppressed by large, competing vegetation except in the strip mowed in July as well as November.

Best planting dates - August, April, June, October

Best mulch - No-mulch, excelsior blanket, wheat straw.

#### 'KY 31' tall fescue:

This species was common the first test year, but is now scarce in most plots.

Best planting date - August, October, April, June  
Best mulch - Excelsior blanket, or wheat straw (about equal); no-mulch.

Following planting, no plot had soil erosion rated more than moderate. A lack of high intensity rainfall soon after planting, and constructed water control diversions likely reduced the potential for soil erosion. Plots receiving no mulch treatment experienced the most erosion, with little being noted on plots mulched with wheat straw or excelsior blanket. Sufficient cover from mulch, seeded cover crops, invading weeds, and seeded natives soon provided enough cover to eliminate all but very slight erosion. Plantings made in October and April required a slightly longer period of time to develop good cover than did those made in June or August.

When seeded in combination with natives, cover crop initial establishment was unaffected by the presence of natives. Partridge pea was the only native species considered competitive with the cover crops. This species did overtop the cover crops and most other natives in 1994 and 1995. This summer annual was present in large numbers in almost all plots following good seed production in the fall of 1993.

B. Native Species:

1. Fall 1992 observation of native species planted October 1 and 2, 1992:

No germination of the twelve native species was noted in those plots overseeded into cover crops planted in August 1992. The very heavy cover in most plots made detection of these small seedlings impossible if they were present.

Some germination of the following species of natives were noted in those plots seeded to the natives/cover crop combination on October 1 and 2, 1992:

Winter bentgrass  
Partridge pea  
Calliopsis  
Virginia wildrye  
Black-eyed Susan  
Lyre-leaf sage

All seedlings of Partridge pea were killed by the first freeze.

2. January - March 1993 Evaluations  
Plots of both the open area and forest edge revealed the following:

January 19, 1993 - No native plants could be detected in those plots overseeded into established cover crops on October 1 and 2, 1992.

Some small Black-eyed Susan and Calliopsis plants were identifiable in some plots seeded to natives/cover crops on October 1 and 2, 1992. February 1993 - Evaluations were the same as for those of January 19, 1993.

March 10, 1993 - Again, no natives were identified in those plots overseeded in October 1992. The following species were noted in many plots seeded as a natives/cover crop combination at that time:

- Lance-leaf coreopsis
- Calliopsis
- Clasping coneflower
- Virginia wildrye
- Black-eyed Susan

Accurate counts could not be made, but the greatest numbers of natives seemed to occur in plots of no-mulch, excelsior blanket, followed by wheat straw.

### 3. Spring 1993 Evaluations:

On April 14, Partridge pea as well as those species listed in the March 10 evaluation were identifiable in many plots seeded in October 1992. This included those seeded as a combination natives/cover crops and overseeded into established cover. Fewer natives were visible in the overseeded plots.

An evaluation on June 18 revealed the following species to be present in plots of the October 1992 and April 1993 plantings. Species are listed in the order of greatest to least number of plants detectable.

- Partridge pea
- Black-eyed Susan
- Calliopsis
- Lance-leaf coreopsis
- Clasping coneflower
- Little barley
- Lyre-leaf sage
- Virginia wildrye
- Winter bentgrass

More natives are visible in those plots (1) seeded in October vs. April; (2) seeded with a natives/cover crop combination vs. overseeded; and (3) mulched with no-mulch, excelsior blanket, wheat straw (listed from most to fewest natives).

### 4. Summer-Fall 1993 Evaluations

There was no real difference in the germination of native species between the open area and forest edge. The ranking of native species plant numbers when all plots were considered was as follows, from greatest to least:

- Partridge pea

Lance-leaf coreopsis  
Black-eyed Susan  
Calliopsis  
Clasping coneflower  
Lyre-leaf sage  
Purpletop  
Winter bentgrass  
Virginia wildrye  
Little barley

Philadelphia fleabane and Little bluestem were not identified in any plots.

Tables 3 and 4 show average ratings for all native species as a group.

#### 5. Evaluations in 1994.

More native species could be identified in the test plots than previously. Ratings were made for individual species rather than for the natives as a group. The rating scale for plants-per-plot was: 0 = none present; 1 = 1-5 plants present; 3 = 6-15 plants present; and 5 = 16 or more plants present.

