CHESTNUT RESEARCH IN VIRGINIA

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This is an appropriate place to talk about the American chestnut. The chestnut was once abundant in these mountains. The early settlers relied on it for building materials, food, and for tanning leather. There are still many thousands of American chestnuts in the nearby forests. They seldom get very large before the chestnut blight kills them back and they must sprout up all over again. Trees up to two or three inches in diameter are common, but larger trees are scarce. Often the young sprouts will live long enough to produce a few burrs (usually unfilled nuts, rarely sound nuts). They don't live much longer. Large American chestnut trees occur occasionally. Here in Virginia there are several trees over 12 inches in diameter. The largest one we know about is less than 20 miles from here. It is about three feet in diameter. All of these large trees are infected by the blight, and most have been infected for many years.

A short distance from here at the foot of the Blue Ridge Mountains is a small State Forest dedicated to chestnut research. This 420 acre tract was deeded to the State of Virginia in 1969 by Dr. and Mrs. Arthur Valk, reflecting their great interest in the American chestnut. Our initial agreement stressed the work of Dr. Richard A. Jaynes, of the Connecticut Agriculture Experiment Station, for testing hybrid chestnuts; and Dr. Ralph Singleton, retired Professor of Biology at the University of Virginia, for testing American chestnut trees grown from irradiated seed. The first chestnut plantings of both types were made in 1969, the year of dedication. These early plantings are in their ninth growing season.

Hybridization

Our hybrid chestnut planting is the largest in existence, containing about 12,000 trees. The oldest plantings have formed a closed canopy. Some individuals are already 30 feet tall and four inches d.b.h.

The seedlings that Dr. Jaynes supplied come from the most promising hybrids developed over the past 50 years. The original hybrids were crosses of American chestnut with the Chinese and/or Japanese chestnuts. These Asiatic chestnuts are resistant (not immune) to the blight, but inferior to the American as timber trees. It is hoped that hybrids can be produced that will capture the resistance of the Asiatic chestnuts while retaining the timber qualities of the American. The first large chestnut hybrid program begun by the U.S. Department of Agriculture, initiated in 1925 at Glendale, Maryland, was headed by Russell Clapper. A few years later, Arthur H. Graves, working for the Brooklyn Botanical Gardens, started crossing the American and Asiatic chestnuts. The hybrids he produced were planted near Hamden, Connecticut and later donated to the State of Connecticut. This hybrid program was taken over by the Connecticut Agriculture Experiment Station.

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Dr. Jaynes has been growing open-pollinated seed from the most promising hybrids of this program. He also provided seedlings from some of the best hybrids produced by the U.S. Department of Agriculture project. For example, we have both seedlings and grafts of the famous Clapper hybrid, perhaps the best-formed hybrid yet produced. (Unfortunately this tree succumbed to the blight last year at age 31.)

Most hybrids do not have the single straight stem deemed desirable in a forest tree. One reason that the Chinese or Japanese chestnuts are not considered a substitute for the American chestnuts is that the growth habit of the Asiatic chestnuts is more orchard-like than forest-like. Some trees in our hybrid test plantings have exceptionally fine form. We have evaluated older plantings and grading each tree for straightness, single stem form, and branching habit. About four percent of the trees show promise of being good timber type trees. One outstanding parent is the Clapper hybrid.

Future plans for the hybrid planting are not firm, but may involve control crosses between the most promising parents, especially those that are relatively blight resistant. There is little blight infection yet in our hybrid planting. The progeny from these control crossings would be evaluated, and the best of the progeny would again be crossed for a second generation.

Radiation

Dr. Ralph Singleton was the first to suggest the use of radiation to create a mutant American chestnut that might be resistant to blight. "Radiation Breeding" has produced improved strains of a number of agricultural crops, and at the time, Dr. Singleton was involved with mutation breeding of corn. His first chestnut was irradiated at the Brookhaven National Laboratory in 1956. Most of the seedlings produced from this early radiated seed were planted on land belonging to Dr. Albert Dietz of Wadsworth, Ohio. Many of these trees were later moved to the Lesesne State Forest. We have planted about 3,000 American chestnut trees on the Lesesne State Forest that originated from irradiated seed.

