QUALITY OF YELLOW-POPLAR PLANTING STOCK VARIES BY MOTHER TREE AND SEEDBED DENSITY

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Survival and growth of planted yellow-poplar are very important in the Southeast, where it is one of the most widely planted hardwoods.[1] Past research has shown that survival and growth can be increased through use of high-quality planting stock; quality is generally based on root-collar diameter (3, 4). This paper reports the effect of seedbed density, seedbed root pruning, and seed origin (from various "mother trees") on seedling root-collar diameter. The influence of mother tree and seedbed root pruning on planting survival is also considered..

Methods

Seed from eight trees in western North Carolina was collected in 1959, kept separate by mother tree, stratified, and sowed in the spring of 1960. Roots of half the seedlings from each mother tree were pruned in the nursery bed at a depth of 8 inches in September 1960; an undercutting bar was used to lift seedlings. In the early spring of 1961 all seedlings were lifted, and seedbed densities were determined for each 2- by 4-foot mother tree plot (eight plots for each tree). They were then graded to determine the proportion of plantable seedlings- -those between 0.20 and 0.60 inch in root-collar diameter (3, 4). Seedlings of the "plantable" category were planted on cleared forest land to test the effect of parent tree and root pruning on seedling survival.

Results

The variation in seedbed germination among the eight seedlots was highly significant. Bed density averages by mother tree ranged from 8.9 to 20.2 seedlings per square foot (table 1); individual plot densities were 4.7 to 27.2 seedlings per square foot.

Seedling quality varied considerably with seedbed density. At low densities most of the seedlings were of plantable size (0.20-0.60 inch), whereas high densities produced many seedlings too small to plant. However, the number of plantable seedlings per square foot increased with bed density up to the limits of the data. Extrapolation beyond the data indicated that the maximum plantable seedlings, about 25 per square foot, might have been

TABLE 1.--Average seedbed density by mother tree

Mother tree number	Seedbed density	Mother tree number	Seedbed density
	Seedlings per square foot		*Seedlings per square foot*
1	18.5	5	14.4
2	12.5	6	19.0
3	20.2	7	14.1
4	15.8	8	8.9

[1]Grateful acknowledgment is given to the Tennessee Valley Authority for cooperation in planning the study and for use of their Clinton, Tenn., nursery.

produced at a bed density between 45 and 50 seedlings per square foot. This is only 3.6 plantable seedlings more than the number that would have been produced at a bed density of 30. The number of undersize seedlings per square foot increased rapidly at the higher bed densities and might have been about half the total produced at a density between 45 and 50 (fig. 1). The number of oversize seedlings varied with seedbed density, but they were not a serious problem in the test.

Seedling quality varied significantly with mother tree. Because seedbed density varied by mother tree and seedling quality varied by seedbed density, there was an indirect relationship between mother tree and seedling quality. To determine the direct effect of mother tree on seedling quality, the effect of seedbed density was removed in a covariance analysis. This analysis removed most of the variation in large seedlings, but it left a significant variation in small seedlings that is attributable only to mother tree.

Root-shoot weight ratios were determined on 50 plantable root-pruned seedlings and 50 plantable unpruned seedlings from each of six progeny groups (extra plantable seedlings were not available from two progeny groups). Individual "t" tests showed root pruning in the nursery bed increased root weight in relation to shoot weight in four of the six groups. Root-pruned seedlings also tended to have a more fibrous root system than unpruned seedlings (fig. 2). The root-pruning treatment had no effect on seedling size distribution.

First-year survival of planted seedlings varied significantly by mother tree but not in relation to the presence or absence of root-pruning (table 2).