Philadelphia fleabane was present in such a small number of plots that it was not rated. Little bluestem was identified in so few plots of the forest edge that it was not rated in that test area.

Ratings changed from spring to late summer for several species. Tables 5a and 5b are ratings assigned for plots of the open area, and 6a and 6b are those for the forest edge. Values listed are a total score of ratings from the four replicated plots, along with planting date and mulch treatment totals. Species that could be identified at only one rating period appear only in the appropriate table.

#### 6. Evaluations in 1995

Greater numbers of most species of natives were present in 1995 than had been previously observed. Philadelphia fleabane however, was rare and not included in evaluations for this period. Unlike in 1994, ratings for the spring-early summer flowering species changed little by late summer-fall, and therefore ratings were assigned only for the spring-summer period. The rating scale was changed to allow a greater spread of plants-per-plot, making the performance of each species more distinguishable. Rating scale for plants-per-plot was: 0 = none present; 1 = 1-10 present; 3 = 11-30 present; 5 = 31 or more present.

Ratings for open area plots are shown in Tables 7a and 7b, and those for forest edge plots are in Tables 8a and 8b. Values listed are a total score of ratings from the four replicated plots, along with totals for planting dates and mulch treatments. Stand ratings shown in the legend

correspond to the increased scale of plants-per-plot shown above.

### **CONCLUSIONS**

- A. Greater numbers of cover crop plants and 27 percent more natives occurred in the open area than along the forest edge. Competition from woody plants, shading, and less desirable soil conditions may all have contributed to reduced performance overall along the forest edge. However, in one replication where soil conditions equaled or exceeded those found in the open area stands were still reduced.
- B. Under the conditions of this test, the natives as a group produced 26 percent better stands overall when seeded in combination with cover crops onto a clean tilled site. This was somewhat unexpected in light of past experience at seeding some of these species, where loose, freshly tilled sites have yielded poorer germination than have untilled site with some vegetation present. However, in this test the plots were well rolled to compact the soil prior to planting. Also, the high rate of fertilizer applied produced very heavy growth of cover crops and weeds, which may have suppressed most natives. In general, more natives were present where overall vegetative cover was less dense.
- C. Initially, wheat straw mulch inhibited the establishment of natives. However, by the end of this test, little overall difference due to mulch treatments was noted.
- D. August was the best planting date for both the open area and forest edge, followed by June, April and October.
- E. For comparison, one additional plot was added in the open area each planting date. These plots varied from other treatments by being seeded only with natives (clean tilled) and by receiving only one and one half tons per acre of wheat straw mulch. The results are not shown in this report, but these plots averaged more natives than any other mulch-seeding procedure combination.
- F. As a group, the twelve species of natives were still increasing in visual impact at the end of this test, with Purpletop, Virginia wildrye, and Little bluestem most noticeably so. Perennials such as Black-eyed Susan, Lance-leaf coreopsis and Winter bentgrass appeared to have reached their maximum visual impact under the management applied. Of the annual species, Partridge pea was the species most noticeable. Others such as Little barley, Calliopsis, Claspig coneflower, and the perennial Lyre-leaf sage were somewhat suppressed by the competing vegetation and appeared to be in a slight decline. These latter species, plus some others, appeared in good numbers in the frequently mowed alleyways. Philadelphia fleabane was noted as rare in the test plots.

### **MANAGEMENT IMPLICATIONS**

- A. Partridge pea should be seeded alone in selected areas, rather than in a mixture with other natives. It is showy in flower,

but tends to dominate most other native species. It is very intolerant of mowing during the growing season.

- B. Lyre-leaf sage and probably Little barley could be used best in a frequently mowed area, provided spring mowing can be delayed until mid to late May.
- C. Mowing at least once in summer after the natives set seed (mid July to mid August) seems to be beneficial to most of the natives except Partridge pea. Another mowing following a frost is recommended.
- D. A close mowing of established cover prior to overseeding the twelve native species appears to aid seed germination. Stands recorded may have been influenced by the overall cover crop and weed vegetation differences following a particular planting date, as well as by other environmental differences.

Mention of a registered trademark does not imply endorsement by USDA, NRCS.

#### ACKNOWLEDGMENTS

Funding was provided by NPS to conduct this test of establishment methods for plants occurring along sections of the Natchez Trace Parkway. Assistance provided by NPS personnel in planning and conducting this test is greatly appreciated.

Table 1.

