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Survival of Longleaf and Loblolly Pines Planted at Two Spacings in an East Texas Bahiagrass Silvopasture

Brian P. Oswald
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, Texas 75962, boswald@sfasu.edu

Kenneth W. Farrish
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, kfarrish@sfasu.edu

Micah-John Beierle

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ABSTRACT

The practice of combining intensive timber and forage production on the same site, a silvopasture system, offers landowners the potential for diversification of income. The establishment of such a system in a pasture setting offers unique challenges compared with traditional timber or forage systems. In 2003, a silvopasture demonstration was established south of Carthage, Texas, in a pasture dominated by bahiagrass (*Paspalum notatum*). Four replications of treatments composed of open pasture, longleaf (*Pinus palustris*) and loblolly (*Pinus taeda*) pine planted at a traditional spacing, and longleaf and loblolly pine planted at a silvopasture spacing were established. Due to high mortality rates, replanting of trees occurred in 2004 and 2005. Third-year seedling survival was highest for loblolly pine in both planting systems, and forage production levels did not significantly differ among treatments. Wild hog damage contributed to the low longleaf pine seedling survival rates.

Keywords: *Pinus palustris*, *Pinus taeda*, plantations, agroforestry

Silvopasture is an intensive, multiple resource management practice that integrates forest and forage production. This integration allows landowners to have management and economic diversity across the same land unit. Livestock, timber, and even recreational opportunities may offer cash flow opportunities for an operational silvopastoral system (Harwell and Dangerfield 1991). Overall increases in financial return and economic diversity have been noted from silvopasture systems compared with either pine plantations or forage systems alone (Clason 1988, Dangerfield and Harwell 1990, Harwell and Dangerfield 1991, Lawrence and Hardesty 1992, Zinkhan 1996).

A silvopasture system may be established in either an existing plantation or, more commonly, an existing pasture (Clason 1999). The variety of options (i.e., tree spacing, tree species, and forage species) provides landowners tremendous flexibility for management. East Texas traditions of forage, livestock, and timber production and an established infrastructure of watering systems, fencing, and livestock handling facilities make the region an ideal setting for their integration. A common question is the ability of tree seedlings to successfully establish within a well-established pasture without unacceptable mortality caused by competition from the forage crop. Another common issue for those managing pastures is the impact of tree establishment on forage production. In addition, data are lacking on what forage or tree species to use, what spacing to be used, and what possible pitfalls may hinder the establishment of a silvopasture system in East Texas. The objective of this case study was to explore the establishment success of a silvopasture system in a bahiagrass pasture using loblolly pine (*Pinus taeda*) and longleaf pine (*Pinus palustris*) and two tree spacings (traditional plantation and a common silvopasture spacing).

Site Description

The study site is located south of the city of Carthage in Panola County, Texas, approximately 80 km southwest of Shreveport, Louisiana, and 241 km west of Dallas, Texas. The regional climate is classified as subtropical, permanently humid climate with mean rainfall of 112 cm and an average growing season of 240 days (USDA Natural Resources Conservation Service 2004). The site contains several soil types: Bowie fine sandy loam, Sacul fine sandy loam, Nahatche complex, Cart-Erno complex, and Wrightsville-Cart complex (USDA Natural Resources Conservation Service 2004).

Methods

In 2003, four replicates were laid out in a bahiagrass pasture. Within each replicate, 5 planting arrangements were randomly assigned: bahiagrass open pasture, no trees; longleaf pine or loblolly pine on traditional plantation spacing (2.1 × 3.7 m spacing for 1,282 trees ha^{-1}); and longleaf pine or loblolly pine on silvopasture spacing (1.8 × 9.1 m for 598 trees ha^{-1}), each within a 4.1-ha treatment block. A banded application of Arsenal (glyphosate) at 4 oz A^{-1} was applied in the fall of 2003, and the rows were ripped prior to container-grown seedlings being planted in the winter. Oust Extra (56.25% sulfometuron methyl and 15% metsulfuron methyl) at 3 oz A^{-1} was applied the following spring to further control herbaceous competition. A fertilizer application of 20-8-15 at 68 kg ha^{-1} (375 lbs A^{-1}) was applied in the summer of 2004.

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Brian P. Oswald (boswald@sfasu.edu), Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Box 6109 SFA Stn, Nacogdoches, TX 75962-6109. Kenneth W. Farrish and Micah-John Beierle, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, TX 75962-6109. *Funding was provided by USDA Natural Resources Conservation Service Agroforestry Center and McIntire-Stennis Cooperative Research Program. The authors gratefully acknowledge the access to a bahiagrass pasture provided by Sid and Kim Fowler, owners of the K-S Ranch in Carthage, Texas.*

Table 1. Mean bahiagrass dry forage production by treatment for the Carthage silvopasture study site for May 2006.

Treatment	Tons ac^{-1}	Mg ha^{-1}
Bahiagrass	0.83	2.64
Loblolly silvopasture	0.81	2.66
Longleaf silvopasture	0.77	1.91
Loblolly plantation	0.76	1.74
Longleaf plantation	0.71	1.76

Mean square error = 0.2561.

