Continued Investigations in First-Year Survival of Long Cottonwood Cuttings

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One-year-old cottonwood stem cuttings, planted in December, February, and March, had over 90 percent first-year survival when soaked in water or when planting holes were filled with dry sand and flooding did not occur.

Cottonwood cuttings of 8 feet or more planted in 3-foot deep holes have apparent advantages over standard 20-inch cuttings. These advantages include less intensive site preparation requirements, reduced deer protection costs, and less critical weed control early in the growing season following outplanting. Two previous studies of long cuttings of five Stoneville clones showed better survival of rooted cuttings compared to unrooted cuttings (92 percent vs. 36 percent) (*6*) as well as unrooted cuttings soaked in water prior to planting compared to unsoaked cuttings (93 percent vs. 86 percent) (*4*). More than a 90-percent survival rate would permit wide planting spacing for sawlog production without requiring any pulpwood thinnings.

The two studies cited earlier differed in time of planting, method of planting, size of planting stock, and soil types. Therefore, three additional plantings in 1978, 1979, and 1980 were made to directly compare the effects of these various planting variables.

Methods

For plantings in 1978 and 1980, long cuttings of four Stoneville clones (66, 67, 74, and 240 or 238) were planted in 3 months—December (9th to 22d), February (11th to 17th), and March (20th to 22d). Treatments used were: rooted and unrooted material that was soaked or not soaked in water with available soil or dry sand used as filler in the planting holes. In 1979, the March planting could not be included with plantings of the other two dates because of high water.

Cuttings were 1-year-old stems. Rooted cuttings had a foot of rooted material with lateral roots pruned, while unrooted cuttings were cut above ground. Length of soaking varied from 3 to 6 days the first year, 5 to 9 days the second year, and 2 to 5 days the third year.

A split-split-plot design was used, with months as whole plots, clones as subplots, and treatments as sub-subplots, each sub-subplot containing five cuttings. There were four replications or a total of 640 cuttings planted each month of each year. A 12- by 12-foot spacing was used.

By years, the three Mississippi Delta planting sites were: (1) 1978, cleared land in the Mississippi River batturel on clay-capped soils that graded from Tunica to Bowdre and approaching Commerce at the highest part; (*2*) 1979, a cleared clay-capped site near Steele Bayou; and (*3*) 1980, an old field of Commerce silt loam soil between the Little Sunflower and Yazoo Rivers. All areas are in Issaquena County, Miss.

Planting holes were punched to a 3-foot depth with a 1-1/2-inch iron bar (for unrooted cuttings) or a 2-1/2- or 2-7/8-inch iron bar (for rooted cuttings) driven by a hydraulic system on either a four-wheel pickup or tractor (*1*).

Heights at planting and after 1 year were measured for the first and third plantings. For the second planting, only heights of planted cuttings were obtained in July for the December and February planting dates.

Results

1978. At planting, the average above-ground height of the cuttings was 8.8 feet for unrooted material and 10.6 feet for rooted stock (table 1).

April flooding covered the lowest part of the study area for about 15 days to a maximum depth of about 2 feet. Two replications were completely covered, one partly covered, and the last was mainly free of any standing water.

A May examination showed the December planting had less mortality, but more dieback, than the other 2 months. The highest (driest) replication had the least dieback and mortality and the greatest leaf size, while the lowest (wettest)

[1]A batture is an elevated bed where the river is confined by natural levees above flood plain level.

Table 1.—*Above-ground planted height, first-year height growth, and survival by treatment and month and year of planting*

Month	Treatment			1978			1979		1980		
	Roots	Soak	Sand	Ht.	ΔHt.	Surv.	Ht.	Surv.	Ht.	ΔHt.	Surv.
				- - *Ft* - -		*%*	*Ft*	*%*	- - *Ft* - -		*%*
December	0	0	01	9.2	-1.8	85	7.2	56	5.1	5.0	94
	0	0	11	9.2	-1.4	71	7.2	61	5.0	4.9	91
	0	1	0	8.4	0.3	92	7.3	52	5.1	5.3	96
	0	1	1	8.4	0.8	93	7.2	69	5.0	5.5	99
	1	0	0	10.5	-1.1	70	7.9	88	5.3	5.2	92
	1	0	1	10.5	-2.0	64	7.8	90	5.3	5.7	91
	1	1	0	10.3	-1.2	79	7.6	89	5.3	5.1	96
	1	1	1	10.2	-0.7	77	7.6	93	5.2	5.5	99
February	0	0	0	9.5	-0.3	45	6.0	19	6.0	4.2	82
	0	0	1	9.4	-0.6	65	6.0	32	6.0	4.7	91
	0	1	0	9.1	-0.7	76	5.9	15	6.2	4.5	98
	0	1	1	9.2	0.1	85	5.9	24	6.1	5.1	94
	1	0	0	10.8	-1.0	66	7.8	45	6.5	4.5	92
	1	0	1	10.5	-1.1	70	7.8	43	6.4	3.7	95
	1	1	0	11.2	-1.3	69	8.0	45	6.4	3.7	95
	1	1	1	11.1	-1.1	80	7.9	47	6.3	4.0	99
March	0	0	0	8.6	0	81	-2	—	6.1	2.9	95
	0	0	1	8.6	-0.7	74	—	—	6.0	3.1	96
	0	1	0	8.0	-0.6	83	—	—	6.2	2.7	94
	0	1	1	8.1	0.2	79	—	—	6.2	3.0	95
	1	0	0	10.2	-1.5	44	—	—	6.0	3.1	96
	1	0	1	10.7	-2.6	42	—	—	6.0	3.7	96
	1	1	0	10.8	-2.6	60	—	—	6.0	2.8	90
	1	1	1	10.7	-2.2	60	—	—	6.0	3.6	94

[1] 0 = without; 1= with.

