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Chestnut Breeding in the United States for Disease and Insect Resistance

Sandra L. Anagnostakis

The Connecticut Agricultural Experiment Station, New Haven, CT 06504

Chestnut: A Prized Tree with a Long History

The genus *Castanea* (family Fagaceae) is found in north temperate climates around the world, and is highly prized in many different cultures for its nutritious nuts and valuable timber. Selection for larger, better-tasting nuts has been ongoing in Asia and Europe for centuries. Jaynes (48) quotes Eynard et al. as saying that selections of *C. crenata* Siebold & Zuccarini were known in Japan more than 1,000 years ago. In China, there are at least four species of *Castanea*. Liu Liu wrote in her treatise that chestnuts were found in the ruins of an ancient city in China, demonstrating that they were in use there 6,000 years ago (17). Early trade routes moved European chestnut trees (*C. sativa* Miller) west of their native range (in the Caucasus mountains), and the Romans then moved them across their empire to provide support posts for grapevines, as well as for the nuts (25,37). Cultivar selection in Turkey, Italy, Spain, and Portugal has been extensive, and regional favorites developed.

The many uses of the wood of American chestnut (*C. dentata* (Marshall) Borkhausen) made this "all purpose" tree extremely valuable in its native range in North America (Figs. 1 and 2). Nut production was important as a food source for rural families and many species of birds and animals. The other American species in the genus *Castanea* are classed as chinquapins, and may be divided into several or lumped as a single species (11,55). The small nuts from these trees and bushes serve primarily as mast for wildlife (69).

Botany

Most chestnuts produce two kinds of flowers, usually at the ends of the branches where they are exposed to full sun, although the American chinquapins produce their flowers on spurs at the sides of the branches. Long, cylindrical male catkins have dense stamens that bear the anthers. These produce abundant pollen that is both windborne and carried by insects. The female flowers are prickly involucre with 6 to 14 ovules. The stigmas bristle out of the end of the involucre and are receptive after most of the catkins have bloomed, and remain so for 1 to 2 weeks (Fig. 3). Catkins at the base of the female flowers delay blooming until the female flowers are receptive (duodichogamy). Trees that are interspecific hybrids are often "male sterile" and produce catkins that never bloom to

produce pollen (Fig. 4). Phenology was elaborated by Bounous et al. (20). The nuts form only if the trees are cross-pollinated, but rare self-fertile trees have been reported. All of the species (6 or 13 depending on whether you believe the lumpers or the splitters) are cross-fertile in both directions, but there appear to be some weak genetic barriers between certain species (48,49). Nuts are generally three per bur, and the involucre splits into four sections that fold back to release the ripe nuts (Fig. 5). The *Castanea* called chinquapins have single nuts in each bur, and the involucre splits into two sections. Branches of most *Castanea* rarely continue to grow beyond the flowers, but since American chinquapin female flowers are formed on short spurs, the main branches continue to elongate. Chestnuts are not hard-shelled like other tree nuts, so they are



Fig. 1. An American chestnut tree photographed in Scotland, CT in 1905. The tree was 83 feet tall, 27 inches in diameter, and 103 years old, and it occupied 900 square feet (44).

Corresponding author: Sandra L. Anagnostakis, The Connecticut Agricultural Experiment Station, Box 1106, New Haven, CT 06504; Phone: 203-974-8498, Fax: 203-974-8502, E-mail: Sandra.Anagnostakis@ct.gov

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