RESULTS FROM TEN LOBLOLLY PINE PROVENANCE TESTS IN TENNESSEE

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Ten seed source tests of loblolly pine in Tennessee (Table 1) were measured and analyzed for growth characteristics during 1969 and 1970. The provenance tests were evaluated to determine from which locations within the species range superior phenotypes should be selected for establishment of seed orchards of loblolly pine in Tennessee. In addition, five needle characteristics were studied to determine if needle variation follows regional patterns.

GROWTH RATE

Growth data from the ten provenance tests evaluated indicate that trees from the northeast part of the species range are best suited for planting in Tennessee. Loblolly pines from deep south Coastal Plain sources consistently showed the poorest growth. Trees from northeast sources had the fastest growth in height, diameter, volume of wood per tree and volume of wood per acre. The only exception was the South Carolina Piedmont source; trees of this provenance had the greatest volume growth per acre at the Ames plantation. This result was in part a reflection of unusually high survival, but South Carolina Piedmont trees also had good growth at the Chickasaw, Friendship and Highland Rim plantations.

The adaptability of loblolly pine for planting in Tennessee appears to be related to mean length of the freeze-free period of the seed source. Trees of provenances with between 190 and 210 freeze-free days (northeast sources) produced the most wood; this period corresponds to the mean freeze-free period of most of the provenance test locations. Provenances with freeze-free periods between 210 and 240 days (inland sources) produced trees with intermediate growth and trees adapted to longer freeze-free periods (deep south Coastal Plain sources) generally yielded the poorest results. Wood production expressed as tons per acre followed a pattern very similar to volume growth per acre. At Counce and Ames there was a very strong correlation between these characteristics with r^2 . 98%. Figures 1 through 4 graphically depict mean wood production of trees from north-eastern, inland and deep south sources in the Ames, Highland Rim,

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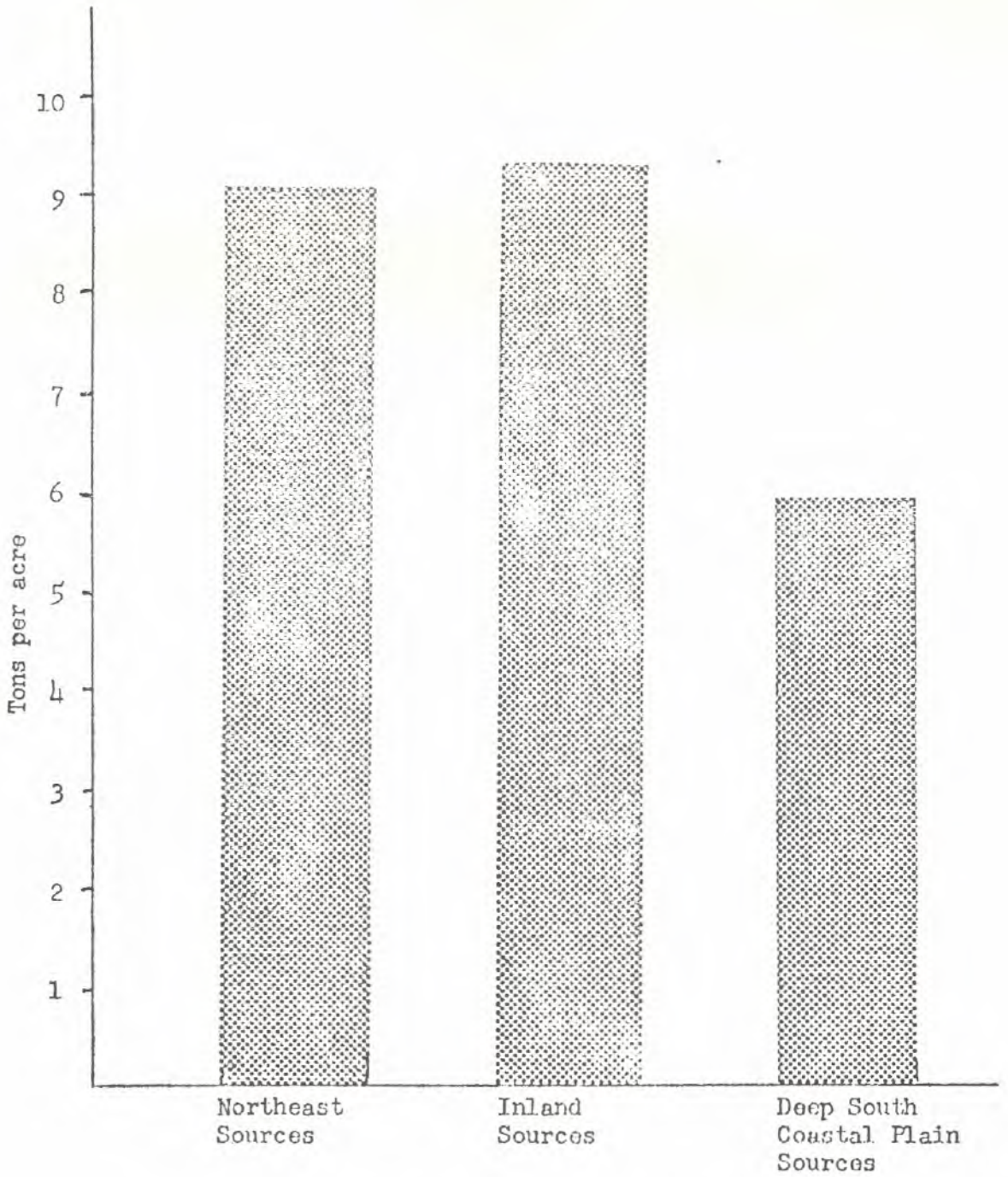

