Chestnut Breeding in the United States Department of Agriculture

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ABSTRACT.—For many years tree breeders in the U.S. Department of Agriculture crossed the principal chestnut and chinkapin species in an effort to produce blight-resistant trees that might be suitable substitutes for the American chestnut for timber and nut production. Results of this work are reported.

Breeding chestnut trees resistant to blight began in the Division of Forest Pathology, U.S. Department of Agriculture, in 1909. The purpose of the breeding work was to develop blight-resistant chestnut trees to replace the American chestnut *(Castanea dentata* [Marsh.] Borkh.). The objectives at first were twofold: (1) to develop a blight-resistant forest chestnut for tannin, timber, and food for wildlife; and (2) to develop blight-resistant strains that would produce nuts of high quality for orchard planting. About 1930, most of the orchard selection and breeding work was transferred to the Fruit and Nut Crops Section, USDA, and in 1954 the forest chestnut breeding work was also transferred to this section.

Dr. Walter Van Fleet, who actually began hybridizing chestnuts as far back as 1894, was in charge of the early chestnut breeding work. One of his first crosses was between the Paragon variety of the European chestnut *(C. sativa* Mill.) and the American chestnut, to improve the quality of the Paragon nuts. However, the resulting hybrids were all blight-susceptible and were eventually killed by the blight fungus. Later, Van Fleet began crossing our native Allegheny chinkapin *(C. pumila* [L.] Mill.) with Asiatic chestnut species that were highly resistant to the blight fungus. In 1911, an experiment area was established near Glenn Dale, Maryland, and the work of developing blight-resistant chestnuts was carried on there for almost 50 years.

In 1925, Russell B. Clapper began hybridizing chestnuts, and for the next 25 years he worked in chestnut breeding in the USDA. During this period,

about 40 percent of the possible combinations of the 13 species of *Castanea* were crossed successfully. The hybrids obtained from these crosses were fertile, which indicates that all species of *Castanea* have the same number of chromosomes-24.

Clapper wanted to obtain blight-resistant hybrids that had the vigor and erect growth form of the native American chestnut. The selection of parent trees with these desired characteristics met with considerable difficulty. American chestnut occurred mainly as short-lived sprouts and selection for the desired form was almost impossible. Also, most of the Asiatic introductions were from orchard rather than forest trees and many lacked hardiness when planted in this country.

Selections of Japanese chestnut (*C. crenata* Sieb. and Zucc.) and the Chinese chestnut (*C. mollissima* Bl.) were crossed to produce hybrids that were fully blight-resistant, but poor vigor and growth form made most of them unsatisfactory as forest trees. Hybrids resulting from crosses between the Japanese chestnut and the American chestnut were unsatisfactory in most cases because they were too susceptible to the blight fungus. Crosses between certain selections of the Chinese chestnut and American chestnut showed the greatest promise as forest trees. A number of hybrids of this type were produced in 1932, and additional ones in 1935 and later. In 1935, a selection of the Chinese chestnut was crossed with an American chestnut sprout growing near the Glenn Dale, Maryland, experimental area. After 18 years, the progeny of this cross averaged 9 inches in diameter at breast height and 37 feet in height. Most of the Chinese-American hybrids were upright in growth form and intermediate between the parents in blight-resistance.

In 1950, I took over the forest chestnut breeding program and continued with the work until 1960 when the program was discontinued. During the period from 1950-60 we backcrossed first generation Chinese X American hybrids to the Chinese species in order to increase their resistance to the blight fungus. Many of these backcrosses of Chinese X American on Chinese appeared to be unusually high in resistance to the blight. We had also started to intercross first-generation Chinese X American hybrids when the breeding program was discontinued. Second generation Chinese X American hybrids appeared to be considerably more blight-resistant than the first generation trees. In the period from 1925 to 1960, more than 10,000 hybrid chestnuts were produced at the Glenn Dale, Maryland, experimental area.

In order to test the growth rate, blight-resistance, and tree form of hybrid chestnuts under forest conditions, a number of outplantings were made. Between 1947 and 1955, J. D. Diller established 15 hybrid chestnut plots on cleared forest land in 13 eastern states. Trees in test plots were evaluated and released from competing vegetation in 1964 and 1965. Records were taken of the trees that had satisfactory average annual height growth, forest-tree form, and were disease-free.

In the second phase of the chestnut work, the development of blight-resistant selections that would produce nuts of high quality for orchard planting, the pure Chinese chestnut proved satisfactory. Therefore, outstanding seedlings of this species were selected and tested for possible release later as new horticultural varieties. Among characteristics taken into consideration in this selection work were earliness of coming into bearing, productivity, time of nut maturity, color, size, uniformity, and flavor of nuts; and, vigor and blight-resistance of the trees. The USDA released several early bearing horticultural varieties of the Chinese chestnut including the Crane, Meiling, Nanking, and Orrin.