



TRC9802

Seedbed Evaluation Criteria

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History:

The objectives of this project were to identify, and test plant materials to use for new highway construction, and rehabilitate on existing highways. Seedbed preparation evaluations were also conducted, along with soil testing and amendments evaluated.

Responsibility:

The Natural Resources Conservation Services' (NRCS) Booneville Plant Materials Center (PMC) conducted the research. The NRCS is an agency of the United States Department of Agriculture. James R. King, Manager of the PMC, is the principal investigator.

The objectives of Phase I:

1. Establish a general seedbed evaluation criteria based on physical and chemical factors existing at the site(s).
2. Recommend grasses and/or plant species conducive to area, topography, terrain, and slope position. This recommendation shall be also based on seedbed evaluation criteria, organic matter content, soil nutrient, soil texture, soil temperature, and moisture holding capacity.
3. From the above information, proper soil amendments shall be determined.
4. Select planting and/or seeding sites were established and monitored.

Site characterizations were done in 1997, 1998, and 1999 for sites on I-540 (Mountainburg), Greenwood, Magazine, Fifth-Six, and Batesville. Soil samples were collected by PMC staff and analyzed by the University of Arkansas Soils Laboratory, Fayetteville, Arkansas. Amendments were determined and applied based on results of that analysis. Poultry litter was used in a comparison test at Batesville to determine its benefits over commercial fertilizer.

<u>SPECIES:</u>	<u>COMMON NAME</u>	<u>VARIETY*</u>	<u>RATE/ACRE**</u>
<i>tripsacum dactyloides</i>	Eastern gamagrass	'PETE'	10 lb.
<i>andropogon gerardii</i>	Big bluestem	'KAW'	5 lb.
<i>panicum virgatum L.</i>	Switchgrass	'ALAMO'	5 lb.
<i>sorghastrum nutans</i>	Indiangrass	'LOMETA'	5 lb.
<i>schizachyrium scoparium</i>	Little bluestem	'ALDOUS'	5 lb.
<i>heliopsis helianthoides</i>	Maximillian sunflower	'PRAIRIE GOLD'	3 lb.

* Seed used is commercially available from many sources.

** Seed rates based on Pure Live Seed (PLS).

Germination was established by randomly counting seedlings (per square ft.) These species were planted (seed) in a randomized complete block arrangement and replicated three times within each treatment. Treatments were as follows*:

1. Lime, fertilize, broadcast, mulch (small grain straw)
2. Lime, fertilize, broadcast, mulch (grass hay)
3. Lime, fertilize, disk, broadcast, mulch (small grain straw)
4. Lime, fertilize, disk, broadcast, mulch (grass hay)
5. Lime, fertilize, disk, broadcast, roll, mulch (small grain straw)
6. Lime, fertilize, disk, broadcast, roll, mulch (grass hay)

Treatment 1:

Germination and stand counts were nearly impossible in treatments one, three, and five since the small grain straw used as mulch contained large amounts of seed from cool-season annual grasses, such as oats and ryegrass. Germination of these annuals was excellent and has provided outstanding erosion protection on the steepest part of this site. Stand percentages were evaluated from 1998-2001 and consistently supported the use of 'Alamo' switchgrass, 'Cheyenne' indiagrass, and 'Kaw' big bluestem.

Treatment 2:

Germination in treatments two, four, and six (grass hay mulch) were obvious, since there was no cool season annual present. Germination/stand: eastern gamagrass 5%, big bluestem 80%, little bluestem 1%, Maximilian sunflower 5%, switchgrass 90%, indiagrass 80%.

Treatment 3:

(See Treatment 1)

Treatment 4:

Eastern gamagrass 10%, big bluestem 90%, little bluestem 0%, Maximilian sunflower 5%, switchgrass 95%, indiagrass 90%.

Treatment 5:

(See Treatment 1)

Treatment 6:

Eastern gamagrass 5%, big bluestem 95%, little bluestem 0%, maximillian sunflower 10% switchgrass 95%, indiagrass 95%.

