SECOND TECHNICAL SESSION

Chairman: F. Mergen

ANATOMICAL CRITERIA FOR EARLY SELECTION IN POPLARS

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One of the most apparent and serious drawbacks to the rapid improvement of forest trees is the time element; especially the time required for progeny testing or, putting it another way, the time required to grow a tree to the size or age at which its potential can be evaluated.

Often times the value of a tree or shrub used for ornamental or fruit production purposes may be judged when the plant is relatively young but many of the important characteristics of forest trees are those concerned with growth and development over an entire rotation. Therefore the most accurate appraisal of growth potential must be based on long-term tests.

The way to eliminate the time and space required for large-scale progeny tests is to establish methods of early selection for desireable characteristics.

In order to provide a basis for the work on early selection criteria in poplar, it would be well to examine some of the results of research on the selection of apple rootstocks in England. Commercial varieties of apples are usually propagated by grafting, In Europe, and to a lesser extent in the United States, the grafts are made on rootstocks selected to modify the growth of the scion in a particular manner. This is the so-called "rootstock effect". The "Malling" series of rootstocks developed at the East Mailing Research Station, Kent, England, is well known. Research in developing improved rootstocks is still going on at that Station.

In 1936, Dr. A. Beryl Beakbane and her associates at East Mailing began a series of investigations of the anatomy of roots and stems of apple rootstocks and its influence on the rootstock effect. They found that certain anatomical characteristics of the roots, especially the relative amount of bark, were very useful in the selection of dwarfing and vigorous rootstocks, Such anatomical selection criteria are now being used to a large extent in their breeding program.

Dr. Ernst J. Schreiner visited East Mailing in 1952 and it was at his suggestion that the work with poplars was undertaken. This paper can only report the highlights of the poplar study.

Preliminary studies of root bark percent (the relative proportion of the cross-sectional area occupied by bark) were made on five hybrid poplar clones at two different ages. The results indicated that root bark percent is a clonal characteristic, independent of the growth of an individual ramet on a fairly uniform site. Where the difference in height between the tallest and shortest tree of the same clone at 9 years was as much as 11 feet, there was no significant difference in root bark percent.

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More intensive research was carried out with 25 clones representing 18 different parentages. These clones were represented in the 1949 sapling clonal tests at Williamstown, Massachusetts, and Beltsville, Maryland, and exhibited a wide range in growth vigor.

Cuttings of these clones were planted in 4 randomized blocks in the spring of 1958 in the nursery area of the Morris Arboretum in Philadelphia, Pa. In November of the same year all plants were dug out for examination.

The following anatomical determinations were made on the roots and stems:

1. Bark percent
2. Percent fibers in the bark
3. Percent vessel area in the wood
4. Size of vessels
5. Percent ray tissue in the wood

The determination of bark percent is easily made using vernier caliper measurements of the diameter of the organ before and after removal of a ring of bark (cover picture). The other characteristics were determined from mic roscopic sections by photographic techniques. The material was sectioned, without embedding, on a sliding microtome. Sections were cut at 30 microns, stained in safranin and fast green, and mounted in Canada balsam.

Bark percent was found to vary with diameter so this study was limited to roots in the 7-9 mm, diameter class. The range among clones for root bark percent was from 39 to 77 percent, and there were highly significant differences between clones. The root bark percent determined on the roots of trees 1-year-old from cuttings was found to be inversely correlated to a high degree of significance with height, diameter, and volume growth of the same clones in 9-year-old replicated outplantings at the two locations mentioned. The correlation coefficients were on the order of -0.8. Thus a clone with a low percentage of root bark would be more vigorous than one with a proportionately thicker bark.

Considering the bark percent of the stem, it was found that there were no significant differences between clones in this character. The range was only from to 54 percent. There was significant correlation with some of the growth variables but present evidence, especially the lack of significant differences between clones, would argue against this characteristic being used as a selection criterion at the present time.

There is one other characteristic worth mentioning in this rather brief summary, That is the percentage of the root bark area occupied by fibers. The range of variation was from 1 to 16 percent., and the differences between clones were highly significant. Highly significant positive correlations were obtained between this characteristic and five of the six growth variables. Therefore the clone with a greater area of fibers was more vigorous. There was, however, no correlation of fiber percent in the stem bark with growth.

The other characteristics (percent vessel area, vessel size and percent ray area) were variable and showed significant differences between clones. But the coefficients of correlation with growth rate were usually less than 0.2 and were statistically non-significant.

The work described above was done on plants derived from cuttings. Investigations on a limited amount of available material also showed that it might be possible to use these criteria in selection among seedlings. Furthermore, sone evidence indicates that the use of these criteria would be more meaningful in selecting within seedling progenies.

What does all this mean? It means that by using the relatively simple method of determining root bark percent (plus supplementary study of root bark fibers, if deemed necessary) it would be possible to select the inherently fastest-growing trees after one or two years in the nursery. Depending on the particular margin of safety required, the best one percent, 10 percent, or 50 percent could be selected, 'At any rate there would be a considerable saving in the testing and selection phases of the breeding program.

Although this study was confined to poplars, it is possible that similar studies in other genera would yield valuable information regarding early selection. At the present time it appears that the techniques described here would be most applicable to hardwood genera. The amount of hardwoods planted is small and therefore more control should be exercised over the selection of the planting stock. Most hardwood seedlings develop strong root systems and must be root pruned before planting; thus material for anatomical study is readily available.