PRELIMINARY REPORT ON CLONAL DIFFERENCES IN THE WOOD AND PHLOEM OF POPULUS DELTOIDES AND P. TRICHOCARPA[1]

William J. Gabriel
Forest Geneticist
Northeastern Forest Experiment Station
Forest Service, U. S. Dept. Agriculture
Upper Darby, Pennsylvania

This study of clonal variations of wood and phloem in the genus Populus is based on material from a rather complete collection of clonal stocks from various localities within the natural range of eastern cottonwood (P. deltoides) and balsam poplar (F. trichocarpa). Each clone was represented by a plot of 4 ramets in the genetics plantings of the Maria Moors Cabot Foundation for Botanical Research, and was grown under as uniform environmental conditions as possible at Weston, Massachusetts.

Comparisons were based on samples taken from individual trees at the same height (ca. 1 foot above the ground) and at the same relative position in each stem, to eliminate the confounding of position effect with variations due to other factors.

Thin sections, of wood and phloem, each 20 microns in thickness were stained with Haidenhain's and 1 percent safranin for the study of anatomical structure.

The lines of investigation and a summary of the results are as follows.

Specific Gravity

Of nine P. trichocarpa clones examined, the specific gravity varied from a low of 0.402 to a high of 0.704. Differences between clones of similar are and growth rate in P. deltoides were somewhat less, ranging from 0.466 to 0.655. The variation between clones of the same species was statistically significant.[2]

Wood Rays

Differences in wood-ray structure were observed between clones in both species. The majority of the clones examined had uniseriate rays and high, narrow ray cells; however, certain clones were found that were characterized by multiseriate rays and low, broad ray cells.

Fiber Length

In P. trichocarpa, fiber lengths in three clones from Alaska average 501, 506, 538 microns, as compared with an average length of 776 microns in a clone from the State of Washington. The difference between the Washington clone and the Alaskan clones was found to be statistically highly significant.

The average fiber lengths of five clones of F. deltoides were 737, 710, 707, 670, and 485 microns. An analysis of variance showed that this difference in fiber length was highly significant.

[1] This investigation was carried out in 1954-55, while the author was employed by the Maria Moors Cabot Foundation for Botanical Research, Harvard University, Cambridge 38, Massachusetts.

[2] Analysis based on 2 of 4 ramets from a clonal plot.

A "t" test applied to observations on nine clones (four P. trichocarpa and five P. deltoides) indicated that the difference in fiber length between species was statistically significant.

Phloem

Anatomical differences in the individual phloem elements were not found in this study. Examination of the overall phloem anatomy of on ramet from each of a total of 30 clonal lines of P. trichocarpa an P. deltoides indicated that the samples studied fall into the following four categories on the basis of fiber arrangement. This applied only to sections taken approximately 1 foot above the ground and did not apply to samples taken 3 feet above the ground.[3]

P. trichocarpa

1. Fibers in undulating and occasionally discontinuous bands of varying width.
2. Fibers in non-undulating continuous bands of uniform width.
3. Fibers in massive oval-shaped bundles.
4. Fiber bands with inclusions of groups of sieve tubes and parenchyma cells.

P. deltoides

1. Fibers in isolated and somewhat circular clusters, linear in arrangement, separated by ca. 10 rows of parenchyma cells and sieve tubes.
2. Fibers in continuous and rather narrow bands, variable in width., broken only by single ray cells.
3. Fibers in linear and somewhat separate groups, width not uniform separated by as few as one ray cell to as many as 12 combined rays cells, sieve tubes, and parenchyma cells.
4. Fiber's in thin continuous bands, mostly one cell wide but rarely two cells wide, broken only by single ray cells.

Conclusions

Data from individual trees indicated statistically significant differences in fiber length and specific gravity between clones in the two species of Populus that were studied. Variations were also apparent in the fiber arrangement in the phloem. The observed differences occurred in relatively young trees--5 years or less in age. It is concluded, on the basis of the significant variation found between clones and the relatively uniform environment in which they were grown, that much of the observed clonal differences may be genetically controlled.

It is suggested that further study be carried out along these lines, using more mature trees to test whether the juvenile traits observed are of a permanent or temporary nature.

[3] Variations in anatomical characteristics due to position or height in individual trees will be reported in a later paper.