Site 1 Data:

A site evaluation was conducted at the Highway 71 relocation planting in March, 1998 to determine if plants had broken dormancy and, if so, to establish stand counts. Each of the 90 grass plots was examined. There was little sign of regrowth by any of the established species. The mulch used at this site contained an unusual amount of seed (oats), which germinated in the fall of 1997. The oat plants and lack of regrowth by perennial plants made it impossible to determine stand percentages. The site was evaluated again in May to collect this data. The predominant species was 'Alamo' switchgrass with 90 to 100% stands in all replications and all treatments. 'Lometa' indiagrass followed with 75 to 90% stands in all replications and treatments. 'Kaw' big bluestem and 'Pete' eastern gamagrass were next with 60 to 70%. The 'Maximillian

perennial sunflower has stands ranging from 70 to 90 percent. 'Aldous' little bluestem was considered a failure in all replications and treatments. The overall condition of the site in May was excellent. The drought conditions of the summer caused most of the plants to go into dormancy. The fall evaluations were very difficult since there was virtually no growth during the summer and early fall months. The effect of the drought was more apparent where grass hay mulch was used (10% stand reduction). The decomposition rate of the grass hay mulch was faster than that of the small grain straw mulch. This advanced decomposition of mulch allowed more heat from sunlight to contact the soil, magnifying the effects of the drought. Evaluation of drought survival made in 1999-2001 indicated that 85-90% survived and didn't show any abnormal growth habits.

Site 2:

Site characterization was done September 8, 1997 for Site 2 (Batesville Site). Soil samples were collected by AHTD staff and analyzed by the University of Arkansas Soils Laboratory, Fayetteville, Arkansas. Amendments were determined based on results of this analysis. October 8-10, sixty plots were established on site two using the following species and treatments:

<u>SPECIES</u>	<u>COMMON NAME</u>	<u>VARIETY*</u>	<u>RATE/ACRE**</u>
<i>tripsacum dactyloides</i>	Eastern gamagrass	'PETE'	10 lb.
<i>andropogon gerardii</i>	Big bluestem	'KAW'	5 lb.
<i>panicum virgatum L.</i>	Switchgrass	'ALAMO'	5 lb.
<i>sorghastrum nutans</i>	Indiangrass	'LOMETA'	5 lb.
<i>schizachyrium scoparium</i>	Little bluestem	'ALDOUS	5 lb.
<i>heliopsis helianthoides</i>	Maximilian sunflower	'PRAIRIE GOLD'	3 lb.
<i>wheat/wheatgrass X</i>	Regreen	'REGREEN'	110 lb.
<i>dactylic glomerata L.</i>	Orchardgrass	'BOONE'	20 lb.

* Seed used is commercially available from many sources.

** Seed rates based on Pure Live Seed (PLS).

Treatments*:

1. Lime, broiler litter, disk, broadcast, roll, mulch** (grass hay)
2. Lime, commercial fertilizer, disk, broadcast, roll, mulch (grass hay)

* There were sixty total plots in this study, including all treatments and replications

** Mulch used was grass hay, 1,200 lb. round bales (5'X6'). Applied with a tractor mounted round bale mulcher at a rate of 2 tons/acre.

Site 2 Data:

Evaluation of the Batesville site was April 1998. Orchard grass stands were 80 to 90% in all replications. Switchgrass stands were 40 to 50% in all replications. Eastern gamagrass had 10% stand in replication 3, and no apparent germination in other replications. Big and little bluestem had no germination in any replications. No apparent difference in stand percentages was noted between the use of commercial fertilizer and broiler litter treatments. The evaluations in July revealed that 90% of the orchard grass had died during the drought. Some germination of the other species was noted: Eastern gamagrass 15% across replications and treatments and; big bluestem 20%. Little bluestem was a failure in all replications and treatments. The site was

evaluated in 1999-2002. All orchardgrass had died, with eastern gamagrass increasing from 15% to 25%. Indiangrass had survived well, along with switchgrass.

Site 3 Mountain View (56)

The first component (cool season perennial species) 'Hydrogel' test was planted at 56 near Mountain View October 7, 1998. The objective of this study is to evaluate the effectiveness of the gel product to eliminate the need for irrigation water application to establish the vegetation.