Figure 1. Wood production of loblolly pine from the three primary geographic provenance areas in nine years at the Ames Plantation.

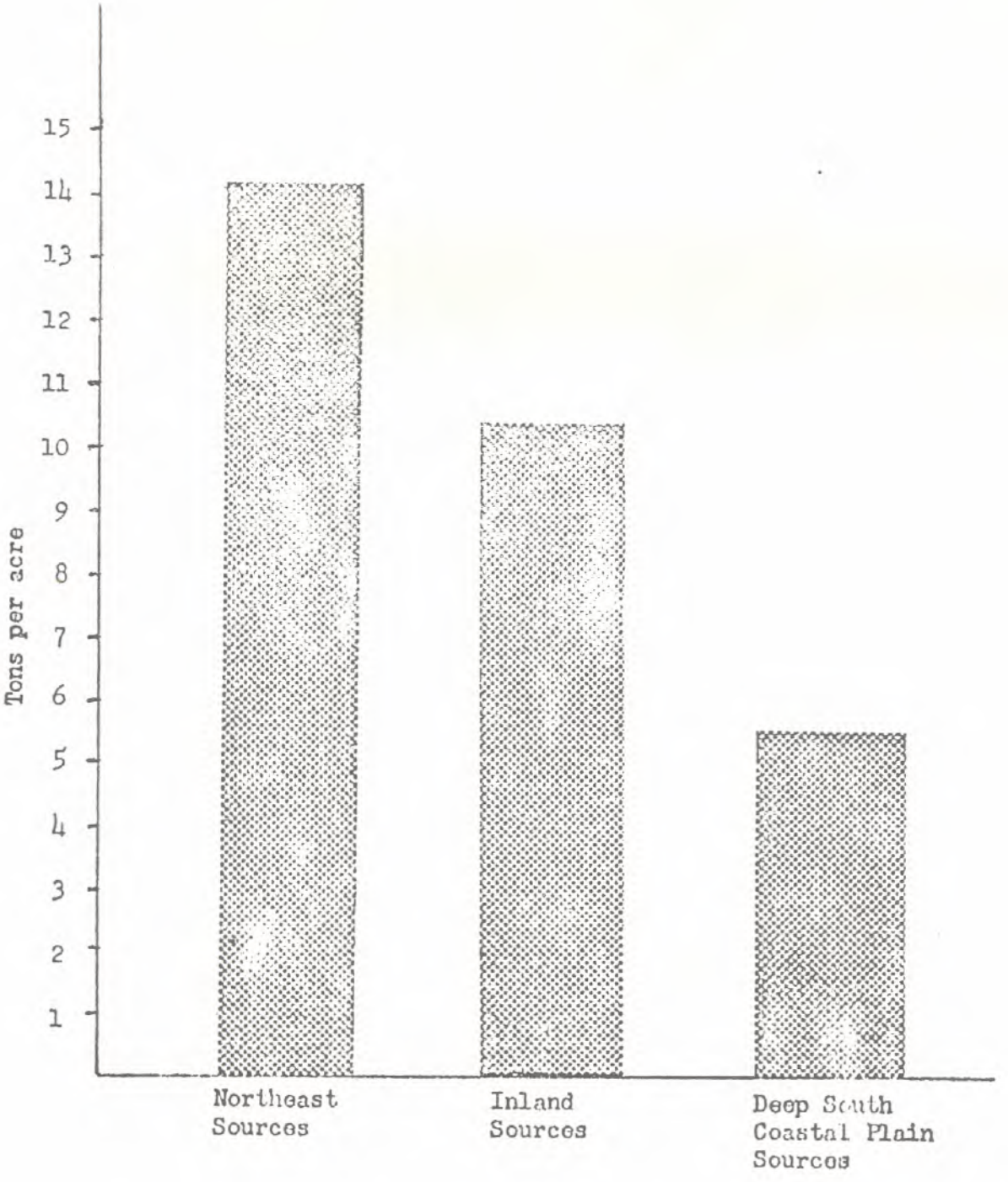

Figure 2. Wood production of loblolly pine from the three primary geographic provenance areas in eight years at Highland Rim.

