United States Department of Agriculture

Forest Service

Southern Forest Experiment Station

Research Note

SO-343
December 1987

Planted Hardwood Development on Clay Soil Without Weed Control Through 16 Years

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SUMMARY

Average survival at age 16 was determined for five hardwood species that received no weed control after planting at 10- by 10-foot spacing on cleared Sharkey clay soil. The average survival rates, in percent, were: sweetgum (*Liquidambar styraciflua* L.), 35; cottonwood (*Populus deltoides* Bartr. ex Marsh.), 45; Nuttall oak (*Quercus nuttalli* Palmer) and sycamore (*Platanus occidentalis* L.), 81; and green ash (*Fraxinus pennsylvanica* Marsh.), 96. Corresponding average heights, in feet, were: 25, 41, 20, 29, and 27.

Additional keywords: Cottonwood (*Populus deltoides), sycamore (Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), Nuttall oak (*Quercus nuttallii*), sweet pecan (*Carya illinoensis*).

INTRODUCTION

General recommendations for hardwood plantings are to use good seedlings on well-prepared, suitable sites with at least first-year weed control. What happens to plantings when no weed control is done except for initial site preparation? Little information is available on such plantation development with minimal vegetative control. This note presents survival and d.b.h. and height information for 16-year-old trees on Sharkey clay soil which never had the benefits of weed control after planting.

METHODS

This study was located in the Delta Experimental Forest near Stoneville, Mississippi. The slackwater area was cleared of trees, raked and disked prior to planting before the 1971 growing season.

Species planted were cottonwood (CW —*Populus deltoides* Bartr. ex Marsh.), sycamore (SY — *Platanus occidentalis* L.) green ash (GA — *Fraxinus pennsylvanica* Marsh.) sweetgum (SG — *Liquidambar styraciflua* L.), Nuttall oak (NO — *Quercus nuttallii* Palmer), and sweet pecan (SP —*Carya illinoensis* (Wangenh.) K. Koch). One-year-old nursery grown seedlings or 20-inch-long CW cuttings were used.

No weed control was one of three control treatments. The other two treatments were disking and mowing. All three treatments were in a split-plot design with six blocks. Species subplots consisted of 4-column by 6-row plantings (24 trees) on a 10-foot spacing. Each CW row contained a separate Stoneville clone: 66, 67, 78, 82, 213, or 244.

Because of interest in possibly increasing tree growth, all species except SP were thinned in disked plots and CW, SY, and GA were thinned in mowed plots after 5 years. Mowing and disking treatments were maintained through 10 years and trees were remeasured after 15 years. Those results were published (Krinard and Kennedy 1987). This note presents the 16-year remeasurement of the study's check trees, which had been measured the last previous time at 4 years after planting (Kennedy 1981). Contrasts between means were tested at the 0.05 level using Duncan's multiple range test.

RESULTS

At age 2, mean survival without weed control ranged from 65 percent for SP to 99 percent for GA (table 1). Two years later survival of SP was down 8 percentage points, and CW and NO were each down 5 percentage

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Table 1.—*Average survival and height at ages 2, 4, and 16 and average d.b.h. at age 16 with no weed control*

	Age 2		Age 4		Age 16		
Species[1]	Survival	Height	Survival	Height	Survival	Height	D.b.h
	%	ft	%	ft	%	ft	in
CW	76bcd[2]	6.6a	71bcd	10.3a	45b	41.3a	5.5a
SY	84ab	4.6b	84ab	6.9b	81a	29.1b	3.3b
GA	99a	4.7b	98a	7.8b	96a	27.3b	3.0b
SG	69cd	2.4c	69cd	4.4c	35b	25.1b	3.2b
NO	85bc	1.6cd	80bc	3.0cd	81a	19.7c	1.9c
SP	65d	0.8d	57d	1.5d	...[3]	...	...

[1] Species: CW = cottonwood; SY = sycamore; GA = green ash; SG = sweetgum; NO = Nuttall oak; SP = sweet pecan.

