Tree Improvement In Minnesota
A Status Report

-1983-[1]

Carl A. Mohn[2]

Tree improvement activities are now being integrated into the forestry programs of the DNR, other public agencies and industry in Minnesota. This move to utilize a body of research results in a systematic way is a relatively recent development. The establishment of formal improvement programs by several organizations in the state and the formation of the Minnesota Cooperative Tree Improvement Program have occurred within the past four years.

These new programs may change substantially in the years to come. Such an evolution is to be expected as solutions to problems are proposed and tested in the "real world." While the future will bring change, my assignment today is to report on the present status of tree improvement in Minnesota. Within the given time this can only be done in a general way, so discussions of specific programs will have to be postponed. This talk will be limited to a brief overview of (1) the goals of tree improvement in Minnesota, (2) where we stand at the moment, (3) how we got there, and (4) what the future may bring.

TREE IMPROVEMENT GOALS

The goal of our tree improvement work is clear. It is:

> "To increase the productivity of Minneosta's forestry plantings by making planting stock with best feasible genetic makeup as widely available as possible."

Note that it is the productivity of our plantations which concerns us, not genetic improvement per se. Genetics is a tool which we can use to increase the quantity and/or quality of the wood we produce. The returns from using this tool are a product of the level of genetic gain achieved and the acreage impacted. Productivity increase from a tree improvement depends as much on the time it takes to get improved materials into the field and the amount of improved material produced as it does on the level of genetic improvement achieved.

As a result, Minnesota's applied improvement programs are generally concerned with the acquisition and production of significant quantities of seed which incorporates a measure of genetic improvement. Our thrust is towards the control of seed origin, seed production areas and seed orchards. The first priority is the rapid transfer of research results to the practitioner. Eventually tissue culture and other "high tech" techniques may play a role in our program. "Trees in a bottle" are a legitimate area for research, but the techniques can not yet be considered proven components of the types of programs required to reach our goal.

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[2]Professor, College of Forestry, University of Minnesota

CURRENT STATUS

Minnesota foresters have made giant strides towards the implementation of sound tree improvement programs over the past few years. Progress has been made in two areas: (1) controlling seed source; and (2) the development of seed production areas and seed orchards.

Seed Source Control. Although the importance of seed source has been recognized for many years, until recently most of us expended little or no effort in this area. Seed source was easily overlooked as we dealt with the numerous problems associated with large scale reforestation efforts. Even when records of seed source were carefully maintained in the nursery, there was little attempt to match seed source with planting location. As a result, we may have reduced the potential productivity of many of our plantations.

Over the past five years there has been a change. Where seed comes from and where the seedlings produced from it are planted has become a concern at all levels in our forestry organizations. There is solid support for establishing systems which control where our nurseries get their seed from, maintain the seed lot identity of seedlings in the nursery and allocate seedlings in a manner which matches seed source with planting site.

Programs of seed source control are in place in several organizations. In general, these are the producers of relatively small numbers of seedlings of a limited number of species. Their nursery production is planted within a rather limited geographic area.

Larger producers who face more complex situations and are moving gradually towards total seed source control. For example, the Minnesota DNR, Division of Forestry, produces almost 20 million seedlings annually and distributes them to thousands of users for planting in all areas of our large and environmentally diverse state. Given these circumstances, developing a system which will provide an adequate level of seed source control and not reduce the efficiency of nursery operations is not simple. A successful system will require computer aided record keeping plus the input of field foresters, nurserymen and administrators. The DNR is committed to the development of such a system and first steps towards implementation have been taken. It is expected to be in full operation by 1985.

Seed Orchards and Seed Production Areas. The development of seed orchards will yield a level of genetic improvement substantially greater than that obtained from source identified seed collected in unmanaged natural stands. The genetic quality of seed production area seed is somewhat lower than orchard seed but better than source identified. A summary of where we stand today in seed orchard and seed production area development is given in Table 1 on the following page.

A total of 75 acres of seed orchard have been established in Minnesota. Work on the several of these orchards began in the early 70's and some seed has been produced. More than half of the seed orchards have been established since 1980 and it is expected that the acreage will double over the next five years.

Table 1. Minnesota Tree Improvement Installations, June 1983.

