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Deep-Planting Small Slash Pine on Old Field Sites in the Carolina Sandhills

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Abstract. This study was established to investigate the effect of deep-planting on survival and growth of small slash pine seedlings. It is located on furrowed old fields in the Savannah River Project near Aiken, S. C. Seedlings were graded on size and root development, and planted at three depths: to the bud, halfway between root collar and bud, and at standard nursery depth. Each treatment was replicated three times on three surface soil types, sand, sandy loam, and loamy sand. In all cases deep-planting improved fifth-year survival, planting to the bud was best, and planting halfway between root collar and bud was better than standard planting. The best five-year height growth was obtained by planting halfway between root collar and the bud. Large seedlings had over-all better survival and height growth than smaller seedlings, but grade of stock caused no significant difference in survival when seedlings were planted to the bud.

ON the typically difficult sites of the Carolina Sandhills—coarse, deep sands subject to high temperatures and drought—better survival is usually obtained by planting large seedlings (*3*). In some years, or in certain lots of nursery stock small seedlings prevail; at such times the planter has no choice except to use the little trees on hand. Obviously, guidelines are needed for the best use of these small seedlings. With this in mind, Shipman and Hatcher found that first-year survival improved with the depth of planting of small slash pine seedlings in old fields (*4*). This paper summarizes the fifth-year results of that study.

Past work of others indicates that results from planting seedlings deep depend on site and species. Switzer reported that deep-planting can seriously reduce survival and height growth of loblolly pine on poorly drained silt and clay (*7*). Similarly, Kashi found that deep-planting loblolly in a wet year on a Cahaba fine sandy loam reduced survival but slightly increased height (*1*). Slocum noted that deep-planting loblolly in the North Carolina Piedmont did not affect survival but increased height growth (*5*). Reporting on later work, Slocum and Maki found again that survival of loblolly was not affected but height growth increased (*6*). In support of Shipman and Hatcher's work, Malac and Johnson found that deep-planted slash have a higher survival than normal plantings in an old field (*2*).

In the study reported here, morphological grade 3 seedlings, as defined by Wakeley (*8*), were divided into four subgrades, based on stem length, stem diameter, and root formation; grade 2 seedlings were used as a check (Fig. 1 and Table 1). These seedlings were outplanted near Aiken, S. C., on furrowed old fields at three depths, to the bud, halfway between bud and root collar, and at standard depth. The fifteen treatments were replicated three times on three soil types, sand, sandy loam, and loamy sand. All sites were furrowed three inches deep with a Sieco disk plow 75 days prior to planting.

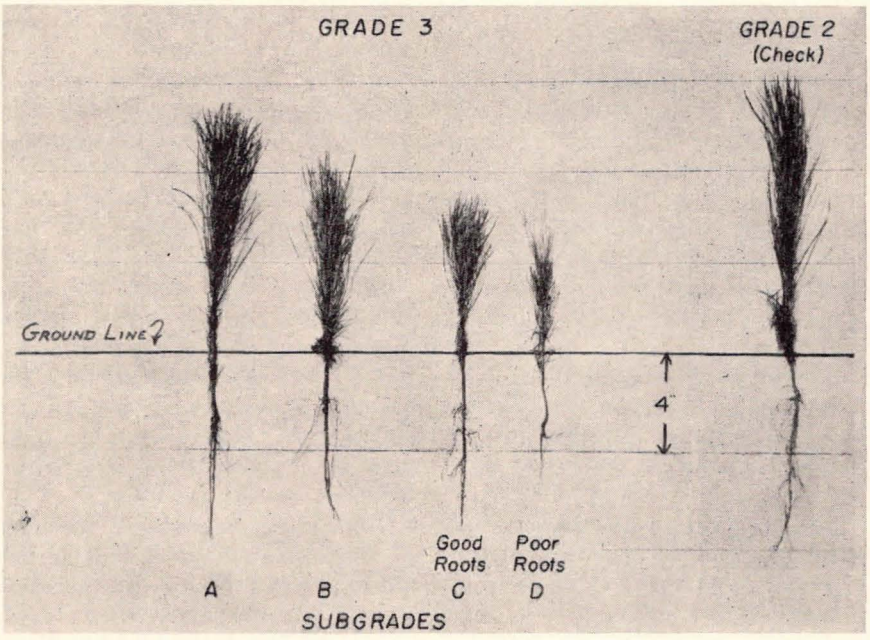

FIG. 1.—Seedlings used in study.

