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Survival and Growth of Graded Longleaf Pine Nursery Stock

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THE CAROLINA-GEORGIA sandhills are among the most difficult planting sites in the South. Poor survival has characterized most plantings of the native longleaf pine (*Pinus palustris*). However, a study by the Southeastern Forest Experiment Station shows that successful establishment and growth of planted longleaf pine may depend largely on size and form of seedlings used. In the absence of other criteria, it appears that morphological grade can be used by nurserymen and planters for evaluating drought hardiness and vigor of longleaf pine planting stock.

Morphological grades tested in this study were developed by Wakeley as follows (*5*) (Fig. 1):

Grade 1—Top 12 to 16 inches high; stem ¼ to ½ inch at ground line; needles abundant, almost all in 2's and 3's; winter buds present.

Grade 2—Top 8 to 15 inches high; stem at least 3/16 inch at ground line; needles moderately abundant, at least part in 2's and 3's; buds with scales usually lacking.

The experiment was installed early in 1953 at the Atomic Energy Commission's Savannah River Project near Aiken, S. C. Plot locations were level old fields abandoned about six years and occupied by a cover of annual weeds, broomsedge (*Andropogon* spp.) and wiregrass (*Aristida stricta*). Six 1/5-acre plots were established, three on sandy loams and three on deep sand. Each plot contained eight randomized subplots, four planted in January and four planted in March. These were equally divided by seedling grades and seedling treatment (needles clipped to 5 inches and needles unclipped). Thus, each subplot contained 50 trees, totalling 2,400 for the experiment. All were hand-planted at a 4 by 4 foot spacing. The 1-0 planting stock was grown at the Stuart Nursery in Louisiana

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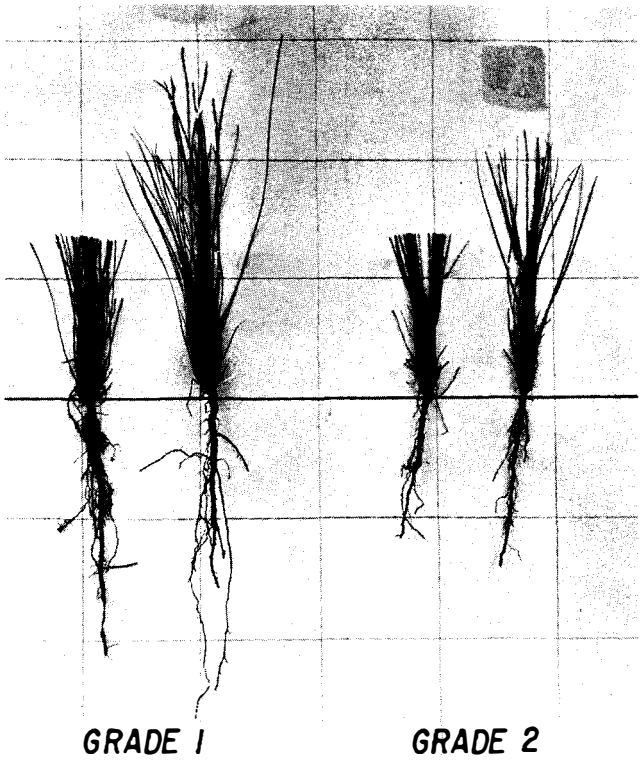

Left

FIG. 1.—Longleaf pine planting stock, morphological grades 1 and 2. One-half of each grade was foliage-clipped to 5 inches in length. Horizontal and vertical lines are 4 inches apart.

Right

FIG. 2.—Survival of planted 1-0 longleaf pine by morphological grade and soil type.