If radiation should produce a mutation imparting disease resistance in a cell of one of the chestnut seeds, this mutant cell would divide and produce a disease resistant sector in the developing chestnut tree. (There is little chance that a wholly resistant tree would develop from an irradiated seed. A chestnut seed is largely embryo and contains thousands of cells, and mutations occur in single cells). If this mutant sector is a part of the tree bearing flowers, and if the flowers on this mutant sector pollinate or are pollinated, about half of the resulting seeds could contain the mutant gene for resistance in all their cells. The "second generation" mutant trees may not be resistant, however, because most radiation induced mutations in agricultural crops have been recessive. Only self-pollinated or if two such second generation trees were crossed, might resistant trees be produced. It is not until the third generation that resistant trees should be expected.

Although very little blight at present in the hybrid planting; in the radiated American planting, the blight is already very serious. Many trees were killed before they bore seed. Trees that bear seed rarely bear a second crop. We collected our first seed from the radiated planting in the fall of 1975. This past spring we planted about 500 seedlings in another small State Forest near Warrenton, Virginia. This is the start of the second generation.

Breeding Surviving American Chestnuts

Early in my talk I mentioned that we have a few large surviving native trees in Virginia, especially in the upper Piedmont and Blue Ridge Mountains. It is interesting to speculate why these large trees have not been killed by the blight when most of their neighbors were killed years ago. Perhaps they escaped infection for a while or are just slow to die. On the other hand, perhaps they contain some genetic resistance to the blight. They often occur in pairs or small groups, and this could mean that such a surviving pair or small group had a common parent which had some genetic resistance to the disease.

To test the possibility that some of the surviving trees might posses genetic resistance, the U.S. Forest Service started a project in 1954, headed by Jesse Diller, to locate surviving native chestnut trees larger than eight inches DBH. By 1965, over 500 trees had been located, and they were grafted onto Chinese chestnut root stock. The next step would have been to make crosses among the surviving grafts, but when Jesse Diller retired, so was the project. Dr. Eyvind Thor started a similar project in 1960 at the University of Tennessee, using surviving native chestnuts from the southern Appalachians. He is working with about 40 large survivors and some of his early grafts have already been crossed and the progeny planted.

We would like to do a similar thing on the Lesesne State Forest. We are waiting for a better technique for rooting cuttings from older chestnut trees. The American chestnut is difficult to graft on Chinese root stock and the grafts do not survive well. We would rather have the American chestnuts growing on their own roots. Some progress in rooting has been made in recent years. We hope that before long we can gather together on the Lesesne State Forest cuttings from many or most of the large surviving trees in Virginia.

Hypovirulence

About 1938, the chestnut blight fungus arrived in Europe, and spread rapidly killing European chestnut trees. The European chestnut is almost as susceptible to the blight as the American chestnut. In 1951 an Italian scientist reported that infected trees in some stands were recovering from the blight. No one paid much attention to such reports until 1965, when two French scientists took cultures from blight cankers that were healing over and isolated a strain of the chestnut blight that was much less virulent than the normal strain. This strain, which was unable to kill the trees it infected, was termed "hypovirulent". When the hypovirulent strain and the normal

virulent strain are grown together in culture, the virulent strain is converted into a hypovirulent strain. According to the literature, there are stands in northern Italy and southern France which were once seriously infected, but which now are almost fully recovered from the blight.

Dr. Jaynes and his colleagues at the Connecticut Agriculture Experiment Station obtained a European hypovirulent strain in 1966, a year after it was reported. In repeated cultures growing together with the virulent strains common in Connecticut, some hypovirulent strains were isolated which stopped the growth of local virulent strains. In the fall of 1974 they introduced these hypovirulent strains into actively growing cankers on chestnut sprouts growing in six woodland plots. A year later, most cankers had stopped growth. Some had begun to heal over. To date no hypovirulent strains have been recovered from uninoculated cankers on the same or nearby chestnut sprouts. This means that the hypovirulent strains has not spread naturally.

This summer we will also inoculate with the hypovirulent strains provided by Connecticut Agriculture Station scientists. The question remains, will these hypovirulent strains spread from canker to canker and from tree to tree, and be able to maintain themselves in the forest as they apparently have in Europe?