NOTE: Six Hours after the site was planted and mulched it received 6.25 inches of rain. Ninety five percent of the mulched slope held in excellent condition. Five percent that was damaged by the heavy rain was replanted and mulched the following day.

COMMON NAME	VARIETY*	RATE/ACRE**
Orchardgrass	Boone	30 lb.
Western wheatgrass	Rosana	20 lb.

* Seed used is commercially available from many sources

** Seed rates based on Pure Live Seed (PLS)

These cultivars were planted (seed) in a randomized complete block arrangement and replicated three times within each treatment. Treatments were as follows:

1. Broadcast, Hydrogel, mulch, fertilizer and tackifier (no irrigation water applied).
2. Broadcast, mulch, fertilizer and tackifier (irrigation water added at one inch per week for three weeks).

Site 3 Data:

The site was evaluated for germination percentages in October 1998. All plots and subplots had 90 to 100% germination. Hulan Rice (Resident Engineer, AHTD, Batesville) evaluated the plots for effectiveness of the Hydrogel vs. irrigation during the three weeks following planting, and noted slight to no difference in germination rates of the plots. The site was evaluated three times during the 1999-2002 growing seasons. The warm season component of this test was planted in 1999. The warm season component of the test is designed like the cool season with exception to the species used. During the 1999-2000 growing season it was obvious that the Hydrogel was totally ineffective. This fact became apparent, in 1999. Since the only alternative was to increase the rates of product, it was obvious we would have to cross the economic threshold. Hydrogel was dropped as an amendment in 2002.

Site 4 Texarkana

The first component (cool season perennial grasses) of the second Hydrogel test was established in Texarkana, October 8, 1998. The objective of this study was to evaluate the effectiveness of the gel product, to eliminate the need for irrigation water application, and to establish vegetation. The seeding and gel application was done on an unprepared (no-till) seedbed on a 3:1 slope.

COMMON NAME	VARIETY*	RATE/ACRE**
Reed canary grass	Common	25 lb.
Orchardgrass	Boone	30 lb.
Western wheatgrass	Rosana	20 lb.

* Seed used is commercially available from many sources

** Seed rates based on Pure Live Seed (PLS)

These cultivars were planted (seed) in a randomized complete block arrangement and replicated three times within each treatment. Treatments were as follows:

1. Broadcast, gel, fertilize.
2. Broadcast, fertilize.

Site 4 Data

The Texarkana site was evaluated for germination percentages in November 1998. Stand percentages; reed canarygrass 65%; orchardgrass 80%, and western wheatgrass 50%. The November evaluation revealed no difference in stand percentages based on gel vs. no gel treatments. It is expected that the effects of the gel treatments would not become obvious until early summer 1999. This gel study was also abandoned when no differences in establishment could be measured at the economically highest rates.

Phase II:

Phase two addresses rehabilitating problem areas along existing highway rights of way in Arkansas. The PMC staff established perennial plants in planting cones in the greenhouse during the winter of 1997-98. These plants include: sericea lespedeza, 'Alamo' switchgrass, 'Lometa' indiagrass, 'Pete' eastern gamagrass, and 'Kaw' big bluestem. They were planted (hand) during the first week of May 1998.

A 2:1 slope along Highway 71, one half mile south of the 71/10 intersection southwest of Greenwood, and a site on highway 109, south of Magazine, were identified by the AHTD as a choice for this research. Data was collected on plant persistence, drought tolerance, and ability to control erosion of the slope.

Highway 71/10 Greenwood

Plants on highway 71/10 were space planted in May, 1998 on the 2:1 slope using all of the above mentioned species. The soil conditions were so severe; a generator powered drill was used to bore planting holes in the slope. Plants were placed in a gully cross section arrangement, randomized and replicated across 10 gullies at different elevations. Initial planting survival; sericea lespedeza -90%, 'Alamo' switchgrass - 85%, 'Lometa' indiagrass - 60%, 'Pete' eastern gamagrass - 70%, and 'Kaw' big bluestem - 50%. It was impossible to determine if plants were dead or dormant during and following the summer drought. Survival data collected in the spring 1999 indicated that 'Alamo' switchgrass and some common sericea lespedeza had survived the harsh conditions of the slope. Data collected in 1999-2003 indicated that 50% of the 'Alamo' switchgrass had survived and were actually catching silt, and beginning to rehabilitate the gullies.

