

# Reproduction potential and natural canker infection on backcrossed restoration chestnut trees



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# Active Coal Mining in Appalachian



**Surface Mining for Coal - Muskingum County, Ohio**

# 1977 - Surface Mining Control and Reclamation Act (SMCRA)



## Positives:

- Land Stability
- Erosion control
- Forage land

## Negatives:

- Invasive species
- Habitat loss
- Arrested succession



# Appalachian Regional Reforestation Initiative

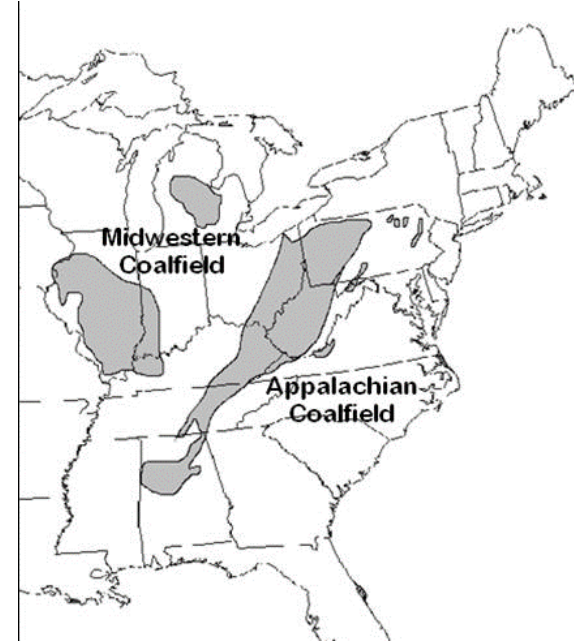
**Established trees can  
accelerate forest succession**

**Forestry Reclamation Approach:**

- Appropriate substrate
- Loose soils
- Proper ground cover
- Proper planting methods using a valuable native tree species



