Forest Tree Improvement in the Department of Genetics at the University of Wisconsin

by R. G. Hitt 1/

The University of Wisconsin in cooperation with the Wisconsin Conservation Department undertook a program in forest tree improvement in July of 1948. The general objective of the program was for the improvement of the genetic quality of the forest tree planting stock used in Wisconsin reforestation. The program has been developed along three general lines. They are:

1. Selections and testing of superior forest tree species

1/ Forester-in-Charge, Forest Genetics Research University of Wisconsin, Madison, Wis.

2. Hybridization studies

3. Specialized studies on such problems as vegetative propagation, flower induction, establishment and maintenance of forest tree seed orchards, etc.

To date, over 360 individual tree selections have been made. Not all of these, however, represent plus-tree selections. Many of the individual tree selections have been used to provide stock for progeny tests and as parent stock for forest tree seed orchards to be established.

Species of interest include red, white, and jack pines, white and black spruces, and some balsam fir. In addition, some individual tree selections have been made for quaking and bigtooth aspen, and several birch population collections have been acquired.

An attempt has been made to build up a collection of breeding material for future research. Included in the collection. are some 20 species of Pinus, 5 species of Larix, 6 species of Picea, 3 species of Abies, and 3 species of Betula. Representative samples of all this material are being grown in breeding collection areas in several locations throughout the State.

Approximately 100,000 trees from open-pollinated seed from individual trees or selected areas are now involved in progeny and provenance tests, The trials are composed of 36- and 64-tree plots replicated 2 or 3 times within a trial. The trials are then replicated on 2 or 3 different sites in central and northern Wisconsin. Periodic survival counts, growth records, and other observations will be made on the areas. Certain provenances or individual tree selections which prove to be superior to others in the test will be used as seed sources for future reforestation work and as parent stock for seed orchards.

Controlled pollinations have been performed during the years as time, personnel, and flowering on the pines permitted. The majority of these pollinations have been made on red pine, although some work has also been done with jack pine, Austrian pine, and white and Norway spruces. Both intra- and interspecific crosses have been attempted. Results to date have boon rather poor. Many cones have been lost through insect damage. To date no interspecific crosses have yielded seed. A small scale sel compatibility test with red pine has been in progress for several years.

The object of several of the special iced studies is to provide information of value for the systematic development and management of a network of forest tree seed orchards. In addition, a number of the studies will yield data of value in the pursuit of other phases of the tree brooding research.

All of the flower induction studies to date have involved the use of mechanical means. Girdling (both semi-circular and spiral), strangling, root pruning, defoliation, and phloem inversions have been used on different age classes of red pine. The results have been variable. The spiral girdle gave the greatest immediate response in number of both male and female

flowers. This treatment also caused the greatest damage to the treated trees, resulting in the death of the terminal portions of branch tips. The semi-circular girdle gave increased flowering and did not noticeably injure the growing crown.

Response to strangulation was slow, but as the trees grew and began to strangle themselves, flowering increased.

Root pruning did cause increased flowering on already flowering material and initiated flowering on non-flowering trees.

Most phloem inversions failed to grow; however the few inversions which did take did not stimulate or initiate flowering on 8- to 12-year-old red pine. The number of trees which survived was small; hence these results should not be considered conclusive.

The techniques for field grafting of red pine have been developed sufficiently to allow for their widespread application in the establishment of a network of forest tree seed orchards in Wisconsin.

The grafting is done in the early spring before new shoot growth begins. Stored or freshly collected scions are used. Prior to grafting, the scions are dipped in a 25-percent solution of liquid latex and allowed to dry. This anti-desiccant helps to carry the scion over the first few weeks while the callus tissues are formed. A veneer graft is used. Grafting success ranged from 5 to 100 percent depending on scion lots. The average percent of grafts to "take" however, was about 65.

Greenhouse grafting has been continued. The percent of successful grafts here, however, was about 35. Various species of Pinus were used as under stocks to determine graftability as well as for studies to determine understock influence on the stimulation of precocious flowering.

Vegetative propagation by means of rooted cuttings has been attempted. Spring "planted" cuttings taken from 2-2 red pines several weeks prior to "planting" gave as high as 25 percent rooting. The American Chemical Company's experimental powder Rootone #104 gave rooting of 25 percent after 17 weeks in out-of-doors cutting beds. When a second replicated bed of cuttings was allowed to over-winter and the trial was read after 64 week, rooting had dropped to 19 percent.

Air layering of red, white, jack and Scots pines yielded no rooted branches. The treatments were applied in late June and early July. This undoubtedly was too late in the growing season, and better results would certainly be expected provided the treatments could be applied earlier in the spring prior to bud break

Dormant vegetative bud primordia, formed at the base of each needle fascicle in Pinus, can be stimulated into growth by injury or removal of the distal portion of the branch. When the tip is removed or injured, an abundance of small branches or scions are produced by growth of the latent

buds. Thus it is possible to produce large numbers of scions for increasing selected genotypes by grafting.

Branch-tip clipping trials were carried out in northern Wisconsin on 9-year-old plantation red pine. When the treatment was applied prior to the third week in July, the bud primordia were sufficiently stimulated and had enough growing season remaining after treatment to form good scions. These scions were large enough at the end of the growing season to be used for grafting the following April. As few as one and as many as 40 buds were stimulated into growth on a single clipped terminal.

The first of the forest tree seed orchards to be established in Wisconsin was set out on an abandoned field in the Kettle Moraine State Forest near Eagle, Wis., in April 1955. Rabbit damage to many of the trees considerably reduced the number of live stems. More trees were added to the original planting in the spring of 1957. Measures have been taken to protect the trees from further animal damage. Field grafting also was carried out for seed orchard purposes during the spring of 1957.

Cone-crop prediction surveys as well as cone-picking time studies have been conducted The information gathered has been made available to the Wisconsin Conservation Department to assist them in planning their cone-buying programs. Data are also being accumulated relative to the cyclic nature of flowering of red pine.

The Verified Forest Tree Seed program which was initiated in November 1956 by the Wisconsin Conservation Department in cooperation with the forest tree improvement program has already been discussed.

A new investigation has been undertaken for several populations of red pine which show a high degree of basal forking. Several mutant red pines have been found including a prostrate bushy type, a "snake" type which has a tendency to form very few side branches, and a fastigate type which has short, fine, acutely angled branches. Those types are being vegetatively propagated, and studies to determine their genetic makeup are planned.