

Regional Efforts to Restore American Chestnut (*Castanea dentata*)

A Human Response to the Tragic and Somewhat Ironic Decline
of A Great American Tree



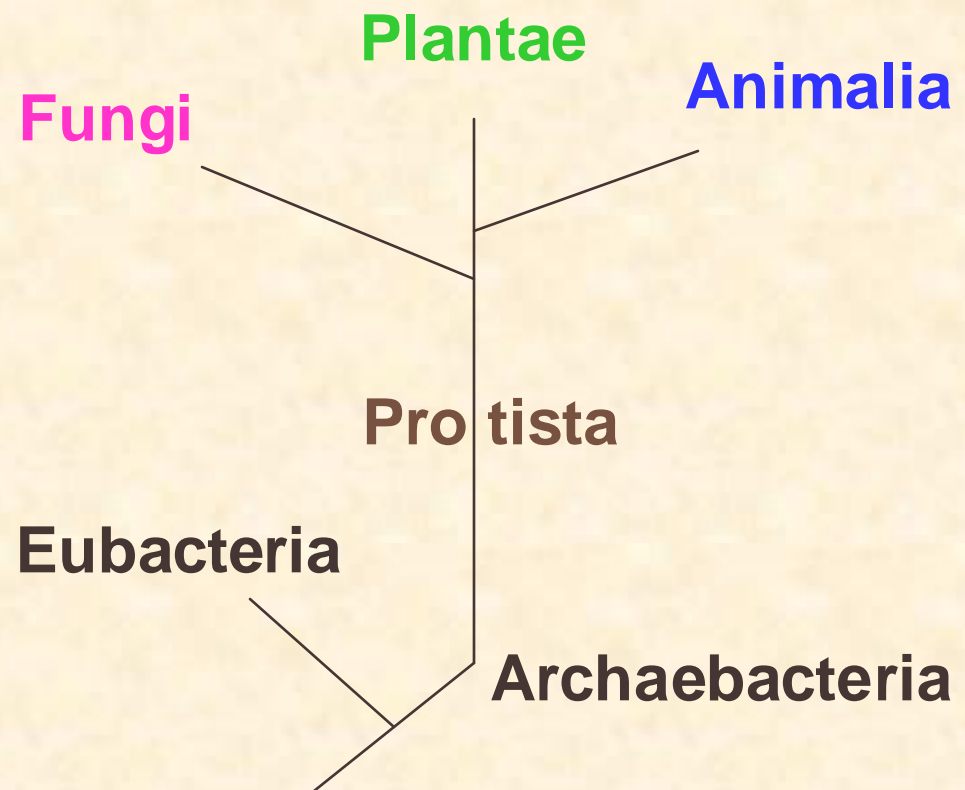
Robert Strasser



How does American chestnut fit into the diversity of living things?



Domain – Eukarya
Kingdom – Plantae
Phylum – Anthophyta
Class – Dicotyledones
Order – Fagales
Family – Fagaceae
Genus – **Castanea**
Species - **dentata**



Origins of Life > 3.5 BYA

Chestnut Identification - Genus *Castanea*

- Four species of chestnut tree in the world:
 1. Chinese – *Castanea mollissima*
 2. Japanese – *Castanea crenata*
 3. European – *Castanea sativa*
 4. American – *Castanea dentata*
- Several species of Asian and North American chinkapin, the smaller cousins of chestnuts
- All hybridize to some degree
- All are in the ***Fagaceae*** family, which includes Beech (***Fagus***) and Oak (***Quercus***).

Migration Pathway – *Castanea*

- Direction of dispersal and evolution of *Castanea* from Asia to Europe to North America.
- Chloroplast DNA sequences suggest a common *Castanea* ancestor originated in Asia about 40 – 60 million years ago. *Castanea dentata* probably diverged from *C. sativa* in the late Eocene epoch – approximately 35 million years ago.



Acknowledgements Fenny Dane, PhD.



