

MAKING HISTORY: FIELD TESTING OF BLIGHT-RESISTANT AMERICAN CHESTNUT (*CASTANEA DENTATA*) IN THE SOUTHERN REGION

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INTRODUCTION

The American chestnut (*Castanea dentata* Marsh. Borkh.) was decimated by an exotic fungus (chestnut blight [*Cryphonectria parasitica* Murr. Bar]) in the early part of the 20th century. The American Chestnut Foundation (TACF) uses a back-cross breeding program to produce a tree that is predicted to be American chestnut in character with blight resistance from Chinese chestnut (*Castanea mollissima* Blume). The first breeding generation produced in TACF's program predicted to have stable blight resistance is referred to as the "BC₃F₃" and nuts were first available for testing in autumn 2007. Our objective was to examine first-year response in bud break phenology and growth and to determine competitiveness of TACF's American chestnut breeding material, including the putative blight-resistant generation.

METHODS

Nuts were collected at TACF's Research Farm in Meadowview, VA, in autumn 2007, and grown for 1 year at the Georgia Forestry Commission's state nursery near Byromville, GA. Experimental material consisted of five breeding generations containing: three genetic families of American chestnut (240 seedlings), two genetic families of Chinese chestnut (182 seedlings), two genetic families of BC₁F₃ (206 seedlings), two genetic families of BC₂F₃ (194 seedlings), and five genetic families of BC₃F₃ (337 seedlings). Seedlings from each family were divided into two seedling size classes (small and large) by visually assessing size. Seedlings were planted at three national forests in Region 8 of the U.S. Forest Service in February 2009. Stands were treated with a shelterwood with reserve prescription (2-4 m² ha⁻¹ residual basal area), and stump sprouts were treated with an herbicide application. Seedlings were planted on a 2.5- by 2.5-m spacing using a single-tree plot, incomplete block design with a factorial treatment arrangement of family and seedling size. We assessed bud break in late April/early May using phenological stages ranging from 0 (bud dormant) to 5 (internodes visible and leaves enlarged). We measured planted chestnuts for total height and ground-line diameter (GLD), determined whether the tree was free-to-grow, and noted any damage. We assessed competition within a 6.2-m² plot around each planted chestnut. Four classes defined density of competition (Low = 0-5; Medium = 6-15; High = 16-30; Extreme >30). All data were analyzed in SAS (SAS Institute, Cary, NC). Main effects (planting location, breeding generation, family, and seedling size class) and interactions were tested using PROC MIXED. Differences were significant at a $\alpha \leq 0.05$.

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RESULTS AND DISCUSSION

Across three locations, survival averaged 88 percent, and 93 percent of seedlings were free-to-grow. Bud break was affected by breeding generation, family, and seedling size class, but not by location. Chinese seedlings were more developed (ranking = 3.5) than any other generation. The BC₃F₃ were more developed (ranking = 2.3) than American seedlings (ranking = 1.8), possibly indicating a departure from desired characteristics of TACF's breeding program. Small seedlings were significantly but only slightly more developed (ranking = 2.6) than large seedlings (ranking = 2.5).

Across locations, seedlings were 96 cm in height and 12.3 mm in GLD at planting, and were 97 cm tall and 13.2 mm in GLD after one growing season. Locations exhibited differences in height and GLD growth, likely due to differences in deer browse pressure. Height growth was also affected by breeding generation, family, and seedling size. Chinese seedlings had the smallest height growth at each location (-25 to 9 cm), but height growth of BC₃F₃ seedlings depended on location (-3 to 18 cm). The American, BC₁F₃, BC₂F₃, and BC₃F₃ seedlings did not differ in height growth. Breeding generation, family, or seedling size did not affect GLD growth. Small size seedlings had larger height growth (7 cm) than large size seedlings (3 cm), but small seedlings were smaller in total height after 1 year (83 cm), compared to large size seedlings (111 cm).

Location 3 had the smallest height growth due to heavy deer browse pressure (84 percent of trees browsed). Trees without deer browse were 26 cm taller than trees with deer browse. Blight affected six American trees and one BC₃F₃ tree.

Yellow-poplar (*Liriodendron tulipifera* L.) and red maple (*Acer rubrum* L.) were the most common and the tallest competitors. Plots most commonly had a low density class (48 percent of plots) and only 1 percent of plots had an extreme competition density class. Height of the tallest competitor on average ranged from 82 cm to 147 cm. With the exception of Location 2, the majority of planted chestnut trees were taller than the competition.

Protection of seedlings will be critical for future development, and deer shelters and fencing are being erected. Treating stump sprouts prior to planting appears to be effective at controlling competition after one growing season, but competition control will be applied if planted seedlings begin to lose dominance. Seedlings will need to overcome planting shock and deer browse pressure before we can make inferences on growth performance and blight resistance. We predict that larger size seedlings will be more competitive over time, despite their slower growth in the first year. We predict the putative blight-resistant chestnut seedlings (BC₃F₃) will eventually thrive and be competitive with natural competition.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.