OBSERVATION RATINGS OF COVER CROPS  
 OPEN AREA TEST PLOTS  
 RATED DECEMBER 1, 1993

Planting date	Mulches			Average
	Straw	Blanket	None	
August 1992 <sup>1</sup>	3.75	4.00	3.75	3.83
October 1992 <sup>2</sup>	2.88	3.38	3.00	3.08
April 1993 <sup>2</sup>	1.13	0.88	0.88	0.96
June 1993 <sup>2</sup>	1.38	2.25	2.25	1.96
August 1993 <sup>1</sup>	2.25	3.75	3.75	3.25
Average	2.10*	2.60*	2.47*	2.39*

<sup>1</sup> Average for 4 plots.

<sup>2</sup> Average for 8 plots.

\* Calculated using an average rating for the August 1992 and August 1993 plantings.

Rating scale - 0 = none  
 1 = 20%  
 2 = 40%  
 3 = 60%  
 4 = 80%  
 5 = 100%

Ratings are for ground cover provided by cover crops species only.

Table 2.

OBSERVATION RATINGS OF COVER CROPS  
FOREST EDGE TEST PLOTS  
RATED DECEMBER 1, 1993

Planting date	Mulches			Average
	Straw	Blanket	None	
August 1992 <sup>1</sup>	2.75	3.35	3.25	3.08
October 1992 <sup>2</sup>	2.50	3.50	3.50	3.17
April 1993 <sup>2</sup>	1.25	1.50	1.63	1.46
June 1993 <sup>2</sup>	1.25	1.38	2.00	1.83q
August 1993 <sup>1</sup>	1.50	2.25	1.75	1.83
Average	1.78	2.28	2.41	2.16*

<sup>1</sup> Average for 4 plots.

<sup>2</sup> Average for 8 plots.

\* Calculated using an average rating for the August 1992 and August 1993 plantings.

Rating scale - 0 = none  
 1 = 20%  
 2 = 40%  
 3 = 60%  
 4 = 80%  
 5 = 100%

Ratings are for ground cover provided by cover crop species only.

Table 3.

OBSERVATION RATINGS OF NATIVE PLANTS  
OPEN AREA TEST PLOTS  
RATED DECEMBER 1, 1993

Planting date	<u>Planting Sequence<sup>1</sup></u>		<u>Mulches<sup>2</sup></u>			Average
	Natives/ Cover		Straw	Blanket	None	
	Together	Natives Overseed				
October 1992	2.59	0.92	1.63	1.50	2.13	1.76
April 1993	0.67	1.42	1.25	0.63	1.25	1.05
June 1993	0.58	0.25	0.63	0.50	0.13	0.42
August 1993	1.75	0.75	1.63	1.25	0.88	1.25
Average	1.40	0.84	1.28	0.97	1.09	1.12*

<sup>1</sup> Average for 12 plots.

<sup>2</sup> Average for 8 plots.

Rating Scale - 0 = none  
 1 = very poor  
 2 = poor  
 3 = fair  
 4 = good  
 5 = excellent

Table 4.

OBSERVATION RATINGS OF NATIVE PLANTS  
FOREST EDGE TEST PLOTS  
RATED DECEMBER 1, 1993

Planting date	<u>Planting Sequence<sup>1</sup></u>		<u>Mulches<sup>2</sup></u>			Average
	Natives/ Cover	Natives Overseed	Straw	Blanket	None	
	Together					
October 1992	1.75	0.92	1.25	0.88	1.88	1.33
April 1993	0.92	1.00	1.13	0.88	0.88	0.96
June 1993	1.25	0.33	0.88	0.75	0.75	0.79
August 1993	2.16	1.33	2.25	1.25	1.75	1.75
Average	1.52	0.90	1.38	0.94	1.31	1.21*

<sup>1</sup> Average for 12 plots.

<sup>2</sup> Average for 8 plots.