[2] Means in column followed by same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

[3] Not measured.

points; the other three species were unchanged. Twelve years later, at age 16, SY, GA, and NO survivals were essentially unchanged from year 4, and ranged from 81 to 96 percent. CW and SG survival had greatly decreased, to 45 and 35 percent, respectively. At the 5 percent level of significance, GA = SY = NO > CW = SG. SP survival at age 16 could not be reliably determined because of the number of water hickory (*Carya aquatica* (Michx. f.) Nutt.) sprouts in some situations. However, the SP survival rate was thought to be very low because of the absence of any *Carya* spp. stems in some plots where SP had occurred at age 4. SP was more "off-site" than the other species with an estimated midrange site index of 80 feet compared to 85 feet for GA, 90 feet for SY, SG and NO, and 95 feet for CW (Broadfoot 1976).

Survival among CW clones was not significantly different on the unweeded sites although mean clonal survival ranged from 38 to 58 percent. From two to four replications of each clone had only one or no surviving stem. Stem cankers of *Septoria, Phomopsis,* and *Fusarium* spp. were noticeable on some surviving trees. These cankers had played a part in the mortality as evidenced by the 15 stems of 4-to-8-inch diameter that had broken off 3 to 16 feet above the ground. The best surviving CW plot had 71 percent survival; poorest surviving plot had 17 percent survival.

Stem cankers, mainly *Botryosphaeria ribis*, were also noted on SG. Twenty-four percent of the living SG had brown leaves and nearly dead stems and/or cankers when measured in the fall after the 16th growing season. One SG plot had no living stems at age 16, compared to 62 percent survival at age 4, while another plot had only one nearly dead tree (4 percent survival), compared to 54 percent survival at age 4. As natural regeneration covered the study area these two plots became mainly a GA thicket in one case and a water hickory stand in the other. Best SG survival was 71 percent, down from 83 percent at age 4.

The individual NO, SY, and GA plots have had fairly consistent survival, from 75 to 100 percent, except for the one SY plot that has maintained 33 percent survival since the second year.

Average tree height at age 16, to the nearest foot, was 41, 29, 27, 25 and 20 feet, for CW > SY = GA = SG > NO, at the 5 percent level of significance. At age 4 the relationship was similar except SG was less than SY and GA. The tallest tree measured per plot varied from 41 to 60 feet for CW, 31 to 41 feet for SY, 30 to 41 feet for GA, 16 to 34 feet for SG, and 23 to 35 feet for NO. CW clones did not differ in height even though clonal means varied from 34 to 48 feet.

In the mixture of planted trees and natural regeneration that developed over the years, there were no suppressed CW and no dominant SG and NO at age 16 (table 2). While nearly half of the NO were supressed, the same percentage of SY and GA were dominant-codominant and only 10 percent suppressed. Of the 454 trees planted per acre, 28 percent of CW were dominant or codominant, 37 percent of SY, 45 percent of GA and 12 percent of each of SG and NO.

On the basis of crown class, all intermediate CW were intermediate to other planted CW. Three-fourths of the stems that were taller than intermediate planted trees of species other than CW or suppressed planted trees were some combination of natural GA, natural CW, water hickory, and the planted species itself. Other overtopping species included natural NO, natu-

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Table 2.—*Planted trees per acre, (percent of trees), and average d.b.h. and height by species and crown class at age 16 with no weed control.*

	Crown Class															
	Dominant				Codominant				Intermediate				Suppressed			
Species[1]	T/A[2]	(Pct)[3]	D.b.h.	Height	T/A	(Pct)	D.b.h.	Height	T/A	(Pct)	D.b.h.	Height	T/A	(Pct)	D.b.h.	Height
		%	*in*	*ft*		%	*in*	*ft*		%	*in*	*ft*		%	*in*	*ft*
CW	48	(24)	7.1	49.5	73	(37)	5.2	40.6	76	(39)	4.2	34.2	...	...	...	...
SY	6	(2)	5.1	38.5	157	(44)	3.8	32.4	151	(43)	2.7	26.1	39	(11)	1.8	19.7
GA	12	(3)	4.0	33.5	182	(44)	3.5	29.6	185	(44)	2.8	26.1	39	(9)	1.8	18.1
SG	...	...	...	...	54	(35)	3.8	29.4	85	(55)	3.1	24.6	15	(10)	2.8	18.7
NO	...	...	...	...	54	(15)	2.9	25.9	136	(39)	2.2	22.0	163	(46)	1.3	16.4