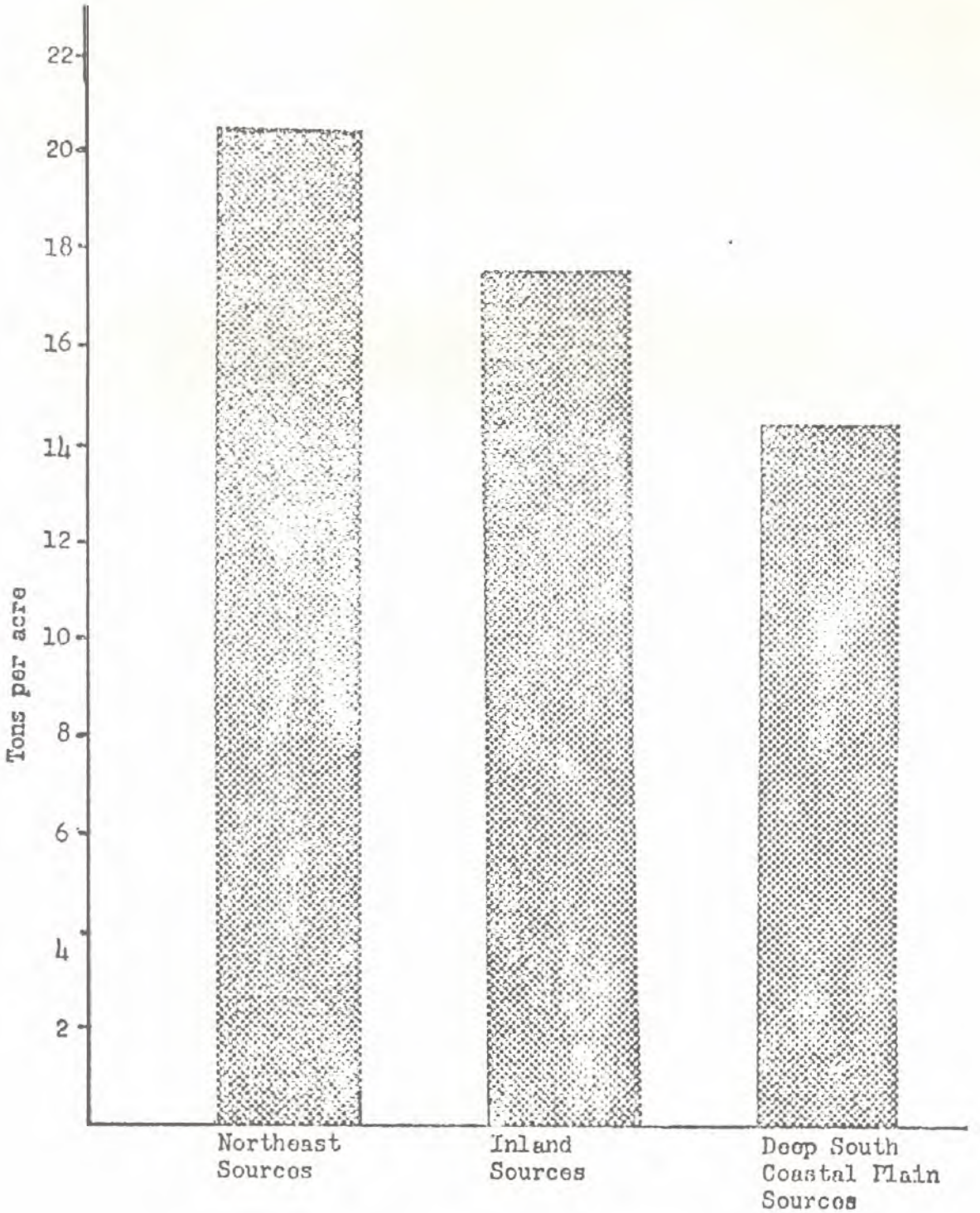

Figure 3. Wood production of loblolly pine from the three primary geographic provenance areas in ten years at Counce.

