FIRST YEAR, ROOT-SHOOT GROWTH OBSERVATIONS OF EASTERN COTTONWOOD SEEDLINGS AND CUTTINGS[1]

After one growing season, seedlings produced greater root- and top-dry-matter than cuttings. Root development, height, and diameter growth were best on 10-inch stock.

H.E. Garrett
Associate Professor, School of Forestry, Fisheries and Wildlife, University of Missouri,

Literature relating studies of rooting relationships and the links of roots to growth—either height or diameter-of eastern cottonwood (*Populus deltoides* Bartr.) is scarce. Root-shoot growth knowledge becomes increasingly important with the recent emphasis on growing high-quality fiber on short rotations (*1, 2, 4, 5*) and the decreases in cottonwood growing stock which is due in part, to the conversion of bottomland forests to agricultural land (*3, 6*). This study explored some of the root-shoot growth correlations of cottonwood.

Methods

A November planting of both cutting and seedlings was made at two depths—10 and 20 inches. The planting site, located one mile southwest of Carbondale, III. was surrounded by natural stands of the study species. The soil was silt loam of the Bonnie series having low organic matter, slow permeability, and a high available water capacity.

Treatment consisted of placing a perforated bag containing ½ pound of 12-12-12 fertilizer, in an auger-drilled, 8-inch-diameter hole and covering the bag with approximately 3 inches of soil before the planting stock was positioned. Following planting, all exposed tops were sheared at ground level. Weeds were controlled by mowing and shallow cultivation. In total, 26 replications of four trees each were established.

At the end of the first growing season, 12 replications of intact plants were removed using a trenching machine and digging forks. Root development and top growth were measured. Differences among treatment means were evaluated by analysis of variance and Duncan's multiple range test.

During the study year, neither precipitation nor temperature varied significantly from their annual averages. Precipitation measured 40.63 inches, and the mean annual temperature was 58.1 ° F. Although a combined precipitation deficit of 5.39 inches was recorded during March, April, and May of the study period, above average rainfall during June, July, and August provided ample moisture for growth throughout the summer months.

Results and Discussion

After one growing season no significant differences were found between either root or shoot growth of cuttings and seedlings. Seedlings did, however, produce slightly greater root- and top-dry-matter than cuttings—an average of 225 to 219 grams of root material and 545 to 533 grams of top material, respectively. Root-shoot ratios based on ovendry weights were 0.41 for cuttings and seedlings. While the combined mortality of all plantings was 30 percent, no difference in survival of seedlings and cuttings was observed.

Planting depth was found to have a greater impact on growth and development than the type of planting stock used. However, contrary to some recommendations (2, 3), 10-inch plantings proved superior to 20-inch plantings. An average of 235 to 209 grams of root-dry-matter and 577 to 500 grams of top-dry-matter was produced respectively by 10- and 20-inch plantings with differences in top-dry-matter being significant at the 5-percent level. The number of roots produced in the first 10-inch taproot section and the diameter and length of roots in the first 5-inch taproot section were significantly greater for the 10-inch stock (tables 1, 2, and 3). Ten-inch stock produced a root-shoot ratio of 0.41 and 20-inch stock a ratio of 0.42.

[1]Contribution from the Missouri Agricultural Experiment Station. Journal Series Number 7619.

Table 1.—*Lateral root diameter for cottonwood cuttings and seedlings by 5-inch taproot sections*

Planting depth and stock	Mean root diameters in 32d of an inch by 5-inch taproot sections			
	1	2	3	4
10" Cottonwood Seedling	14[1]	12		
20" Cottonwood Seedling	10	8	7	6
10" Cottonwood Cutting	12	9		
20" Cottonwood Cutting	10	9	6	6

[1] Means based on roots greater than 118" diameter

Table 2.—*Lateral root length for cottonwood cuttings and seedlings by 5-inch taproot sections*

Planting depth and stock	Mean root length in inches by 5-inch taproot sections			
	1	2	3	4
10" Cottonwood Seedling	42[1]	29		
20" Cottonwood Seedling	38	41	24	22
10" Cottonwood Cutting	43	39		
20" Cottonwood Cutting	35	32	26	17

[1] Means based on roots greater than 118" diameter

Table 3.—*Number of lateral roots for cottonwood cuttings and seedlings by 5-inch taproot sections*

Planting depth and stock	Number of roots by 5-inch taproot sections			
	1	2	3	4
10" Cottonwood Seedling	6[1]	9		
20" Cottonwood Seedling	6	4	3	9
10" Cottonwood Cutting	5	11		
20" Cottonwood Cutting	7	3	3	11