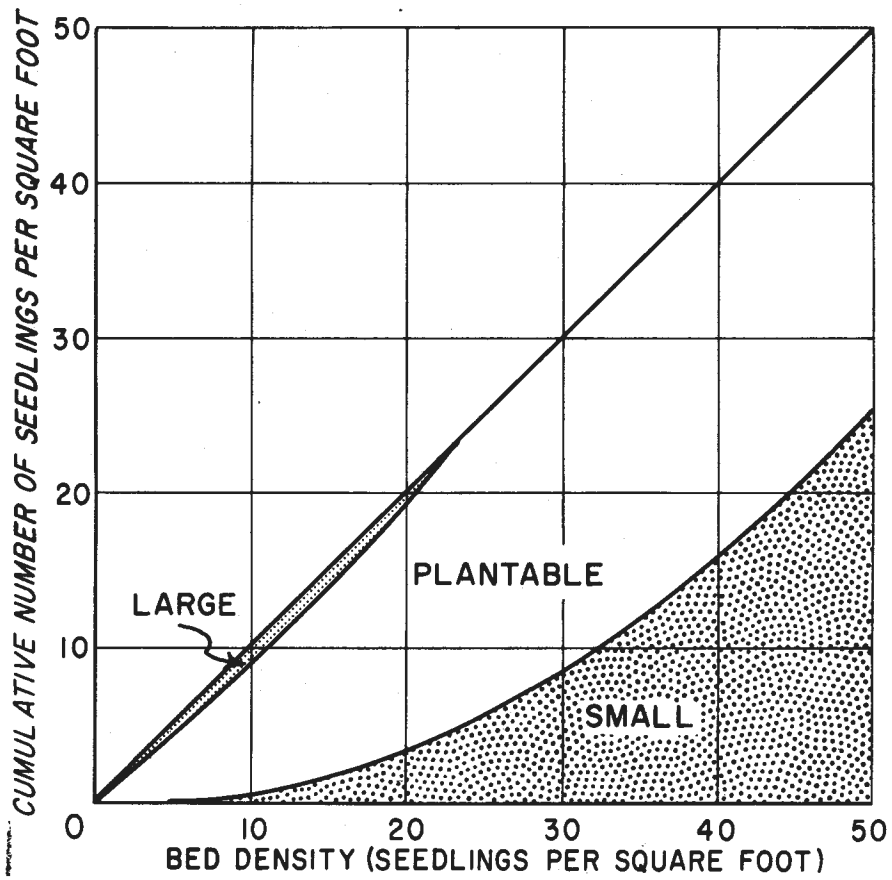

Figure 1.--Relation between bed density and cumulative number of seedlings in the small, plantable, and large groups.