Highway 109 Magazine

A 100 ft. length of slope (3:1) was the site of a 'vegetative terrace' test using 'Pete' eastern gamagrass. The vegetative terraces were established vegetatively in May 1998. Eastern gamagrass plants were planted (hand) one foot apart within the rows and two feet between the rows on an unprotected 3:1 slope. Three vegetative terraces were established. The performance was outstanding during the spring and summer of 1998. Only one percent mortality. Plant diameters increased an average of 4 inches during the establishment year. Their performance in 1999-2002 was very impressive; the plants grew together within the rows in mid 2001, forming a solid wall of vegetation.

Results/Conclusions Obtained:

Seedbed preparation is very important when warm season perennial native grasses are used. The native species, for the most part require better seed to soil contact than typical introduced warm season grasses, such as bermudagrass. The more compacted the seedbed is, the better stand is achieved. Results show that compacting the seedbed before and after planting will produce the best overall stand. Based on tests carried out at AHTD construction sites, and on-Center, the following native grasses species establish the fastest and provide the best soil protection (presented in highest to lowest order):

Switchgrass ('Alamo'), planted between Feb 1, and June 15, at a rate of 4 lb. PLS/ac. has established and provided soil protection the fastest across sites, replications and treatments.

Indiangrass ("Cheyenne") planted between Feb. 1, and June 15 at a rate of 5 lb PLS/ac.

Site characterization has proven to be the largest factor in establishment of native species in disturbed areas. Plots that had nutrients adjusted (based on soil test results) for optimum plant growth, consistently yielded more dense cover and established faster with less moisture requirement. Each site will need to be characterized individually for its particular requirements.

The species tested in this contract, are all native to the southern and southeastern US. They will perform well with soil Ph of 5.5. Results of site evaluations using same species, establishment techniques, and compaction equipment, have proven the need for individual site characterization. Chemical fertilizer vs. Organic fertilizer tests proved that fertility is not the only factor in establishment. Where ideal soil fertility/pH conditions existed, the stand failed due to drought. This problem usually occurs when planting is carried out during a dry time of year. Planting dates have been established and published to avoid this situation.

Implementation/Summary Statement:

Individual site characterization is required prior to planting. **Each** site should be soil tested. Adequate amendments (according to soil test recommendations) should be applied prior to or during planting, with the exception of lime, which should be applied as far in **advance** of planting as possible. Lime should be applied prior to the first tillage operation of seedbed preparation, to incorporate it into the soil. Seedbed preparation, if physically possible, significantly increases the establishment of native warm season perennial grasses. Tillage operations should parallel the slope to minimize furrows up

and down the slope that will channel water and cause advance erosion prior to stand establishment.

The ideal seedbed will be disked until residue free, to a depth of 4-6". It will then be leveled and compacted with a heavy (concrete or water filled) roller. Drill the native grasses seed at a depth of one half inch, and then compact again with roller. Planting dates/rates should be observed. "Alamo" switchgrass (5 lb Pure Live Seed (PLS)/acre), "Kaw" big bluestem (6 lb PLS/ac), "Cheyenne" indiagrass (6 lb PLS/ac), "Aldous" little bluestem, (7 lb PLS/ac), "Pete" easterngamagrass (10 lb PLS/ac) should be planted during the following dates: January 1 thru May 15.

Highway Department vegetative specifications may be revised to reflect these criteria for more successful cover establishment that will be drought tolerant, aesthetically pleasing, easily maintained, and long lived. Significant portions of this study are immediately useable, with others needing more research. For example, seedbed preparation, site characterization, soil amendments, planting rates, planting depths, and species/cultivar selection, are all issues that are ready to be incorporated into AHTD spec. Planting dates is another issue that needs to be tested further.

Since AHTD can't guarantee completion dates that will fall into planting windows, we must open those windows wider, by identifying species/cultivars that may be planted in drier parts of the year, and/or techniques enhance establishment of tested species/cultivars. At any rate, specifications, based on this research, may now be written that will insure the best rate of success in establishing vegetation on new and existing highway construction.

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