SOUTHERN FOREST EXPERIMENT STATION

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WATER TABLE DEPTH AND GROWTH OF YOUNG COTTONWOOD

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SOUTHERN FOREST EXPERIMENT STATION

Planted cottonwood grew best when the water table was about 2 feet deep, whether the tree was planted on soil with a high water table or the water table was raised 1 year after planting. Growth over a 1-foot-deep water table was about the same as over no water table, but a surface water table restricted growth of cuttings planted in the water, and killed trees planted the year before.

Additional keywords: *Populus deltoides*, soil moisture, tree growth.

The amount of soil moisture available in the growing season strongly influences survival and growth of newly planted trees. In river bottoms where cottonwood (*Populus deltoides* Bartr.) is normally planted, water table depth usually determines moisture supplies to tree roots. In some cases the table may be so near the soil surface that it limits aeration. In others, it may be at depths beyond reach of the young roots. This note reports the influence on cottonwood performance of water table raised before and 1 year after planting.

PROCEDURE

Soil from the surface foot of Robinsonville fine sandy loam was screened through 0.2-inch hardware cloth to remove debris and settled into steel barrels by gently tamping and moistening. The barrels, with volumes of about 7.5 cubic feet, had been painted on the outside with aluminum to reflect heat and minimize its absorption by the soil.

One cottonwood cutting 10 inches long was planted in each barrel of soil. All cuttings were taken from the same clone and were treated with a systemic insecticide to reduce insect attack.

At the start of the first growing season, three such barrels were assigned to each of four treatments: (1) control, no water table; (2) water table 2 feet from surface; (3) water table 1 foot from surface; and (4) water table at soil surface.

At the end of the growing season, the plants were lifted and their stems and roots were measured.

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Three barrels similarly planted were treated as controls in their first growing season and assigned to each of the four treatments at the beginning of the second growing season. Heights and diameters of the trees were measured at the beginning and end of that season. The trees were then lifted, roots and tops were separated, roots were washed and air-dried for 2 hours, and plant parts were weighed.

The assigned water levels were maintained by punching holes at appropriate points in the sides of the barrels and seeping water in at the bottom (fig. 1). Equal amounts of water were added to all barrels in periods of low rainfall. The amount used was that judged sufficient only to maintain normal welfare of the controls. Treatment means were compared by Duncan's new multiple range test with significance at the 0.05 level.

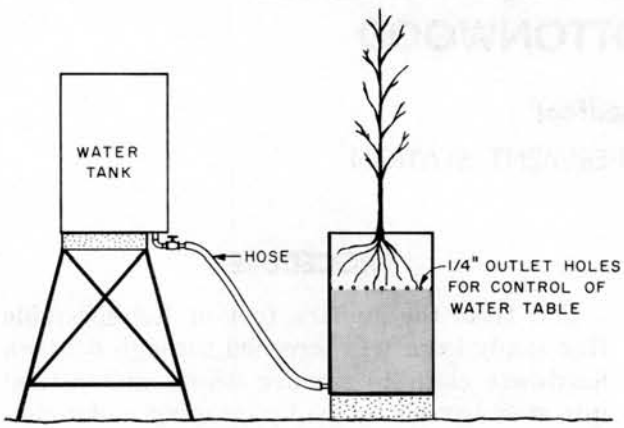

Figure 1.—*Water table in barrel set at 1 foot from soil surface.*

RESULTS

Newly Planted Cottonwood on Established Water Tables

Best height growth was made by the cottonwood cuttings where the water table was 24 inches deep (fig. 2). Growth of controls was about the same as that with 1- and 2-foot water tables during April and May, but control growth dropped in June and July, apparently due to low rainfall. Cottonwoods on 1- and 2-foot water tables continued to grow rapidly through July, but slowed sharply in August and September. Root, stem, and total plant weights were also influenced by water table depth (table 1).

