

UNITED STATES DEPARTMENT OF AGRICULTURE
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BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING DIVISION OF
FOREST PATHOLOGY
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GROWING CHESTNUTS FOR TIMBER

BY JESSE D. DILLER

Plant Industry Station, Beltsville, Maryland

Before the turn of the century, and even before chestnut blight had swept through our eastern forests, destroying one of our most valuable commercial timber trees, European and Asiatic chestnuts had been introduced. They made variable growth in the Gulf States, along the eastern seaboard from: Florida to southern Maine, the southern half of Pennsylvania, southwestern Michigan, southeastern Iowa, down the Mississippi River Valley and on the Pacific Coast. These trees were grown for horticultural purposes, and for the most part, represented large-fruited varieties of Japanese chestnuts. They were not regarded as having forest-tree possibilities, for in the open situations in which they were usually planted to insure early fruiting, the trees developed low-spreading crowns, resembling orchard trees. However, after the blight became fully established and it became apparent that our American chestnut was doomed, and that these scattered Asiatic chestnut trees had a natural resistance to this disease, a new interest developed in the Asiatic chestnuts as a possible substitute for the American chestnut.

The interest in and need for resistant, forest-type chestnuts became so great that the U. S. Department of Agriculture imported from the Orient seed of strains that might be suitable for the production of timber, poles, and posts, with tannin and nuts as valuable by-products--qualities inherent in our native chestnut. The Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering, has been carrying on the project of testing Asiatic chestnuts as timber trees. Professor R. Kent Beattie of this Division was in China, Korea, and Japan from 1927 to 1930, and collected over 250 bushels of seed for shipment to this Division. The seeds represented four species: *Castanea mollissima*--the Chinese chestnut; *C. henryi*--the Henry chinkapin; *C. seguinii*--the seguin chestnut; and *C. crenata*--the Japanese chestnut.

Direct Seeding Studies

At the very beginning of these investigations in growing Asiatic chestnuts as timber trees, it was believed that greater success in establishment could be obtained by planting seedlings, rather than by direct seeding. In direct seeding trials during the early thirties the planted nuts were promptly devoured by rodents. Sixteen years of field experience has proven the soundness of this belief. The imported nuts were planted in the Division's nursery at Glenn Dale, Md., and the resulting seedlings distributed as 1- and 2-year-old trees to cooperators throughout the eastern United States.

In order to thoroughly test the possibilities of direct seeding as an economical method of establishment, this Division during~ seven years (1939 to 1942, and 1944 to 1946) planted over 7,000 nuts by direct seeding in 200 locations in 18 eastern States. It was suspected that the greatest hazard to direct seeding in or near forests would be rodents. Accordingly, in the spring of 1939 and 1940, 400 nuts and 600 nuts, respectively, were

¹Reprinted from Northern Nut Growers Assoc. Ann. Rpt. 37: 56-70. 1946.

coated with a strychnine-alkaloid rodent repellent, and a comparable number of seeds, for both years, were left untreated to serve as checks. The checks were held in sphagnum moss at Beltsville, Md., and the nuts to be treated were packed in sphagnum moss and expressed to Denver for treatment by the Division of Wildlife Research, the Fish and Wildlife Service, Department of the Interior. Only 5.9 and 2.5 per cent of the treated seeds developed into seedlings, whereas 22.6 and 13.5 per cent of the untreated seeds produced seedlings. Not only did more of the treated seeds fail to germinate than of the untreated seeds, but the seedlings from the treated nuts were less vigorous. Because of the results obtained, the rodent-repellent study was discontinued at the end of the second year.

In 1941 and 1942, over 4,000 untreated chestnut seeds, representing 22 strains, were planted in 12 locations in eight eastern States. The seed source was entirely from American-grown, Asiatic chestnut trees growing in 28 locations in 16 eastern States. They represented Chinese, Japanese, hybrids, and also a limited quantity of American chestnut seed. Seed of the American species was included primarily to determine whether or not it differs from the Asiatic species with reference to establishment by direct seeding. The results for the two years confirmed our earlier beliefs: Only 2.2 per cent in 1941, and 4.0 per cent in 1942, developed into seedlings, of which only a remnant have survived. No species or strain differences were apparent.

"Tin Can" Method

In 1944, the tin-can method was employed in planting 400 nuts in four eastern States.