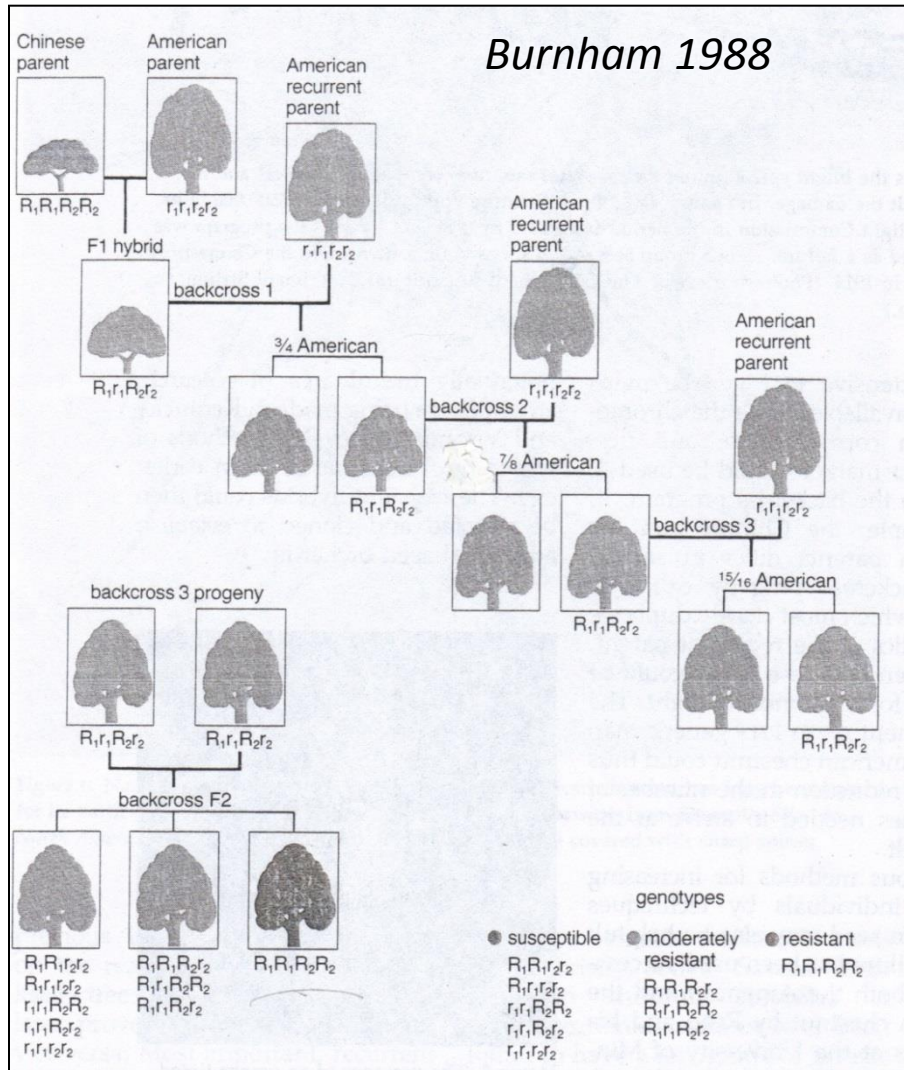
# Chestnut in Coal Mine Reclamation



- Fast growth rate and tolerance to dry soil conditions
- Fast nut production and habitat creation
- Native range of chestnut overlaps with Appalachian coal sites