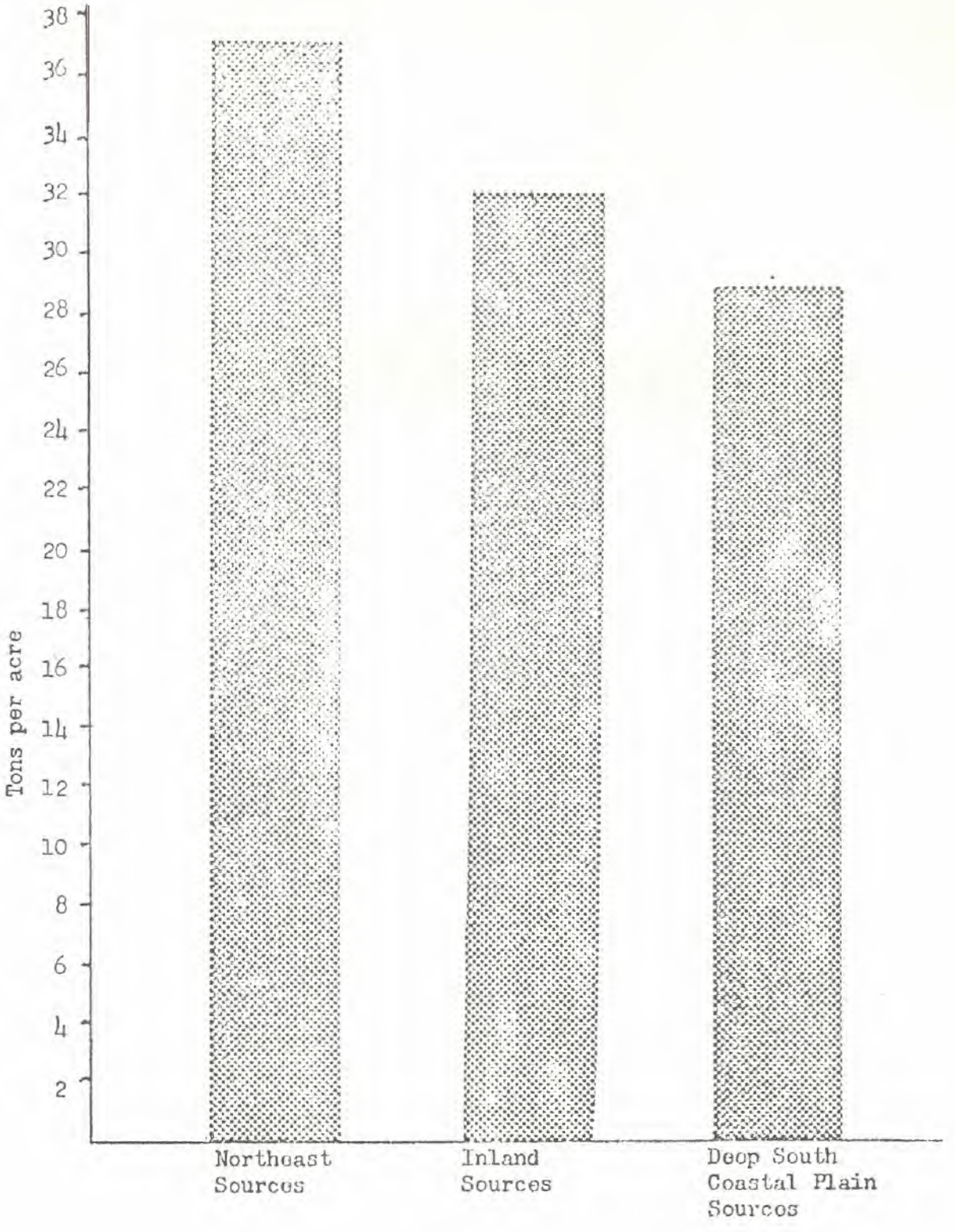

Figure 4. Wood production of loblolly pine from the three primary geographic provenance areas in fourteen years at Stephen's Switch.

Counce, and Stephen's Switch plantations. All sources north of and including North Carolina were combined into the northeast group, all Piedmont and inland sources south of North Carolina were in the inland group and all Coastal Plain provenances south of North Carolina were included in the deep south Coastal Plain sources. Histograms for the Highland Rim, Counce, and Stephen's Switch plantations indicate that the trees of northeast sources have the highest wood production. At Ames however, trees from inland sources produced slightly more wood per acre than trees of the northeast sources. Ames is the most southwestern planting location and has the mildest climate of the four plantations. Higher wood production of trees from inland sources at Ames would, therefore, seem to support the hypothesis that adaptability of loblolly pines for planting **in Tennessee is** related to the mean freeze-free period.

WOOD SPECIFIC GRAVITY

Few significant differences along sources were found for specific gravity determined from 11 mm. wood cores (extracted with benzene and alcohol). However, there was a trend for trees from northeastern sources to have the highest specific gravity at five planting locations. Evidence for this trend appeared to be strongest at Ames where a Virginia Piedmont source was ranked highest and the Southern source lowest. This ranking was even more apparent when the Southern source was separated into its component Southwest and Southeast sources. Analysis of variance at this location now revealed significant differences among seed sources and the Duncan's Multiple Range Test indicated that trees from the Virginia Piedmont had significantly higher wood specific gravity than trees of all other sources. Trees of the Southeast source had significantly lower specific gravity wood than trees of all other sources. However, there is conflicting evidence from some of the other provenance test plantations; a southern source was ranked high with regard to specific gravity in four locations. Apparently the regional variation pattern for wood specific gravity is weak and not consistent with the patterns observed in studies of natural variation. The large among-tree variation and apparent genotype-environment interaction tend to confuse any regional pattern.

