

Forest Tree Improvement in the Department of Plant
Pathology at the University of Wisconsin

by J. G. Berbee 1/

For a number of years the University of Wisconsin and the Wisconsin Conservation Department have cooperated on programs aimed at the development of superior disease- and insect-resistant trees. Two major projects have been carried out in the Department of Plant Pathology. One is concerned with the blister rust resistance in white pine and the other with poplar improvement.

Blister Rust Resistance in White Pine

Progress in the development of blister-rust-resistant white pines has continued along several main lines, including selection, testing, breeding, and vegetative propagation. The investigations have been made by R. F. Patton and A. J. Riker.

Resistance of parent selections in the form of grafts has been tested in the Blister Rust Nursery and also in outplantings in a number of different places in this country and abroad. Of the original 163 selections, 40 have been rated highly resistant and many of these have been used in the breeding program. Additional selections have been made and tested for resistance, and others will be, to encompass a wider range of climate and genotypes.

To determine the inheritance pattern of resistance, the progeny from resistant trees have been tested. Seedlings from open-pollinated resistant trees had little, if any, more resistance than ordinary seedlings. Thus, emphasis has been placed on controlled crosses between resistant trees.

A total of 263 different controlled crosses have been made. Artificial inoculations of 900 seedlings from the first crosses have indicated that, on the average, a low percentage of the first-generation seedlings had resistance to blister rust. Some parents appeared to have greater ability than others to pass their resistance on to their offspring. The single self-pollination included among these first crosses produced stunted seedlings, but these had such less infection than the checks. In further tests in the Blister Rust Nursery, over 8,000 seedlings, including those from crosses between resistant eastern white pine and resistant western white pine have been inoculated and results will be available soon. To introduce additional resistance factors from naturally resistant species, a number of other interspecific crosses have been made. Sound seed has been obtained on eastern white pine from controlled pollinations with Mexican white pine, Himalayan pine, Japanese white pine, and Balkan pine. Pollen from eastern white pine yielded some seed on Balkan pine. From these and other progenies under test, selections of F₁ individuals will be made for further screening and for the production of F₂ generations through F₁ intercrosses or backcrosses to the parents. If a useful

1/ Forest Pathologist, University of Wisconsin, Madison, Wis.

percentage of resistance can be transmitted through the seed from certain combinations, the eventual establishment of a seed orchard is contemplated.

Methods of vegetative propagation have continued under investigation. Apparently, top grafting field trees may speed up the establishment of seed orchards. In trials designed to promote early flowering, F_1 seedlings were grafted into the crowns of large flowering white pine trees. However pollen has not yet been secured from grafts made as early as 1953.

Rooting cuttings has proved cheaper than grafting. With 4-year-old trees and suitable treatments it has been successful. With 15- to 60-year-old trees the results have been variable; at best 25 to 30 percent of the cuttings have rooted. Ten years after establishment in plantations trees from rooted cuttings have proved indistinguishable from trees of seedling origin.

Poplar Improvement

The aim of this project has been to develop a number of poplar clones resistant to diseases and insects, capable of rapid growth on several different sites, and suitable for a variety of uses. The program has included selection, introduction, breeding, and testing. It has been carried on by J. E. Kuntz and K. R. Shea, A. J. Riker, and, more recently, by J. G. Berbee.

Through the cooperation of various agencies, clones have been obtained from many different places, including South Dakota, Minnesota, Pennsylvania, Maine, Canada, and Holland. In cooperation with the Harvard Forest, 400 other clones from various parts of the United States have been obtained. About 50 clones have been supplied by the Northeastern Forest Experiment Station. Approximately 200 Wisconsin poplar trees have been selected as superior. In all, over 750 clones have been set out for study.

To evaluate this material, cuttings from the various clones were set out in replicated blocks. In these tests, most of the hybrid poplars developed elsewhere have proved unsatisfactory in Wisconsin. However, a few of the native and introduced selections have been found resistant to one or several of the diseases and insect pests of poplar, and have desirable growth characteristics.

In further trials, these promising clones will be used in small plantations on a variety of soils in Wisconsin.

A large number of trees also has been obtained by controlled pollinations using elite Wisconsin trees as parents. The following crosses have yielded progeny: A monoecious quaking aspen selfed; quaking aspen (female) with bigtooth aspen*, eastern cottonwood*, and white poplar*; bigtooth aspen (female) with eastern cottonwood and white poplar*; white poplar (female) with balsam poplar and eastern cottonwood; and balsam poplar (female) with eastern cottonwood and quaking aspen. For those species indicated by the

asterisks, the reciprocal crosses also have been successful. In addition, progeny have been obtained from intraspecific crosses with all of the above species.

Approximately 10,000 seedlings obtained from these crosses have been planted near Madison and near Wausau. Their resistance to cankers incited by Hypoxyton pruinaum (Klotzsch) Cke., Septoria musiva Pk., and Cytospora chrysosperma (P.) ex Fr. is being tested by artificial inoculation. Continued evaluation of the seedlings over a period of years will be necessary.