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Bedding Improves Yellow-Poplar Growth on Fragipan Soils

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SUMMARY

Yellow-poplar can be grown on soils that have a shallow fragipan — but unless such sites are bedded, growth is likely to be extremely poor. In a Tennessee study, bedding increased height of planted yellow-poplar over 5 years, but fertilizer did not. Because of the cost of bedding and the availability of nonfragipan sites, it would ordinarily be better not to plant yellow-poplar on soils with shallow fragipans.

Additional keywords: *Liriodendron tulipifera* L., fertilization.

INTRODUCTION

Fragipan soils in middle Tennessee often support unproductive stands of blackjack (*Quercus marilandica* Muenchh.) and post (*Q. stellata* Wangenh.) oaks. A current proven management practice is to convert such sites to pine. The purpose of this study was to determine if intensive cultural treatments could make these shallow soils suitable for growing quality hardwoods. Because yellow-poplar (*Liriodendron tulipifera* L.) is site sensitive, it was chosen as the test species.

METHODS

The study area originally supported a stand of blackjack and post oaks. The soil (Dickson series, fine-silty, siliceous, thermic Glossic Fragiudults) had a fragipan at 15 to 20 inches. The site sloped about 2 percent to the south. All merchantable timber had been harvested from the site several years before. The resulting sprout stand was later burned, and in the following spring regrowth was treated with a mist-blower application of 2,4,5-T. In September, five beds about 4 feet wide, 12 to 18 inches high, and 360 feet long were prepared with a road grader. An unbedded area of equal size also was established, and both were set up in a split plot design with 10 replications. The beds and untreated rows were the major plots. Sixteen-tree row segments constituted the minor plots. Each received either no fertilizer, 150 lbs N/acre, or 150 lbs N/acre + 100 lbs P/acre. Fertilizer treatments were applied 1 month before planting.

Yellow-poplars (1-0 seedlings) grown from local seed were graded to a uniform root-collar diameter. Shoots were clipped to 12 inches; roots were pruned to 9 inches. Seedlings were hand-planted in April 1972 at a spacing of 6 feet within rows and 12 to 15 feet between rows. For 5 years, height measurements and survival counts were made each fall. Significance of the analysis of variance was tested at the .05 level.

RESULTS AND DISCUSSION

After 5 years, bedded yellow-poplar seedlings were considerably taller than unbedded seedlings (table 1). Height growth of bedded and unbedded seedlings was not improved by fertilization.

The average annual height growth of both bedded and unbedded seedlings appeared to increase at least through age 4 (table 2). At age 4, the growth of bedded seedlings was 2.8 times greater than that of controls — a 182 percent increase in growth. The increased rate of height growth due to bedding is likely to continue for several years.

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Table 1.—*Average height of yellow-poplar*

	Bedded			Not bedded		
	No fert.	150N	150N+ 100P	No fert.	150N	150N+ 100P
	Feet					
Planting ht.	.90	.92	.90	.89	.79	.72
Year 1	1.07	1.26	1.10	1.00	1.05	.93
Year 2	1.97	2.19	1.50	1.26	1.52	1.26
Year 3	2.73	3.03	2.14	1.62	2.03	1.69
Year 4	4.57	4.89	3.55	2.11	2.72	2.32
Year 5	6.30	6.60	5.32	2.36	3.26	2.90

Table 2.—*Mean annual height growth and total height of bedded and unbedded yellow-poplar seedlings*

	Mean height growth			Mean total height		
Year	Not bedded	Bedded	Increase[1]	Not bedded	Bedded	Increase[1]
	Feet		Percent	Feet		Percent
1	.19	.23	21	.99	1.14	15
2	.35	.74	111	1.35	1.89	40
3	.43	.74	72	1.78	2.63	48
4	.60	1.69	182	2.38	4.34	82
5	.46	1.74	278	2.84	6.07	114

[1]Due to bedding.

After 5 years, survival was significantly better on the unbedded plots (table 3). On the bedded plots, using N + P fertilizer resulted in significantly lower survival than using either N alone or no fertilizer.

The soil on which this study was performed has a shallow fragipan. The hardness and poor internal drainage of the fragipan prevent trees from rooting deeply. Planting yellow-poplar on soil beds increased the depth to the fragipan and helped keep some of the roots above the saturated subsoil in winter and spring. Bedding also concentrated the richer topsoil into the planting row where seedlings could use it more effectively.

Insufficient packing of the beds probably caused the lowered survival rates. The beds were fluffy after being pushed up by the road grader and were not mechanically packed, although they were allowed to settle over winter. Broadfoot and others (1972) maintained that loosening the soil is not always desirable as some plants require dense soil for good root-soil contact. Root-soil contact is doubly important for newly transplanted seedlings.

Weeds, chiefly blackberries and grass, grew on all plots, especially fertilized beds, and might have con-

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Table 3.—*Fifth-year survival of planted yellow-poplar*

	Bedded			Not bedded		
	No fert.	150N	150N+ 100P	No fert.	150N	150N+ 100P
Percent survival	85.0	83.8	70.0	93.8	86.2	93.8

tributed to seedling mortality or prevented a response to fertilizer. Russell (1977) found that both weed control and fertilization were necessary for best growth of planted yellow-poplar.

In spite of dramatic growth increases caused by bedding, heights of bedded plots were similar to those of the poorest yellow-poplar plantations of the region on soils without fragipans. However, if management plans require growing yellow-poplar on fragipan soils, bedding should make it possible. Other valuable, but less site-sensitive hardwoods, might reach commercial growth rates on bedded fragipan soils.

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