TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM

Project Summary Report 1504-S
Project 9-1504: Comparison of Erosion Control and Engineering Properties of Turf Sod and Four Mixes of Native Grasses, Forbs and Wild Flowers

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PROJECT SUMMARY REPORT

Native Vegetation or Bermudagrass? Testing the Erosion Control and Engineering Properties of Roadside Vegetation

Over the past two decades, increased interest has surfaced around using native plants in roadside revegetation efforts rather than the more standard practice of using introduced species and exotics. Interest in using natives has evolved from a number of different practical and environmental concerns. Researchers are facing issues such as:

- the need to back–breed seed sources in order to recover pest and disease resistance,
- the collection and use of regionally native seed to achieve greater survivability, and
- concerns over the escape of introduced species like Sapium and Melaluca.

Each of these concerns represents a legitimate area of inquiry in its own right, and some research from this study and others would, on the surface, appear to argue strongly for the use of native plants for reclamation and revegetation activities like those associated with roadside stabilization.

On the other hand, there has been little systematic research focused on the benefits of using native grasses, forbs, and wildflowers rather than commercially available, introduced, or selected grasses for roadside reclamation efforts. A modest body of research has been developed related to the reclamation of forest and park road slopes, landfills, and opencast mined lands. This research has been focused on the reestablishment of stable, early successional plant communities, or concerned with the establishment of productive forage and pastureland. However, few studies compare the productivity or value of either strategy.

For these reasons, this project was initiated to look specifically at the benefits and performance of native plant materials compared to an introduced

Figure 1. TxDOT/TTI hydraulics and erosion control field laboratory

species commonly used in the erosion control mixes for the stabilization of roadsides in Texas. The research questions were:

- After roadside establishment, do the native grasses, forbs, and wildflowers reduce sediment and therefore provide erosion protection that is equal to, or better than, the erosion protection achieved by bermudagrass?

- Based on the percent of surface cover, do the native species tend to maintain themselves and resist invasion of other species?

- How do native species compare to bermudagrass in terms of soil nailing and reinforcing characteristics?

What We Did . . .

The researchers conducted this investigation at the Texas Department of Transportation (TxDOT)/Texas Transportation Institute (TTI) Hydraulics and Erosion Control Field Laboratory. This facility allowed for testing at a scale and under conditions which fairly represented the highway roadside environment. Researchers used the following procedures in the investigation.

Tests were conducted on embankment plots with 1:2 clay slopes and 3:1 sandy slopes. These soils are typical of the soils weathered in arid to semi-arid conditions of the southwestern portion of the United States.

Table 1. Sediment loss for native vegetation tests 1999 and 2000

Plot	Crop	Sediment Loss 1999* (kg per m²)	Sediment Loss 2000 (kg per m²)
S16	Bermuda only	1.214	1.158
S17	Native grasses	1.252	1.200
S18	Wildflower mix	1.547	1.660
S19	Native forbs/grasses	1.301	1.395
S20	Crownvetch	1.255	1.391
CL12	Crownvetch	0.028	0.024
CL13	Native forbs/grasses	0.035	0.031
CL14	Wildflower mix	0.040	0.038
CL15	Native grasses	0.033	0.032
CL16	Bermuda only	0.030	0.035

* Note: To be approved for use by TxDOT, vegetative cover should not lose more than 1.22 kg/m² on sand and no more than 0.034 kg/m² on clay.

Four native seed mixes were compared to control plots seeded with common bermudagrass. Seed and fertilizer were hydraulically applied to all seeded plots in accordance with standard TxDOT specifications for hydraulic mulching and seeding.

Researchers allowed the vegetation to establish in two growing seasons because of the drought conditions experienced in the summer of 1997 when the initial planting was conducted. When researchers reviewed the plots in November 1997, and again in the spring of 1998, they found the established cover so poor that testing was infeasible. As a result, the researchers extended the establishment period to a second year and conducted some plot reseeding.

After initial establishment, researchers subjected each test plot to vegetation establishment and sediment control tests used to test erosion control blankets on slopes. A rainfall simulator emulated rainfall intensities at 1.2 in/hr, 5.75 in/hr, and 7.25 in/hr. Each rainfall event was applied to the plots in two separate repetitions. After the rainfall simulation events, researchers collected and weighed the sediment.