Over the next 2 years, forage production and seedlings survival were monitored. Forage production was measured by clipping 4 randomly located plots per treatment plot, oven dried, and weighed. Expansion to the per-hectare level was determined by estimating the plot area producing forage within each treatment plot and then calculating the equivalent forage production on a per-hectare basis. In the winters of 2005 and 2006, seedlings lost to mortality were replaced so that the area could also be used as a demonstration area, but overall survival numbers were recorded. A second application of Oust Extra (3 oz ac^{-1}) was applied in the spring of 2006. Hay cutting was performed multiple times each year during the period of this study. Using 2006 data for seedling survival at the end of a 2-year establishment period, analysis of variance (SAS Institute 1999) was used to determine whether significant differences in forage production and seedling survival occurred, and Tukey's Student range (honestly significant difference) test was applied when significance was found at the $\alpha = 0.05$ level.

Results and Discussion

No significant difference was found in 2006 for forage production regardless of treatment (Table 1). Although this represented a single sampling period comparison, the results were consistent with those found in earlier sampling periods. Forage production was already at a high level prior to plot establishment, and the fertilizer treatments used in this study maintained the overall capacity of the area to produce forage, even when a proportion of the area was not producing trees.

Seedling survival was significantly greater for loblolly pines than longleaf pines in both silvopasture and traditional spacing arrangements (Table 2). Negligible mortality was attributed to the hay cutting activities. Machine operators were careful to avoid rows of seedlings, which were easy to locate with the residual effect of the herbicide treatment. Herbaceous vegetation encroachment into the sprayed rows was minimal, so little mortality can be attributed to herbaceous competition. A majority of the mortality was attributed to wild hog (*Sus scrofa*) activity. Hogs came from adjacent forested landownership, much of which is low-lying hardwood-pine mix, a perfect habitat for wild hogs. The hogs did not appear to eat many of the longleaf pine seedling root systems. Mortality was caused instead by the longleaf pine seedlings in the grass stage being buried when the hogs burrowed along the rows where herbicide had been applied. The herbicide may have actually made it easier for the hogs to root within the rows, since the dead herbaceous vegetation was not producing viable, growing roots. The decaying roots may also have been a better habitat for grubs, although this was not documented in this study. For whatever reason, the majority of the hogs' rooting activity was along and within these areas, burying the longleaf seedlings, causing mortality. Although rooting activity was also recorded in loblolly pine rows, the height of the seedlings limited burial- caused mortality.

Table 2. Percentage of seedling survival after replanting in 2004 and 2005 for the Carthage silvopasture study site sampled in May 2006.

	Silvopasture		Plantation	
	Loblolly	Longleaf	Loblolly	Longleaf
Mean	94.9%(A)	56.1%(B)	89.9%(A)	45.3%(B)

Percentages in a row with same letter are nonsignificantly different at the $\alpha = 0.05$ level. Mean square error = 120.8430.

Conclusions

It does appear that a silvopasture system in a bahiagrass pasture is possible in East Texas when using loblolly pine. Forage production in the form of hay and good seedling survival can occur, with fiber production and grazing occurring on the same site. The use of longleaf pine appears to be more problematic. Although there does not appear to be any difference in the ability of longleaf pine and loblolly pine seedlings to establish based on factors that influence seedling establishment, there is a greater risk in losing a large portion of planted seedlings to indirect hog damage through burial of the seedlings. On the basis of these results, it is recommended that anyone considering a silvopasture management option for East Texas pastures should use loblolly pine containerized seedlings or be prepared for active hog control.

Literature Cited

CLASON, T.R. 1988. *Economic potential of planted pines in pastures.* Louisiana Agric. Exp. Stn. 88-80-2196.

CLASON, T.R. 1999. Silvopastoral practices sustain timber and forage production in commercial loblolly pine plantations of northwest Louisiana, USA. *Agrofor. Syst.* 44:293–303.

DANGERFIELD, C.W., AND R.L. HARWELL. 1990. An analysis of a silvopasture system for the marginal land in the Southeast United States. *Agrofor. Syst.* 10:187–197.

HARWELL, R.C., AND C.W. DANGERFIELD, JR. 1991. Multiple use on marginal land: A case for cattle and loblolly pine. *For. Chron.* 67(3):249–253.

LAWRENCE, J.H., AND L.H. HARDESTY. 1992. Mapping the territory: Agroforestry awareness among Washington State land managers. *Agrofor. Syst.* 19:27–36.

SAS INSTITUTE. 1999. *SAS/STAT users guide, version 8.* SAS Institute, Inc., Cary, NC. 3884 p.

USDA NATURAL RESOURCES CONSERVATION SERVICE. 2004. *Official soil series descriptions.* Available online at soils.usda.gov/technical/classification/osd/index.html; last accessed Oct. 17, 2007.

ZINKHAN, F.C. 1996. Public land-use professionals' perceptions of agroforestry applications in the South. *South. J. Appl. For.* 20:162–168.