EFFECTS OF SPRING VERSUS FALL SOWING OF LONGLEAF PINE SEEDS IN THE NURSERY ON FIELD PERFORMANCE'

Chuck Fore[2] and James P. Barnett[3]

ABSTRACT-Despite advances in the production and planting of bare-root longleaf pine seedlings, problems continue to persist with first-year survival. Survival surveys conducted in 1988 and 1989 by the Georgia Forestry Commission showed survival rates of 35 and 47 percent, respectively, for longleaf pine seedlings planted in those years. In this paper, we look at the influence of season of seed sowing in the nursery on seedling survival in the field. In March and December of 1995, five sites were planted with bare-root longleaf pine seedlings, which were grown from fall- and spring-sown seed. Seedlings planted in March 1995 grown from spring-sown seeds had an average survival of 71 percent compared to 51 percent for seedlings grown from fall-sown seeds. Seedlings in the December 1995 planting grown from spring-sown seeds averaged 88 percent survival compared to 54 percent for seedlings from fall sowing. These results suggest that spring sowing of seeds in the nursery may improve field survival of longleaf pine seedlings over those sown in the fall.

INTRODUCTION

Prior to European settlement and until the early part of this century, longleaf pine (*Pinus palustris* Mill.) was the most prevalent yellow pine species in the southern Coastal Plain. Since then, large tracts of longleaf pine have been cut with very little replacement. Much of the longleaf acreage has been converted to slash and loblolly pine plantations due to the difficulty in regenerating longleaf pine (Landers and others 1995). The two major reasons why industrial companies and nonindustrial private landowners have favored other species over longleaf pine are the higher initial survival rates and the resulting lower establishment costs of the other species.

In recent years, there has been a renewed interest in planting of longleaf pine. However, adequate seedling survival is still problematic with longleaf pine. Survival has improved with the use of container-growing stock, but the cost of container longleaf seedlings is at least double that of bare-root stock (Barnett and McGilvray 1997). Survival surveys conducted by the Georgia Forestry Commission (GFC) for their seedlings in the late 1980's demonstrate significant differences in seedling survival between bare-root longleaf pine planting stock and that of other southern pine species (tables 1 and 2).

Even with improvements in longleaf pine seedling handling and planting methods (Barnett and Dennington 1992), survival of bare-root seedlings continues to be marginal or highly variable. One factor, which may contribute to lower survival rates for bare-root planting stock, is the season in which the seed is sown in the nursery. All or nearly all tree

Table 1—GFC Statewide seedling survival survey-l 988

Pine species	Seedlings shipped	Orders sampled	Seedlings sampled	Percent sampled	Percent survival
Improved lob.	89,664,746	210	7,964,670	8.9	73.8
Liv. parish lob.	16,645,150	29	1,243,000	7.5	68.6
Improved slash	61,774,713	163	6347,725	10.3	75.2
High gum slash	1,185,000	1	370,000	31.2	61.7
Longleaf	2,051,820	13	199,000	9.7	34.6

Table 2—GFC Statewide seedling survey-1989

Pine species	Seedlings shipped	Orders sampled	Seedlings sampled	Percent sampled	Percent survival
Improved lob.	48,080,386	122	4,209,536	8.8	79.8
Liv. parish lob.	3,336,100	12	299,000	9.0	77.6
Improved slash	69,707,960	200	5482,835	7.9	77.4
High gum slash	3,000,000	2	105,000	3.5	93.9
Longleaf	2,500,000	4	85,000	3.4	46.8

'Fore, C.; Barnett, J.P. 1999. Effects of spring versus fall sowing of longleaf pine seeds in the nursery on field performance. In: Landis, T.D.; Barnett, J.P., tech. coords. National proceedings: forest and conservation nursery associations-1998. Gen. Tech. Rep. SRS-25. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 47-49.