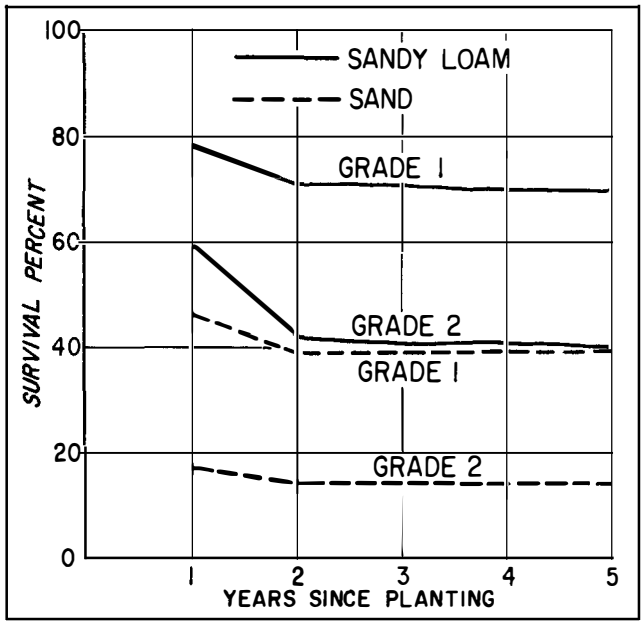

TABLE 1.—AVERAGE SECOND-YEAR SURVIVAL OF PLANTED LONGLEAF PINE, ACCORDING TO SEEDLING GRADES, SOIL TYPE, AND SEASON OF PLANTING

Seedling grade	Soil type	Survival	
		Winter-planted	Spring-planted
1	Sandy loam[1]	76	66
	Sand[2]	40	38
2	Sandy loam	58	27
	Sand	18	10

[1]18 inches or less to clay layer.
[2]36 inches or more to clay layer.

TABLE 2.—EFFECT OF SEEDLING GRADES ON THE 5-YEAR HEIGHT GROWTH OF PLANTED LONGLEAF PINE

Height in feet	Total surviving trees	
	Grade 1	Grade 2
	Percent	
0.0- 0.9	7.2	8.2
1.0- 3.9	17.3	28.5
4.0- 6.9	35.5	47.8
7.0- 9.9	33.6	14.8
10.0-12.9	6.4	.7

from seed collected near the planting sites.

Rain gages and soil thermometers were placed at each plot location. Also, at approximately three-week intervals, soil moisture measurements were taken at 2- and 6-inch depths on each plot throughout the growing season. Although the average rainfall is 45 inches a year, a rain-free interval of three to four weeks may occur at any time during the critical growing season months of May, June, and July. In 1953, the local climatic record showed a scant .06 inch of rain between May 8 and June 6. During this same period, the lowest soil moisture levels, and highest soil temperatures of the season occurred. In May, surface soil temperatures on deep sands rose to 145° F., while moisture levels were as low as 1 percent. These conditions put all grades of planting stock to a severe test during the early part of the first growing season. Climate during the second growing season after planting was equally difficult on seedling survival. In fact, the growing season of 1954 was the hottest on record.

Seedling Survival

Top-grade longleaf pine seedlings proved most capable of withstanding the full impact of these climatic extremes. This is borne out by the survival at the end of the second growing season which, for grade 1 seedlings, was significantly better[1] than that of grade 2 seedlings grown under similar conditions of soil and planting season (Table 1).

Season of planting had only a small effect on the survival of grade 1 seedlings, the results from spring planting being only slightly poorer than those of winter. In contrast, spring-planted grade 2 seedlings had a significantly[2] poorer survival than similar seedlings planted in the winter. Apparently these smaller seedlings lacked the necessary vigor to become established during the short interval between March and the advent of the hot, dry early growing season of the first year.

[1]At 1 percent level of probability.
[2]At 5 percent level of probability.

On similar soils, grade 1 seedlings survived consistently better than grade 2. However, grade 2 seedlings planted on sandy loam survived somewhat better than grade 1 stock on sand. In this case the factors associated with a better site outweighed any advantages of seedling morphology on the poorer site.

Regardless of seedling grade, very little mortality occurred from the second through the fifth growing season and the early survival advantages of the better grade seedlings were maintained (Fig. 2).

Clipping the foliage to 5 inches in length had little or no effect on over-all survival. For reasons unknown, any benefit from foliage clipping showed up on winter-planted stock, while adverse effects were noted on spring plantings. However, other studies indicate that clipping the foliage to 1/3 the natural length is beneficial (*1*), pointing to the need for additional study of foliage clipping at least in this locality.