By this method 15.5 per cent of the planted nuts developed into seedlings, representing a fourfold increase over results obtained for the three previous years. One end of a No. 2 can is removed, and a cross is cut in the other end with a heavy-bladed knife. The open end of tube can is then forced into the ground, over the planted nut, so that the top lies flush with the ground level. The four corners at the center of the cut top then are turned slightly upward, to allow a small opening through which the hypocotyl of the developing seedling can emerge. The can completely disintegrate by rusting within two or three years, and does not interfere with the seedling's development.

Full examination made of the various burrows about the tin cans, and also of the teeth marks on fragments of chestnut seed coats lying about, indicated that not only squirrels, but other rodents, such as chipmunks, field mice, moles, and even woodchucks were probably involved in the direct seeding failures.

In 1945 and 1946, the tin-can method was tested widely on farms, to determine its possibilities in securing establishment of blight-resistant chestnuts without a great outlay of cash to farmers. In 1945, five seeds were distributed to each of 90 cooperators residing in the Piedmont and southern Appalachian regions, and in the lower Mississippi and Ohio River valleys; and in 1946, to 38 cooperators residing in the Middle Atlantic States. Preliminary results indicate that 40.0 and 37.2 per cent of the nuts planted by the farmers developed into seedlings. It should be pointed out that these results are not strictly comparable with those of previous years, because most of the farmers preferred to plant the chestnuts in their gardens, and under these conditions the nuts were not exposed to the severe competition and the extreme rodent hazards that occur in the forests.

Further proof of the superiority of planting seedling stock over direct seeding as a method of establishment is indicated in the results of an experiment initiated in 1939. One hundred and fifty 1-year-old seedlings and 150 nuts, all of the same Chinese strain, were planted on cleared forest lands in the Coastal Plains, the Piedmont, and the southern Appalachian regions, and in the Middle West. At the end of the eighth year, at each location, establishment and development of those originating from the 1-year-old transplants were better than those originating from seed, and their average survival was six times greater. Appalachian regions, and in the Middle West. At the end of the eighth year, at each location, establishment

Distribution of Planting Stock

During the period 1930 to 1946, the Division of Forest Pathology distributed thousands of Asiatic chestnut seedlings to Federal, State, and private agencies for experimental forest plantings in 32 eastern States. The ten States receiving the most planting stock, in the order named, were: North Carolina, Tennessee, New York, Pennsylvania, West Virginia, Virginia, Ohio, Georgia, South Carolina, and Maryland. The purpose of this seedling distribution was to obtain information concerning the little-known characteristics of the Asiatic chestnuts--their soil and climatic requirements, and their range adaptability.

Selection of Planting Sites

At first the selection of the planting sites was left entirely to the judgment of the cooperators, and most of them assumed that the Asiatic chestnuts have site requirements similar to those of the native American chestnut. Because the American chestnut often occurs on dry ridges and upper slopes, especially where soil is thin and rock outcrops are frequent, the cooperators proceeded to plant the Asiatic chestnuts on similar "tough" sites. They believed that the planting of forest-tree species is justified only on deforested areas that have reverted to grassland, or worn-out, unproductive agricultural land, or on wastelands--sites that we now know are better suited to the growing of conifers rather than hardwoods. As a result of this unfortunate choice of site selection, together with the several severe drought periods recurring in the early thirties, the cooperators lost most of their trees during the first and second years after planting. Inspections of some of these planted areas after a lapse of from 10 to 15 years indicated that the sites still support only a scant herbaceous cover, with broom sedge and poverty grass predominating, and with no evidence of native woody species encroaching on the areas. The few surviving Asiatic chestnut seedlings were sickly looking, multistemmed, misshapen trees, heavily infected with twig blight and chestnut blight, and severely damaged by winter injury. But despite these heavy losses, a few plantations succeeded at least in part and from these limited areas, together with an appraisal of the situations where some of the earlier planted chestnuts grew well, valuable information as to the site requirements of the Asiatic chestnut species was obtained.

