RESPONSE OF IMPROVED AMERICAN CHESTNUTS TO PLANTING PRACTICES ON RECLAIMED SURFACE MINED LAND

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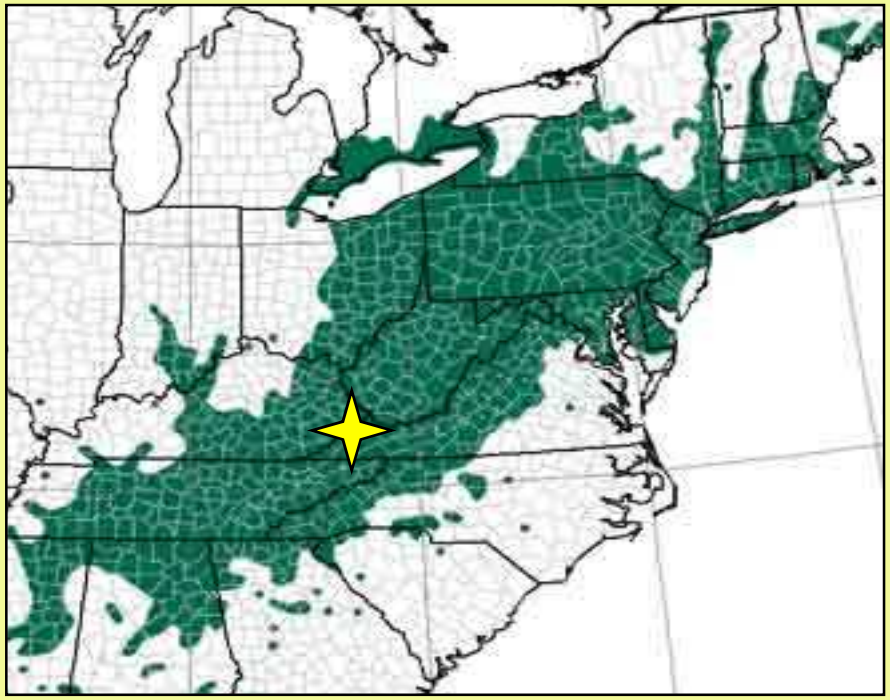
Introduction:



American Chestnut's Former Range

The Appalachian Coal Basin

- American chestnut was an ecological and economic foundation species in Appalachia
- The chestnut blight made it functionally extinct
- Space on reclaimed lands can be used for reintroduction within the core of its range

Study location

The Tree



- Grew over 12 feet in diameter and over 120 feet in height: “redwoods of the east”
- Occupied over 25% of the canopy in its range
- 200 pounds / acre of nuts annually for people, livestock and wildlife: a staff of life
- Light, strong, straight-grained, rot-resistant and workable wood: a near perfect medium
- Extremely fast growth, especially from stump sprouts: rebounded from clear-cutting of the industrial revolution to come to dominance

The Blight

- *Cryphonectria parasitica* – a fungus
- Introduced from Asia ~1900
- Destroyed 4 Billion Trees by 1940
- Identified by basal orange cankers
- Trees persist as short-lived stump sprouts that rarely reach maturity, some mature survivors out there

Restoration with American - Chinese Hybrids

Chinese Chestnut

- Chinese chestnut resists the blight, but lacks the architecture and shade tolerance to live in the Eastern forests and lacks the structure of a timber tree
- Hybridization and selective backcrossing with American chestnut has goal of achieving blight resistance plus botanical and structural similarity to the Americans

ACF Breeding

American Chestnut Foundation Nursery

- Americans bred with Chinese to make a 1:1 hybrid
- Hybrid individuals selected to be backcrossed with pure Americans for a 3:1 hybrid “B1”
- B1 individuals bred for “F2” and “F3” generations
- Further selection and backcrossing for “B2” 7:1 and “B3” 15:1 hybrids which are also bred for F2 and F3
- Results in multiple generations of each backcross level
- “B3F3” is botanically the same as American, blight resistance and structure promising, but being tested
- We used B1F3, B2F3, B3F2 and pure lines of Chinese and American in our experiments

“Operation Springboard”

- Planting chestnut forests using successful hybrids demands large, cleared spaces within the original range
- Reclaimed mine land creates such space
- Single-species or mixed chestnut forests can now be established with the Forestry Reclamation Approach

- What is the best planting method?
- How do chestnuts interact with groundcovers?
- How do the various breeding generations perform on mined lands?

Objective:

- Test effects of breeding generations and methods of establishment on the survival and growth of hybrid chestnut on reclaimed mined land

Methods:

- 2008-2009 Groundcover Trial
  - 3 groundcover treatments: conventional, tree-compatible and annual ryegrass
  - 6 breeding generations
  - All chestnuts planted as nuts in tube shelters amongst 13 other Appalachian tree species;
  - All sites: FRA loose graded on steep slopes (~60%)
  - 3 Blocks

- 2009 Planting Method Trial
  - 2 planting treatments: nuts in tube shelters and 1 year-old bare root seedlings without shelters
  - 5 breeding generations
  - Chestnuts planted without other species
  - 3 FRA loose graded steep sloped (~60%) sites and 1 flat, ripped site
  - 4 Blocks

Methods:

- Nuts planted in mix of native forest soil, mine spoil and potting soil (peat with vermiculite)
- Nuts protected with tubex, rebar stake and rocks
- Bare root seedlings planted by hand with a hoe-dads
- Groundcovers hydroseeded
- Cumulative survival and height of all planted trees measured at end of 2009

Mixing Soil

Nuts with Shelters

Hypotheses:

- Hybrid chestnuts will have greater survival and be taller than pure American chestnut
- Annual ryegrass will allow greater survival and height of chestnut than the conventional groundcover
- Bare root seedlings will have greater survival and height than nuts with tree shelters

Results:

Planting Method Trial – after one year

- Bare root seedlings 83% (a) 470mm (a)
- Sheltered nuts 76% (b) 347mm (b)
- Chinese 89% (a) 740mm (a)
- American 87% (a) 432mm (b)
- B1F3 84% (a) 310mm (c)
- B3F2 73% (ab) 273mm (c)
- B2F3 66% (b) 287mm (c)

Groundcover Trial – after two years

- Annual Ryegrass 71% (a) 286mm
- Tree compatible 60% (ab) 295mm
- Conventional 50% (b) 236mm
- Chinese 84% (a) 373mm (a)
- B1F3 73% (ab) 352mm (a)
- B3F2 65% (abc) 276mm (ab)
- American 2 58% (abc) 203mm (b)
- American 1 58% (abc) 244mm (ab)
- B2F3 48% (bc) 273mm (ab)

(Alpha = 0.10)

Discussion:

- Blight-resistance of hybrids should make a difference over Americans in the coming years, no blight observed yet, so other causes of mortality acting now
- Tree architecture and shade tolerance of hybrids will make a difference over Chinese only as canopy closes
- Planting only annual ryegrass improves chestnut survival, and also improves natural succession
- Bare-root seedlings out-performed sheltered nuts, plus they can be included in the normal FRA tree mixes and procedures of planters

Tube Issues

- Rodents get trapped in tree tubes and eat trees or nuts, then die: set stake inside so they can't get in but can get out
- Coyotes rip up tree tubes to get trapped rodents and bears gnaw on tree tubes
- Deer do browse on chestnut; tubes are necessary for nuts or seedlings where deer are very numerous, especially because of the high cost of hybrids

Rodent Skull and Dead Nut in Tube

Chestnut: Deer Browsed and Re-sprouted

Observations for Future Study

- **Chestnuts now doing poorly on the flat, wet, ripped post-SMCRA abandoned block:**

  Is it *Phytophthora* root rot or soil physics?

- **Chestnuts now doing best on an FRA block with pure brown sandstone spoil with course texture, 4.9 pH, the least extractable N and P and the lowest CEC:**

  What is its most competitive soil niche?

Cattails growing next to chestnuts on wet block with poor performance.

Conclusions:

- Hybrids haven't shown evidence of superiority after 1-2 years, but should later
- Hybrid chestnuts can be included in FRA planting mixes as bare root seedlings and planted normally, just like other species
- Annual rye groundcover improves survival
- Tube shelters should be employed where deer browse is known to be a problem, but set stake inside tube to avoid rodent problems

Credits

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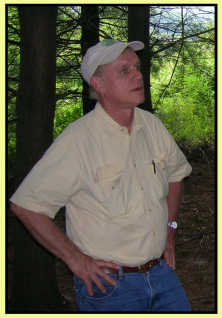

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Questions and Discussion