SOAKING AIDS SURVIVAL OF LONG, UNROOTED COTTONWOOD CUTTINGS

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Unrooted,1-year-old cottonwood switches of five Stoneville clones, when soaked in water for 5 days before planting, had a first-year survival rate of 96 percent compared to an 86 percent survival rate for unsoaked cuttings.

Long, rooted cottonwood (*Populus deltoides* Bartr.) cuttings can be made from standard 20-inch cuttings that are grown in the nursery for 1 year and lifted with about a foot of rooted material. When planted in 3-foot-deep augered holes, these long cuttings have the advantages of being above the reach of deer, of being readily seen by tractor drivers early in the first growing season while cultivating for weed control, of requiring no straddle cultivation, and of having a survival rate of 90 percent or better (*4*). With such good survival, cuttings can be planted at wide spacing (24+ feet) for increased diameter growth and shorter sawlog rotations without the need for thinning small pulpwood.

The disadvantages of using rooted cuttings are the nursery expense of lifting and transporting the planting stock and the expense of making and filling planting holes, particularly on new ground where augers can get hung up in old tree roots. Using unrooted cuttings would simplify nursery operation and also permit use of a smaller planting hole; however, a study showed that while there is good survival with long, rooted cuttings, there is very poor survival with unrooted cuttings (*4*). There have been several studies indicating that soaking unrooted cottonwood cuttings before planting increases survival in the greenhouse and in the field (*1, 2, 3*).

The object of this study was to determine if any of several soaking treatments of long, unrooted cottonwood cuttings before planting would increase survival to a satisfactory level.

Methods

The study was done in a Bowdre-Tunica soil mixture on Ajax Bar, Issaquena County, Miss., in cooperation with the Anderson-Tully Company. Cuttings from five Stoneville cottonwood clones—66, 67, 74, 238, and 240—were each given four different soaking treatments: (1) water, (2) 5 percent sucrose solution, (3) 0.5 percent sucrose solution, and (4) 0.5 percent sucrose solution plus 25 p/m IBA. The cuttings in the control were not soaked.

A split-plot design was used, with clones as whole plots and treatments as subplots, each subplot containing five cuttings. There were five replications, and cuttings were planted at a 12- by 12-foot spacing.

One-year-old stems were cut from the nursery on Friday morning, December 10, 1976, and placed in solution within 3 hours. The cuttings were stood in 55gallon drums containing 40 gallons of solution, which covered about the lower 3 feet of the cuttings. The drums were placed under a shed until taken to the planting site about 117 hours later. Cuttings ranged in length from about 6 to about 12 feet.

Moisture contents (dry weight basis), based on a composite of samples taken at various location within a stem, were determined right after cutting and again after soaking for each cutting.

On December 15 cuttings were planted in holes punched 3 feet into the ground. The holes were made with a 1.5-inch iron bar attached to a hydraulic soil probe mounted on a four-wheel-drive pickup. After a cutting was placed in a hole, the hole was filled in with dry blasting sand.'

After planting, the heights of the cuttings were measured. The last week of May the surviving trees were counted. After one growing season, the height and d.b.h. of the surviving trees were measured.

Results

Based on samples taken from four cuttings per clone, mean moisture content at time of harvest from the nursery varied from 107 percent in Clone 74 to 119 percent in Clone 238. Based on samples from two to five

[1]This planting procedure was described in an unpublished speech presented by Andrew G. MacKay, Bryant & May (Forestry) Ltd., Bedfordshire, England, at the Symposium on Eastern Cottonwood and Related Species, September 29, 1976, Greenville, Miss.

clones, mean moisture content after soaking was 122 percent for cuttings soaked in 5 percent sucrose (four samples), 110 percent for 0.5 percent sucrose (three samples), 127 percent for sucrose plus IBA (four samples), and 133 percent for water (five samples). The mean moisture content was 111 percent for the unsoaked control (two samples).

The mean heights above ground of the newly planted clones were: Clone 66, 5.1 feet; Clone 67, 6.5 feet; Clone 74, 6.8 feet; Clone 238, 6.0 feet; and Clone 240, 5.6 feet. The height of individual cuttings varied from 3.4 to 9.2 feet. The mean heights of the clones were significantly different from each other at the 0.05 level by Duncan's multiple range test.

During the survival count in May, 95 to 98 percent of the trees receiving soaking treatments had leafed out and were apparently growing in acceptable fashion, 1 to 3 percent of the trees were dead, and 1 to 2 percent of the trees had sprouts coming from either the base of the stem or the ground although the major portion of the stem was dead. In comparison, only 76 percent of the control trees were growing acceptably, 10 percent were dead, and 14 percent were sprouting from the base or the ground.