Correlation analysis for the 10-year-old Ames plantation (183 trees sampled) and the 15-year-old Stephen's Switch plantation (95 trees) disclosed no correlation between specific gravity and d.b.h. The well-known relationship between age and specific gravity was confirmed, with older plantations having higher values than younger plantations. At Ales the average specific gravity was 0.364, at Stephen's Switch 0.381 and the 20-year-old Norris-Loyston plantation averaged 0.406.

NEEDLE CHARACTERISTICS

Five needle characteristics were evaluated; number of needles per fascicle, needle length, number of stomatal lines per needle, number of serrations per centimeter of needle margin, and number of stomates per centimeter of needle length. The variation in number of needles per fascicle and needle length was apparently environmental; no geographic pattern was evident. Data for number of stomatal lines and number of serrations per centimeter indicate that trees from eastern sources have needles with higher numbers of stomatal lines than those of western sources, and that trees from inland sources have needles with higher serration frequencies than trees from coastal sources.

No geographic pattern for stomatal frequency was evident. However, needle data from the Ames plantation were significantly correlated ($r=0.535$) with data from parental trees observed in a 1958 natural variation study. This correlation implies the existence of some genetic control over the geographic variation in stomatal frequency.

CONCLUSIONS

Statistically significant growth differences were consistently obtained in only four test plantations. Three of these had the greatest number of sources represented. The only plantation with a large number of sources (eight) which did not yield significant differences among sources was the one at Norris-Loyston where only three replications were used as opposed to the four replications present in all other tests. In addition, statistical significance was obtained in provenance tests only where widely divergent sources were represented. Apparently, to detect differences among provenances where relatively similar seed sources are represented, either number of seed sources or number of replications must be increased.

Based on these data, it is recommended that most loblolly pines to be used in establishment of seed orchards in Tennessee should be selected from Maryland, Virginia, and North Carolina.