

AN OVERVIEW OF THE NORTH CENTRAL FINE HARDWOODS TREE IMPROVEMENT COOPERATIVE

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Abstract. -- The North Central Fine Hardwoods Tree Improvement Cooperative was formed in 1986 by state government forestry agencies in eight states (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin). The role and organization of the cooperative is described and its initial activities and accomplishments are summarized. Future activities of the cooperative are also discussed.

Additional keywords: Breeding strategy, black walnut, northern red oak, *Juglans nigra*, *Quercus rubra*.

INTRODUCTION

High level (Johnson and Overton 1984) tree improvement programs involving plus tree selection, seed orchards, and progeny testing require considerable investments and trained personnel. Tree improvement cooperatives have been successful in the South and Pacific Northwest because they provide the most economical means of breeding forest trees, even though the members of these cooperatives are large forest industries practicing intensive forest management on large landholdings. In comparison, forest industries in the north-central United States have proportionally smaller landholdings and reforestation problems. In this region, cooperative effort is essential because individual organizations lack the resources to conduct long-term breeding programs. However, cooperative tree improvement programs here have met with limited success.

The need for further cooperative effort in the north-central United States has been recognized (Overton and Kang 1985, Johnson and Overton 1984, Rieminsheneider 1981). A recent analysis of the needs and opportunities for cooperation within the region suggested that State forestry agencies should provide the impetus for organizing cooperative programs in applied tree improvement (Overton and Kang 1985). As a group, these agencies are the largest producers of reforestation material and have the largest applied tree improvement programs in the north-central region. However, they do not have a tradition of providing leadership for cooperative tree improvement programs. This may have been because, collectively, they lacked the expertise for

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conducting such programs and because, individually, States had not clearly defined the goals and objectives of their own programs (Overton and Kang 1985).

In recent years, the scope of State tree improvement efforts has increased considerably. During the period from 1980 to 1986, most States in the north-central region drafted comprehensive plans for tree improvement programs. In addition, the number of north-central States with full-time Tree Improvement Specialists increased from two (Indiana and Missouri) to six with the addition of positions in Ohio, Wisconsin, Minnesota, and Michigan.

One result of this increase in State programs was the establishment of the North Central Fine Hardwood Tree Improvement Cooperative (NCFHTIC) in 1986. This cooperative program was initiated by seven States: Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, and Wisconsin; and was joined by Michigan in 1987. This paper describes the role of the cooperative and summarizes its initial accomplishments. Future activities and further development of the cooperative are also discussed.

COOPERATIVE GOALS AND OBJECTIVES

The Co-op established four goals to guide long-term planning and program development:

- I. Increase the efficiency of individual state tree improvement efforts through interstate coordination and cooperation in the selection, evaluation, breeding and commercial production of genetically superior fine hardwoods.
- II. Identify and promote research on problems associated with the genetic improvement and culture of fine hardwoods.
- III. Develop a multi-disciplinary approach to the genetic improvement and culture of fine hardwoods.
- IV. Conserve the genetic resource of fine hardwoods by establishing and maintaining a breeding population with a broad genetic base.

To meet these goals, the Co-op developed a number of objectives, the most important of which included:

Set species priorities for cooperative activities.

Develop breeding strategies for each species that include delineation of breeding zones and standardized selection procedures.

Establish procedures for identifying and transferring germplasm.

Establish organizational guidelines for the Co-op.

Identify researchable problems affecting the efficiency of the Co-op program.

PROGRESS TO DATE

Species Priorities. Black walnut is the highest priority species in the Co-op. Black walnut is the only fine hardwood in the north-central region that is commonly grown in plantations and for which stumpage values currently justify plantation culture (Hoover 1985). Red oak is next highest in priority because of its increasing use in underplanting (Johnson *et al.* 1986) and interplanting (Johnson 1971) during the regeneration of natural hardwood stands. It should be stressed here that Co-op members are not all working at the same intensity on these species. Differences in the scope and size of existing State programs, as well as the priority of walnut and red oak in the overall tree improvement program of each State, affect the level of participation. However, all States are making selections that will be available to other members.

