SHORT TERM PROGENY TESTS FOR BLACK WALNUT AND TULIP POPLAR

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INTRODUCTION

The Indiana Division of Forestry initiated a tree improvement program in 1971. The two principal species of interest are black walnut (Juglans nigra) and tulip poplar (Liriodendron tulipfera). The ultimate goal of this program is to insure that seedlings distributed by our nurseries will give the best performance possible when outplanted by Indiana landowners.

A tree breeding strategy is a work plan for the systematic genetic improvement of a tree species over multiple generations of selection. The Indiana Division of Forestry Tree Breeding Strategy for black walnut and tulip poplar include the following steps: a) selection of superior phenotypes; b) grafting of these selections into state seed orchards, and c) evaluating these selections by means of half-sib progeny tests. In the case of black walnut, the selections were made by Purdue University and the Indiana Division of Forestry. Over 200 selections are currently being evaluated in a clone bank located at Purdue.

Half-sib progeny tests are designed to evaluate a selected individual's performance in a tree improvement program based on the performance of that individual's open-pollinated progeny (male parent unknown). Progeny testing provides information of the genetic value of the parent trees. A good progeny test requires: a) uniform planting areas representative of sites that seed orchard seedlings will be planted on in the future; b) replication over several sites and years; c) a realistic statistical design which can allow for the determination of family differences on each location; d) replication in nursery beds carried through to outplanting, and e) cultural practices similar to those in common use today.

CURRENT STATUS

During past years, progeny tests have been placed in different areas of Indiana on private, state-owned, and university-owned lands. Travel to these scattered sites to provide uniform maintenance and to collect data has become impossible as additional tests were added annually. Fortunately, studies on good walnut sites have shown little family by site interaction, i.e. the families having rapid growth on a particular site also grew rapidly

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on other sites (McKeand, 1978). Since walnut is recommended for planting only on good sites, there is no reason to continue planting in many different locations. Therefore, good sites at the two state nurseries and at the Purdue University Martell Forest will become the standard progeny test sites.

Black walnut produces highly variable seed crops. Tulip poplar always has a low percentage of filled seed. As a result, seed supply has greatly influenced past progeny test designs. Replication of an open-pollinated progeny family within a test was impossible in some years and results from such tests were limited in their application.

Beginning in 1979, attempts to circumvent the problem of inadequate seed supply were implemented. Only those families containing sufficient numbers of seedlings were planted. The result was a balanced, replicated experimental design which will yield more information than was previously available.

PROCEDURE

In 1979, black walnut progeny test outplantings were established at the Vallonia and Jasper-Pulaski state nurseries. At each location, ten families were planted in a randomized complete block design with 5 replications. Each family was arranged at random within each replication and represented by a 4 tree single row plot at a spacing of 4 x 4 feet. McKeand (1978) showed that 5 replications and about 4 to 6 seedlings per replication were adequate to determine significant family differences. A single border row was planted around each test. A similar test was established for tulip poplar. Fifteen half-sib families were planted in a randomized complete block design at Vallonia Nursery in 1979. Each family was randomized within each of 5 replications and represented by a 4 tree single row plot. Spacing was 5 x 5 feet and a single border row surrounds the planting.

Close spacing solves several major progeny testing problems. By reducing the land area required, less soil variation is encountered and hence a better understanding of genetic differences is obtained. Close spacing also reduces weed control problems common to larger land areas.

The principal trait of interest in these plantings is juvenile height growth for both black walnut and tulip poplar. Emphasis on this trait will help to insure successful plantation establishment by minimizing the competitive effects of weeds. In addition, landowner interest will be intensified by planting fast growing stock in their plantations.

The experimental design used in these plantings can allow for the determination of statistical differences among half-sib families in the test. Selections whose progeny are significantly better than the nursery checks within the test will be retained in the state seed orchards. It should

be stated that such a design does not allow for the calculation of heritabilities and hence estimates of "genetic gain".

Research conducted at Purdue University showed that a period of only 4 years was needed to evaluate progeny performance (McKeand, 1978). As a result, these tests will be terminated at the end of the fourth growing season in the field, allowing for the establishment of a new test on the same site the following year.

SUMMARY

Both black walnut and tulip poplar have inherent characteristics which confound tree improvement efforts. Short-term progeny testing will hopefully provide useful information on the value of the selected trees in the Indiana Division of Forestry Tree Improvement Program. By employing this procedure time and land base requirements common to traditional progeny testing can be minimized.

LITERATURE CITED

McKeand, S.E. 1978. Analysis of half-sib progeny tests of black walnut. Unpublished M.S. thesis. Purdue University, West Lafayette, Indiana. 56p.