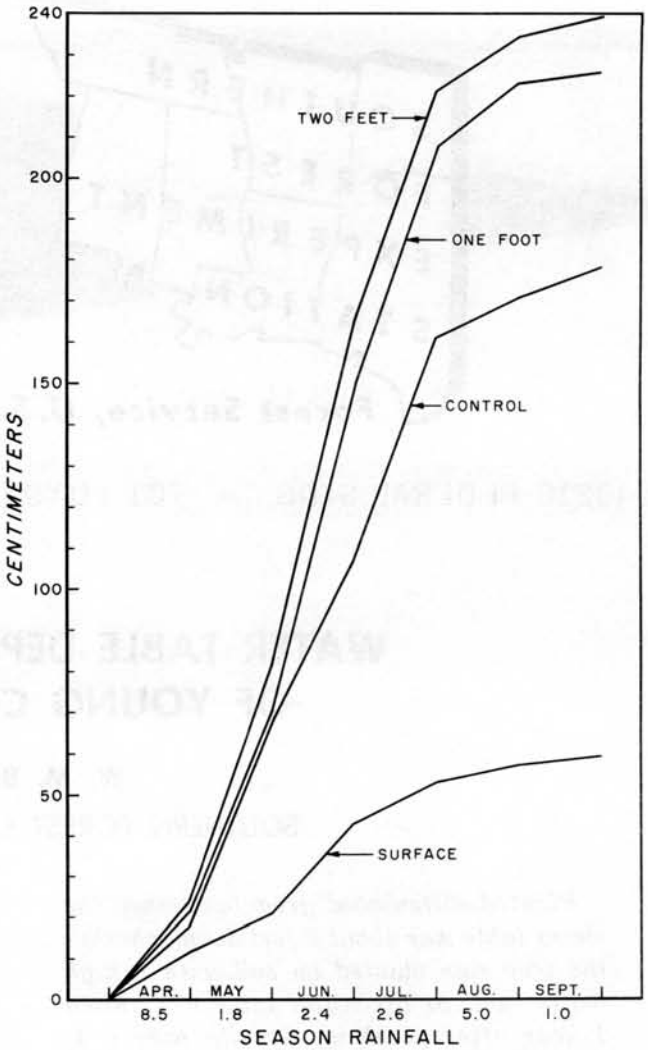

Figure 2.—*Average cumulative height growth of juvenile cottonwood on established water tables at various depths.*

Table 1.—*Growth of newly planted cottonwoods with water tables at various depths*

Measurement	Water-table depth			
	Surface	Control	1 foot	2 feet
	——————Cm——————			
Average height:				
Stems	58.3	177.7	225.0	239.0
	——————G——————			
Average green weight:				
Stems	18.0	452.0	603.3	818.7
Roots	34.3	245.0	913.3	1,126.7
Total plant	52.3	697.0	1,516.6	1,945.3

Values underscored by the same line are not significantly different at the 5-percent level, according to Duncan's new multiple range test.

Root weight exceeded stem weight at all water table levels but the control, because most of the original cutting was below ground level and was included as part of the root system. In no case did the root system extend into the free water below the table level (fig. 3). Where the water table was at the surface, roots extended out from the cutting in a zone within 1 inch of the soil and water surface. The soil was gray throughout. Occasional rainshowers probably provided the surface inch or so of soil with enough oxygen to keep the plants alive through the growing season.

The results of this study indicate that cottonwood can be established and will grow satisfactorily on loamy soils with shallow water tables. But the planting will probably fail if the soil is saturated or if the free water table is at the surface during the first growing season.

Year-Old Cottonwoods

Again, the water table 24 inches from the surface was best for growth. Differences in height and root growth due to treatment were statistically significant (table 2).

Where the table level was raised to the ground surface, the plants died in late August. The control and 1-foot treatments produced similar intermediate results.