Researchers documented vegetation density of the 1 m plots using random video/digital pictures. After the photographs were processed with proprietary software, they were used to determine the vegetation surface cover. In addition, random quadrats were analyzed for the coverage of desirable and planted species in relation to the total vegetative coverage. The detailed procedures for erosion control performance data collection appear in the procedures manual included in Appendix B of the detailed research report.

Shear strength values were based on a comparison of samples taken from the control plots. Researchers took five random 10 cm x 3 cm cores from each plot. Detailed descriptions of the testing methods are included in the final research report.

What We Found . . .

Due to the period of research and the climatic extremes experienced, researchers had difficulty making any strong conclusions based on the data shown in Table 1. It is important to note that the research was conducted on very steep slopes typical of highway and bridge embankments. This is in sharp contrast to most other research of this type. The steep slope exposes the vegetation to greater heating, and the upper parts of the slope tend to be very drought prone. However, several observations were made that should be of some benefit and will also provide a basis for continuing inquiry into the engineering properties of vegetation used in highway and public works construction.

1. Wildflower-only mixes did not prove successful. They did show some germination in the first year of planting, but this vegetation appeared to be gone by the second year of the project. A recent check of the plots however, revealed a greater persistence than was evident in 1999 and 2000.

2. Bermudagrass was very aggressive in the first few years of planting. However, where researchers originally planted native grasses and forbs, they began to gradually displace the bermudagrass. This displacement likely can be attributed to shading of the low growing invaders and the fact that mowing was being done at this time.

3. Native grasses will continue to increase if mowing is not permitted. However, stands of natives will still require some cultural management, such as mowing or burning, to maintain their vitality and prevent the invasion of woody species.

4. The erosion control properties of native grasses do not appear to be as effective as the grass mixes currently used by TxDOT. This is probably a function of their clump forming growth habit and the slow developing nature of the native species. This finding argues in favor of the practice of using nurse grasses with the native prairie species.

5. The vegetation reached at least 70 percent cover by the second year. However, the aesthetics of the natives probably would not meet expectations during some parts of the year.

6. Finally, there was no evidence that the native plant materials made a significant difference in the rate of surface erosion or contributed to any increase in tensile strength of the surface soil layer. However, in two or three years, the larger natives, such as Switchgrass and Little Bluestem, will develop more mature root systems that may indeed show some increase in soil shear strength.

The Researchers Recommend . . .

Overall, the native species mixes can be a tool in the vegetation management scheme of a transportation system. Based on the findings, natives by themselves will probably not provide the slope protection and cover achieved with the current seed mixes. It should be emphasized that the current seed mixes are composed of commercially available seed, and many of these vegetation species are considered native, or at least native selections.

When considering the application of native vegetation on the roadside, the researchers strongly suggest the consideration of the following issues:

1. Mowing practice and use of herbicides should be limited on new plantings for a period of at least 5 years, regardless of the interim appearance. After 5 years, the area of right–of–way outside the clear zone should not be mowed more than once a year and at a height of no less than 8 inches.

2. The public sense of aesthetics could be problematic in and around urban centers and limit a wider use of native grasses.

3. Stands of tall grasses can become a safety consideration with respect to limiting sight distance in curves. Likewise, tall grass inside the clear zone may be perceived as dangerous by the driving public and discourage them from pulling off the pavement in emergency conditions.

4. Because mowing should be infrequent in order to allow native grasses to reach their full potential, there is a possibility for invasion of woody species, particularly in the eastern parts of the state.

For More Details . . .

The research is documented in Report 1504-2, *Erosion Control and Engineering Properties of Native Vegetation Compared to Bermudagrass.*

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To obtain copies of the report, contact Dolores Hott, Texas Transportation Institute, Information & Technology Exchange Center, (979) 845-4853, or e-mail d-hott@tamu.edu. See our on-line catalog at http://tti.tamu.edu.

TxDOT Implementation Status August 2001

The research evaluated the performance of native grasses to current TxDOT grass mixes used in the right-of-way. The research did not indicate that native grasses would perform better than the current TxDOT grass mixtures. TxDOT will continue to use the recommendations as specified in Texas Standard Specifications (Item 164) Seeding for Erosion Control

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