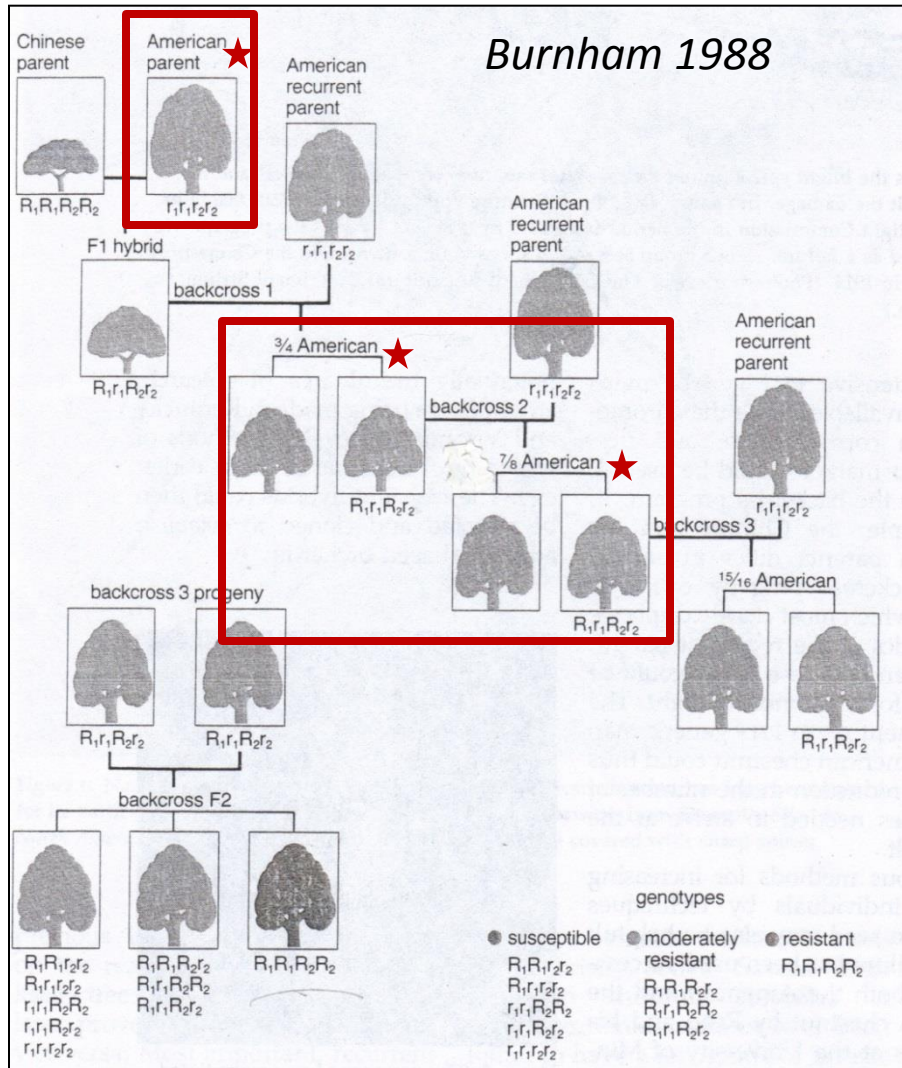


# American Chestnut in Restoration





# American Chestnut in Restoration



Seed lines sampled in this presentation – Suitable for large-scale restoration plantings?



