Restoring the American Chestnut

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Our Mission…….

Restore the American chestnut to our eastern woodlands to benefit our environment, our wildlife, and our society.

THE AMERICAN CHESTNUT FOUNDATION®

Impacts to wildlife populations

- Chestnut prolific, consistent producer
- Mature white oak – 1,000 nuts, chestnut = >6,000
- The health of wildlife directly tied to reproductive output

Impact to our rural communities

- Chestnut used for many products
- Charcoal, furniture, fence posts, barns, tannic acid for leather production, railroad ties, telephone polls and nuts

Shelton family and American chestnut in what is now Great Smoky Mountains National Park, TN.

Developing a disease-resistant chestnut

- Backcross breeding program – both blight resistance and resistance to ink disease (caused by *Phytophthora cinnamomi*)
- Biotechnology – For over two decades TACF's NY state chapter has been using biotechnolgy to develop a blight-resistant tree.

Backcross Breeding

Goal of TACF:

To introduce the genetic material responsible for the blight resistance of the Chinese tree into the American species

Sprouting Chestnut

TACF's backcross breeding program

BACKCROSS BREEDING SIMPLIFIED

Dr. Joe James – our ink disease champion!

- Developing tree resistant to both blight and ink disease (caused by *Phytophthora cinnamomi*)
- Developing a tree resistant to ink disease just as important as blight resistance!

TACF chestnut breeding orchards

- 300 breeding orchards
- 125,000 chestnut trees
- See what volunteers can do!!

- Photo by Joe Schibig

What does blight resistance look like?

The First Test Plantings by the USDA Forest Service (Southern Research Station and the Southern Region), The University of Tennessee, and the American Chestnut Foundation

- Goal
  - To test TACF American chestnuts that have been traditionally bred for blight-resistance for the ability to survive, compete, and remain blight-resistant in forest conditions within the species' native range

Establishing Field Tests

- Established 11 plantings in 2009, 2010, and 2011 on National Forests in TN, VA, NC
  - In real world forest conditions
  - Planted 4596 trees: mixture of American (837), Chinese (535), B1F3 (470), B2F3 (455), B3F2 (277), and B3F3 (2022)

- We used bare-root nursery stock grown for one year in a commercial nursery
- The seedlings were grown to maximize seedling quality because the planting sites would contain fast-growing competition and deer that can browse up to 4.5'
- We split seedlings into two size groups to determine effects on growth and survival

- We planted seedlings on newly harvested sites using modified planting bars
- Stump sprouts from competing vegetation were treated with herbicides to give the chestnuts a better chance of survival and fast growth

- It will be just as important to determine if these trees can grow and survive in this highly competitive environment as it will be to determine blight-resistance.

Deer browse in 2009 plantings

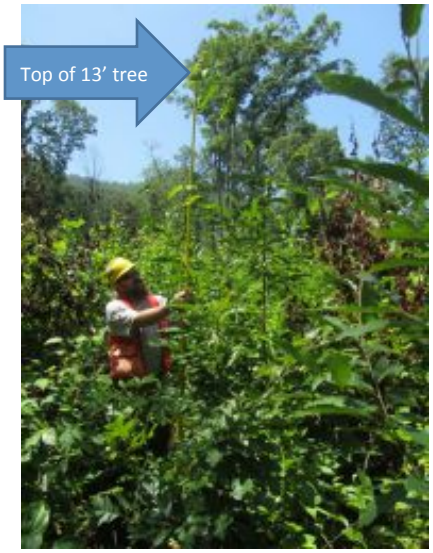
- 1st year browse was 80% at TN, 46% at VA, and 13% at NC
  - We sheltered trees at TN and VA in year 2
- At planting, only 7% of trees were above browse line
- A 20" tree at planting was 5 times more likely to be browsed than a 60" tree
- 58% of trees above browse line by 3rd year

2009 Plantings: 3rd year growth

- Total height=6' across all sites
- American (6.9') and B3F3 (6.2') were taller than Chinese (5.0')
  - Americans were significantly taller than B3F3 (but were same at time of planting)
- Large size class trees were 13" taller than small size class trees at end of 3rd year

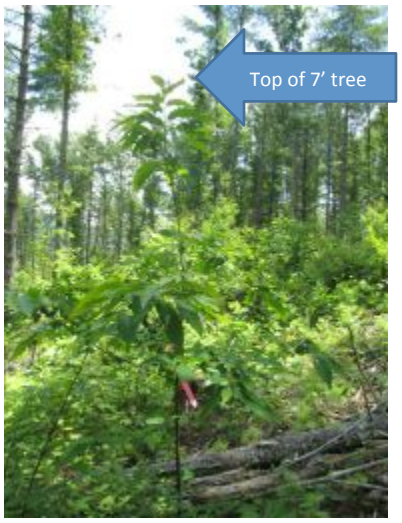
2009 Plantings: 3rd year survival

- 3rd year survival averaged 80% across all 2009 sites
- Chinese had lower survival at the TN planting (43%) compared to rest of generations and Americans
  - B3F3 had similar survival to Americans at all plantings
- Blight on less than 5% of trees
  - Too early to test resistance



2010 Plantings: Growth and Survival

- One planting was wiped out by root rot (ink disease) caused by *Phytophthora cinnamomi*
  - Planting was not well-drained
- The other planting has 70% survival and trees are averaging 6.6 feet in height after 2 growing seasons



2011 Plantings: Growth and Survival

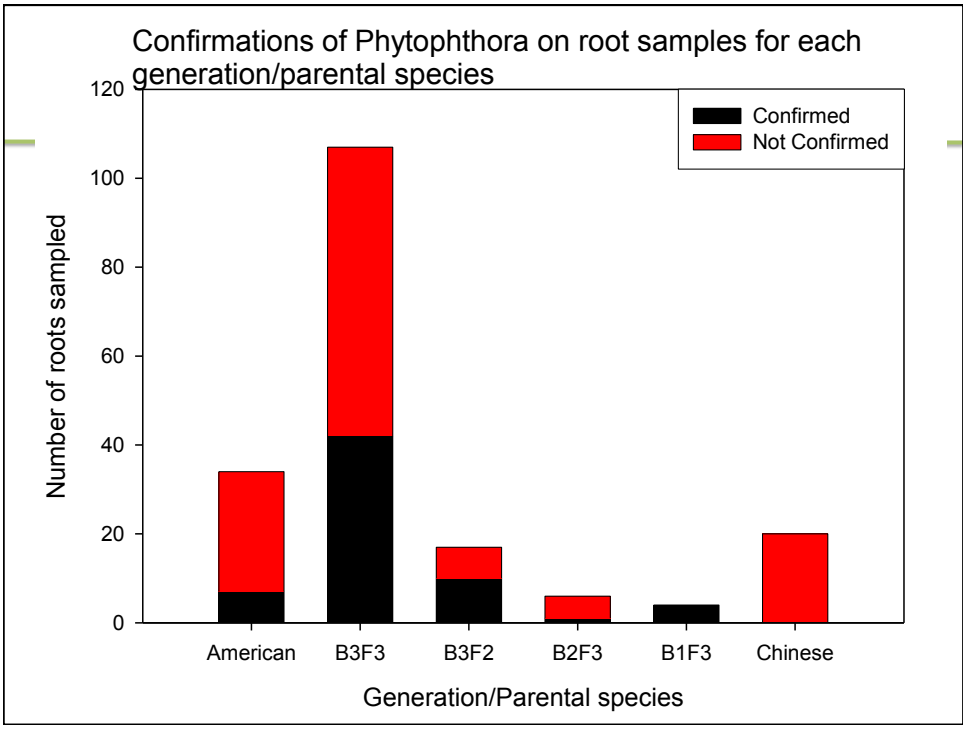
- These plantings are compromised by root rot (ink disease) caused by *Phytophthora cinnamomi*
- Overall survival ranged from 51 to 83% after one year and is dropping fast
- Growth was negative due to dieback

Phytophthora cinnamomi: What is it?

- Exotic fungal pathogen that came into US in 1870s
- Attacks chestnut, shortleaf pine, and Frasier fir
- Is most virulent in clayey, compacted, or poorly drained soils
- Chestnuts show little resistance
- No chemical treatment is effective
- Comes from commercial nursery soils and is transplanted through bare-root nursery seedlings
- Does not grow in northern latitudes (above ~40°)

Root rot caused ink disease (*Phytophthora cinnamomi)*

- Confirmations were made *at all 11 sites* by pathology experts
  - Under-estimating presence of the disease



Other pests we have seen:

- Non-native:
  - Asiatic oak weevil (*Cyrtepistomus castaneus*)
    - Identified at 4 plantings
  - Asian chestnut gall wasp (*Dryocosmus kuriphilus*)
    - Identified at 5 plantings
  - Ambrosia beetle holes
    - Identified at 1 planting


Asiatic oak weevil


Asian gall wasp

Other pests we have seen:

- Native:
  - Chestnut sawfly (*Craesus castaneae)*
    - Identified at 2 plantings
  - Periodical cicadas (*Magicicada* spp.)
    - Severe damage at one planting
  - Squirrel chewing to bark
  - Tree hopper scars
  - Caterpillar defoliation
  - Deer browse and rub


Chestnut sawfly


Cicada damage

Summary

- Restoration success will depend on how well these trees adapt to the natural environment and resist exotic pests other than blight
- 2009 plantings are doing well because minimal Phytophthora and we protected from deer
- Seedling quality at planting does make a difference in total height

Summary cont.

- Chestnut grows fast! ~ 1 foot/year
- B3F3 not behaving exactly like Americans in height or in budbreak phenology
- *Phytophthora* will be major obstacle in restoration
- Blight-resistance will be tested this coming year

Barriers: *Phytophthora*?

- Use containerized seedlings
  - Increased costs (5-10x of bare-root)
  - RPM® (Root Pruning Method) is most advanced technology (Forrest Keeling nursery)
  - Need to develop quality seedling balanced with logistical constraints

RPM seedling on left; bare-root seedling on right

Moving forward with restoration – the vision

- Testing this past winter – 17% of Restoration Chestnuts 1.0 showed good resistance
- This should increase over time
- Planting and long-term testing critical

We are at a crossroads!

- Test and evaluate 1 million trees in the next 7 years!!!!!
- This will strain our resources
- Must use best science
- We can't reintroduce without this testing

Acknowledgements

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Websites

- Stacy Clark's research page:
  - http://www.srs.fs.usda.gov/uplandhardwood/americanchestnut.html
- TACF:
  - www.acf.org – Main Page
  - http://www.acf.org/Tree_ID/5species.php - Page on chestnut ID
- MOU between USDA Forest Service and TACF:
  - http://fsweb.wo.fs.fed.us/aqm/grants/static/servicewide_agreements/american_chestnut_foundation/10-MU-11132425-123.pdf