Roots grew slowly in high water tables while they developed rapidly in the control and 2-foot treatments. Even though top growth of the control and the 1-foot table was about the same, root development of the control was considerably better during the second season. The reason for the restricted root growth of the surface and 1-foot-table treatments is most likely lack of adequate aeration. The roots under water in each case were dark gray to black, and many appeared dead. Apparently, soil moisture filled the pores above the 1-foot table enough to reduce aeration and growth.

Table 2.—*Growth of cottonwoods when water tables were controlled during the second growing season*

Measurement	Water table depth			
	Surface	Control	1 foot	2 feet
	——————*G*——————			
Green weight:				
Tops	753a[1]	1,246b	1,289b	1,698c
Roots	934a	1,669ab	1,029a	1,923b
Total plant	1,687a	2,915bc	2,318ab	3,621c
	——————*Cm*——————			
Height:				
Initial	184a	168a	179a	174a
Final	209a	239ab	252b	300c
Increase	25a	71b	73b	126c
	——————*Cm*——————			
Diameter:				
Initial	2.57a	2.47a	2.47a	2.43a
Final	3.50a	3.90b	3.70ab	3.90b
Increase	.93a	1.43b	1.23ab	1.47b

[1] Within rows, values followed by same letter do not differ significantly at the 0.05 level, according to Duncan's new multiple range test.

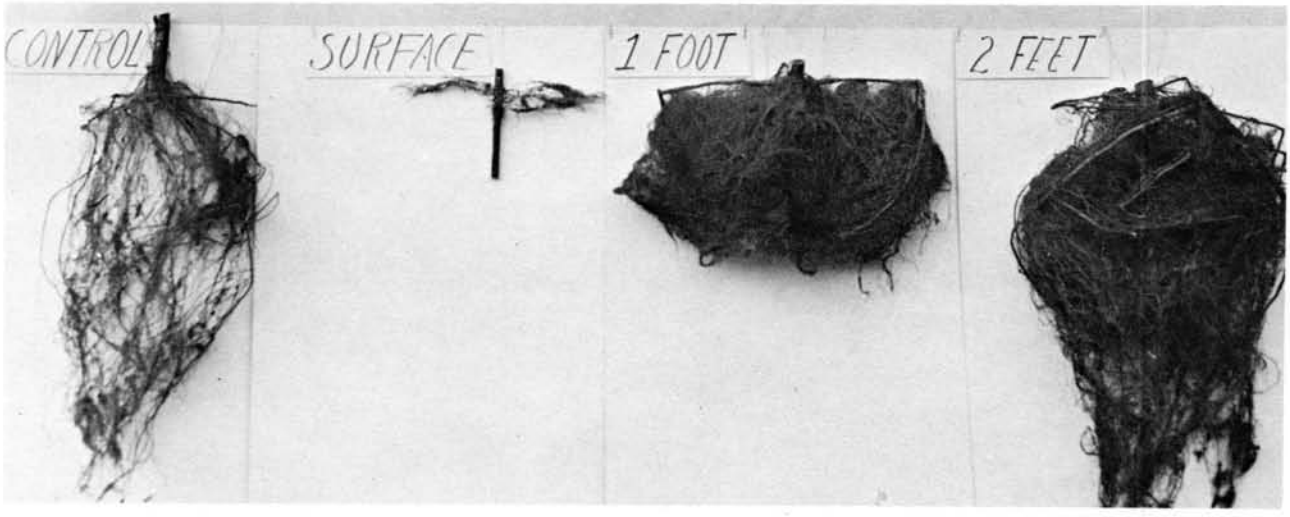

Figure 3.—*Cottonwood root systems after one growing season with water table at various depths.*

but not enough to kill the trees. Above the 2-foot table there was sufficient well-aerated soil along with an abundant moisture supply.

It can be safely concluded from these data that juvenile cottonwood is benefited by water tables raised into the lower portion of its normal root zone. However, where water tables are raised high enough in porous root zones to saturate the soil, death is likely to occur near the end of the second growing season.