

First-Year Survival of Morphologically Graded Loblolly Pine Seedlings in Central Louisiana

Charles R. Venator

Research Plant Physiologist, USDA Forest Service,
Southern Forest Experiment Station, Pineville, La.

Morphological grades have definite correlations with loblolly pine seedling survival potentials. Such grades are especially important when droughts occur in the first growing season. At such times intermediate-sized seedlings survive drought stress better than larger or smaller seedlings.

For more than 50 years, nursery personnel have recognized that grading southern pine seedlings can improve regeneration success. Seedlings generally are graded for such morphological characteristics as height, root collar diameter, presence of secondary needles, needle length, woodiness of stem, presence of bark on the stem, and terminal bud condition. A description of morphological grades for uninjured 1-year-old southern pine seedlings is given by Wakeley (7), and these grade classes are widely used throughout the South.

In the past decade, many nursery workers have stopped grading seedlings to reduce operating expenses. This practice is questionable because, during the same period, several reports have indicated that grades 1 and 2 loblolly and slash pine seedlings outgrew grade 3 when fieldplanted (8, 3, 4). In Queensland, Australia, Bacon and others (1) distinguished eight morphological grades of slash pine seedlings. Six of these

eight grades had statistically better survival and growth rates than the two inferior seedling grades. Although there is little disagreement that larger seedlings grow faster than smaller seedlings, there is varying evidence that larger seedlings survive better than smaller seedlings, as was pointed out by Wakeley (8). In a review paper, Sutton (6) discussed the relative merits of planting-stock quality and grading and how this affected seedling survival. He emphasized that morphological grade alone is not a reliable indicator of the capacity of seedlings to survive. He reviewed the impact of several physiological conditions such as mineral nutrition status, hormonal levels, and cold hardiness, but no conclusions were made. He concluded that much work remains to describe the physiological characteristics of high-quality seedlings and the impact of such characteristics on seedling survival.

The survival of morphologically graded loblolly pine seedlings is discussed in this report. These data were collected from a study designed to test the effect of seedling grade on survival and long-term growth. Shortly after planting, a severe, prolonged drought struck central Louisiana. Consequently, data reported here reflect the ability of the various grades to survive drought conditions.

Materials and Methods

In January 1980, seedlings that conformed to three different grade classes were selected from tubs at the Forest Service W. W. Ashe Nursery in Mississippi. Root collar diameters were greater than 7/32 inch for grade 1 seedlings, from 4/32 to 6/32 inch for grade 2 seedlings, and from 2/32 to 3/32 inch for grade 3 seedlings. The seedlings used in this study were grown at a seedbed density of about 27 per square foot. Except for the slightly larger root collar diameters, all other morphological characteristics described by Wakeley (7) were followed.

After grading, the seedlings were packed in polyethylene-lined kraft paper bags and stored at 34° F for 30 days. They were planted in February 1980 in six random blocks. Each block had 121 seedling plots of grade 1, grade 3, a mix of grades 1 and 2, and a balanced mix of all three grades planted at an 8- by 8-foot spacing.

In an effort to achieve adequate stocking for the long-term volume production part of this study, two seedlings were planted 6 inches apart. Because of the statistical design selected (to measure competition between plots and within plots having mixed seedling grades), there were 1,861 grade 1, 1,686 grade 2, and 2,712 grade 3 seedlings planted. The seedlings were handplanted on a sandy loam site that had been bushhogged

and burned the previous fall. Survival was determined in late October 1980.

Results and Discussion

A count showed that only 50.2 percent of the grade 1 seedlings survived, while 65.9 percent of the grade 2 seedlings survived (table 1). Intermediate in survival to these two grades were the grade 3 seedlings, of which 53.8 percent survived.

Seedling survival apparently was influenced to a large extent by the severe drought that began in early spring of 1980 and extended to midsummer. The drought undoubtedly reduced seedling survival in this specific study since some nearby 3-year-old plantations were so severely affected that they had to be replanted. Table 2 illustrates the severity of the 1980 drought. For May through August, total rainfall was 3.02 inches versus a 16-year average of 18.24 inches. Total rainfall for May through September was 4.99 inches versus an average of 22.05 inches. Thus, total rainfall for the 4-month period was 16.6 percent of the expected amount and for they-month period only 22.6 percent of normal. For 1980, rainfall was only 65 percent of the 16-year rainfall average. As a result of this low survival, the long-term objective of this study was cancelled since adequate and uniform stocking was not obtained for any of the three grades.