[1] Species: CW = cottonwood; SY = sycamore; GA = green ash; SG = sweetgum; NO = Nuttall oak.

[2] Trees/acre.

[3] Percent of trees within a species.

ral SG, American elm (*Ulmus americana* L.) black willow (*Salix nigra* Marsh.) boxelder (*Acer negundo* L.), honeylocust (*Gleditsia triacanthos* L.) persimmon (*Diospyros virginiana* L.), red maple (Acer rubrum L.), roughleaf dogwood (*Cornus drummondii* C. A. Meyer), sugarberry (*Celtis laevigata* Willd.), and willow oak (*Quercus phellos* L.).

DISCUSSION

When hardwoods are planted without weed control on cleared clay soils, some species are better able to survive and compete than others. In this test SY, GA, and NO survival was 80+ percent, and the trees grew fairly well through 16 years. A growth comparison may be made between trees that received weed control treatments (Krinard and Kennedy 1987) and those that did not. The 163 SY and 194 GA dominant-codominant trees per acre averaged 5 and 6 feet shorter, respectively, at age 16 than the 109 trees per acre of the same species in disk and mow plots at age 15. Unthinned NO, which was mowed for 5 years and either mowed or disked for the next 5 years, averaged 83 percent survival and 24 feet in height at age 15, compared to 81 percent and 20 feet in 16 years for NO with no weed control.

CW and SG, two species that did not do well without weed control, had less than 50 percent survival in 16 years and low vigor. Height of 16-year-old dominant-codominant CW was 16 feet shorter than thinned, disked, or mowed trees after 15 years. Unthinned SG that received weed control for 10 years averaged 76 percent survival and 28 feet tall at age 15, in contrast to 35 percent and 25 feet at age 16 for SG without weed control. Neither CW nor SG showed low vigor and accompanying canker problems where thinned after 5 years and where vegetation was controlled through 10 years.

The planting area for the study was intensively site prepared prior to planting in preparation for random assignment of weed control treatments, and thus some vegetative control was obtained at that time. All planting survival may therefore have fared better than on sites simply sheared and the debris pushed to one side, and some sprout development eliminated because of root-stump destruction. Conversely, disking and resulting bare soil exposure may have been responsible for the greater than expected natural CW establishment and the black willow. At age 4 survival ranged from 91 percent for disked plots to 80 percent for mowed plots to 76 percent for check plots. In spite of the site preparation, the area has come back to be well stocked to the expected slackwater site species of mainly GA and water hickory, along with a mixture of 8 to 10 other species.

At age 16 there seems to be sufficient numbers of dominant and codominant planted SY and GA to be components of the future stand without any management steps required. On these sites GA naturally reproduces without need for planting. Obviously, the oaks can sustain themselves and more than sufficient numbers of codominants and intermediates exist to assure an oak component in the sawtimber stand. However, if oaks are to be favored, the option is available to do some release for better distribution of free-to-grow trees.

Some hardwood species may be planted on cleared clay soils without followup weed control, and adequate survival and growth through 16 years may be expected. However, it would appear that at least 1 year of weed control, considering the cost of clearing already invested, would be the prudent thing to do because all the species can be grown where weeds are controlled. This information would have no bearing at all on planting old fields with clay soils without weed control because of

an entirely different set of grass and weed conditions. On this study's cleared site, competition to the planted trees appears to have mainly come from other tree species and vines rather than from grass and broad-leaved weeds.

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