TABLE 1.—DESCRIPTION OF SEEDLINGS USED IN DEPTH OF PLANTING EXPERIMENT

Seedling grade	Seedling subgrade	Average shoot length	Average stem diameter	Root development
		Inches		
No. 2		12	⅛ or larger	Fair to good
No. 3	A	10	Less than ⅛	Fair to good
	B	8	Less than ⅛	Fair to good
	C	6 or less	Less than ⅛	Fair to good
	D	6 or less	Less than ⅛	Poor

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TABLE 2.—FIFTH-YEAR HEIGHT OF SLASH PINE SEEDLINGS BY GRADE OF STOCK AND PLANTING DEPTH

Seedling grade	Depth of planting			
	Standard	Half-stem	To the bud	Average for all depths[1]
	Feet			
Grade 2	10.2	10.4	9.8	10.1
Grade 3				
A	8.5	9.2	8.6	8.8
B	9.2	8.8	8.7	8.9
C	9.2	9.5	8.8	9.2
D	8.4	8.2	7.9	8.2
Average all grades[2]	9.1	9.2	8.7	

[1]Lowest significant difference in height due to grade is 0.42 foot for average of all depths of planting.
[2]Lowest significant difference in height due to planting depth is 0.32 foot for average of all grades of stock.

TABLE 3.—FIFTH-YEAR SURVIVAL OF SLASH PINE SEEDLINGS BY GRADE OF STOCK AND DEPTH OF PLANTING

Seedling grade	Depth of planting			
	Standard[1]	Half-stem[1]	To the bud[1]	Average for all depths[2]
	Percent			
Grade 2	80.0	90.2	94.7	88.3
Grade 3				
A	56.9	74.2	87.8	72.9
B	68.4	76.9	84.0	76.4
C	77.3	84.4	89.8	83.8
D	40.0	60.0	89.1	63.0
Average all grades[3]	64.5	77.2	89.1	

[1]Lowest significant difference in survival due to grade within a single depth of planting is 11.2 percent.
[2]Lowest significant difference in survival due to grade is 4.5 percent for average of all depths of planting.
[3]Lowest significant difference in survival due to depth of planting is 3.5 percent for average of all grades of stock.

Results

Analyses of variance made on the average height and survival measurements at the end of the fifth growth season indicate a number of significant treatment effects (Tables 2 and 3).

Height.—1. The average height growth of seedlings planted to standard depth and to the half-stem was greater than for stock planted to bud.

2. Grade 2 seedlings had greater height growth than all other classes of stock. Subgrades 3A, 3B, and 3C had greater height than 3D.

Survival.—1. Survival of all grades of stock on all three soils was increased by planting the seedlings deep. Survival of seedlings planted to the bud was best and seedlings planted to the half-stem survived better than standard plantings.

2. Grade 2 seedlings survived better than all classes of stock except subgrade 3C. Subgrade 3C had better survival than the larger 3A seedlings.

3. In addition to the over-all effect of grade of stock and depth of planting on survival, there is an important interaction between the two variables. *When seedlings are planted to the bud, grade of stock has no significant effect on survival.* Thus, the disadvantage of planting small stock is greatly reduced by planting deep.

Discussion

It is apparent that a survival benefit can be obtained by planting small slash pine seedlings deep on the old fields of the sandhills. The benefits to be obtained by this planting procedure seem to increase with a decrease in quality of planting stock. The survival of the poorest seedlings (subgrade 3D) was more than doubled by planting them to the bud. At the same time average height of these seedlings after 5 years was reduced less than a half-foot.

Observation of root systems of the deep-planted stock gave no evidence of any critical malformation, but there is a slight tendency for them to grow upward toward the surface (A_1) soil horizon. No roots were observed on the stem portion of deep-planted seedlings.

It is likely that the advantages of deep-planted stock and larger stock are related to the moisture supply in the sandy study area. The use of deep-planted small stock and large stock would expose each seedling to a greater depth of soil and a greater supply of water at critical times early in the first year. In this study a severe drought occurred during the spring after planting and any small moisture advantage may have been critical.

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