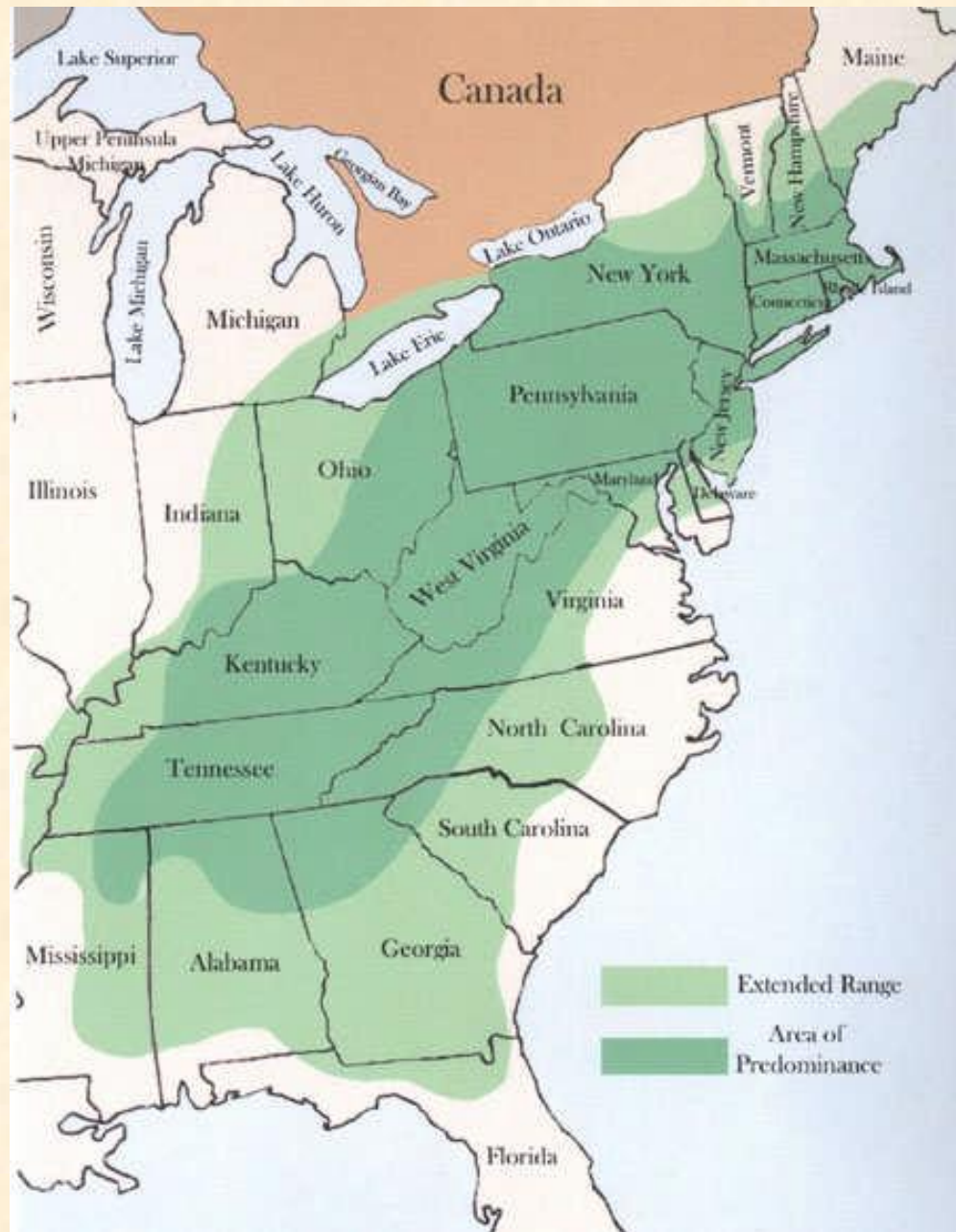
Castanea Leaf Identification (L to R): American Chestnut (*C. dentata*), Chinese Chestnut (*C. mollissima*), Chinkapin (*C. pumila*), European Chestnut (*C. sativa*), and Japanese Chestnut (*C. crenata*).



Chestnuts (Left – Right): American, Chinese, Japanese, European



Historic
Natural
Range of
American
Chestnut
(*Castanea
dentata*)



Old Growth
Giant
Southern
Appalachians



Chestnut Wood - A Major Historic Resource





Chestnuts Are A Great Food !