SPECIES	ACRES SEED PROD. AREA	ACRES GRAFTED ORCHARD	ACRES SEEDLING ORCHARD	COMMENTS
white spruce	---	24	4	grafts for 5 additional acres completed
black spruce	---	1	12	
red pine	35	---	25	
jack pine	---	---	10	seedlings for 20 more acres being grown
white pine	---	---	---	grafting for 5 acres of orchard in progress
black walnut	---	---	---	grafting for 5 acres of orchard in progress
scotch pine	---	---	---	grafting for 4 acres of orchard in progress

The emerging systems of seed source control and the establishment of seed orchards are encouraging steps. However, when the size of the tree improvement task of Minnesota foresters is considered, it is clear that we can't become complacent. A sense of where we stand can be obtained by comparing the anticipated seed production from orchards <u>now in place</u> to the state's projected seed needs. For most species, these orchards will provide less than 20 percent of the seed we'll need--even after they are in full production. We will have to depend heavily on source identified seed and seed from yet to be developed seed production areas for many years.

In summary, Minnesota foresters have established the mechanisms for the development of long-term improvement programs and have taken the first steps toward getting improved materials into the field in quantity. Other "northern" states are in the same situation or contemplating a similar commitment to genetic improvement. An examination of how the Minnesota program reached its current position can provide prospective for those of us who are directly or indirectly involved in tre improvement work.

PROGRAM DEVELOPMENT

<u>Research.</u> Our tree improvement work is an outgrowth of research in Minnesota and elsewhere which has provided information and plant materials. In Minnesota, the research effort dates back to the early 1940's when T. Schantz-Hansen initiated a jack pine provenance study at the Cloquet Forestry Center. Since then the College of Forestry has been involved in forest genetics research projects on a continuing basis. This research has been funded by the Minnesota Agricultural Experiment Station, the Blandin Foundation, and several forestry organizations within the state. The Minnesota DNR, Potlatch Industries, Blandin Paper Company, Bosie Cascade, Diamond International, several counties, other public agencies and individuals have cooperated by providing land, labor and materials. Much of the work in Minnesota was initiated in cooperation with researchers located outside Minnesota at Universities, USDA-Forest Service laboratories and Canadian research centers.

Over the last 25 years we've established more than 100 test plantings at numerous locations within the state. Approximately 75 of these plantings are still being maintained and are serving the applied tree improvement programs by providing information and materials.

The research program has had three phases. The first phase involved provenance or seed source testing and began in the 1940's. Provenance testing started slowly, increased rapidly in the late 1950's and early 60's (as the regional project NC-99 was implemented) and peaked in the mid- to late 1960's. We have established provenance tests of all important native timber species and several potentially valuable exotics. Provenance tests of white spruce, red spruce, Norway spruce, Scotch pine, red pine, jack pine, ponderosa pine, Japanese larch, tamarack, northern white cedar, balsam fir, paper birch and eastern cottonwood were established before 1970. These provenance tests have provided the information needed to develop seed source recommendations and materials for seed orchards. Many are still active and contributing information to our research and applied programs.

Since 1970 relatively few provenance tests have been initiated. The only major timber species being examined in recently established tests is black spruce. However, provenance tests of red maple, silver maple and European alder established in the 70's may eventually contribute to applied tree improvement programs.

As the rate at which provenance studies were established dropped off, the focus of our research shifted to taking a closer look at genetic variation among individual trees. In this second phase we began our work with populations selected on the basis of the results of the provenance tests. The first of these studies, established in 1967 in cooperation with the Blandin Paper Company, involved progeny of over 200 white spruce trees selected in Minnesota. Tests of white spruce from the Ottawa River Valley, black spruce, red pine and jack pine followed. Recently we have concentrated on testing materials derived from controlled crosses.

Work in this area is in full swing and will be a major component of our research program far into the future. These tests have, or will, provide the information needed for developing efficient applied program projects and serve as a source of materials for future seed orchards. Many of the studies are coordinated with the improvement programs of cooperators.

Work in the third phase of our research program is just beginning. As the results of research are used in applied programs we are getting feedback which identifies problems encountered in the field. We are realizing that the level of genetic improvement is not the only area we must consider in serving our clientele and our research activities are being adjusted accordingly.

Seed orchard management is one of the "non-genetic" areas we must emphasize. Progress in this area is critical to our applied programs. For example, erratic seed crops and harvesting difficulty are clearly limiting factors in red pine improvement. They must be dealt with, if our applied programs are to produce at their potential. This year we initiated a study of fertilizer treatments combined with thinning which may help us get more reliable seed production on younger (shorter) trees. Other studies of this nature will follow.

