

TREE IMPROVEMENT IN ONTARIO

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When looking over the agenda for today's technical session it is noted that most of the speakers will deal with a particular avenue of investigation in a particular species and that the speaker dealing with the general subject of tree improvement would range over many aspects of a number of species. The observation raises the question of whether it is better to know everything about something or something about everything. This group, discussing the subject of forest genetics might properly be placed in the former category,

But current thinking on forestry does not favor confinement of either the forest worker or his field of endeavor. It is necessary to keep in mind the total concept of forestry as a biological science. So that from his chosen position somewhere between forest genetics and forest utilization, somewhere between viable seed and falling tree, the forester could answer the question by safely removing the matter of degree and say that it is desirable, indeed necessary, that he should know many things about many things.

From this comfortable, but none the less challenging position, the tree improvement worker can see how he fits into the large group of professionals engaged in manipulating natural processes and can determine to what extent his endeavors in a particular line of investigation are justified in the light of the well-documented future demand for forest products.

The tree improvement program carried out by the Timber Branch of the Department of Lands and Forests is concerned with two important aspects, namely the improvement of seed availability and the improvement of seed quality. Indicative of our concern with volume of seed is the fact that we have in storage, at the Tree Seed Plant at Angus, 60 miles north of the city, over 1.8 billion viable seeds of 43 species, weighing over 10 ½ tons and valued at \$250,000. From this plant we distribute about one-half billion viable seeds annually to ten provincial nurseries for the production of planting stock -- the current target being 64,000,000 trees -- and to our field offices for use in other techniques of artificial regeneration such as direct seeding. Over the past 10 years we have processed on an average of 8,500 bushels of cones annually. Predicted requirements for seed ten years from now indicate that we will process over 20,000 bushels annually. The modern extraction plant at Angus, completed in 1963, is capable of processing 30,000 bushels annually.

Fortunately we are in the position of not only being the supply depot for all seed used in the province's artificial regeneration program, but we also control the source of supply. In 1961, we recognized nine seed collection zones, or site regions as we now call them, as identified by our Research Branch. These are based from north to south on effective temperature and from east to west on effective humidity. They constitute a refinement of the seven seed zones previously used in the seed collection program.

Prior to 1954, there was little attention given to the quality of trees or stands which supplied our requirements. Seed collection was supervised by the staff of the Seed Plant who traveled out to various sections of the province dealing with local store-keepers and railway station agents to whom contracts were issued. In most cases, the location of the trees was unknown to the purchasing agent and picker would obviously have tended to collect from large-crowned, limby specimens which were easy to climb. In 1954, the responsibility for seed collection was delegated to the

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twenty-two district field offices across the province. Expanding planting programs of that period created rapidly increasing demand for seed. Handling the seed collection program at the local level meant that field staff had to become familiar with seed as the raw material of the regeneration program and with collection procedures. They gained a new awareness that the source of seed contributed to the quality of the new stands being established. It became possible to obtain seed from many new populations and increased the number of locations for seed collection within the natural range of each species. Field staff were most familiar with the quality of stands within their respective area of administration. Responsibility for seed collection gave them the opportunity to control seed source by directing contract pickers to good quality stands.

For certain species and particular areas it became apparent that natural stands were not extensive and in many cases were inaccessible. The need for a program which would emphasize the production aspect of tree improvement was recognized.

In 1958 a tree improvement program was prepared taking into account both the short-term and long-term aspects of tree improvement. Because we are concerned with production it was necessary to consider the relative importance of species in the regeneration program. White, red and jack pine and white and black spruce together make up about 95 percent of the total seed requirements. The program is therefore concerned mainly with these species.

Beginning with the forecast of demand by species and site region and taking into consideration the location, extent and accessibility of natural stands of each species, percentage quotas were set for the three main sources from which seed could be obtained; namely general collections, seed production areas and seed orchards.

General Collections .--Fortunately, logging operations in jack pine, white and black spruce are carried out extensively in all sections of northern Ontario. General collections is the system of contract or piece-work collection where field staff issue contracts to individuals who pick cones from the slash of logging operations and are paid a stated price per bushel. This method of seed collection continues to supply the bulk of our seed requirements. Improvement in seed quality will depend on the degree of control exercised by field staff in locating and designating stands or logging areas from which the seed may be collected.