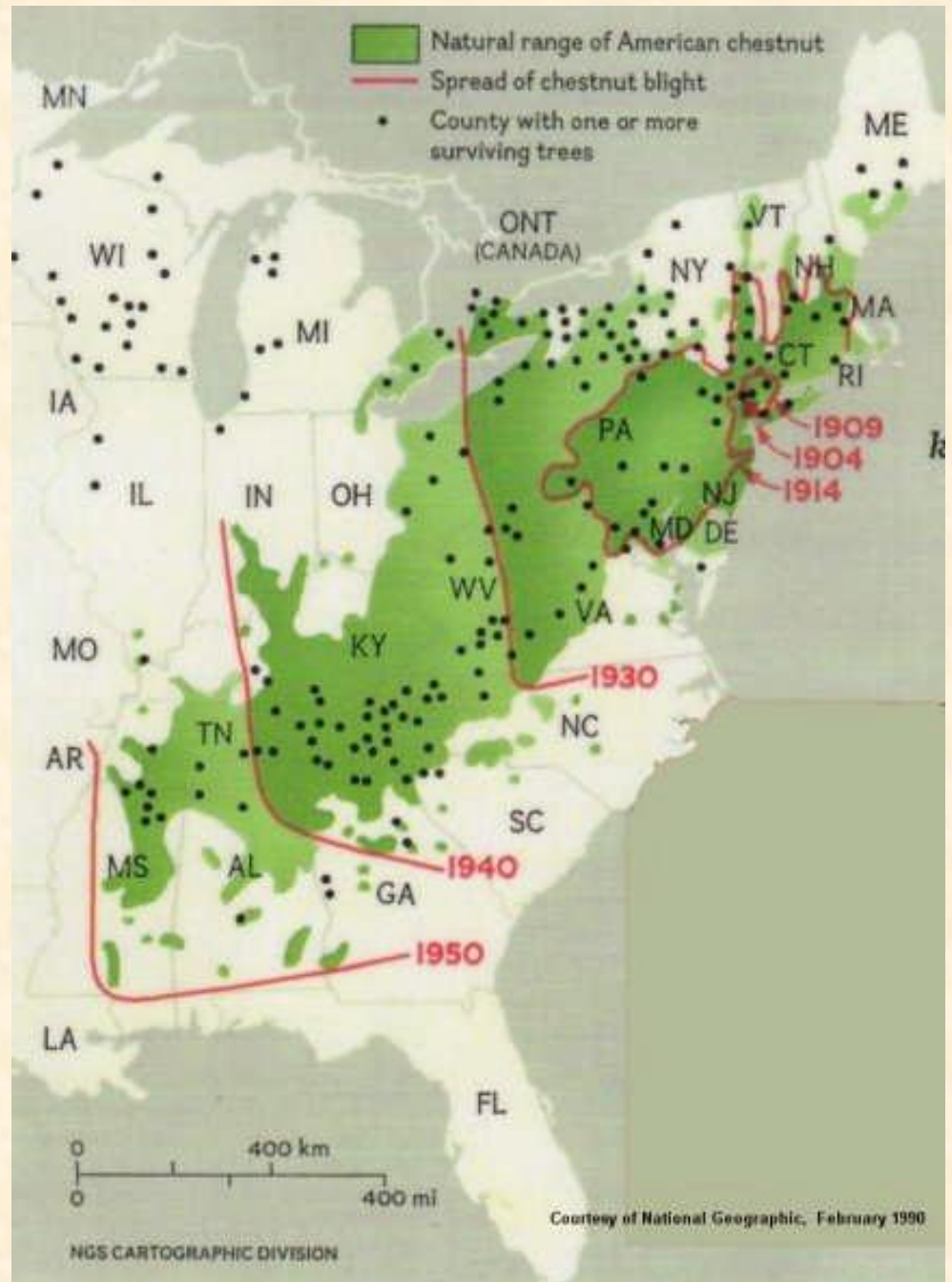


1904: Beginning of the Disease Pandemic

- ❖ Parasitic fungus - *Cryphonectria parasitica*
- ❖ Enters bark and infects cambium, not roots
- ❖ Rapid, uncontrollable dispersal



