FOREST GENETICS Al THE UNIVERSITY OF MICHIGAN

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INTRODUCTION

The School of Natural Resources at the University of Michigan has maintained a small program in forest genetics since 1930 when research was initiated to develop chestnuts resistant to the chestnut blight. In keeping with the tradition of a liberal arts university center, each staff member has been permitted to develop his interest in forest genetics

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independently, without the setting up of long-term group projects. Because the School of Natural Resources has close contact with strong departments of Botany and Zoology in the same building, and because no agricultural experiment station exists at the University, the research program in forest genetics has tended to remain on a small scale and to stress the interest of individual staff members and graduate students.

At the present time, work is in progress or has been initiated on four general problems: (1) the development of blight-resistant chestnut trees; (2) the testing of ponderosa pine for resistance to a rust tentatively identified as Cronartium cerebrum; (3) the development of a Norway spruce strain resistant to the spruce gall aphid; and (4) the testing of various European races of Scotch pine.

WORK IN PROGRESS

Blight-resistant Chestnut

The chestnut blight spread rapidly into the southeastern part of Michigan from 1927 to 1929. Chestnut planted in 1906 at the Saginaw Forest near Ann Arbor became infected with the blight after 1931. Beginning about 1930, a long-term program was initiated to develop blight-resistant chestnut stocks.

Chestnut is native to southern Michigan as far north as St. Clair County and provided an important nut crop in the state as long ago as 18$$. In 1931, Michigan orchards were yielding 5-8 bushels of chestnuts per acre practically every year, bringing a price of from $60 – $100 per acre to the grower.

In 1930, over 2,000 seedlings grown by the Division of Forest Pathology from seeds collected from blight-resistant trees in Korea and Japan were tested in Ann Arbor by Professor Dow V. Baxter. These trees were grown in pots so that they could be transplanted into the field in the pots without exposing the roots. By virtually eliminating the possibility of death due to faulty transplanting, it was possible to test the seedlings solely for hardiness in southern Michigan. Most of this material was not frost-hardy, but 37 nut-bearing trees were selected for further study. In 1949, nuts selected from 15 of the best trees were planted out, and have been carefully followed since. In 1951, a second selection was made, this being nuts from the best single tree. Forty seedlings from this generation are now in a cold frame, and will be planted out in the near future.

In 1950, another lot of 100 seedlings of Castanea mollissina and crosses between C. mollissina and C. dentata were obtained. Some 60 of these plants have been planted in pots for three years. These pots have been placed in pits with top light designed to force juvenile height growth. The trees will be planted out in the University of Michigan Botanical Gardens this spring, and will eventually be matched with the selections obtained from the original 2,000 for hardiness, nut production, and nut quality.

The chestnut breeding program is well along and appears very promising. It may well lead to a revival of the nut-growing industry in southern Michigan.

Rust-resistant Ponderosa Pine

This is a story of two ponderosa pine plantations, one heavily infested with the rust fungus, and the other a healthy stand. These plantations and others representing five additional seed sources are now under study by Professor Dow V. Baxter and the Laboratory of Pathology in Forest Practice.

Resistance to fungi varies among races as well as species of trees. In 1928, ponderosa pine grown from Black Hills seed was planted in the Stinchfield Woods near Ann Arbor. Since that time, a rust fungus tentatively identified as Cronartium cerebrum has -- together with "winter kill" -- destroyed a large part of the stand. The majority of infections have occurred in the part of the plantation nearest an oak forest -- an alternate host for the rust should the fungus prove to be Cronartium cerebrum.

In the second plantation, which is also near the oak, and which has been in the field for a longer period and therefore more subject to chance infestation than the first, no rust occurs. Differences in the amount of "winter kill," furthermore, are also apparent between the two plantations.

Pine stock from four different sources has been obtained and has been potted for later field inoculation tests to determine the susceptibility of different kinds of stock to this rust. A fifth source (Nebraska Sand Hills) will be represented by stock that is to be shipped this spring. Natural infection tests, as well as laboratory and greenhouse inoculations, are planned.