# Study Site - Former Surface Mine Land



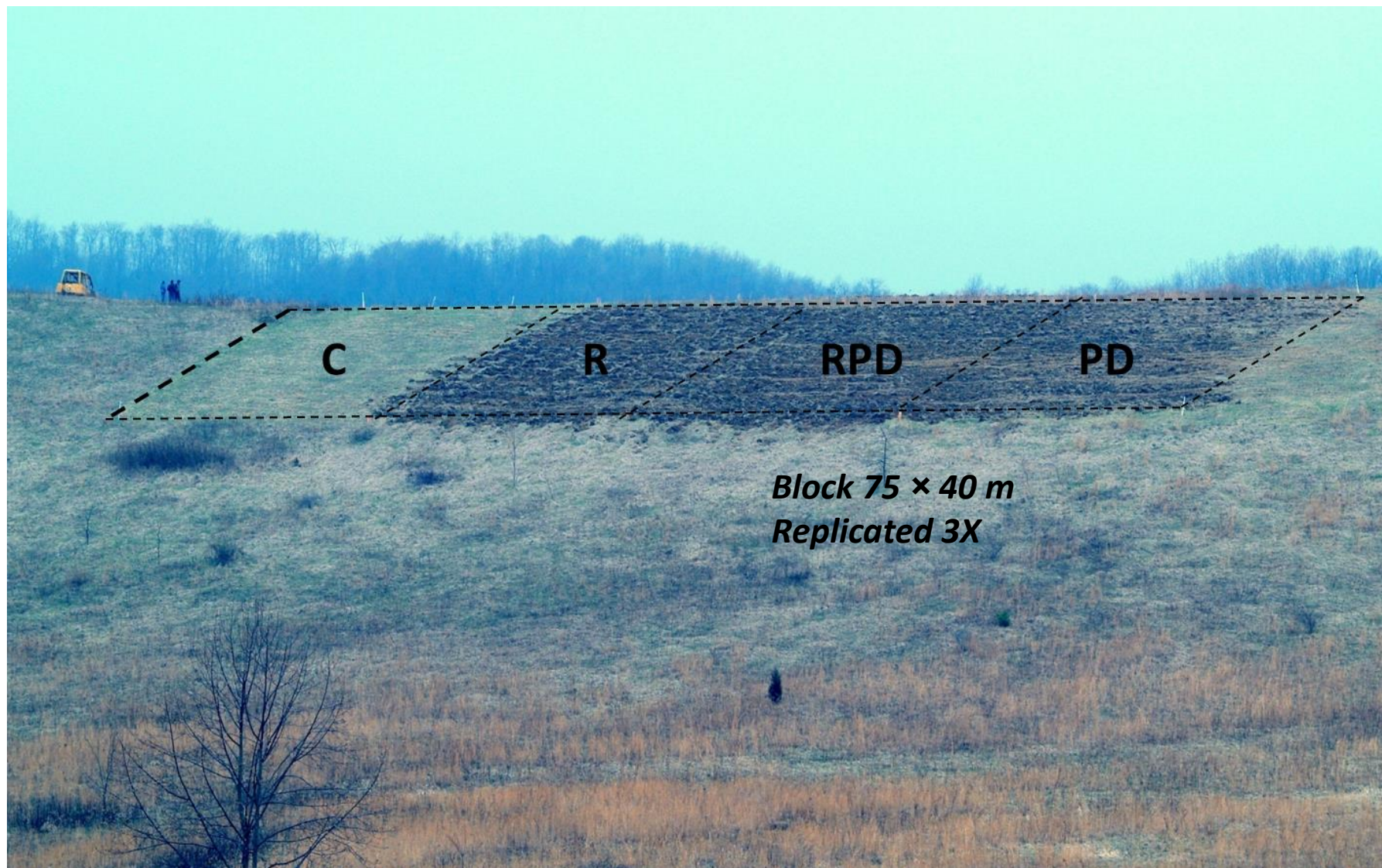


# Site Specifics of Study Plots

Soil parameter	Mean
<b>Physical</b>	
O.M.	1.3%
Sand	60%
Silt	23%
Clay	17%
<b>Chemical</b>	
pH	5.5
N	< 2 ppm
P	8 ppm
K	78 ppm
Ca	720 ppm
Mg	182 ppm
Mn	3.8 ppm

- Historically forestland
- Surfaced mined and reclaimed 1970s
- Sandy loam with pH conducive for chestnut
- Low in Organic Matter and Macronutrients
- Low in soil microbial activity
- Highly compacted with invasive species

# Field Testing Planting Methods





# Planting Methods



1,187 chestnuts mixed planting: Pure American,  $BC_2F_3$ , and  $BC_1F_3$  as 1 – year-old bare root seedlings



# Year 1: Establishment



Ripped plots: pure American chestnut (left) and B<sub>1</sub>F<sub>3</sub> (right)



# Year 3: Seedling Growth





# Year 4: Reproduction





# Aerial view after 4 years





# Year 6: Growth and Establishment



**High growth (2 m) and survival (80%) in plots that applied deep-soil ripping (~ 1 m depth)**



# Year 6: Growth and Establishment



**Pure American chestnuts were taller, however, the B<sub>2</sub>F<sub>3</sub> chestnuts had greater survival**



# Vegetation Composition

Species name	Common Name	% Cover
<i>Festuca arundinacea</i>	Tall Fescue	29.0
<i>Lespedeza cuneata</i> (Dumont) G. Don	Chinese Lespedeza	16.3
<i>Solidago canadensis</i> L.	Canada Golden Rod	10.8
<i>Rudbeckia hirta</i> L.	Black Eyed Susan	10.7
<i>Festuca arundinacea</i> Schreb.	Tall Fescue	6.5
<i>Achillea millefolium</i> L.	Yarrow	4.1

- 34 species were documented across treatments this study
- Five plant species made up 70% of the vegetation sampled
- The two most abundant herbaceous plants were reclamation species
- Two native species were abundant in survey
- Ripping in absence of plow/disking promoted species evenness
- One very interesting plant found in vegetation sample...



# Next Generation Chestnut





# Current Study:

Objectives:

Reproduction potential  
of soil treatments and  
chestnut lines

Measured via flower  
production in June and  
chestnut production in  
October on 7-year-old  
chestnuts





# Flowers and Burs by Treatment

Treatments	% Flowering trees	n Surviving trees
Control	41.2 <sup>a</sup>	51
PD	51.8 <sup>a</sup>	193
R	57.9 <sup>a</sup>	176
RPD	51.3 <sup>a</sup>	226

Treatments	Ave. Bur Count	n Surviving trees
Control	3 <sup>a</sup>	51
PD	74 <sup>b</sup>	193
R	101 <sup>b</sup>	176
RPD	113 <sup>b</sup>	226

