

DIVERSITY AMONG PROGENIES OF SELECTED PHENOTYPES
OF YELLOW BIRCH

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Abstract .--Five years after planting on the Maryland coastal plain, ten progenies of Betula alleghaniensis, grown from seed of selected open-pollinated trees in Maine, New Hampshire and Vermont, ranged from 6.9 to 10.2 feet in height and from 52% to 92% in survival. At eight years, 42% to 81% of the stems had one or more forks, and 7% to 53%, two or more forks. In all above characteristics, the progeny from Grafton County, New Hampshire, was most outstanding. The percentage of trees with two or more forks per stem was inversely correlated to the elevation of the seed source ($r = -.63$). The advance of flushing leaves in mid-April was also studied, but differences among individual populations were below the 0.05 level of significance.

Additional keywords: Betula alleghaniensis, height growth, survival, stem quality, leaf flushing.

Yellow birch (Betula alleghaniensis Britton) is an important component of forests in eastern regions of Canada and the United States. Its range extends from Newfoundland and Nova Scotia in the east to Minnesota in the west, and along the Appalachian Mountains to Georgia in the south (Gilbert 1960). Maryland has a few scattered stands of yellow birch in its western counties.

Wood of yellow birch is in high demand for valuable products such as veneer and furniture. This contributes to its rating as one of the most valuable species of northern hardwoods. Various silvicultural methods are used for its perpetuation and regeneration (Burton 1969, Zillgitt and Eyre 1945). Also, ecological and practical information is gathered for its natural and artificial establishment (Goodman and Krefting 1960, USDA 1974). With increasing interest in direct seeding and planting nursery-grown trees, it is important to select the best seed sources. Such sources can be selected geographic stands, selected superior phenotypes or special seed orchards.

MATERIALS AND METHODS

This experiment was designed to study the variation in yellow birch grown from seed of selected open-pollinated trees in New England - four in Main, three in New Hampshire and three in Vermont. The phenotypes were selected on the basis of outstanding height growth, stem straightness, branch-angle, etc. Detailed data on their location and characteristics are recorded in the Select Tree Register maintained by Region 9 of the Forest Service, USDA.

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Seeds were collected and sown in the New Hampshire State Forest Tree Nursery in Fall 1972. Two-year-old trees used in this experiment were obtained in Spring 1973.

The plantation was established in early May on the property of the Chesapeake Bay Foundation, near Annapolis, Maryland. The area is known as the Meredith Creek Recreation Center, located less than one mile southwest of the Chesapeake Bay Bridge. It is a level site elevated about 20 feet above sea-level, representative of Maryland's coastal plain with deep fertile soil, mild climate and a long growing season.

The ten experimental populations were planted at random in each of five blocks. The plots were 5-tree rows with trees spaced every four feet within the row-plots, and eight feet between the rows and between the plots. This experimental design offered the following degrees of freedom (df): 9 for populations, 4 for blocks, 36 for error, and 49 for total.

Data on survival rate, tree height and advance in flushing new leaves in mid-April (1t±) were collected at five years after planting in April 1978. Grades of advance in tree flushing ranged from 1 = no leaves to 10 = leaves fully developed. Number of forks in the stems was recorded in June 1981, at eight years after planting. Analysis of variance was calculated with the University of Maryland computer.

RESULTS

Survival

Survival rates at five years after planting ranged from 52% to 92% (Table 1). This variation among the individual populations was not significant at 0.05 level. However, on the average the progenies from Vermont showed somewhat higher mortality than those from Maine and New Hampshire. It is possible that they were less adapted to Maryland's maritime climate.

Height

Seven-year heights ranged from 6.9 feet to 10.2 feet. Considering the plantation mean as 100%, this variation extended from 85% to 126%. The slowest growing progeny (G-30) originated from Vermont; the most rapidly growing - from Grafton County in New Hampshire. In general, the heights of populations from any single state were variable. For example, the height indices of the populations from New Hampshire ranged from 89% to 126%, and those from Vermont, 85% to 107%. No additional height measurements were made during the growing season in mid-June 1981, when stem quality was assessed. Visual observation suggested that there was no significant change in the rank of growth rate, and "Grafton" progeny was the most outstanding.