Rating Scale - 0 = none  
 1 = very poor  
 2 = poor  
 3 = fair  
 4 = good  
 5 = excellent

Table 5a. Ratings of Native Plant Stand Densities on Open Area Germination and Establishment Test Plots - May 19, 1994

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Partridge pea</b>								
October 1992	7	4	12	23	20	14	14	48
April 1993	13	13	9	35	9	9	13	31
June 1993	6	6	3	15	4	4	8	16
August 1993	1	3	1	5	7	8	2	17
Treatment Total	27	26	25	78	40	35	37	112
<b>Calliopsis</b>								
October 1992	0	0	1	1	0	6	1	7
April 1993	1	1	5	7	4	0	5	9
June 1993	2	0	2	4	4	1	1	6
August 1993	13	14	13	40	6	0	2	8
Treatment Total	16	15	21	52	14	7	9	30
<b>Lance-leaf coreopsis</b>								
October 1992	18	16	18	52	6	6	3	9
April 1993	6	2	6	14	14	1	4	19
June 1993	8	16	5	29	5	0	0	5
August 1993	6	12	3	21	2	4	1	7
Treatment Total	38	46	32	116	27	8	14	49
<b>Clasping coneflower</b>								
October 1992	6	0	0	6	1	14	15	30
April 1993	7	3	6	16	1	1	1	3
June 1993	2	0	2	4	4	1	1	6
August 1993	14	20	13	47	16	10	18	44
Treatment Total	29	23	21	73	22	26	35	83
<b>Black-eyed Susan</b>								
October 1992	18	18	20	56	1	5	16	22
April 1993	5	2	4	11	11	3	12	26
June 1993	7	8	0	15	0	0	3	3
August 1993	20	20	11	51	13	2	4	19
Treatment Total	50	48	35	133	25	10	35	70
<b>Lyre-leaf sage</b>								
October 1992	12	10	3	25	0	0	4	4
April 1993	4	1	0	5	0	0	0	0
June 1993	1	1	3	5	0	0	1	1
August 1993	3	3	2	8	1	4	5	10
Treatment Total	20	15	8	43	1	4	10	15
<b>Winter bentgrass</b>								
October 1992	13	6	5	24	2	0	4	6
April 1993	6	13	7	26	9	1	7	17
June 1993	1	2	1	4	6	3	7	16
August 1993	0	5	0	5	3	6	7	16
Treatment Total	20	26	13	59	20	10	25	55

Continued

Table 5a. Ratings of Native Plant Stand Densities on Open Area Germination and Establishment Test Plots - May 19, 1994

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
Virginia wildrye								
October 1992	16	1	0	17	0	1	13	14
April 1993	18	9	11	38	9	0	0	9
June 1993	20	16	18	54	15	18	14	47
August 1993	<u>3</u>	<u>13</u>	<u>16</u>	<u>32</u>	<u>20</u>	<u>20</u>	<u>20</u>	<u>60</u>
Treatment Total	57	39	45	141	44	39	47	130
Little barley								
October 1992	0	1	1	2	0	4	6	10
April 1993	12	10	2	24	7	1	5	13
June 1993	15	14	20	49	20	20	18	58
August 1993	<u>16</u>	<u>20</u>	<u>20</u>	<u>56</u>	<u>18</u>	<u>20</u>	<u>20</u>	<u>58</u>
Treatment Total	43	45	43	131	45	45	49	139

Legend: 0-4 = Poor Stand.  
 5-9 = Fair Stand.  
 10-14 = Good Stand.  
 15-20 = Excellent Stand.

Table 5b. Ratings of Native Plant Stand Densities on Open Area Germination and Establishment Test Plots - August 30, 1994

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Partridge pea</b>								
October 1992	20	20	20	60	20	20	20	60
April 1993	20	20	18	58	20	18	20	58
June 1993	18	20	20	58	20	20	16	56
August 1993	18	16	12	46	20	20	18	58
Mulch Total	76	76	70	222	80	78	74	232
<b>Lance-leaf coreopsis</b>								
October 1992	16	20	18	54	1	6	12	19
April 1993	4	3	2	9	10	5	6	21
June 1993	10	12	3	25	5	0	1	6
August 1993	18	12	9	39	8	8	12	28
Mulch Total	48	47	32	127	24	19	31	74
<b>Lyre-leaf sage</b>								
October 1992	2	1	0	3	1	0	2	3
April 1993	1	2	1	4	0	0	0	0
June 1993	0	1	0	1	0	0	0	0
August 1993	2	1	0	3	2	1	2	5
Mulch Total	5	5	1	11	3	1	4	8
<b>Black-eyed Susan</b>								
October 1992	5	8	6	19	2	2	5	9
April 1993	1	2	3	6	4	1	2	7
June 1993	4	3	2	9	0	0	0	0
August 1993	16	20	14	50	3	2	2	7
Mulch Total	26	33	25	84	9	5	9	23
<b>Virginia wildrye</b>								
October 1992	3	1	1	5	0	1	4	5
April 1993	5	1	4	10	1	0	0	1
June 1993	8	3	6	17	2	2	1	5
August 1993	6	9	3	18	6	6	8	20
Mulch Total	22	14	14	50	9	9	13	31
<b>Purpletop</b>								
October 1992	3	2	4	9	0	0	0	0
April 1993	0	0	0	0	1	1	3	5
June 1993	0	0	0	0	0	1	1	2
August 1993	0	0	0	0	0	1	1	2
Mulch Total	3	2	4	9	1	3	5	9
<b>Little bluestem</b>								
October 1992	0	2	0	2	0	0	0	0
April 1993	0	1	0	1	2	2	2	6
June 1993	2	1	0	3	0	0	0	0
August 1993	4	3	5	12	0	0	0	0
Mulch Total	6	7	5	18	2	2	2	6