Spread of
*Cryponectria
parasitica*



Sunken Cankers



Point of Entry



Swelling Canker

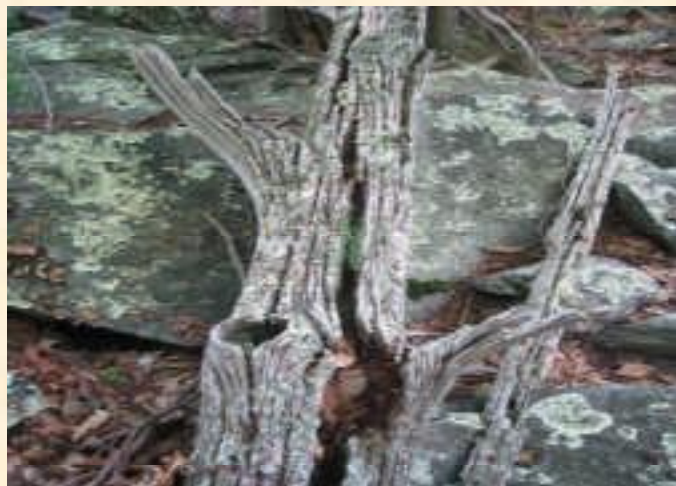




Coppicing – Basal Sprouting in Response to Disease Stress



Consequences
of A Blight
Pandemic



American Chestnut Today

- ❖ Minor component of the under story
- ❖ Few trees flower or grow large
- ❖ Research orchards
- ❖ May disappear without intervention



Why restore American chestnut?

- ❖ Ecological and environmental benefits:
 - Very good mast (nut) producer for wildlife
 - Well suited for mine land reclamation – tolerant of relatively acidic and dry soils
 - Atmospheric carbon sequestration
 - Watershed improvement
 - Reforestation: fast growing
- ❖ Economic value: wood, nuts, carbon credits
- ❖ Educational opportunities





The American Chestnut Foundation

Founded in 1983 with the goal of restoring chestnuts to the forests of Eastern North America.

Beginning in 1987, TACF initiated a systematic program to incorporate blight resistance found in Asian chestnuts into the American chestnut through ***backcross breeding***.

Chinese Chestnut :
Source of Blight
Resistance



Resistance: ability to limit the spread of disease *in vivo*.

Immune --- Resistant --- Susceptible

Blight resistance in chestnut is ranked numerically:

1 - - - - - 2 - - - - - 3 - - - - - 4 - - - - - 5

Strong - - - Good - - - Moderate - - - Poor - - - None

3 Stages of Backcross Breeding: Six Generations in 30 Years

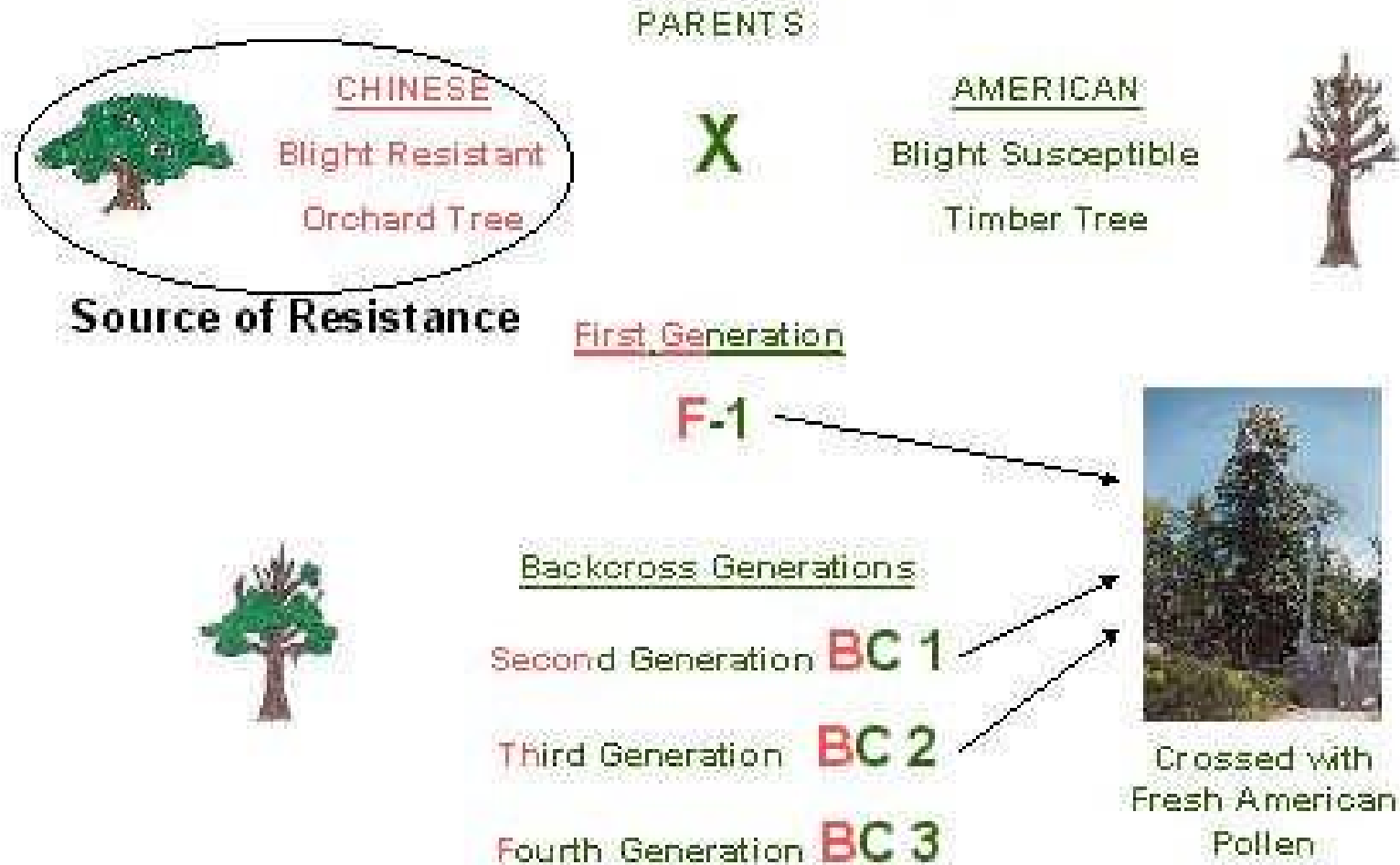
Cross American and Chinese to make an F_1