All trees flowered in all the treatment plots, however, chestnut trees in control plots did not produce burs

# Flowers and Burs by Chestnut Type

<b>Chestnut Tree Type</b>	<b>% Flowering trees</b>	<b>n Surviving trees</b>
<b>Pure Am</b>	53.8 <sup>a</sup>	253
<b>BC1</b>	57.8 <sup>a</sup>	142
<b>BC2</b>	47.6 <sup>a</sup>	252

<b>Chestnut Tree Type</b>	<b>Ave. Bur Count</b>	<b>n Surviving trees</b>
<b>Pure Am</b>	127 <sup>a</sup>	253
<b>BC1</b>	98 <sup>a</sup>	142
<b>BC2</b>	73 <sup>a</sup>	252

**No hybrid vigor observed with regard to bur production after 6 field seasons. Possible *in situ* backcrossing?**



# Potential for Chestnut Dispersal



# Chestnut Blight in Restoration

Few stem cankers  
observed after 4  
field seasons

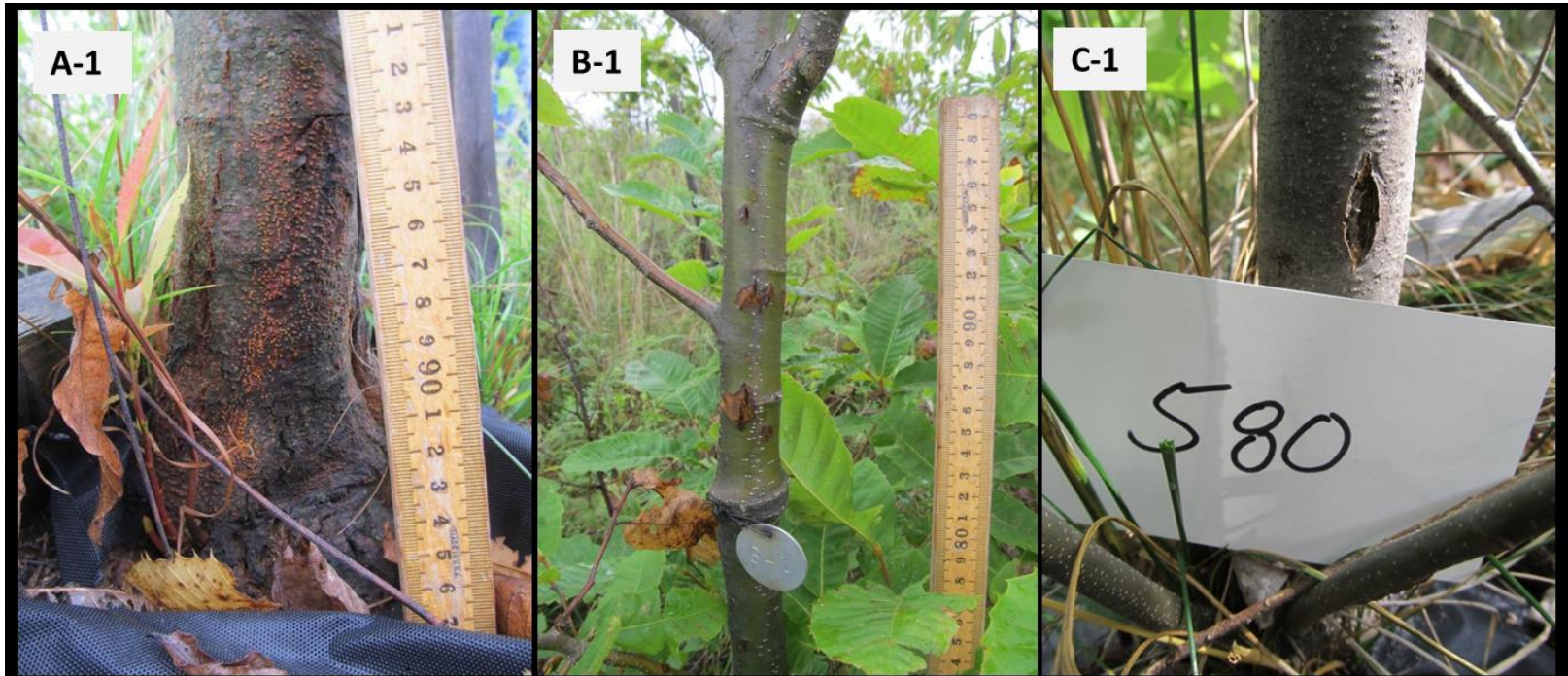
Survey conducted  
on all surviving trees  
after 5 and 6  
growing seasons