Breeding Strategies. The amount and type of breeding that can be conducted on red oak and black walnut is limited by biological constraints (Beineke 1979). For this reason, and because a long-term breeding effort was being developed, the breeding strategy proposed by McKeand and Beineke (1980) using sub-lined breeding populations was adopted by the Co-op (Figure 1). A minimum of 300

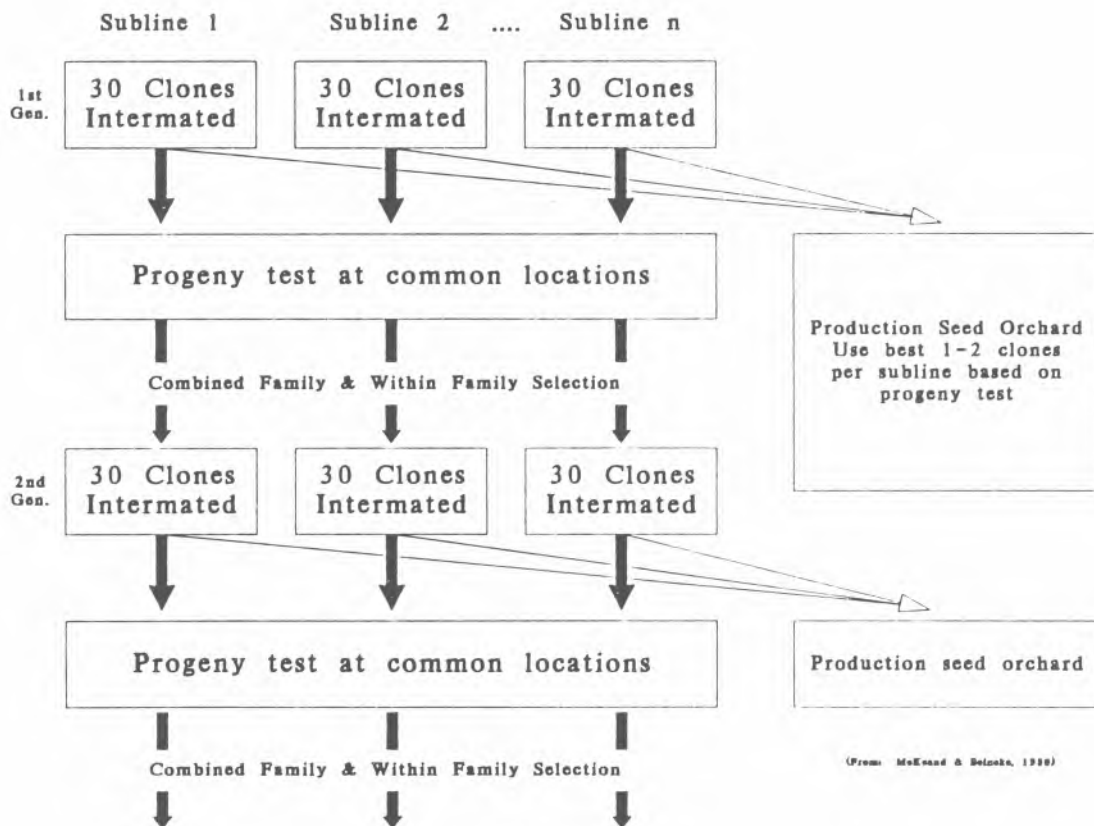


Figure 1. Cooperative breeding strategy for black walnut (from McKeand and Beineke 1980).

plus tree selections will be made in each breeding zone (see below for delineation of breeding zones). These selections will be divided into 10 to 12 sublimes per zone. Additional selections will be entered into breeding populations by creating new sublimes. Open-pollinated families from each subline will be tested in common locations within their respective breeding zones. Advanced generation selections and selection of superior parent material for production seed orchards will be made from these tests. Subline integrity will be maintained over generations. Initial production orchards will be designed to provide material that is well-adapted throughout a given breeding zone.

To begin implementing this strategy, three tentative breeding zones were established by the Co-op (Figure 2). Zone 1 includes Wisconsin, Minnesota,



Figure 2. Tentative black walnut breeding zones.

northern Iowa, and northwest Illinois. Zone 2 is made up of west central and southwest Illinois, southern Iowa and Missouri. Indiana, Ohio, eastern Illinois and southern Michigan make up Zone 3. The tentative breeding zones may be modified as additional information becomes available. In addition, the Co-op adopted the grading criteria developed by Purdue University (similar to that proposed by Beineke and Lowe 1969) for black walnut plus tree selection.

