

EARLY RESULTS OF A SUGAR MAPLE PROVENANCE STUDY

George E. Howell^{1/}

In 1964 the Burlington project of the Northeastern Forest Experiment Station began a provenance study of 30 sugar maple (Ater saccharum Marsh.) sources ranging from Oklahoma to New Brunswick. This study is designed to assess the nature and extent of variation in sugar maple and to provide juvenile-mature correlations of certain characteristics, including sap sugar concentration.

In the fall of 1964, open-pollinated seed collections were made from 8 trees in each of 30 provenances. The identity of each progeny was maintained to study within-provenance variation. Seeds for the Vermont planting were stratified and germinated in the spring of 1965, and as seedlots germinated, they were planted in five prepared beds in the state nursery at Essex Junction, Vermont. Excess germinated seeds were planted at the same time for mortality replacement, and for an outplanting made at Parsons, West Virginia, in 1968. Seeds were also distributed to cooperators in Maine, Quebec, New York, and Michigan.

The germinated seeds were planted in a complete randomized block design with one 2-tree plot of every progeny in each of 5 replicates laid out as adjacent nursery beds. The plots ran parallel to the beds. The seedlings were planted on an 8-inch x 8-inch spacing in 128 rows of 4 and were bordered on either side by a buffer row of seedlings.

The seedlings were carefully handled to obtain uniformity in the nursery. The young plants were shaded, irrigated, and cooled by sprinkling to prevent heat and drought damage, and they were heavily mulched with salt marsh hay each fall to reduce winterkill and prevent frost-heaving. Twelve-inch high hardware cloth was erected around the beds, and poison was distributed to prevent rodent damage.

MEASUREMENTS AND ANALYSES

Height, diameter, presence and absence of forking, date of budbreak and budset, and sap sugar concentration were recorded in the nursery periodically during the period May 1966 to April 1967. Data were recorded directly on IBM port-a-punch cards for computer analysis. Differences among provenances in 2-year heights were tested by analysis of variance.

Two of the characters, forking and survival, were assessed but were not analyzed statistically. Average heights of provenances were plotted over percent of seedlings forking to show the relationship between forking and height growth. Survival data were summarized by ranking 1966 provenance survival from highest to lowest.

RESULTS AND DISCUSSION

Two-year mean height of provenances ranged from 16 cm. (provenance 24, Bradley, Maine) to 38 cm. (provenance 36, Jericho, Vermont). Differences among provenances in height growth were highly significant. The fact that replicate differences were also significant suggests that such factors as variation in time of seed germination and planting (ranging from May to late summer), variation in planting technique, and planting shock partially masked the genetic expression of growth differences. It is possible that the effects of these factors were not outgrown by the end of the second growing season and that the differences found were not true indications of seedling or mature provenance performance.

^{1/} Formerly Associate Geneticist, Northeastern Forest Exp. Sta., Forest Service, U.S.D.A., Burlington, Vt., now a graduate student at Michigan State University, East Lansing, Mich.

In incidence of forking there were large differences among the provenances: In provenance 27 (Amasa, Michigan) 28 percent of the seedlings were forked, as opposed to only 7 percent in provenance 24 (Bradley, Maine). Average height plotted against frequency of forking revealed no clearcut relationship (fig. 1). However, there may have been an increase in forking with increased mean provenance height. If this were substantiated it would suggest that the smallest seedlings may simply not have had a chance to fork, perhaps because of reduced growth rate. If such a pattern actually exists, it should show up more clearly in later years after the nursery effects are outgrown.

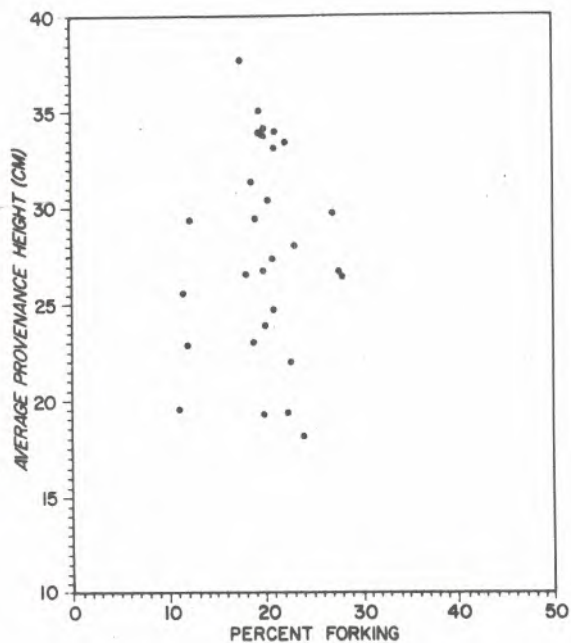


Figure 1. -- Relationship of average height and frequency of forking of provenances.

First-year seedling survival ranged from about 24 percent (provenance 24, Bradley, Maine) to about 52 percent (provenance 35, Fairfield, Vermont). This included pre- as well as post-germination mortality, the former resulting in insufficient numbers of germinates to fill all plots in a few provenances. The nine most successful provenances, as measured by survival, were from northern New England and upper New York State, all lying north of latitude N 42 31'.

CURRENT AND FUTURE WORK

In the spring of 1968, the 3-0 seedlings were outplanted in a 2.5-acre meadow in Fairfax, Vermont. Sufficient lime and superphosphate to raise the soil pH to 5.0, and the phosphorous level to that of productive corn soil, were applied before plowing and harrowing. The seedlings were planted at 5 feet x 10 feet spacing and were mulched with black polyethylene film to hold down grass and weed competition. Only four deaths have been observed at the end of the growing season among the nearly 2,400 trees outplanted.

Measurement of growth characters will resume this fall, and sap measurements will be made as weather and tree size permit. More extensive analysis will be resumed after the 1969 or 1970 growing season to test within- as well as between-provenance differences.

Thinnings are scheduled approximately at ages 18 and 33 years, when it is estimated that significant between-tree competition for growing space will occur. Measurements in the outplanting are contemplated annually for the first five years, then every fifth year to the termination of the study at age 40 or 50 years: