Analysis of the first test plantings using BC3F3 seedlings on National Forests in the Southern Region

Stacy L. Clark, USDA Forest Service, Southern Research Station,
Scott E. Schlarbaum, Department of Forestry, Wildlife & Fisheries, The University of Tennessee

Background

An exotic pathogen, *Cryphonectria parasitica* (Murr. Barr), popularly known as the chestnut blight, decimated the American chestnut (*Castanea dentata* Marsh. Borkh.) tree throughout eastern North America in the first half of the 20th century. American chestnut was a keystone species in the eastern hardwood forests, comprising 25 to 50 percent of total tree density. The species' demise likely had drastic and sometimes negative consequences to forest structure and function, such as reductions in hard mast availability, increased light to the forest floor, and changes in soil chemistry. The species was perhaps the most widely used tree for utilitarian purposes in eastern North American. The tree was highly valued for tanning of leather, lumber, food, and fodder for cattle.

To date, planning for American chestnut restoration has emphasized producing a blight-resistant tree, but successful restoration will also require an understanding of the silvicultural parameters needed to regenerate the species. The Southern Region of the National Forest System (NFS) is receiving chestnut material from the American Chestnut Foundation (TACF) through a 2004 Memorandum of Understanding. The MOU states the Foundation will always treat the Forest Service as the "most favored recipient" of chestnut material, and this offer shall be in perpetuity; however, Forest Service managers need guidelines and recommendations for restoration of the species once seedlings become available in large numbers. Working with the Southern Research Station (SRS) of the Forest Service and the University of Tennessee's Tree Improvement Program (UT-TIP), the NFS established the first field tests using seedlings from the putatively blight-resistant generation (BC_3F_3) in 2009, 2010, and 2011.

Objectives

Determine differences in growth, survival, competitive ability, and blight resistance, among putative blight-resistant families, among breeding generations /parental species, between two seedling size classes (Large vs. Small), in representative forest conditions.

Methods

<u>2009, 2010 Plantings</u>

We established 3 plantings in 2009 and 2 plantings in 2010 on National Forests in TN, VA, NC. We planted seedlings in a ahelterwood with reserve (residual BA=10-20 ft^2/acre), treated stumps and/or stump sprout competitors with herbicide. We planted 2900 trees using a mixture of American, Chinese, B1F3 , B2F3, B3F2, and B3F3 material.

<u>2011 Plantings</u>

We testing two silvicultural treatments: Midstory removal [Low light-planting under full canopy with midstory removed; Loftis (1983)] and a Shelterwood with reserves (High light-10-20 ft^2 BA/acre). We established three replications on National Forests in NC, TN, and VA. We planted a total of 1696 trees using a mixture of: 10 B3F3 families, 1 B3F2 family, 1 American family, 1 Chinese family.

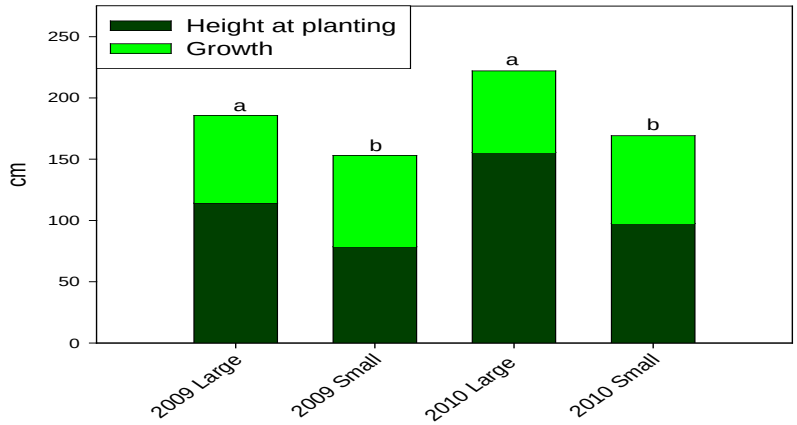
Nursery Protocols

For all plantings we used 1-0 bare-root nursery stock grown to maximize size (Kormanik et al. 2004). Average size at planting was 3.1 to 4.4 ft (ranging from 0.3' to 8.5'). We used a KBC bar or Auger (8" bit). We graded all families into two size classes.

Results

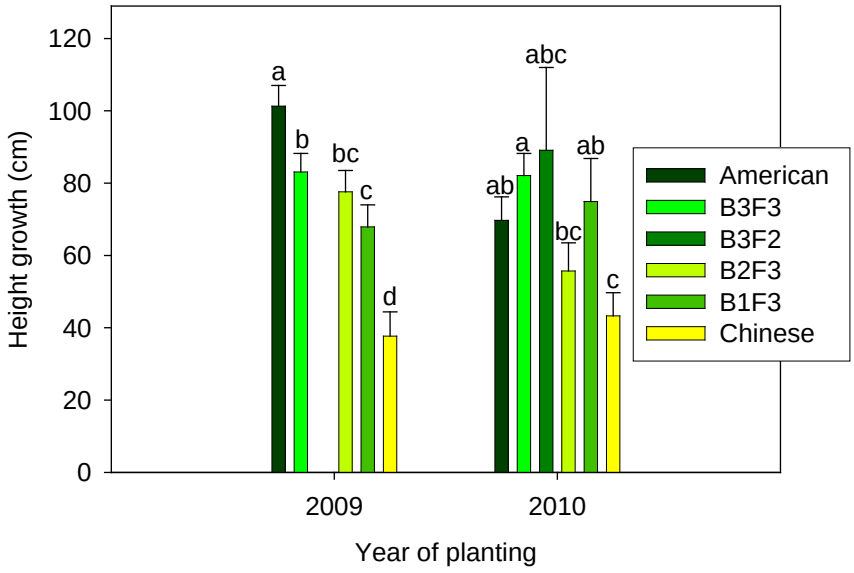
2009 and 2010 plantings, 2nd and 3rd year growth

- Large seedlings were 14-22" taller than small seedlings at both plantings
- Large seedlings not growing any faster



2009 and 2010 plantings, 2nd and 3rd year growth

- American parent had 18 cm more growth than B3F3 at the 2009 plantings

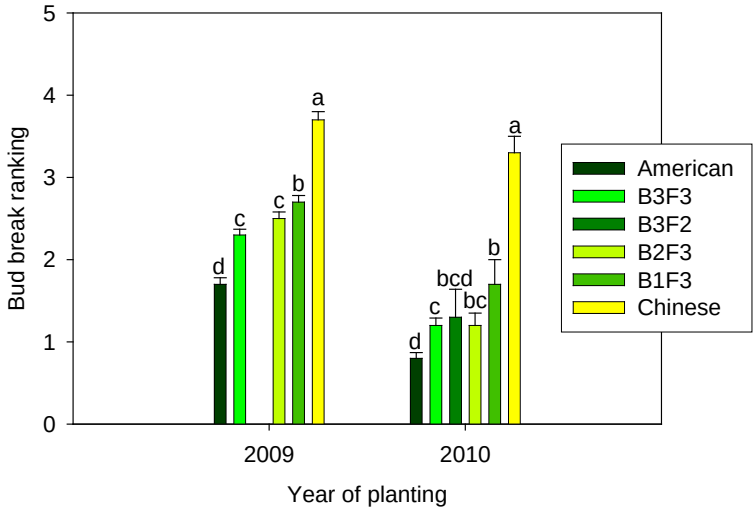


2009 and 2010 plantings, 2nd and 3rd year survival

- VA 2009-88% (moderate deer browse in year 1; sheltered in year 2)
- NC 2009=87%
- TN 2009=75% (heavy deer browse in year 1; sheltered in year 2)
- VA 2010 = 48% (severe *Phytophthora cinnamomi* symptoms)
- TN 2010 = 70% (moderate *Phythophthora cinnamomi* symptoms
- Chinese had lowest survival at 2009 plantings, but highest survival at 2010 plantings

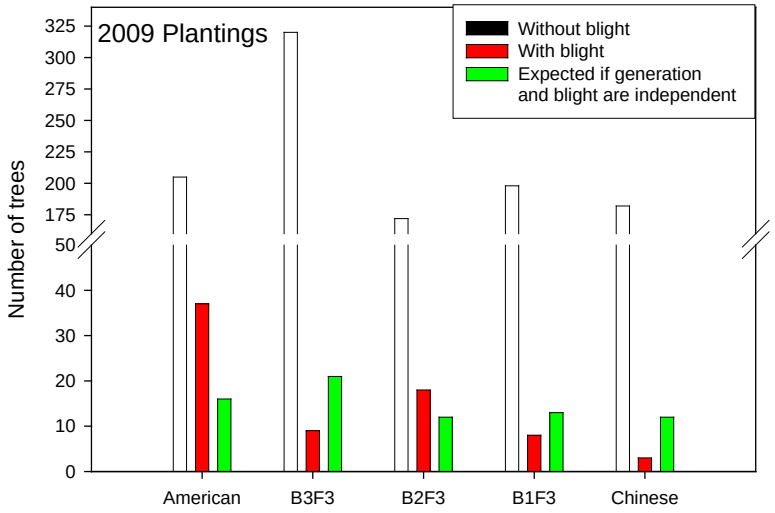
2009 and 2010 plantings, 2nd and 3rd year bud-break phenology

- B3F3 not behaving exactly like the American parent.



2009 and 2010 plantings, 3rd year blight resistance

- Numbers of trees with blight are low, but follow pattern of breeding program

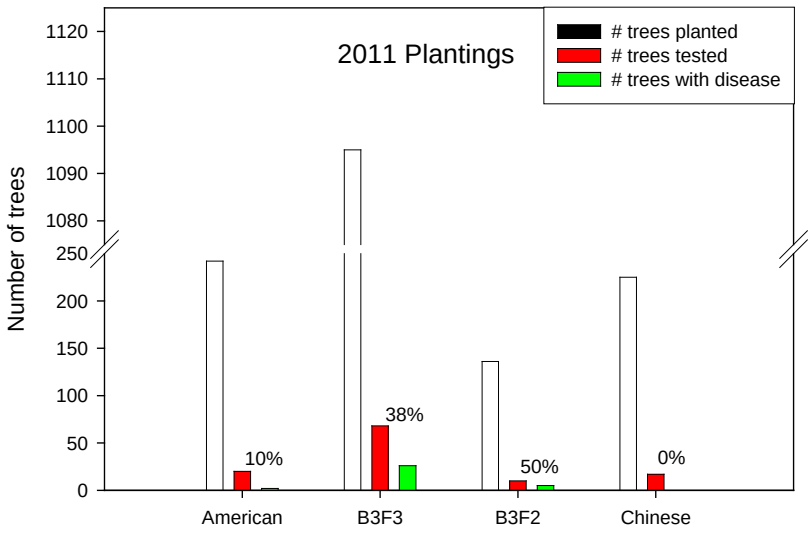


2011 Plantings, 1st year survival

- TN Midstory=71%
- TN Shelterwood=82%
- VA Midstory=76%
- VA Shelterwood=64%
- NC Midstory=50%
- NC Shelterwood=67%
- *Phytophthora* confirmed at all locations
- Survival DROPPING FAST!

2011 Plantings, Root rot caused by *Phytophthora*

- Tested roots from 277 trees from all plantings (156 assayed in lab)
  - Non-systematically
  - Pulled recently dead or dying trees
  - under estimating disease



Summary

Deer protection is important. Seedlings browsed in year 1 were 30 cm (12”) shorter after 3 years compared to unbrowsed trees. Grading seedling helps seedlings get above deer browse and natural vegetation competition. Chestnut grows fast (averages 1’ per year).

B3F3 seedlings are not behaving exactly like Americans, but are not similar to Chinese. B3F3 showing positive levels of blight resistance

Phytophthora confirmed on all 2011 and 2010 plantings. The disease is likely coming from nursery seedling roots. Blight and *Phytophthora* are interacting making blight resistance difficult to test.

Future biological barriers include deer, *Phytophthora,* blight resistance breaking down, other

exotic and native pests (Chestnut gall wasp, Asiatic oak weevil, Ambrosia beetle).

Deer protection has included Liquid Fence® which cost ~$420 to make 80 gallons. 1 gallon treats ~ 50 trees, $0.10 per tree per application. Total cost per tree is $1.40 per year. This method is less expensive than shelters. The repellant appears to be effective if applied correctly.

Phytophthora must be overcome with the use of containerized seedlings. This is add increased costs (5-10x of bare-root). We recommend the RPM™ (Root Pruning Method). It is most advanced technology available (Forrest Keeling nursery). The other option is to grow seedlings in northern nursery. However, this method will also increase costs, produce smaller seedlings (~18"), and makes logistics more difficult.

Budget

Item	Date	Cost
Total		**$6,000.00**
Forestry Suppliers	August 11, 2011	($1,282.84)
Forestry Suppliers/Ben Meadows	8-Sep-11	($531.70)
Travel Clark (Roan Mtn, TN)	August 22-23, 2011	($95.00)
Travel Clark (Norton, VA)	August 29-Sept 2, 2011	($587.10)
Travel Clark (Robbinsville, NC)	November 14-15, 2011	($138.88)
Clemson CRA	30-Oct-11	($2,000.00)
Travel Clark (Atlanta)	Dec 6-7, 2011	($222.84)
Travel Clark (Atlanta)	Jan 30-31, 2012	($226.84)
Travel Clark (St. Louis)	March 4-6, 2012	($762.96)
Travel Clark (Athens)	March 22-23, 2012	($211.74)
Total left		59.90

Acknowledgements

- Forest Service, Region 8: Barbara Crane, the late Don Tomczak (retired), Sandy Henning, Roger Williams (retired), Jim Stelick and staff, John Blanton (retired), Russ MacFarlane and staff, Jason Rodrigue and staff
- The American Chestnut Foundation
- Tennessee Division of Forestry and Georgia Forestry Commission
- Sandy Anagnostakis, Connecticut Agricultural Experiment Station
- UT Tree Improvement Program: David Griffin, John Johnson, Ami Sharp, Tracy Powers, Jay Messer, Luke Allen, Brian Hughett
- UT Postdoctoral Associate: Leila Pinchot
- Steve Jeffers and Inga Meadows, Clemson University
- Gary Griffin, Virginia Tech University (Emeritus)
- Forest Service, State and Private Forestry, Forest Health Protection