Survival and early growth of planted sweetgum related to root-collar diameter

Roger P. Belanger and Robert G. McAlpine

Silviculturist and assistant director, USDA, Forest Service, Southeastern Forest Experiment Station, Athens, Georgia and Research Triangle Park, North Carolina

Planting the larger seedlings gave better survival and growth

Sweetgum *(Liquidambar styraciflua L.)* is a highly desirable species and its planting prospects appear excellent on a wide variety of sites. Economic success of these planting programs depends on the ability of seedlings to survive and grow rapidly with little or no cultural treatments. Studies with yellow poplar *(Liriodendron tulipifera L.), (1,2,3),* sycamore *(Platanus occidentalis L.), (4),* and northern red oak *(Quercus ruba* L.) (5), have shown that morphological grades (height or root-collar diameter) of seedlings are a good measure of early growth potential. This paper reports the relationship between grades of sweetgum seedlings based on root-collar diameters, and survival and growth in a bottomland plantation.

Materials and Methods

Open-pollinated seeds were collected in the fall of 1962 from sweetgum trees growing near Athens, Georgia. Seedlings (1-0) from nine parent trees were graded into four diameter classes as follows:

Grade	Root-collar diameter Inches
1	> ½
2	⅜ to ½
3	¼ to ⅜
4	⅛ to ¼

These seedlings were planted in the spring of 1961 at a spacing of 6 feet by 6 feet on a cleared and harrowed bottomland site in Greene County, Georgia. Experimental design was split-plot with parents assigned to whole plots and root-collar grades allotted at random to the four subplots. Whole plots were randomly assigned in two blocks. The square subplots contained 25 measurement trees surrounded by trees of similar size and parentage. There was no cultivation or fertilization after planting. Herbaceous competition in this plantation during the first 2 years was not severe, probably because the site had been intensively prepared. Total height and survival were recorded after 1, 2, 3, 5, and 7 years.

Results

Grade 1 seedlings grew significantly better (1-percent level) than grade 3 or grade 4 seedlings (figure 1). There was no statistical difference in growth between grade 2 and 3 seedlings. The growth response of the various grades became evident after the first growing season and continued through age 7. At age 7, trees from the largest seedling grade averaged 6.4 feet taller than trees from the smallest seedling grade. Growth differences expressed to date will probably continue for some time.

Seedling survival after 7 years was 100 percent for seedling grades 1 and 2, 98 percent for grade 3, 88 percent for grade 4. Survival of grade 4 seedlings was significantly poorer at the 1-percent level than that of larger seedlings. Most of the seedling losses occurred during the first growing season.

Total tree height of the nine families ranged from 12.4 feet to 20.2 feet after 7 years. Neither the variation in height between families nor the family-grade interaction was statistically significant. Survival of the nine families ranged from 82.5 percent to 99.5 percent. Differences in survival between families were significant.

Although this study was restricted to a single overflow bottom in the Piedmont, these findings may he applicable to other sites. Morphological grades of sweetgum seedlings were a direct measure of subsequent success. Large seedlings survived and grew

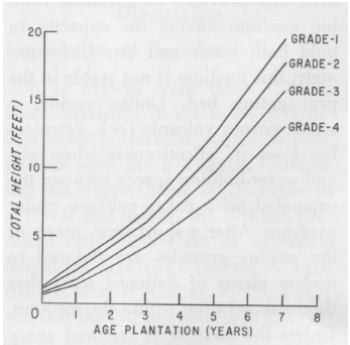

Figure 1.—Early height growth of sweetgum is related to seedling grades. Grade 1, root-collar diameter >½ inch; grade 2, root-collar diameter ⅜ to ½ inch; grade 3, root-collar diameter ¼ to ⅜ inch; grade 4, root-collar diameter ⅛ to ¼ inch.

(Continued from page 1)

better than small ones. We recommend planting sweetgum seedlings with root-collar diameters greater than .25 inch.

Literature Cited

1. Limstrom. G. A.. Finn. R. F.. and Deitschman. G. H.
   1955. Planting stock grades for yellow poplar. J. For. 53:28-32.
2. Rodenbach. R. C.. and 0lson. D. F.. Jr.
   1960. Grading Yellow-poplar planting stock is important. USDA For. Serv. Res. Note SE-I17. 2 p. Southeast. For. Exp. Sin...Asheville. N.C.
3. Sluder. Earl R.
   1964. Quality of yellow-poplar planting stock varies by mother tree and seedbed density. Tree Planters' Notes 65: 16-19.
4. Ike. Albert F.. Jr.
   1962. Root collar diameter is a good measure of height growth potential of sycamore seedlings. Tree Planters' Notes 5-1:9-11.
5. Foster. A. A.. and Farmer. R. E.. Jr.
   1970. Juvenile growth of planted northern red oak: effects of fertilization and size of planting stock. Tree Planters' Notes 21: 1 - 7 .

(Continued from page 4) cedure had no significant effect on survival at any age. However, from the second to the tenth year both terminal growth and total heights were statistically different, usually at the 0.1 percent level or better, with considerable and obvious benefit from cultivation. Ten years after planting, the trees on the cultivated site were about 12.6 percent taller than those of noncultivated sites. This is in accord with other studies of spruce planting (1, 4, 5).

Therefore, in view of the minor cost, there would seem to be considerable benefit from pre-planting cultivation on old-field sites for the planting of white spruce.

Literature Cited

1. Bärring, U.
   1967. Studies of methods employed in the planting of Picea *abies* (L) Karst., and *Pinus silre.tris* L. on farm land in southern and central Sweden. Studi: Forestalia Suecica, No. 50. 332 p.
2. Haugberg, M.
   1971. Planting experiments with Norway Spruce on grass-covered land. English summary. Meddelelser fra det Norske Skogforsoksvesen No. 115:297460.
3. Mullin. R. E.
   1968. Comparisons between seedlings and transplants in fall and spring plantings. Ontario Dep. Lands. Forests. Res. Rep. 85. 40 p.
4. Mullin. R. E.
   1969. Effects of competition on post-planting growth of potted white spruce. USDA. Forest Service. Tree Planters Notes 2011):19-22.
5. Mullin. R. E.
   1973. Post-planting cultivation aids oldfield white spruce plantations. USDA, Forest Service. Tree Planters' Notes 2W) :6-7.
6. Schmidtling. R. C..
   1972. Replacement planting with potted southern pines on research plots. USDA. Forest Service. Res. Note SO146:4 p.

Table 2.—Summary of survival, terminal lengths and total heights at 1, 2, 5, and 10 years, for 2–2 stock only, by main-effect comparisons of hollow spade vs bare-root; and pre-planting cultivation vs. no cultivation

	1st yr.		2nd yr.		5th yr.			10th yr.	
	Surv. percent	Terms. cm	Surv. percent	Terms. cm	Surv. percent	Ht. cm	Terms. cm	Surv. percent	Ht. cm
Hollow-spade ..	97.9	6.89	95.7	4.33	88.2	91.4	19.7	87.6	287.1
Bare-root	96.9	5.44	93.7	4.47	85.9	81.3	16.8	84.8	264.7
	NS	***	NS	NS	NS	*	NS	NS	*
Cult.	98.0	6.18	95.3	5.23	88.8	93.8	20.6	87.9	293.1
Non-cult.	96.9	5.91	93.9	3.86	85.5	79.6	16.1	84.6	260.4
	NS	NS	NS	*	NS	**	**	NS	**

NS = Not significant.
* = Significant at 5.0 percent level.
** = Significant at 1.0 percent level.
*** = Significant at 0.1 percent level.
No significant interactions.