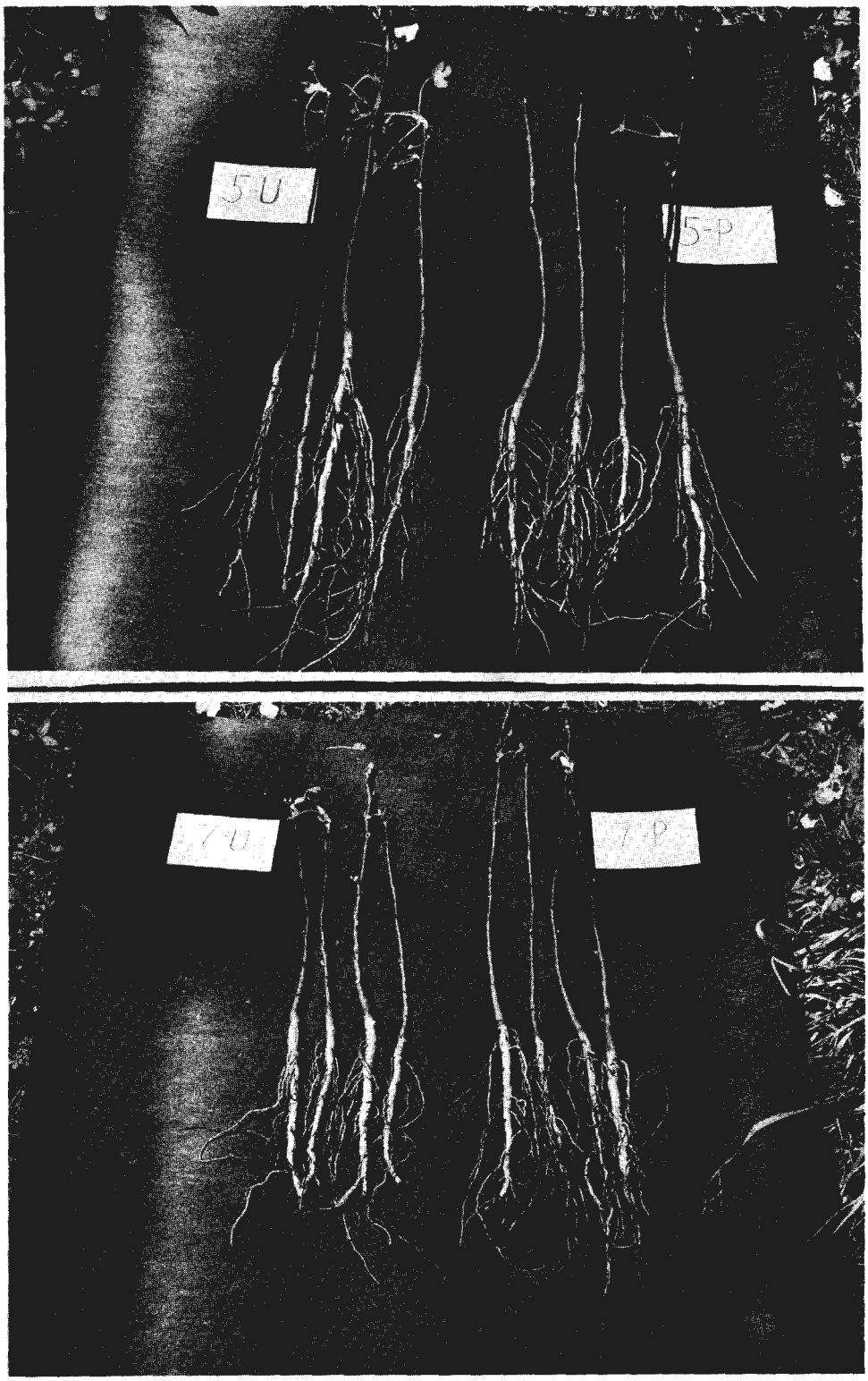

Figure 2.--Root-pruned and unpruned seedlings from tree numbers 5 (top) and 7 (bottom). Pruned seedlings are on the right in both pictures.

TABLE 2.--Average first-year survival of planted seedlings, by mother tree and presence or absence of root pruning

Mother tree number	Roots pruned	Roots unpruned	Average
	Percent	*Percent*	*Percent*
1	86.9	89.3	88.1
2	95.8	95.1	95.4
3	95.3	94.0	94.6
4	90.1	72.2	81.1
5	96.1	74.4	85.2
6	92.2	92.8	92.5
7	96.1	99.8	97.9
8	94.5	76.8	85.6
Average	93.4	86.8	90.0

Discussion

Root-collar diameter of yellow-poplar seedlings grown in nursery beds can be controlled considerably by regulating bed density. However, all variation in seedling size is not related to bed density. Some variation is caused by differences in vigor among groups of seedlings from different mother trees. Some trees tend to produce a higher percentage of small seedlings than some others. This could reflect different degrees of self-fertilization (1) among individual trees as well as other differences in inheritable vigor. Late germination of seeds from some trees may also be a factor (2).

The optimum seedbed density to be used in growing yellow-poplar seedlings varies according to growing conditions at individual nurseries. Nurseries with very favorable growing conditions for yellow-poplar would need to grow the seedlings at a high density in order to keep them from getting too large, while nurseries with less favorable conditions could not use high densities without producing too many small seedlings. Densities used at individual nurseries will also depend upon production policy--maximum production of plantable seedlings per square foot or maximum production efficiency. In this study, maximum production of plantable seedlings might have been achieved at a bed density slightly above 45. However, much more efficient production, with less waste in small seedlings, was achieved at densities of 25 to 30 seedlings per square foot.

Although the quality of yellow-poplar planting stock can be controlled by grading out oversize and undersize seedlings, use of proper seedbed densities permits further improvements. However, more research is required before inherent variation in vigor, as shown by this study, can be used to increase planting stock quality.

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