Backcross F_1 to Americans three times

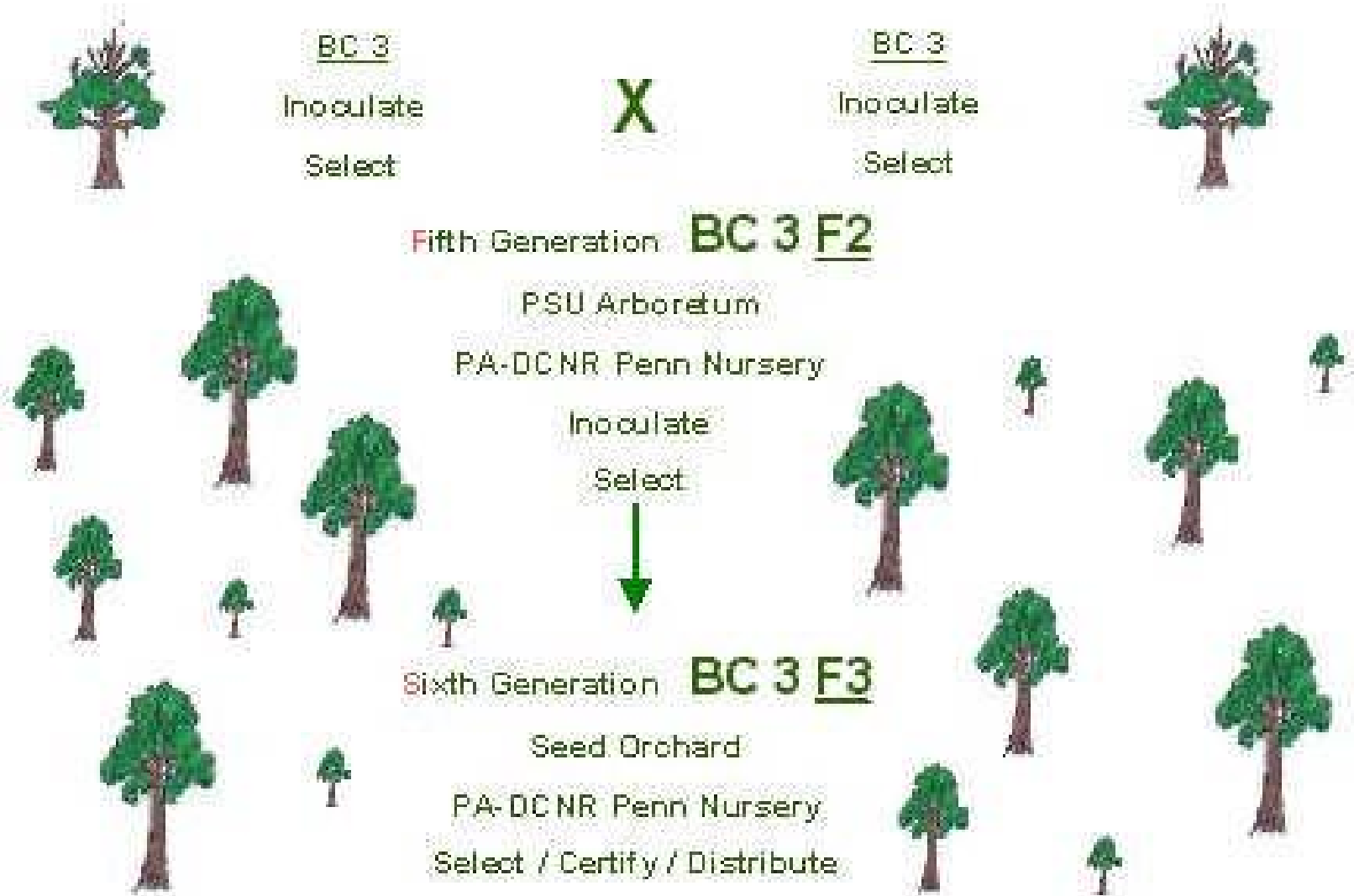
Intercross many third BC trees

The Backcross Breeding Program

(The Path of Most Resistance)



Intercross Generations



Controlled Pollination In the Field



Controlled Pollination – Breeding Monoecious Trees in the Field



Staminate Catkins – Male Flowers



Bisexual Catkins – Female and Male



Pollen Bags Prevent Open Pollination



Dried Pollen Applied From Vials



Growing Chestnuts Advances Research

Screening Chestnuts for Blight Resistance: Paired Inoculations

- ❖ Trees are infected with 2 blight strains
 - **EP 155** – high virulence
 - **SG 23** – moderate virulence
- ❖ Inoculation cankers are evaluated after 1 year
 - **Small cankers** - moderate resistance
 - **Large cankers** - poor resistance