Legend: 0-4 = Poor Stand.  
5-9 = Fair Stand.  
10-14 = Good Stand.  
15-20 = Excellent Stand.

Table 6a. Ratings of Native Plant Stand Densities on Forest Edge (Partial Shade) Germination and Establishment Test Plots - May 16, 1994

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Partridge pea</b>								
October 1992	14	14	16	44	14	18	18	50
April 1993	12	12	16	40	12	14	16	42
June 1993	14	10	16	40	14	20	14	48
August 1993	14	13	10	37	11	16	9	36
Treatment Total	54	49	58	161	51	68	57	176
<b>Lance-leaf coreopsis</b>								
October 1992	4	3	14	21	4	3	4	11
April 1993	1	6	1	8	2	0	0	2
June 1993	14	12	11	37	1	10	0	11
August 1993	12	11	4	27	5	3	3	11
Treatment Total	31	32	30	93	12	16	7	35
<b>Calliopsis</b>								
October 1992	0	0	0	0	0	0	0	0
April 1993	3	0	0	3	1	0	0	1
June 1993	3	4	4	11	0	0	3	3
August 1993	8	5	5	18	3	1	5	9
Treatment Total	14	9	9	32	4	1	8	13
<b>Clasping coneflower</b>								
October 1992	1	0	1	2	0	0	0	0
April 1993	7	2	0	9	0	0	0	0
June 1993	5	5	0	10	3	5	0	8
August 1993	4	8	0	12	3	2	3	8
Treatment Total	17	15	1	33	6	7	3	16
<b>Black-eyed Susan</b>								
October 1992	8	5	18	31	4	4	11	19
April 1993	10	2	2	14	12	4	2	18
June 1993	11	10	5	26	1	3	0	4
August 1993	18	8	15	41	20	4	2	26
Treatment Total	47	25	40	112	37	15	15	67
<b>Lyre-leaf sage</b>								
October 1992	14	14	16	44	3	1	11	15
April 1993	12	5	12	29	8	6	8	22
June 1993	8	12	9	29	10	4	2	16
August 1993	14	14	7	35	5	6	4	15
Treatment Total	48	45	44	137	26	17	25	68
<b>Winter bentgrass</b>								
October 1992	0	3	0	3	0	3	0	3
April 1993	1	3	4	8	5	0	0	5
June 1993	0	4	0	4	7	3	5	15
August 1993	5	9	8	22	6	5	7	18
Treatment Total	6	19	12	37	18	11	12	41

Continued

Table 6a. Ratings of Native Plant Stand Densities on Forest Edge (Partial Shade) Germination and Establishment Test Plots - May 16, 1994

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
Virginia wildrye								
October 1992	12	9	3	24	4	1	0	5
April 1993	18	8	8	34	6	4	3	13
June 1993	14	14	7	35	4	1	5	10
August 1993	3	3	6	12	16	18	6	40
Treatment Total	47	34	24	105	30	24	14	68
Little barley								
October 1992	1	3	4	8	1	0	0	1
April 1993	6	7	2	15	3	0	2	5
June 1993	14	14	14	42	12	7	16	35
August 1993	13	20	15	48	14	13	20	47
Treatment Total	34	44	35	113	30	20	38	88

Legend: 0-4 = Poor Stand.  
 5-9 = Fair Stand.  
 10-14 = Good Stand.  
 15-20 = Excellent Stand.