Seed Production Areas .--Where indigenous stands of suitable quality are not available in sufficient area or extent for general collections, seed production areas are located, reserved and managed for the express purpose of seed production. Where natural stands are lacking, plantations may be used, where these have exhibited better than average growth and form and where the original source of the seed can be determined. The development of seed production areas follows the premise that the relative performance of individuals can be assessed, removing those trees having poor form, heavy and persistent branches, double leaders and forked stems, with additional thinning to provide the crop trees with as much light and nutrient as possible and maintaining an average spacing equal to one-half the height of dominant and co-dominant trees. We require that seed production areas be accessible and reasonably close to one of our field headquarters for ease of management and economical future cone collection. The number and size of seed production areas to be reserved is related to the demand for seed of the required species and site region, at the same time taking advantage of the distribution of natural stands within a site region. If the natural range of a species within a site region is extensive, the total area reserved would be greater in order to obtain a better cross-section of the sites within the natural range. Seed production areas are not isolated. Improvement in quality is obtained by periodic roguing within the stand and increased quantity of seed is obtained by thinning to the desired spacing, hence providing more locations for flower production on full crowns.

We have one seed production area which serves as a sort of "guinea pig". It is a 21-year-old plantation of red pine which has been thinned periodically to about 100 crop trees per acre. Results of fertilizer trials have been masked by the depredations of squirrels and cone insects. Production of seed in meaningful quantities can be expected at this age and the need to protect the investment in thinning, roguing and fertilizing has become very evident. Last spring two light concentrations of DDT were applied, 3 weeks apart, drenching the crown in each application. When the timing, method and intensity of insect control was being considered we realized that we knew little of the life history of the cone-boring insects present. More research into the life history and control of cone insects is required so that investment in cultural treatments in areas managed for seed production can be protected.

We currently have 21 seed production areas in various stages of development with a total area of some 200 acres. The plans indicate that we should have about 500 acres of seed production area of all species under management.

Seed Orchards.--Through the process of natural selection certain individuals have combined their inherited genetic make-up with adaptation to environment to produce a tree which can be seen to be taller, straighter or less limby than its companions. The selection of these "plus" phenotypes is the basis of our seed orchard development program. Vegetative propagation permits the genetic qualities of widely scattered parent trees, unaffected by the rootstock, to be transferred to small, plantable tree which can be handled easily and moved in quantity to the desired planting site. The maturity of the parent tree is retained and hence earlier seed production can be expected. Clonal seed orchards of the grafted trees are planted in a predetermined pattern so that at each stage of development of the orchard there will be an equal number of trees of each clone. As pollination between only these individuals is desired, the seed orchards must be isolated to prevent pollination from outside sources by having a surround of one-half mile to a mile where the particular species does not occur. The present program involves the grafting of some 10,000 scions annually at four of the provincial nurseries which have the facilities and staff to cooperate in this program.

At the present time, we have established ten seed orchard sites and planted 53 acres. The plans indicate that we should have about 200 acres of seed orchard under management. Seed orchards presently being established are primary orchards providing a modest gain in quality. They are set out for the purpose of supplying an early and abundant supply of seed. They are the means of preserving valuable superior phenotypes which otherwise we would not always have with us. They can serve as clone banks for the expansion of desirable material and also simplifying the testing for specific combining ability.

Summary.--Our tree improvement program is based on the requirements of seed for the artificial regeneration program. It is concerned with acquisition of seed of the best quality in sufficient quantity. It is organized so as to control the source of seed, to reserve and culture natural stands or plantations for optimum seed production and to preserve the best phenotypes in seed orchards established and cultured for early and abundant seed production.

We are moving out of the exploitive period into the production management period in forestry. Forest genetics, adequately supported at the academic and sponsoring levels, by supplying scientific facts applicable to the genetic principles in tree improvement, can supply a partial, but very important, answer to the question -- "by what means can we assure the future supply of raw material to meet local, national and world demands for forest products?"