Site Requirements

These field studies clearly showed that the site requirements of the Asiatic chestnuts, particularly with reference to soil moisture, are more nearly like those of yellow poplar, northern red oak, and white ash, than like the American chestnut or the native chinkapin species. On fertile, fresh soils that support the more mesophytic native species. Asiatic chestnuts remained relatively disease-free, developed straight boles, made satisfactory growth, and were able to maintain themselves in the stands in competition with the other rapid-growing associated hardwood species. The indicator plants that suggest good sites for Asiatic chestnuts are: (a) Tree species--yellow poplar, northern red oak, white ash, sugar maple, and yellow birch; (b) shrub species--spicebush; (c) herbaceous species--maiden hair fern, bloodroot, jack-in-the pulpit, squirrelcorn and/or Dutchman's breeches. Plants that indicate sites too dry for forest-tree growth of Asiatic chestnuts are: (a) Tree species--the "hard" pines, black oak and scrub oak; (b) shrub species--dwarf sumac, and low blueberry; and (c) herbaceous species--broomsedge, wild strawberry, and povertygrass. Plants that indicate sites too wet are: (a) Tree species--black ash, red maple, and willows; (b) shrub species--alder; (c) herbaceous species--sedges and skunk cabbage.

Climatic Test Plots'

On the basis of the experience gained from, those earlier, extensive distribution of Asiatic chestnut planting stock, the Division of Forest Pathology, during the years, of

1936, 1938, and 1939, established 21 Asiatic chestnut climatic test plots on cleared forest lands in eight eastern States on the most favorable sites obtainable. These plots, with their isolation borders, aggregating slightly less than 32 acres, and accommodating nearly 22,000 trees spaced 8 by 8 feet, occur from northern Massachusetts, along the Alleghenies southward to the southern Appalachians in southwestern North Carolina, and from the Atlantic seaboard, in southeastern South Carolina through the Middle West to southeastern Iowa. More than 20 strains are being tested at each place, including Chinese, Japanese, sequin, and Henry species, as well as hybrids, and progeny of some of the oldest introduced chestnuts. Most of the plots are fenced against livestock and deer. Although the results from these plots are as yet entirely preliminary, during the 8 to 11-year period of testing valuable information has already been obtained: (1) The range of the Asiatic chestnuts tested does not coincide entirely with the range of the American chestnut or the native chinkapins. All Asiatic chestnut species that have been tested have failed at Orange, Massachusetts, where the American chestnut grew in abundance. In southeastern South Carolina, where the several species of native chinkapin thrive, some of them attaining a height of 20 feet, the Asiatic species have largely failed. On the other hand, in northern Indiana and southeastern Iowa, entirely outside the botanical range of the American chestnut, a few Chinese strains have done remarkably well. (2) The Chinese chestnuts have a much wider range adaptability to site than the Japanese chestnuts; the latter are more restricted to mild climate and appear to require somewhat better site conditions. Of ten Chinese strains tested, only four can thus far be recommended for future planting in the Middle West. One Chinese strain that has thus far proven far superior to the others, in all the climatic plots, was introduced by the Department of Agriculture as seed from Nanking, China in 1924. (3) Poorly aerated soil is an important limiting factor in all regions where the chestnuts were tested.

Establishment by Underplanting and Girdling

On the basis of the field experience gained from the wide distribution of Asiatic chestnut planting stock and the information thus far obtained from the climatic test plots, a new method of establishing Asiatic chestnut under forest conditions was initiated in the spring of 1946, and is now being tried on a limited scale. It consists of underplanting, with chestnut seedlings, a fully stocked stand of hardwoods ranging from 4 to 8 inches in diameter at breast height in which the predominant species are yellow poplar, northern red oak, white ash, and sugar maples. All overstory growth 5 feet and over in height is then girdled. As the girdled overstory trees die, they gradually yield the site to the planted chestnuts in transition that does not greatly disturb the ecological conditions, particularly of the forest floor. Rapid disintegration of the mantle of leaf mold is prevented by the partial shading, which the dead or dying overstory, girdled trees cast. At the same time, the partial shading hinders the encroachment of the sprout hardwoods and the other plant invaders (which would normally become established if the planted area had been clear cut) until the chestnuts have become fully established. not only does this system provide excellent site conditions conducive to the development of forest-tree form in the Asiatic chestnuts, in limited areas, but also under establishment conditions that require a minimum amount of maintenance.

Summary

In general, Asiatic chestnuts, when grown for timber purposes, are best adapted to northern slopes, above frost pockets on cool protected sites, on deep, fertile soils having a covering of leaf litter and humus in the top soil, a soil that is permeable to both roots and water, and that has a good water-holding capacity. The plant association, above mentioned as indicating ideal sites for Asiatic chestnuts for best timber development, occur in rich soils of slight hollows in moist hilly woods and on the mountains in cove sites.