Inoculation of Chestnuts With Blight

1) Bore hole in cambium



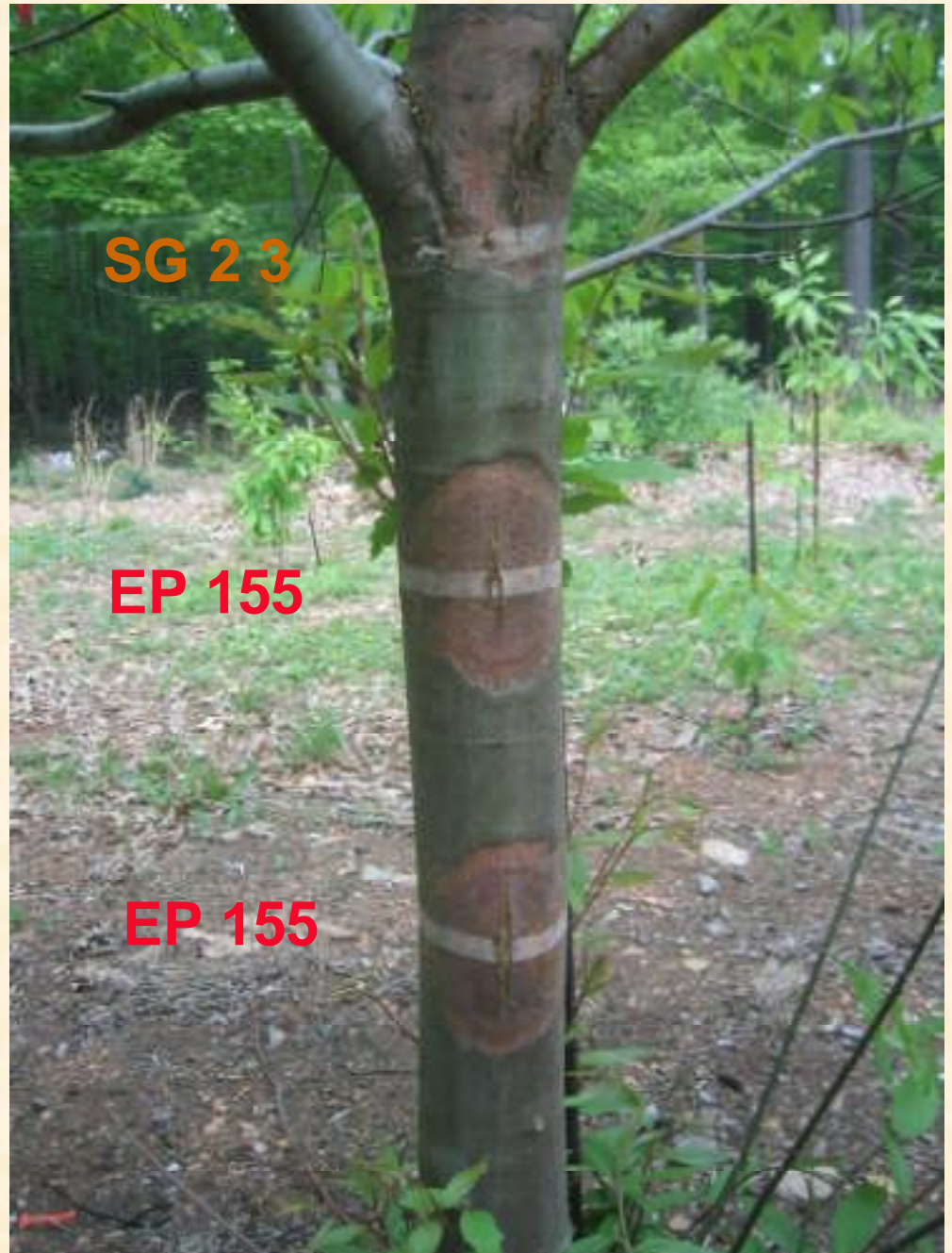
2) Insert cultures



3) Seal with tape



Paired Inoculations
1 year post-innoculation
Resistance Rank: 5
Pure *Castanea dentata*