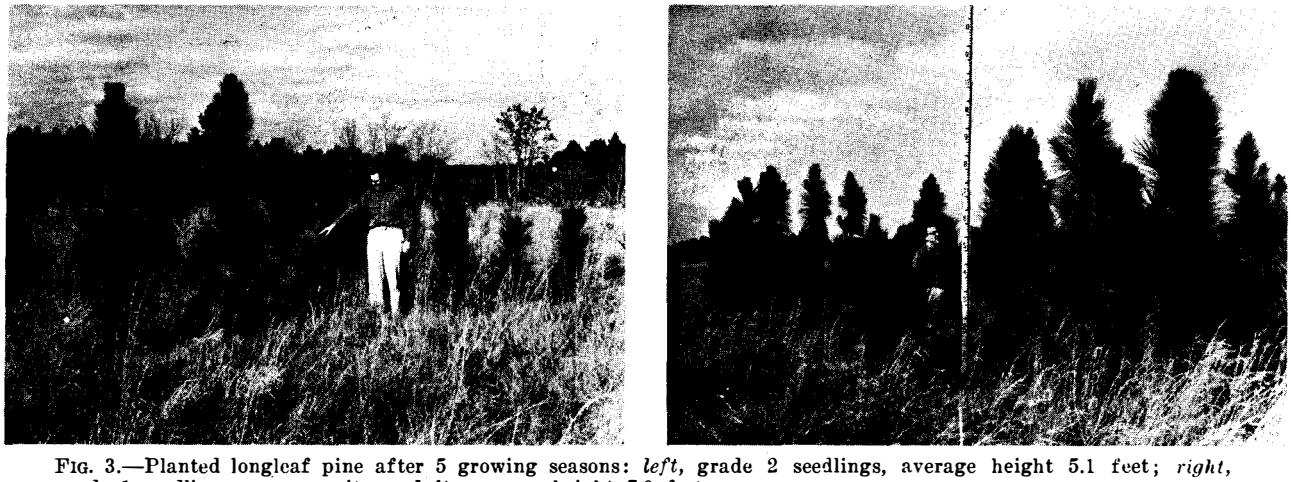

FIG. 3.—Planted longleaf pine after 5 growing seasons: *left*, grade 2 seedlings, average height 5.1 feet; *right*, grade 1 seedlings on same site as *left*, average height 7.0 feet.

The best survival of longleaf pine in the Carolina-Georgia sandhills results from planting grade 1 seedlings on either sands or sandy loam soils of the Sandhill Region regardless of planting date in the dormant season. The most effective use of longleaf pine planting stock—assuming one has a choice—is to plant either grade of seedling on sandy loam soils in mid-dormant season. In the case of grade 2 seedlings, this appears to be a must, because planting on deep sand or late in the season invites heavy seedling losses.

Seedling Growth

The acid test for planted longleaf pine is to have most seedlings making height growth. The trees generally remain in the grass stage until the stems reach a diameter of approximately 1 inch at the ground line. Small seedlings may remain in the grass for many years, particularly where there is severe competition. Planting large seedlings should shorten the period considerably.

On the average, grade 1 seedlings maintained a 1.9-foot height advantage over the smaller grade 2 stock (Table 2 and Fig. 3). At the end of 5 growing seasons, 40 percent of the grade 1 trees were 7 feet tall or better; only 16 percent of grade 2 seedlings could meet these standards. The maximum height obtained for grade 1 was 12.8 feet and 10.4 feet for grade 2. It is too early to tell whether this initial height growth advantage of the better morphological grade will continue.

Discussion and Summary

Similar marked differences in survival and growth attributed to seedling grades have been reported by at least several workers. Hough (*3*) found that larger seedlings not only grew faster initially, but after 10 years had increased their growth rate over smaller stock. In the Lake States, Rudolph (*4*), working with red pine, showed that first-year survival was poorer with small stock. Doyle and Olson (*2*) indicate that grading yellow-poplar seedlings before planting can make the difference between success and failure of establishment in the Piedmont Region. All of this suggests that the true economic basis for successful plantation establishment begins in the nursery —the development of highest quality seedlings that will survive and grow when outplanted.

Currently, researchers are attempting to establish techniques for developing non-visible physiological characteristics which will result in more drought-hardy stock (*6*). However, until this is accomplished, stem size and general appearance (morphological grade) of longleaf pine appear to be highly useful ocular guides for planting on dry sandhill areas.

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