Chestnut blight canker (*Cryphonectria parasitica*) on chestnut basal stem



# Stem Cankers after 6 Field Seasons



**Evident stroma**

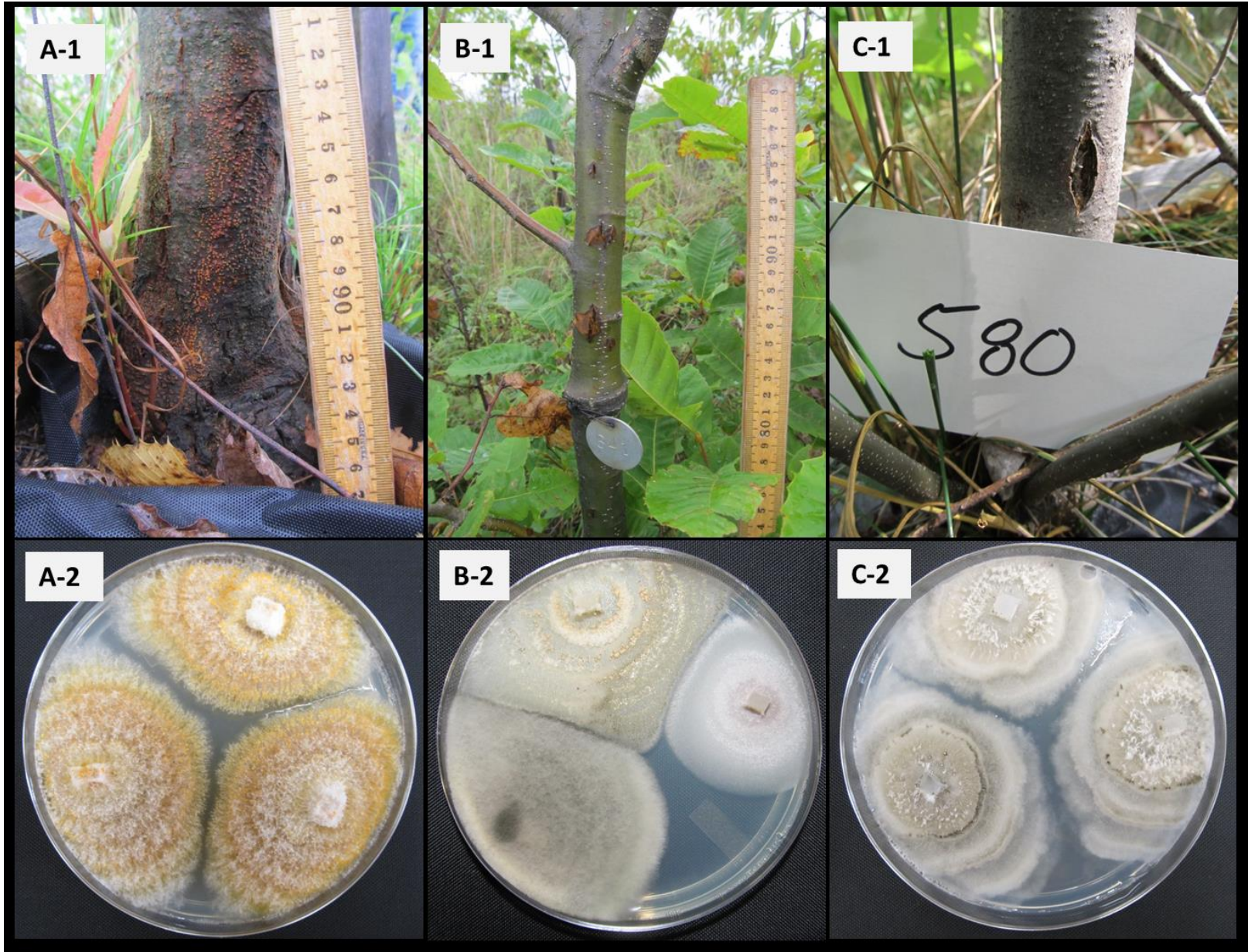
**Necrotic tissue  
with no stroma**

**Callous tissue with  
no evident necrosis  
or stroma**

**A sub-sample of 33 stem cankers representing all canker forms were selected for culturing.**



# Stem Cankers after 6 Field Seasons



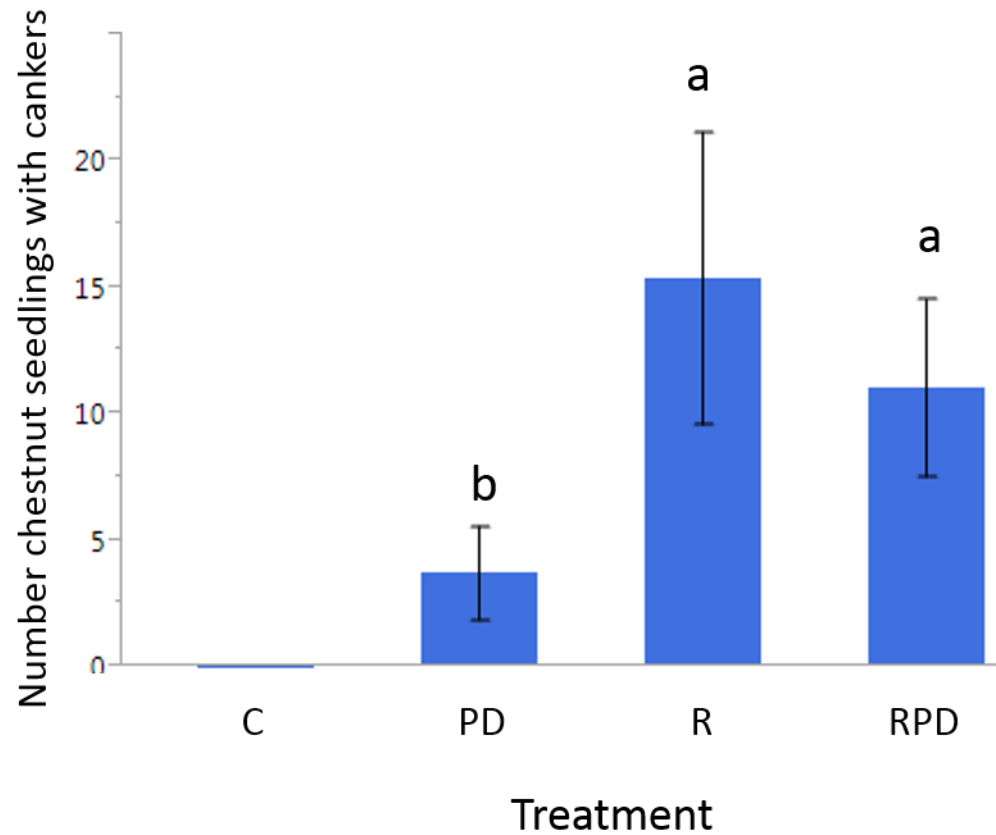


# Canker Production - Treatment

When soil treatments were compared differences existed:

Ripped plots had more canker incidence

Stem basal diameter did have a significant positive impact on canker incidence



# Canker Production – Tree Type

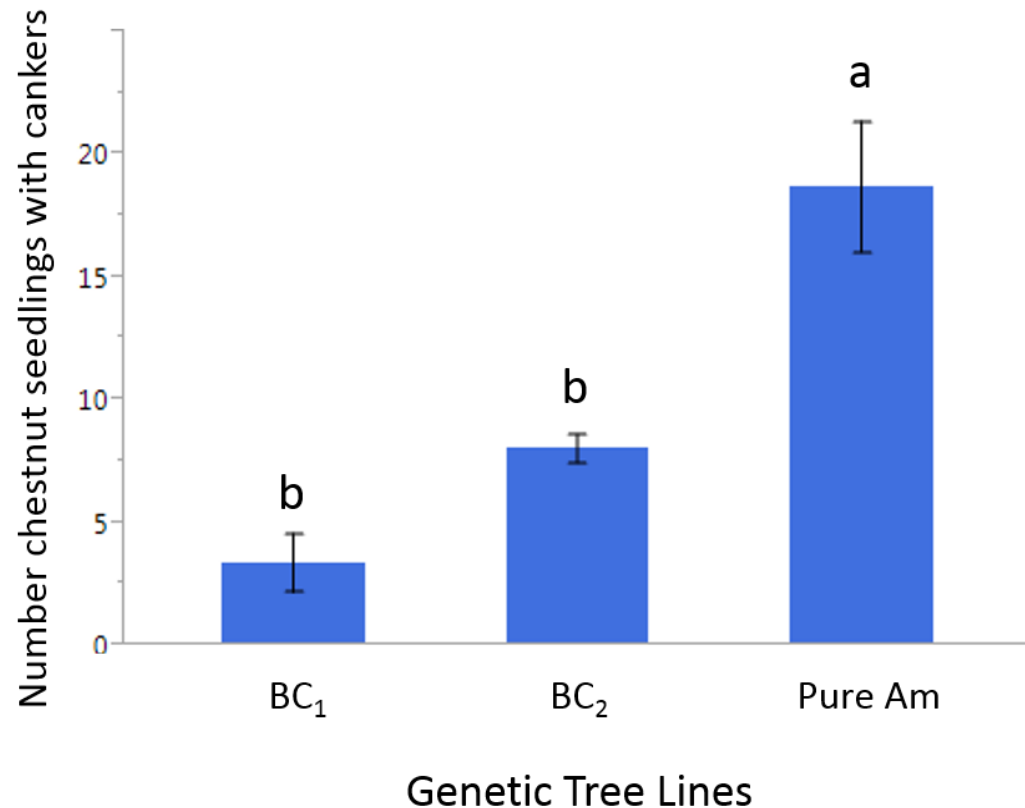
There were differences in canker incidence among genetic lines:

Pure American (26%)

BC<sub>2</sub>F<sub>3</sub> (9%)

BC<sub>1</sub>F<sub>3</sub> (6%)

No significant differences between the hybrids





# Chestnut Blight in Restoration

Chestnut blight will drive selection of genotypes that display varying levels of blight-resistance

Mortality from blight can facilitate tree diversity in a developing stand

Nutrient pools from dead plant material and active soil organisms may aid in seedling recruitment of other native forest species?



# Research Summary

- Ripping yielded greater survival and growth
- Significantly less chestnut blight on hybrids
- Greater seed production in treatment plots
- 862 burs produced during the sixth growing season





# Acknowledgements:

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- The State Chapter of American Chestnut

## Funding:



A scenic landscape featuring a dirt road winding through a lush green field. In the background, there are rolling hills and a dense line of trees, all partially obscured by a light mist or fog. The sky is a clear, vibrant blue, with a bright sun shining from the upper center, creating a soft glow and some lens flare. The overall atmosphere is peaceful and serene.

**Thank you!**