[1] Means based on roots greater than 118" diameter

An increase in both height and diameter growth accompanied the larger root systems produced by the shallow plantings. Twenty-inch plantings averaged 90 inches in height while 10-inch plantings averaged 99 inches—an increase of 10 percent (figure 1). The greatest difference in the height growth of 10- and 20-inch stock was observed in cuttings with 10-inch plantings yielding a 16 percent increase over 20-inch plantings (figure 1). Differences in diameter growth, while not as great as height differences, again reflected the advantage of the 10-inch over the 20-inch stock (figure 2).

The results of this study, while not conclusive, suggest a growth advantage of 10-inch over 20-inch plantings where sufficient surface moisture is available to support growth during the summer months. Ten-inch plantings with their larger root systems concentrated in the upper 10 inches of soil were able to make maximum use of surface moisture made available through frequent light rain during the summer months. While such rainfall patterns are atypical, a similar response might be expected where supplemental irrigation is used to maximize biomass yields on short rotations (*1*).

(Continued on p. 41)

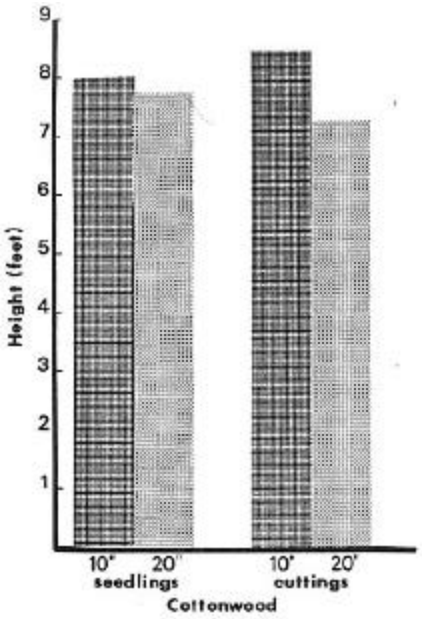

Figure 1.—*The effects of planting depth and planting stock on height growth of 1-year-old cottonwood.*

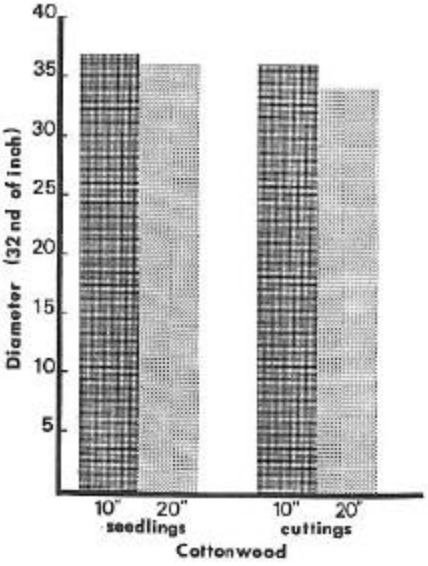

Figure 2.—*The effects of planting depth and planting stock on diameter growth of 1-year-old cottonwood.*

Literature Cited

1. Dawson, D.H., J.G. Isebrands, and J.C. Gordon.
1976. Growth, dry weight yields, and specific gravity of 3-year-old *Populus* grown under intensive culture. U.S. Dep. Agric. For. Serv., North Cent. For. Exp. Stn. Res. Pap. NC-122, 7 p.

2. DeBell, D.S.
1972. Potential productivity of dense young thickets of alder. Res. Note 2, 7 p. Crown Zellerbach, Camas, Wash.

3. Kaszkurewicz, A.
1975. Establishment and early growth of *Populus deltoides* Bartr. Ph.D. Dissertation, La. St. Univ. For. and Wild. Manage. Baton Rouge, La. 229 p.

4. Steinbeck, K., and J.T. May
1971. Productivity of very young *Platanus occidentalis* L. plantings grown at various spacings. In. Forest biomass studies. Misc. Pub. 132, Life S.:. and Agr. Exp. Stn., Univ. Maine, Orono. 205 p.

5. Steinbeck, K., R.G. McAlpine, and J.T. May.
1972. Short rotation culture of sycamore: A status report. J. For. 70:210-213.

6. Sternitzke, H.S., and J.F. Christopher.
1970. Land clearing in the Lower Mississippi Valley. Southeast. Geogr. 10(1):63-66.