Paired Inoculations – Inoculated June 2004 - Resistance Rating: 2.5

ThorpeWood Tree 50 – BC1



SG 2 3

EP 155

June 2005



SG 2 3

EP 155

June 2006



Jan 2008

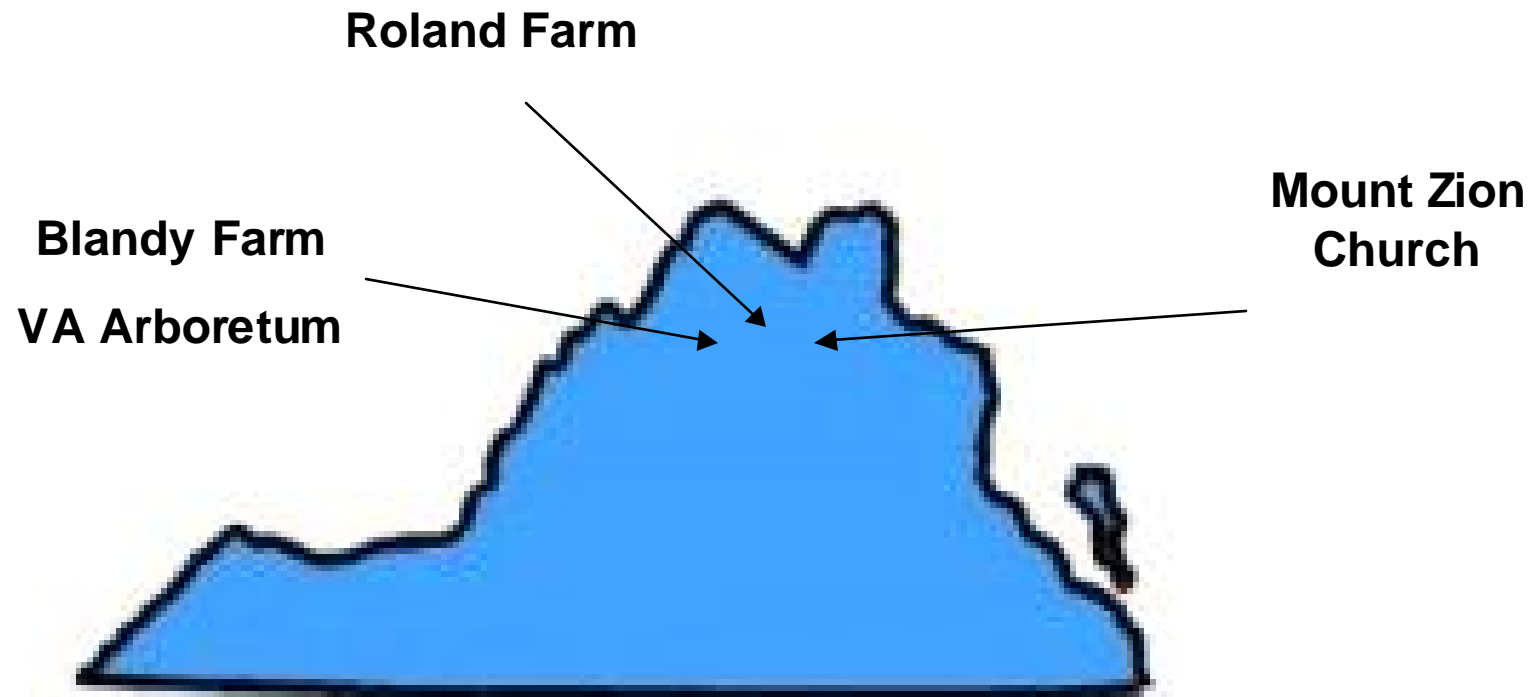
Blight susceptible trees are cut down, but...



... trees with enough **blight resistance** are advanced in the breeding program.



Proposed VATACF Chestnut Orchards



2/27/2008

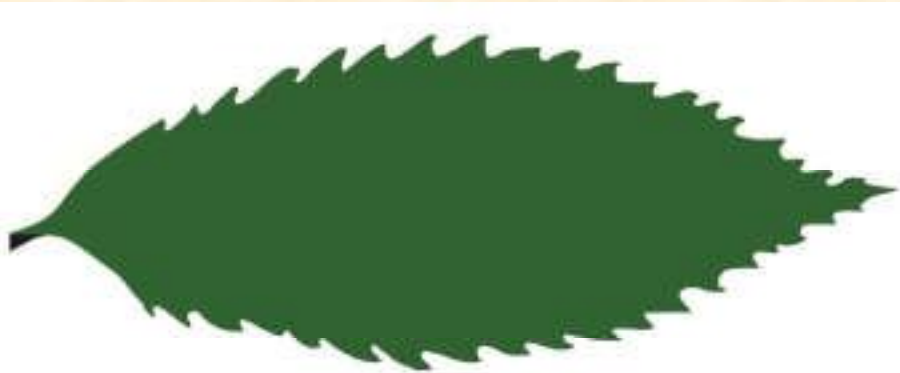


Timeline for Chestnut Restoration in North America

- ❖ 2005 - First BC3F3's harvested
- ❖ 2008 - BC3F3 nuts in various field trials
- ❖ Larger scale restoration will be measured in decades and centuries



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THE
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CHESTNUT
FOUNDATION



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