Table 1.—Percentage of surviving seedlings separated into morphological grades 1, 2, and 3¹

Morphological class	Alive	Total planted	Percentage alive
Grade 1	934	1,861	50.2 ± 24.86b ²
Grade 2	1,111	1,686	65.9 ± 14.49a
Grade 3	1,459	2,712	53.8± 11.93b

¹ Seedlings were outplanted in February 1980, and survival was measured in October 1980.

²Data sets followed by different letters are statistically different at the P - 0.05 level.

Table 2.—Rainfall data for the J. K. Johnson Tract of the Palustris Experimental Station in central Louisiana

Month	Average monthly rainfall	
	1952-1978	1980
	----- ln -----	
January	5.20	6.13
February	4.55	3.85
March	4.90	6.76
April	5.74	5.54
May	5.35	.12
June	3.68	.51
July	5.09	1.51
August	4.12	.88
September	3.81	1.97
October	3.18	4.50
November	5.01	3.78
December	7.12	1.80
Total	57.75	37.35

The Student-Newman-Keuls multiple comparison of means test showed that the mean survival of the grade 2 seedlings was statistically different than grades 1 and 3 at the 5-percent level of probability (table 2). However, because of the drought, none of the three morphological classes of loblolly seedlings had a survival rate close

to the 450 trees per acre that is accepted as normal for operational success.

This study indicates that grade 2 seedlings do have a survival potential edge over the other grades and will survive better in a severe droughty period during the first growing season. Bengtson (2) reported similar results from a 1954 study with slash pine where he compared "super" nursery seedlings with average-sized seedlings. The select seedlings grew faster over an 8-year period, but had about 50-percent greater mortality than the average-size seedlings. He also reported that the first growing season was extremely dry and concluded that this had a negative impact on the ability of larger slash pine seedlings to survive.

Bacon (1) also studied slash pine morphological differences and their effects on seedling survival. He concluded that taller seedlings had higher outplanting mortality. Higher survival was better correlated to larger root collar diameter and to a dormant bud at the time of planting.

Sluder (5) analyzed the interaction between seed size and seedling size on height and survival of loblolly pine. He determined that seed size had no effect on survival at age 3, but seedling size did. The study showed that, at the 10-percent level of statistical significance, select seedlings survived better than average-size seedlings. He did not, however, define the seedling morphological parameters other than "average" and "select."

Given the frequent occurrence of drought in the South, it may be important to put more emphasis on the grading process. Over the past 15 years, seedling grading has

been largely disregarded by most nursery managers. The results of this study indicate that the benefits of grading may only be recognized during times of stress. This may indicate that a generalized balance between top and root system does exist and is manifest during stress.

Existing evidence points toward increased long-term growth and yield of grade 1 seedlings over other grades. However, the results of this study indicate that it may be necessary to modify this by planting grade 1 only in wet sites or at a closer spacing since these appear to be more sensitive to drought than grade 2 seedlings.

Literature Cited

1. Bacon, G. J.; Hawkins, P. J.; Jermyn, D. Morphological grading studies with 1-0 slash pine seedlings. *Australian For.* 40(4): 293-303; 1977.
2. Bengston, George W. Slash pine selected from nurserybeds: 8-year performance record. *J. For.* 61: 422-425; 1963.
3. Blair, Roger; Cech, Franklin. Morphological seedling grades compared after thirteen growing seasons. *Tree Plant. Notes.* 25(1): 5-7; 1974.
3. Burns, Russell M.; Brendemuehl, R. H. Nursery bed density affects slash pine seedling grade and grade indicates field performance. *Res. Pap. SE-77.* Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1971. 7 p.
4. Sluder, Earl R. The effects of seed and seedling size on survival and growth of loblolly pine. *Tree Plant. Notes.* 30(3): 25-28; 1979.
5. Sutton, Roy F. Planting stock quality and grading. *For. Ecol. and Manage.* 2:123-132; 1979.
6. Wakeley, Philip C. Planting the southern pines. *Agric. Monogr.* 18, Washington, DC: U.S. Department of Agriculture; 1954. 233 p.
7. Wakeley, Philip C. Results of southern pine planting experiments established in the middle twenties. *J. For.* 67: 237-241; 1969.