We are also becoming involved in other areas related to applied tree improvement programs. This year we cooperated with the DNR in evaluating the economics of proposed tree improvement activities. This analysis is being used as a guide for a revision of their improvement program. This type of analysis has also helped us in evaluating our research priorities by pointing out factors which limit economic returns.

Applied Programs. While formal tree improvement programs are relatively new to the Minnesota scene, applied improvement activities have a considerably longer history. For example, 4 acres of white spruce progeny test were established in 1967 as a cooperative project betwen the Blandin Paper Company and the University of Minnesota. While this project had research objectives, the intention was also to produce improved seed and the planting has been developed into a producing seed orchard.

Similar projects were initiated with other cooperators. In the 1970's interest in applied improvement grew to a point where a group representing industry, the Minnesota DNR, the U.S. Forest Service and the University of Minnesota were meeting once or twice a year to coordinate their tree improvement activities. This group began a cooperative project aimed at developing grafted white spruce seed orchards and went on to other projects with black spruce and red pine. By 1980, the task of coordinating the tree improvement work in progress and planned had grown to the point where additional technical assistance was needed and some sort of formal organization seemed necessary. In response, a tree improvement specialist was hired and eventually the Minnesota Tree Improvement Cooperative was founded.

Hiring a tree improvement specialist made a trained individual available on a full-time basis to: (1) provide technical assistance for establishing, maintaining, and expanding Minnesota tree improvement programs; (2) coordinate applied improvement programs in Minnesota with each other and with those in adjacent states to make them more cost effective; and (3) work towards the development of mechanisms which will ensure the continuation of long-term progressive tree improvement programs in Minnesota.

A large proportion of the support for this position is provided by a five-year grant from the Charles K. Blandin Foundation. The purpose of this grant is to provide a firm financial base for the position while the program gets started. Eventually all support for the position will be provided by contracts and other agreements with organizations the specialist serves. At present, the Minnesota DNR, Blandin Paper Company, Potlatch Corporation, Cass County, Beltrami County, and IRRRB are participating.

Robert A. Stine began working as the Minnesota Tree Improvement Specialist in August of 1981. He is an employee of the University and works out of the Cloquet Forestry Center because of its proximity to many of the organizations involved in tree improvement work. His job responsibilities are strictly limited to work related to applied tree improvement programs. An Advisory Committee made up of representatives of industry, the Minnesota DNR, Minnesota counties, and the general public provides him with guidance and assistance. Three technical advisors with training in forest genetics sit with this committee.

In 1982, the Advisory Committee formed the Minnesota Tree Improvement Cooperative and became a sub-group of that organization. This new entity was created to make sure that all contributing organizations would be represented in the development of cooperative programs. At present, the Advisory Committee and members of the Minnesota Tree Improvement Cooperative meet jointly to review the activities of the tree improvement specialist and make suggestions regarding program development. As the number of cooperative members grows, separate meetings will be necessary to function effectively.

Research-Application Interactions. Our intent in Minnesota is to maintain our tree improvement research and applied programs as separate entities while recognizing their relationship. Forest genetics research provided the impetus for initiating our applied programs by providing information, materials and demonstrations of the value of genetics as a tool for increasing productivity. It will continue to provide the information needed to increase the effectiveness of these programs. Conversely, applied programs provide feedback on "real world" conditions which can lead to changes in research priorities so that users of the results will be better served. This "cross-pollination" is of mutual benefit and something we wish to maintain.

However, the objectives of research and applied programs are not the same. Research programs generate information and applied programs generate improved materials for planting. Attempting to combine these objectives while establishing a planting or series of plantings requires compromise. At times this sort of compromise may be necessary, particularly when the information base is limited. Maintaining some distance between the research and applied programs, while keeping the lines of communication open, will insure that both sets of objectives are given full consideration.

THE FUTURE

At this time, Minnesota has a number of emerging tree improvement programs which are expected to provide improved planting stock in the immediate future. We have developed an organization to facilitate the continuation and growth of these programs by providing technical assistance, coordination among programs and a link between applied programs and research. If all goes well, it is possible that all planting stock used by Minnesota foresters will be source identified within 5 years and genetically improved by the year 2000.

Our progress to date is the result of the long-term support of many foresters, public officials and interested individuals. If this support continues, our tree improvement programs will produce gains in productivity of our forest plantings which will benefit our entire state.