Table 6b. Ratings of Native Plant Stand Densities on Forest Edge (Partial Shade) Germination and Establishment Test Plots - August 30, 1994

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Partridge pea</b>								
October 1992	20	20	20	60	20	20	20	60
April 1993	20	20	20	60	20	20	20	60
June 1993	20	20	20	60	20	20	18	58
August 1993	20	20	20	60	20	20	20	60
Mulch Total	80	80	80	240	80	80	78	238
<b>Lance-leaf coreopsis</b>								
October 1992	8	8	16	32	2	0	7	9
April 1993	3	6	6	15	5	2	5	12
June 1993	14	14	14	42	2	3	3	8
August 1993	12	18	8	38	8	6	6	20
Mulch Total	37	46	44	127	17	11	21	49
<b>Lyre-leaf sage</b>								
October 1992	14	8	6	28	2	2	9	13
April 1993	2	2	6	10	2	6	2	10
June 1993	10	6	6	22	2	2	1	5
August 1993	7	8	3	18	7	2	5	14
Mulch Total	33	24	21	79	13	12	17	42
<b>Virginia wildrye</b>								
October 1992	7	0	0	7	0	0	0	0
April 1993	4	1	1	6	4	1	0	5
June 1993	0	1	0	1	0	1	0	1
August 1993	1	5	0	6	4	1	1	6
Mulch Total	12	7	1	20	8	3	1	12
<b>Black-eyed Susan</b>								
October 1992	2	5	8	15	0	1	4	5
April 1993	2	0	3	5	5	2	2	9
June 1993	4	3	6	13	0	1	0	1
August 1993	5	8	6	19	7	3	4	14
Mulch Total	13	16	23	52	12	7	10	29
<b>Purpletop</b>								
October 1992	1	1	1	3	1	0	0	1
April 1993	1	0	0	1	0	0	0	0
June 1993	0	0	0	0	0	0	0	0
August 1993	0	0	0	0	0	0	0	0
Mulch Total	2	1	1	4	1	0	0	1

Legend: 0-4 = Poor Stand.  
5-9 = Fair Stand.  
10-14 = Good Stand.  
15-20 = Excellent Stand.

Table 7a. Ratings of Native Plant Stand Densities on Open Area Germination and Establishment Test Plots - June 8, 1995

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Partridge pea</b>								
October 1992	20	20	20	60	20	20	20	60
April 1993	20	20	20	60	20	20	20	60
June 1993	20	20	20	60	20	20	20	60
August 1993	20	20	20	60	20	20	20	60
Treatment Total	80	80	80	240	80	80	80	240
<b>Lance-leaf coreopsis</b>								
October 1992	18	18	18	54	4	5	10	19
April 1993	5	3	3	11	8	9	6	23
June 1993	6	8	8	22	6	1	2	9
August 1993	14	12	9	35	11	8	10	29
Treatment Total	43	41	38	122	29	23	28	80
<b>Lyre-leaf sage</b>								
October 1992	3	6	5	14	3	0	5	8
April 1993	3	3	3	9	3	2	2	7
June 1993	4	3	4	11	0	2	1	3
August 1993	6	5	6	17	10	6	8	24
Treatment Total	16	17	18	51	16	10	16	42
<b>Black-eyed Susan</b>								
October 1992	4	6	8	18	2	5	6	13
April 1993	7	8	4	19	2	3	7	12
June 1993	7	4	3	14	1	5	2	8
August 1993	16	10	4	30	3	4	3	10
Treatment Total	36	28	19	81	8	17	18	43
<b>Virginia wildrye</b>								
October 1992	14	12	10	36	12	11	14	37
April 1993	18	16	18	52	10	7	7	24
June 1993	18	20	20	58	14	18	18	50
August 1993	14	20	20	54	18	18	18	54
Treatment Total	64	68	68	200	54	54	57	165
<b>Clasping coneflower</b>								
October 1992	2	3	0	5	0	2	1	3
April 1993	8	16	6	30	3	2	2	7
June 1993	3	1	2	6	4	6	2	12
August 1993	4	4	3	11	9	6	4	19
Treatment Total	17	24	11	52	16	16	9	41
<b>Little barley</b>								
October 1992	0	0	0	0	0	0	0	0
April 1993	18	14	14	46	1	5	1	7
June 1993	20	16	20	56	20	18	20	58
August 1993	16	11	20	47	18	20	20	58
Treatment Total	54	41	54	149	39	43	41	123

Legend: 1-4 = Poor Stand.  
5-12 = Fair-Good Stand.  
13-20 = Excellent Stand.