Table 2.--Survival, growth rates and stem characteristics of ten progenies of yellow birch grown from seedlots collected from selected open-pollinated trees in Maine, New Hampshire, and Vermont, studied near Annapolis, Maryland.

| (1) | Data code: | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|-------------------|--|-----------|----------------------|---------------------------|--------------------|--------------|--------------|-----|
| Seed lot no. | Provenance of mother trees State county, location | Elevation | Seven-year-old trees | | Leaves on April 18 | Stems with | | |
| | | | Survival | Height actual relative | | 1 or > forks | 2 or : forks | |
| | | feet | % | feet | % of M | grade | % | % |
| | <u>New Hampshire</u> | | | | | | | |
| W-34 | Grafton, Ellsworth | 1,500 | 92 | 10.2 | 126 | 4.1 | 42 | 13 |
| W-85 | 3, Chatham Rd. | 750 | 60 | 7.4 | 91 | 5.4 | 70 | 20 |
| W-77 | Rumney, Stinson | 1,500 | 68 | 7.2 | 89 | 3.3 | 67 | 18 |
| | <u>Maine, Oxford Co.</u> | | | | | | | |
| W-52 | Rt. No. 113, #305 | 1,600 | 60 | 8.8 | 109 | 5.8 | 74 | 12 |
| W-28 | Kings Hwy., #221 | 1,000 | 72 | 8.3 | 102 | 5.5 | 78 | 53 |
| W-36 | Birch Regen., Rd., #312 | 900 | 80 | 7.8 | 96 | 3.8 | 62 | 23 |
| W-27 | Kings Hwy., #220 | 1,050 | 68 | 8.0 | 99 | 4.5 | 81 | 42 |
| | <u>Vermont</u> | | | | | | | |
| G-36 | 1, Gonya Brooks Rd. | 1,500 | 52 | 8.7 | 107 | 3.8 | 62 | 8 |
| G-35 | 3, Pine Brook, #581 | 2,200 | 56 | 7.6 | 94 | 4.7 | 59 | 7 |
| G-30 | 3, Arlington Twn. Rd. | 1,600 | 60 | 6.9 | 85 | 3.1 | 66 | 18 |
| LSD at 0.05 level | | | -- | 3.0 | 37 | -- | -- | 44 |
| F-value | | | 1.7 | 1.9 | 1.9 | 1.2 | .8 | 1.8 |

- (1) W = White Mountain National Forest; G = Green Mountain National Forest.
(5) M = Plantation mean (8.1 feet).
(6) Grades of leaf-flushing on April 18, 1978: 1 = no leaves, 5 = small leaves, 10 = normal-sized leaves, and intermediate grades.

Advance in Leaf Flushing

In mid-April (4/18/78), advance of leaf flushing by individual trees ranged from "no leaves" (grade 1) to "fully developed leaves" (grade 10). Averages for different populations varied from grades 3.1 to 5.8. From the statistical point of view this variation was below the 0.05 level of significance. However, on the average some progenies like W-52 from Maine included more trees with fully developed leaves than some others from Vermont (G-30).

Forked Stems

Over one half of the nine-year-old trees had stems with forks. The number of trees with one or more forks per stem in different progenies ranged from 42% to 81%. This variation, however, was below the 0.05 level of significance. The number of trees with two or more crooks ranged from 7% to 53%; the least significant difference was 44%. Both types of data on number of forked stems showed an inverse correlation with the elevation of the seed source, $r = -0.40$ and -0.63 (significant at 0.05 level), respectively. Apparently trees from low elevations had a stronger tendency to develop forks than those from high elevations. Fortunately, the most rapidly growing population from Grafton County, New Hampshire, had only a moderate number of forked stems, and only 13% of trees with two or more forks.

DISCUSSION

The data indicate that progenies of yellow birch from selected trees showed a significant variation, offering a further possibility of selecting clones for superior growth and better stem quality. In this instance there was a rare case that the same progeny represented a combination of three outstanding traits: the trees grown from seed of a selected tree in Grafton County, New Hampshire, had the greatest growth, the highest rate of survival, and relatively few stems with forks. The record on this progeny's mother tree indicates that at age 50 it was the largest tree on the site and had a 13.2 cubic foot volume, which was superior by at least 17% to any other tree volumes in the immediate vicinity.

The results also suggest that yellow birch can be grown successfully on Maryland's coastal plain. However, seed sources must be carefully selected and tested. Phenotypic selection without further progeny testing may not yield the full advantages in increasing the tree productivity.

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