It is hoped that from this study the susceptibility of ponderosa pine to this rust may be determined. A corollary objective, of course, is to isolate strains of ponderosa pine that may be safely planted in the neighborhood of oak stands.

Norway Spruce Resistant to the Spruce Gall Aphid

In the Saginaw Forest of the University of Michigan, a 50-year-old plantation of Norway spruce is infected with the eastern gall aphid (Chermes abietis). Some of the trees have been heavily attacked while neighboring and even interlocking trees are untouched. A study has been initiated to determine whether this resistance is genetic, and to isolate if possible a strain of Norway spruce resistant to the gall aphid.

This study, being carried on by a graduate student under Professor Samuel A. Graham, involves the establishment of a plantation from open-pollinated seed secured from the infected plantation; the rooting of cuttings from

both susceptible and resistant trees; and controlled pollination of both resistant and nonresistant trees. The initial study is scheduled for completion about 1955, and will probably be followed up by other studies along the same line.

Scotch Pine Seed Source

In the Stinchfield Woods of the University of Michigan near Ann Arbor, three sources of Scotch pine were planted on similar adjacent sites in 1930 and 1933. These three plantations, covering 10 acres in all, have been followed carefully since that time. Permanent sample plots have been established, and each plantation has been given careful thinning treatment as required. The largest plantation represents seed from east Baltic Scotch pine trees (the so-called Riga strain) which are world-famous for their high quality. The two smaller plantations represent southwestern Europe (Bavarian) and northwestern Europe (Norwegian) stock.

In February 1953, a graduate student at the University (William H. D. McGregor) completed a master's thesis on the three plantations. His thesis includes a detailed study of the growth and development of these three plantations. In addition, it presents the results of careful measurement of 30 sample trees in each stand. These trees were studied to determine the nature and amount of injury and crookedness from all sources. In general, the Bavarian trees were found to be the fastest-growing and the Riga trees the slowest-growing. On the other hand, the Riga strain was the straightest and showed the least amount of injury. McGregor concluded that, in general, the Norwegian trees seemed to be doing the best, as an acceptable number of trees were relatively free from deformation and as their growth rate was considerably higher than that of the Riga strain. This conclusion is subject to further studies as the plantations develop.

PLANS FOR THE FUTURE

The School of Natural Resources of the University of Michigan is not concerned with large-scale tree breeding programs such as can logically best be carried on by forest experiment stations and land-grant colleges. Rather, our basic interest is in the solution of fundamental problems in forest genetics, and in the training of graduate-level students in this field, taking full advantage of the close relationships that exist between the School of Natural Resources and the various biological departments in the University of Michigan.

In addition to the projects described above, a number of similar problems await the attack of a properly qualified graduate student. For example, material is on hand for the study of resistance of white pine to the white pine weevil. Since the population of weevils in a white pine plantation is directly proportional to the circumference of the leader, a strain of white pine having thin leaders theoretically should be less conducive to weevil injury than the usual type of tree. One of the

at Stinchfield Woods seems to have unusually thin leaders. Seeds collected from this plantation will be planted with other seed sources in areas where weevils abound to determine (1) whether the narrow shoot is genetically controlled, and (2) whether this strain is actually more resistant to the weevil than other material.

Although no large-scale mass selection or tree breeding trials are contemplated, it is hoped to establish a small field planting of carefully selected stock of known genetic origin. An area of about 10 acres may well be set aside for this purpose. It is hoped to plant here material of known seed source, and of known genetic constitution. Promising hybrids may well be included. Although the planting will be small, the site will be carefully prepared, the trees will be cultivated as needed, and careful observations will be made. This material will be available to interested staff and graduates for further research. We believe that carefully tended field trials of this nature, although small, will provide far more information of a fundamental nature than can be obtained from casually established large-scale field plantings which receive a minimum of care.

Through studies of this type, it is hoped that the School of Natural Resources of the University of Michigan will turn out an increasing number of graduate students thoroughly and competently trained in the field of forest genetics.