[2] _ = not available

replication had the most dieback and mortality.

In July, eight trees (five from the next lowest replication and three from the highest) were dug up with a backhoe and the root systems examined. Roots went to the bottom of only one cutting, but root development was very poor. For the other cuttings, the bottom 2 to 15 inches were dead. The tree with the largest top had the largest root system. For comparison, a long cutting planted a year earlier in the same general area on an unflooded site was excavated. There was no dead stem at the bottom of the cutting and no taproot-only well-developed laterals to the 3-foot depth. The largest and longest roots were closest to the surface.

Neither first-year survival nor growth was satisfactory. Less than 90-percent survival and less than 3 feet of height growth were observed.

For rooted stock, only clone 66 with sand in December and clone 66 with sand and soak in February had satisfactory survival of 90 percent or better. For unrooted stock, several inconsistent combinations of clones and December and March planting treatments had 10-percent mortality or less. Statistically, several significant survival differences (at the 0.05 probability level) showed December survivals greater than those for March planting. Clone 66 survived better than clones 67 and 74 (table 2). Considering replications a fixed effect in spite of differences in evaluation and/or length of overflow, the site at the highest elevation provided higher survival rates than the two lower sites.

Table 2.—*First-year survival by clone and year of planting*

Year	Clone 66	Clone 67	Clone 74	Clone 240[1]
	- - - - - - - - - - - - % - - - - - - - - - - - -			
1978	79	68	64	74
1979	53	71	41	55
1980	92	91	97	98

[1] Clone 238 in 1980.

Increases in mortality between the last of May and the end of the growing season were nearly twice as great for rooted as for unrooted stock in March planting compared to December planting and on the two lowest replications compared to the highest.

Fifty-four percent of the trees were within ±0.9 foot of their planted height at the end of the first year. A third of the trees lost a foot or more of their planted height, and 13 percent grew a foot or more in height. Of the 1,186 living trees, only 3 percent grew ≥ 3.0 feet in height.

1979. Average above-ground heights at planting were 6.6 feet for unrooted cuttings and 7.8 feet for rooted cuttings.

The planting site varied about 4 feet in elevation. The lowest area was water covered from mid-March through May (2 ½ months), while the highest area was covered for 6 weeks. Maximum water depth ranged from 5.5 to 9.5 feet. At the July 5 measurement, none of the trees had leafed out adequately, and many only had a leaf or two. July survival was 90 percent for December-rooted cuttings and 59 percent for unrooted cuttings. The February planting survival was 45 and 22 percent, for rooted and unrooted cuttings.

1980. Average above-ground planted heights were 5.8 feet for unrooted cuttings and 5.9 feet for rooted cuttings.

There was no flooding in this planting. Overall survival was 94 percent. There were no significant differences because of months or treatments. Clones 74 and 240 had significantly better survival than clones 66 and 67. There was a significant month by treatment interaction in that the unrooted, unsoaked, and soil-filler treatment planted in February had less survival than all other combinations.

Average height growth the first year was 5.2 feet for the December planting, 4.2 feet for February, and 3.1 feet for March.

Discussion and Conclusion

Flooding in 2 of the 3 years added another dimension to the survival aspect of planting large cottonwood cuttings. Where water covered the ground, survival was erratic. December planting of unrooted, soaked cuttings with or without sand filler gave satisfactory survival in 1978. In 1979, December-rooted cuttings had 90-percent survival at mid-growing season. No other month and treatment combination had greater than or equal to 90-percent survival. Furthermore, trees that survived did not have healthy leaves, either in quantity or size. The changes in survival in the 1978 planting between late May and the last of the growing season increased the differences already present. This indicates that variables that provided poorest survival conditions early in the growing season either continued to do so for the remainder of the season or weakened the trees sufficiently to produce greater mortality through the rest of the growth period. The main problem associated with first-year flooding appears to be improper root development. Spring flooding after the first year does not appear detrimental (*3*).

Thousands of acres have been planted with 20-inch unrooted cuttings, which are subject to the same problems as long cuttings. For sites where shallow flooding is likely to occur, 1-0 seedlings have been recommended instead of cuttings because of better survival (*5*). Extended flooding in 1973 virtually eliminated cottonwood cutting plantations, while about half of a similar seedling plantation survived (*3*).

A long-cutting planting treatment effectively producing 90-percent survival on sites subject to flooding is not apparent from these studies. However, if such sites are to be planted, early (December) planting is best, possibly because some roots develop prior to flooding. Kennedy (2) found that root initiation in planted cottonwood cuttings took place until temperatures dropped below 50° to 55° F, but that roots that had already started to grow continued growth. No distinction could be made between rooted and unrooted material even though seedlings survived better than unrooted smaller cuttings.

Where flooding is unlikely, time of planting and planting stock, with or without roots, appear unimportant although it would probably be

inadvisable to plant during extended dry periods (*2*). Dry sand filler, which by its flowable nature should eliminate air pockets, provided no higher survival rates than soaking. However, sand backfill is a quicker method to close a punched planting hole (*1*). Water soaking is an easily applied treatment at the nursery. It also has the additional advantage of being an effective and safe method for storing cuttings for short periods of time. Both soaking and sand backfilling are feasible for commercial planting operations.

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