A breeding strategy has not been fully developed for red oak. A strategy similar to that for walnut has been proposed (Coggeshall 1986), but may be modified if cuttings of older material can be successfully rooted (Coggeshall 1987). Breeding zones for red oak will be based on those being developed by the NC-99 Regional Cooperative Project³.

At present, the Co-op is giving high priority to plus trees selection. As of January, 1987, over 130 new black walnut selections and 170 new red oak selections have been identified and are being clonally propagated. Subline and interim clone bank sites are being identified and prepared for outplanting these new selections. Additional funding for this effort, as well as other Co-op activities, has been obtained from the USDA Forest Service, State and Private Forestry, under its Focusing Federal Assistance program. This funding began in 1986 and continues for three years.

To insure continuity of effort, the Co-op is preparing a plan outlining its strategy and objectives for the next ten years. This plan will include activities of the individual members as they relate to the Cooperative program. Background information and plans for individual state programs are being compiled now. A draft of the Co-op plan should be completed early in 1988.

Guidelines for Identifying and Transferring Germplasm. A "Plant Material Exchange Form" has been developed for use when selections are transferred among states. These forms have been adapted for computer storage. The Cooperative has also established Indiana as the Materials Exchange Coordinator and record repository. Copies of all grading forms and location maps of each selection made by Co-op members will be kept on file in Indiana, as well as records of germplasm transfers.

Cooperative Organization. The Cooperative established a Technical/Advisory Committee consisting of the tree improvement specialist in each member State and a representative from the USDA Forest Service, State and Private Forestry. A Committee Chairman and Secretary are elected annually. The cooperative is developing a set of membership criteria. A minimum level of participation has been suggested wherein members would at least agree to select plus trees according to the standard selection criteria, graft them into clone banks, and make them available to the rest of the Co-op.

Identification of Research Problems. The Cooperative identified an immediate need for additional research on seed orchard establishment (e.g. vegetative propagation, site selection, etc.) and management (e.g. soil fertility and moisture requirements, flower stimulation, flower and nut retention, and seed pests). Also, additional research is needed on seedling production (e.g., seed handling, seedling quality standards, and seedling storage) and plantation establishment (e.g., site selection and vegetation management).

³This project is being conducted by the Agricultural Experiment Stations of land-grant universities in the north-central region. The unpublished NC-99 Cooperative Regional Project Outline: "Strategies and Procedures for Advanced Generation Breeding of North Central Forest Trees", was approved in October, 1986.

THE FUTURE

The Co-op has two important tasks to finish in the near future. The first of these is to complete its ten-year plan. This plan will provide a basis for future activities. It will address individual State's needs and priorities for hardwood tree improvement, current and future breeding questions, gene conservation efforts, progeny testing procedures, and seed orchard needs. The second task is to make additional plus tree selections to obtain the minimum number needed (300) in each breeding zone.

Research problems will be addressed by members whenever possible. However, other institutions will also be needed to provide answers to questions outside the realm of Co-op personnel expertise. The Co-op may seek funding for research assistantships to study high priority problems.

One activity the Co-op will address is the evaluation of initial selections. When trees in the sublimes begin flowering, open-pollinated seed will be collected and sown to produce seedlings for progeny testing. Within a particular zone, seedlings from as many clones in as many sublimes as possible will be planted in tests at several locations. The best 1-2 clones from each subline will be included in production seed orchards. Second generation selections will be made in the progeny tests, and the second generation sublimes will be reconstituted. Progeny test designs and selection procedures need to be developed. Additional research is needed on early selection procedures and improving the efficiency of controlled pollination in oak and walnut.

After the black walnut and red oak programs are well underway, additional species may be selected for improvement work. White oak and white ash are possible candidates for Co-op programs.

An Executive Committee should be formed to address questions concerning the overall management of the Co-op, especially those concerning matters of policy and finance. This committee should be made up of persons from each organization that have the authority to approve policy and fiscal matters regarding the Co-op, i.e., State Foresters or their equivalent.

The thrust of the Co-op in the first years will be to establish sublimes and clone banks to provide the broad genetic base necessary to carry out a long-term improvement effort. In subsequent years these objectives will be accomplished and new activities will begin. The future of the Co-op seems good in the near term. Additional States and Canadian provinces have expressed interest in joining the Co-op. With continued support from State agencies and possibly new members, the NCFHTIC will continue to be a result-oriented group.

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