EFFECTS OF EIGHT NURSERY TREATMENTS ON YELLOW-POPLAR SEEDLING CHARACTERISTICS AND FIELD PERFORMANCE

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Because yellow-poplar (Liriodendron tulipifera L.) is the hardwood species most commonly planted in the Southeast, it is important to know which seedling characteristics are desirable for success in planting.

Yellow-poplar seedlings have been graded by root-collar diameter (2). Root length, seedling height, shoot-root ratios, and other characteristics have had less effect on survival (1). Seedling quality varies by mother tree and seedbed density (3).

Although root-pruned seedlings usually have more fibrous root systems than unpruned seedlings (3), little is known how root-pruning, top-pruning, and fertilization of seedlings affects survival and growth in plantations.

Methods

Seed was collected in the fall of 1960 from four mother trees in western Tennessee (A) and eight mother trees in the Cumberland Mountains (B). In December the 12 lots were sown for stratification in the seedbeds.[1]

In the spring of 1961 all beds received 100 lb./acre of ammonium nitrate. Six of the twelve progenies received an additional 100 lb./acre in June and another 100 lb./acre in July. In August three of the six progenies within both fertilizer treatments were rootpruned to 6 inches, and one-half of the seedlings from each progeny were top-pruned to 5 inches. Thus, eight nursery treatments were given; three progenies were represented in each treatment (table 1).

One lot of seedlings was lifted and outplanted in early February 1962 and another in early April. A split-plot design was used in three locations to determine the effects of nursery treatments and early and late planting on survival and growth.

[1]The Division of Forestry Development, TVA, produced the seedlings and established and measured one of the plantations.

Seedling Characteristics

TABLE 1.--Nursery treatments applied to open-pollinated progenies

Treatment	Ammonium nitrate	Pruning	Progenies
	Lb./acre		
1.....	100	none	B2,A17,A21
2.....	100	root	B7,B9,B16
3.....	100	top	B2,A17,A21
4.....	100	root + top	B7,B9,B16
5.....	300	none	B15,B1,A23
6.....	300	root	B13,B12,A5
7.....	300	top	B15,B1,A23
8.....	300	root + top	B13,B12,A5

Seedbed density differed because of variation in germination of seed from mother trees; in addition, it was related to some seedling characteristics. In general, the high-density beds had smaller root-collar diameters (table 2).

TABLE 2.--Average effect of eight nursery treatments on seedling characteristics

Treatment	Root length	Diameter	Height	Root branching index [1]	Density
	In.	*1/16 in.*	*In.*		*Trees/sq. ft.*
1....	8.77	2.80	6.53	3.18	28
2....	6.63	2.28	9.88	4.01	49
3....	7.26	2.43	6.34	3.64	32
4....	8.01	2.57	9.06	3.89	42
5....	8.57	4.12	22.10	3.97	15
6....	7.94	4.07	18.00	4.30	18
7....	8.06	3.18	14.69	3.74	26
8....	6.32	3.11	9.76	4.43	26

[1] Ranging from 1 (carrot-type) to 5 (finely branched).

High nitrogen fertilization mainly increased the height of the seedlings; it usually did not affect root length or root branching. Rootpruned progenies developed more root branches than unpruned progenies. Top-pruning resulted in shorter seedlings with smaller diameters and decreased root lengths.

There is an interesting interaction of pruning and nitrogen fertilizer levels on diameter (table 3). With low nitrogen fertilization (100 lb. ammonium nitrate per acre), the rootpruned seedlings increased in diameter when top-pruned. However, with high nitrogen fertilization (300 lb. ammonium nitrate per acre), the root-pruned seedlings decreased in diameter when top-pruned. These results appear to be independent of stand density and are for all progenies. Thus, the effect of top-pruning on root-collar diameter depends upon the level of nitrogen in the soil.

Field Performance

The growth rate was poor, but survival was satisfactory. On the average the early planting (February) resulted in 79 percent survival after 3 years in the field, while late planting (April) gave 82 percent survival. Only in one location was the difference statistically significant (76 vs. 83 percent).

Height and survival data after 3 years in the field for the 3 locations (Ames in western Tennessee, Scott in the Cumberland Mountains, and Norris Lake in eastern Tennessee) are given in table 4. The difference in site between Ames (relatively good) and Scott (rather poor) resulted in a large difference in height but no appreciable difference in survival.

Nursery seedlings grown with 300 lb. of added ammonium nitrate per acre were onehalf foot taller when planted in the field than those grown with only 100 lb. of ammonium nitrate. After three growing seasons they were still one-half foot taller. Average field survival for seedlings from high nitrogen beds was 83 percent, compared to 78 percent for the seedlings with less nitrogen.

The root-pruned seedlings from low nitrogen beds had the poorest survival whereas those from high nitrogen beds had the best (73 vs. 90 percent); this indicates that only large, vigorous seedlings should be root-pruned in the nursery.

Top-pruning alone or in combination with root-pruning did not benefit survival or growth.

Treatments 6 and 8, both involving 300 lb. of nitrogen and root-pruning, resulted in superior survival. These two treatments had the highest root branching index but not the largest root collar diameter; therefore, root branching may be a better grading criterion than diameter.

TABLE 3.--Effect on diameter of pruning, by progeny and nitrogen levels

Progeny	Nitrogen	No pruning	Root-pruning	Top-pruning	Root- and top-pruning
	Lb./acre	*1/16 in.*	*1/16 in.*	*1/16 in.*	*1/16 in.*
B 2.....	100	2.80	--	2.19	--
A 17.....	100	2.90	--	2.77	--
A 21.....	100	2.69	--	2.34	--
B 7.....	100	--	2.32	--	2.68
B 9.....	100	--	2.88	--	3.22
B 16.....	100	--	1.64	--	1.80
B 15.....	300	4.18	--	2.74	--
B 1.....	300	4.47	--	3.07	--
A 23.....	300	4.06	--	3.72	--
B 13.....	300	--	4.55	--	3.78
B 12.....	300	--	3.72	--	2.81
A 5.....	300	--	3.93	--	2.71

TABLE 4.--Survival and height after three growing seasons in the field

Treatment	Height				Survival			
	Ames	Scott	Norris	Average	Ames	Scott	Norris	Average
	Feet	*Feet*	*Feet*	*Feet*	*Percent*	*Percent*	*Percent*	*Percent*
1.....	2.00	1.00	1.21	1.40	81	80	78	80
2.....	2.34	1.03	1.37	1.58	82	70	68	73
3.....	1.88	.93	1.31	1.37	82	80	84	82
4.....	1.81	.93	1.54	1.43	78	75	80	78
5.....	3.09	1.94	2.17	2.40	87	77	80	81
6.....	2.57	1.64	2.14	2.12	89	90	92	90
7.....	2.63	1.34	1.65	1.87	84	71	72	76
8.....	1.79	1.28	1.53	1.53	86	91	82	86
Average....	2.26	1.26	1.62	1.71	84	79	80	81

Literature Cited

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