Table 7b. Ratings of Native Plant Stand Densities on Open Area Germination and Establishment Test Plots - October 5, 1995

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Purpletop</b>								
October 1992	10	8	12	30	5	4	8	17
April 1993	6	6	6	18	4	4	6	14
June 1993	4	3	3	10	3	4	4	11
August 1993	6	4	6	16	4	3	4	11
Treatment Total	26	21	27	74	16	15	22	53
<b>Little bluestem</b>								
October 1992	1	2	0	3	0	0	0	0
April 1993	1	1	0	2	1	2	2	5
June 1993	1	2	2	5	0	0	0	0
August 1993	4	8	5	17	0	0	0	0
Treatment Total	7	13	7	27	1	2	2	5

Legend: 1-4 = Poor Stand.  
5-12 = Fair-Good Stand.  
13-20 = Excellent Stand.

Table 8a. Ratings of Native Plant Stand Densities on Forest Edge (Partial Shade) Germination and Establishment Test Plots - June 8, 1995

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Partridge pea</b>								
October 1992	20	20	20	60	20	20	20	60
April 1993	20	20	20	60	20	20	20	60
June 1993	20	20	20	60	20	20	20	60
August 1993	20	20	20	60	20	20	20	60
Treatment Total	80	80	80	240	80	80	80	240
<b>Lance-leaf coreopsis</b>								
October 1992	2	3	4	9	2	3	5	10
April 1993	0	4	4	8	3	6	6	15
June 1993	6	10	10	26	3	6	3	12
August 1993	10	12	10	32	12	10	8	30
Treatment Total	18	29	28	75	20	25	22	67
<b>Lyre-leaf sage</b>								
October 1992	12	10	10	32	5	4	12	21
April 1993	8	3	12	23	8	6	10	24
June 1993	12	14	14	40	6	3	3	12
August 1993	12	14	6	32	10	7	10	27
Treatment Total	44	41	42	127	29	20	35	84
<b>Virginia wildrye</b>								
October 1992	8	4	3	15	1	1	1	3
April 1993	18	10	9	37	10	2	0	12
June 1993	16	14	12	42	6	8	6	20
August 1993	18	14	10	42	18	18	20	56
Treatment Total	60	42	34	136	35	29	27	91
<b>Black-eyed Susan</b>								
October 1992	5	4	6	15	2	3	4	9
April 1993	3	4	4	11	8	2	4	14
June 1993	4	11	7	22	3	6	2	11
August 1993	8	5	7	20	5	5	4	14
Treatment Total	20	24	24	68	18	16	14	48
<b>Clasping coneflower</b>								
October 1992	2	1	0	3	1	2	1	4
April 1993	5	1	0	6	0	0	0	0
June 1993	0	1	0	1	0	2	1	3
August 1993	2	2	1	5	2	1	1	4
Treatment Total	9	5	1	15	3	5	3	11
<b>Little barley</b>								
October 1992	0	0	0	0	0	1	0	1
April 1993	5	7	1	13	3	0	1	4
June 1993	12	10	5	27	3	1	6	10
August 1993	6	6	8	20	5	8	12	25
Treatment Total	23	23	14	60	11	10	19	40

Legend: 1-4 = Poor Stand.  
5-12 = Fair-Good Stand.  
13-20 = Excellent Stand.

Table 8b. Ratings of Native Plant Stand Densities on Forest Edge (Partial Shade) Germination and Establishment Test Plots - October 4, 1995

Species/Planting Date	Natives/Cover Crops Seeded Together				Natives Overseeded into Cover Crops			
	Straw	Blanket	None	Date Total	Straw	Blanket	None	Date Total
<b>Purpletop</b>								
October 1992	12	3	6	21	4	2	4	10
April 1993	8	6	3	17	6	2	2	10
June 1993	4	4	1	9	1	2	2	5
August 1993	5	2	1	8	3	3	2	8
Treatment Total	29	15	11	55	14	9	10	33
<b>Little bluestem</b>								
October 1992	1	0	0	1	0	0	1	1
April 1993	0	0	0	0	1	1	0	2
June 1993	3	1	6	10	0	0	0	0
August 1993	2	5	3	10	0	0	0	0
Treatment Total	6	6	9	21	1	1	1	3

Legend: 1-4 = Poor Stand.  
5-12 = Fair-Good Stand.  
13-20 = Excellent Stand.

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