All trees with the main stem dead and without sprouts in May did not develop any sprouts by the end of the growing season. Of the trees listed as acceptable in May, 1.7 percent of the soaked trees and 3.2 percent of the unsoaked trees had died by the end of the growing season. Only one of 24 trees that were sprouting from the base or ground in May had died. One tree tallied as growing acceptably in May later died and sprouted, but the sprout growth failed to reach the planted height.

At the end of the first growing season, there was a significant difference in survival among clones and between soaked cuttings and the control (table 1). There was no significant interaction. Clones 67 and 240 had significantly higher survival than Clone 238. There was no significant difference among soaking treatments, but all treatments produced significantly higher survival rates (9 to 12 percent higher) than the control.

After the first year, there were significant differences in total height among clones and treatments. For height growth, there was no great difference among

Table 1.—*Average height, height growth, diameter, and survival by clones and by soaking treatments after year*

Clones	$\bar{H}$	$?\bar{H}$	$\bar{D}$	Survival	Soaking treatments	$\bar{H}$	$?\bar{H}$	$\bar{D}$	Survival
	feet	*feet*	*inches*	*percent*		*feet*	*feet*	*inches*	*percent*
66	16.Oab [1]	10.9	1.8a	92.0ab	Water	16.5ab	10.5 b	1.9	96.0 b
67	16.8 b	10.4	1.8a	98.4 b	5% sucrose	15.8a	9.8ab	1.8	94.4 b
74	17.0 b	10.1	1.7a	94.4ab	.5% sucrose	16.2ab	10.5 b	1.8	97.6 b
238	15.4a	9.3	1.7a	88.8a	.5% sucrose + 25 p/m IBA	16.7 b	10.6 b	1.9	97.6 b
240	15.7ab	10.1	2.1 b	97.6 b	No soak	15.7a	9.5a	1.7	85.6a

[1] Means followed by same letter not significantly different by Duncan's Multiple Range Test at 0.05 level for each separate column.

clones, but all trees receiving soaking treatments, except those soaked in 5 percent sucrose solution, grew significantly better than did the control. The tallest tree measured was 22.7 feet, which represented 14.4 feet of growth. Of the 24 trees that developed from basal or ground sprouts, heights at the end of 1 year ranged from 7.5 to 18.1 feet, with an average of 14.0 feet.

The average diameter of Clone 240 was significantly greater than that of the other clones, but treatments had no effect on diameter.

Discussion and Conclusions

The soaking treatments in this study significantly increased survival of unrooted cottonwood cuttings; however, the 86 percent survival rate of the unsoaked cuttings was much better than the 36 percent achieved in the earlier study (*4*). In both cases, cuttings were from the same five clones. Differences between this study and the first study were: (1) an earlier planting date—the middle of December versus the first week of February; (2) a 1.5-inch punched planting hole filled with dry sand after planting versus a 6-inch augered planting hole tamped with loose soil after planting; (3) a slightly smaller planting stock—6.0 feet versus 7.0 feet above ground height; and (4) a clay-capped soil that is a slightly poorer site versus Commerce silt loam soil on which the first study was planted.

At this time the most logical reasons for better survival seem to be: the earlier planting date and possible better root development of the cuttings, and the smaller planting hole filled with sand, which has less chance of containing air pockets that could cause drying of the cuttings. However, records of climate were not kept with either study, and rainfall after planting and soil moisture conditions may be as important to survival of long cuttings as the other factors.

The initial moisture content of our cuttings was about twice as great as the moisture contents reported by Edwards and Kissock (*3*). Our determinations were based on dry weight, while Edwards and Kissock most likely used wet weight.

While some of the cottonwood stems that died back and sprouted from the base actually grew more than some of the stems that did not die back, such plants would be subject to deer browsing if protection were not provided. If survival at the end of the year were based only on living plants that did not come from low sprouts, then survival of soaked cuttings would be 95 percent and of the unsoaked cuttings 73 percent. Also, if cottonwood sprouts need to be at least 4.5 feet above ground to be beyond deer browsing,[2] then about 5 percent of the trees planted in this study were too small. To avoid this danger, cottonwood switches in the nursery should be at least 8 feet tall for planting as unrooted cuttings.

Additional testing is needed before any large scale plantings are started, but long, unrooted cuttings soaked for about 5 days before planting in 3-foot-deep holes appear to survive as well as long, rooted cuttings and require simpler nursery and planting techniques.

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