[2]Georgia Forestry Commission, McRae District Office, Rt. 1, 80x 67, Helena, GA 31037; TEL: 423/263-1626.
[3]USDA Forest Service, Southern Research Station, 2500 Shreveport Hwy., Pineville, LA 71360; TEL: 318/473-7216.

nurseries which produce bare-root longleaf planting stock sow the seeds in the fall. Fall sowing is based on the fact that longleaf seeds normally germinate in the fall immediately after seed fall. Also, fall sowing allows seedlings more time to attain a desired size before lifting (Huberman 1938, Shipman 1958). Numerous studies have shown that larger seedlings (root-collar diameters) perform better than smaller ones in the field (White 1981).

A case study, which is summarized in this paper, seeks to determine if the season of sowing of longleaf pine seeds in the nursery affects the survival rate of longleaf seedlings after outplanting.

METHODS

Longleaf pine seedlings from fall- and spring-sown seeds were planted on four sites in Dodge County, GA, and one site in Wheeler County, GA. The seed source was open pollinated or wild seed from southern Georgia and northern Florida. Seedlings produced from fall sowing were sown in November 1993 and 1994 at the GFC's Walker Nursery. Seedlings produced from spring sowing were sown in April of 1994 and 1995 at the same nursery. Seedlings grown from 1994 spring-sown seed came from a nursery bed that had been replanted due to a previous germination failure. This particular bed was fertilized and watered in an attempt to bring the seedlings up to an acceptable size to be sold the following winter. The seedlings produced from the spring sowing in 1995 were grown in a bed with loblolly pine and received the same cultural practices. The second spring sowing had a few problems with germination because of mulching problems. However, enough seeds germinated to supply the trees needed for the test plots.

Two sites were planted in March of 1995 and three sites were planted in December of 1995. In each planting season, both types of seedlings were lifted and planted at the same time. All seedlings were graded to meet a 1/2-inch minimum root-collar diameter prior to packing. Seedlings were planted within 8 days of lifting. At each site, half of the area was planted in fall-sown and half in spring-sown production. Each study area encompassed about 1.5 to 2.5 acres. In the spring following planting, the pines were sprayed with a herbicide in a 4-foot wide band over the top to control weed competition. Weeds included field broadleaf weeds along with Bermuda and Bahia grasses. The March 1995 plantings were sprayed with 24 ounces per acre of Velpar-L® in April 1995. The December 1995 plantings were sprayed with 24 ounces per acre of Velpar-L® and 1 ounce per acre of Oust® in May 1996. One site was a Bermuda grass pasture, which had been harvested for hay previously. That particular field was scalped prior to planting in addition to herbicide application to control grass competition (Shoulders 1958). However, half of the seedlings from the spring-sown treatment were planted in unscalped areas due to not properly anticipating the acreage needed for this particular site.

RESULTS AND DISCUSSION

In April 1996, a survival check was conducted on the first two sites, which were planted in March 1995. At each location, five l/50-acre plots were installed and measured for the spring- and fall-sowing treatments. On each plot, the total dead and live seedlings were counted. Table 3 shows the results for these plantings. The results from these two sites show a 39-percent improvement in field survival resulting from spring sowing in the nursery.

In March 1996, twenty-five l/50-acre plots were established on the remaining three sites, which were planted in December 1995. Plot centers were marked with flagging tape. The plots were established to determine the initial planting rate for seedlings from the two nursery treatments. These plots were measured in the fall to determine seedling survival. On two sites, nine plots were established and on one site, only seven plots were established. On one site, five of the plots could not be found during the fall due to the heavy grass development. However, since all plots were mapped when they were originally established, the survival checks were very close to the original plot centers. Table 4 presents the results from the December 1995 plantings.

The results of the December 1995 plantings show a 26-percent better survival rate of seedlings from spring-sowing over fall-sowing treatments. However, the Stuckey Tract showed comparable survival rates from fall- and spring-sown seeds. This is likely due to half of the seedlings from the spring-sown treatment being planted in heavy Bermuda grass which had not been scalped.

These test plots indicate that survival of bare-root longleaf pine seedlings may be improved by sowing the seeds in the nursery in the spring rather than the fall. Differences in survival may be due to differences in the physical characteristics of the seedlings produced in the two growing environments. From personal observations, the seedlings

Table 3-Field survival measurements for the March 1995 plantings

Site location	Season of sowing	Trees planted	Surviving trees	Survival
		Per acre	Per acre	Percent
Dodge County	Fall	750	420	56
Fordham Tract	Spring	680	500	74
Wheeler County	Fall	650	300	46
Johnson Tract	Spring	650	450	69
Weighted average	Fall	700	360	51
All plots	Spring	665	475	71

Table 4-Field survival measurements for the December 1995 plantings

Site location	Season of sowing	Trees planted	Surviving trees	Survival
		Per acre	Per acre	Percent
Dodge County Stuckey Tract	Fall	620	400	65
	Spring	788	538	68
Dodge County Coffee Tract	Fall	763	363	48
	Spring	800	550	69
Dodge County O'Conner Tract	Fall	813	400	49
	Spring	710	480	68
Weighted average All plots	Fall	723	388	54
	Spring	758	516	68

from the spring-sown seeds had noticeable physical differences (other than size, since comparable seedling grades were planted) from seedlings from the fall-sown seeds. Seedlings grown in the spring had shorter needles at lifting than those grown through the fall and winter. Earlier studies have shown that reduced needle length, and therefore, smaller transpirational surface area may result in improved seedling survival on adverse sites (Allen 1955, Allen and Maki 1951). Thus, shorter needles may result in less demand for water from stressed root systems.

Also, the spring-sown seedlings tended to have more lateral roots and these developed further down the taproot than fall-sown ones. Results from studies on the effect of soil temperature on root development of longleaf pine seedlings indicate that numbers of roots increase as soil warms from 55 to 74 °F. (Sword 1996). It may be, then, that because the soil temperature warms faster in the spring, this will favor the development of a more fibrous root system and would be advantageous to seedlings when outplanted onto adverse sites.

CONCLUSIONS

The results of this study indicate that spring sowing of longleaf pine seeds in the nursery should be further investigated as an alternative to fall sowing. Fall sowing is justified based on development of larger seedlings that will survive and grow better upon outplanting. However, there are some other data that indicate that seedlings from spring-sowings perform better than those sown in the fall if lifting is delayed until late in the season (Barnett 1991). The key to understanding these interacting responses is production of seedlings of equal size regardless of whether seeds are fall or spring sown. Quality longleaf pine seedlings can be produced from seeds sown in the spring, if appropriate seedbed densities and cultural practices are used. The possible improvement of field survival by 26 to 39 percent by shifting from fall to spring sowing should not be ignored.

REFERENCES

Allen, R.M. 1955. Foliage treatments improve survival of longleaf pine plantings. Journal of Forestry. 53: 724-727.

Allen, R.M.; Maki, T.E. 1951. Foliage treatments reduce early mortality of longleaf pine planted on adverse sites. Journal of Forestry. 49: 115.

Bamett, **J.P.** 1991. Seedbed densities and sowing and lifting dates affect nursery development and field survival of longleaf pine seedlings. Tree Planters' Notes. 42: 28-31.

Barnett, J.P.; Dennington, R.W. 1992. Return to longleaf. Forest Farmer. 52: 1 l-1 2.

Barnett, J.P.; McGilvray, J.M. 1997. Practical guidelines for producing longieaf pine seedlings in containers. Gen. Tech. Rep. SRS-14. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 28 p.

Huberman, M.A. 1938. Growing nursery stock of southern pines. USDA Leaflet 155. Washington, DC: U.S. Department of Agriculture. 8 p.

Landers, J.L.; Van Lear, D.H.; Boyer, W.D. 1995. The longleaf forests of the Southeast: requiem or renaissance? Journal of Forestry. 93: 39-44.

Shipman, R.D. 1958. Planting pine in the Carolina sandhills. Paper 96. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 43 p.

Shoulders, E. 1958. Scalping-a practical method of increasing plantation survival. Forest Farmer. **17(10):** 1 O-1 1.

Sword, **M.A.** 1996. Root-zone temperature and water availability affect early root growth of planted longleaf pine. In: Edwards, J.B., ed. Proceedings of the 8th biennial southern silvicultural research conference. Gen. Tech. Rep. SRS-1. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 373-353.

White, J.B. 1981. The influence of seedling size and length of storage on longleaf pine survival. Tree Planters' Notes. **32(4):** 3-4.