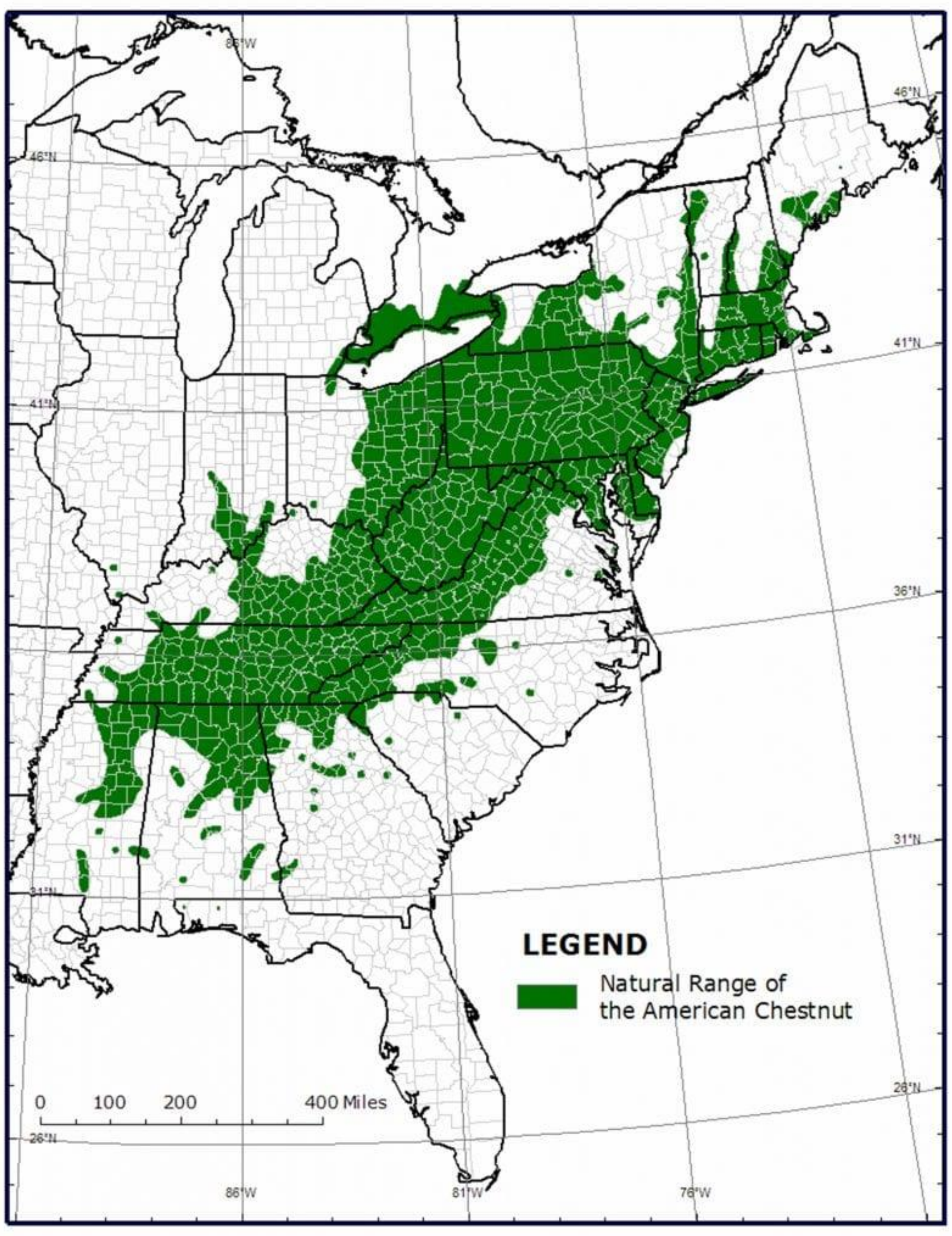
The American Chestnut:

Will it ever return to its natural range?

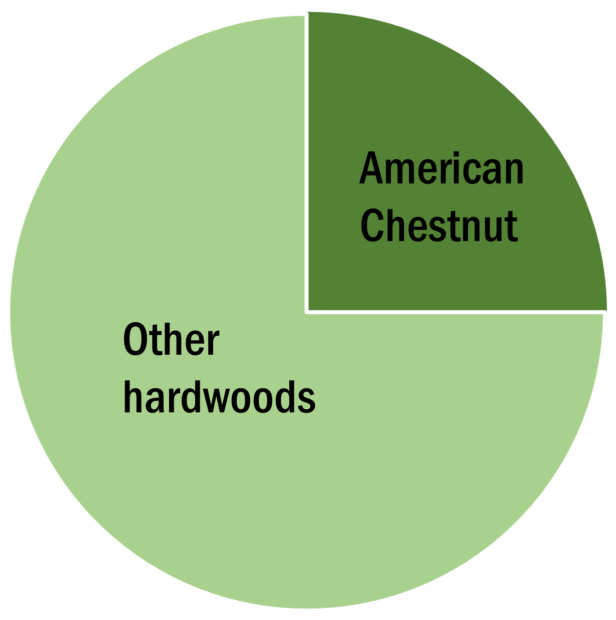
The American Chestnut

For hundreds of years, the American chestnut served as a dominant hardwood species in North American ecosystems. The tree boasted a large range along the east coast, and made up over a quarter of all hardwood trees within this range.

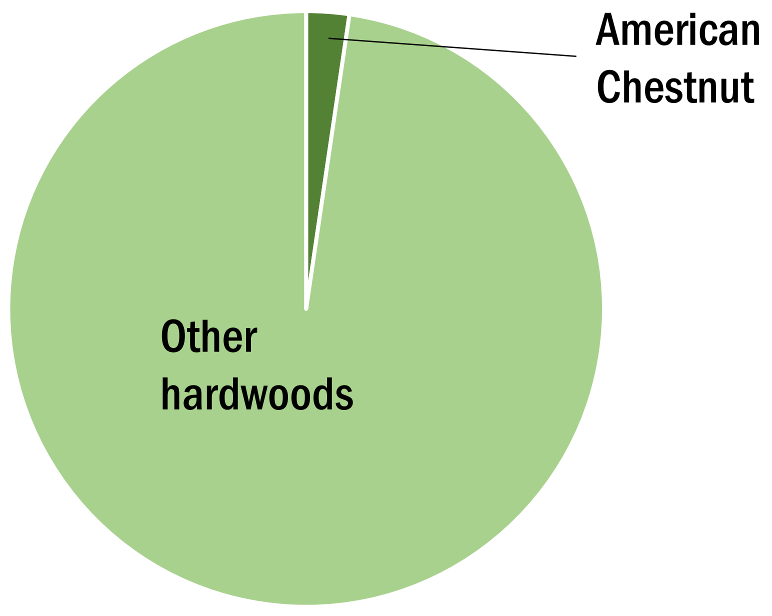


Map of the American chestnut's natural range.
Source: American Chestnut Foundation

Species composition of hardwood trees from Maine to Florida (early 20th century)



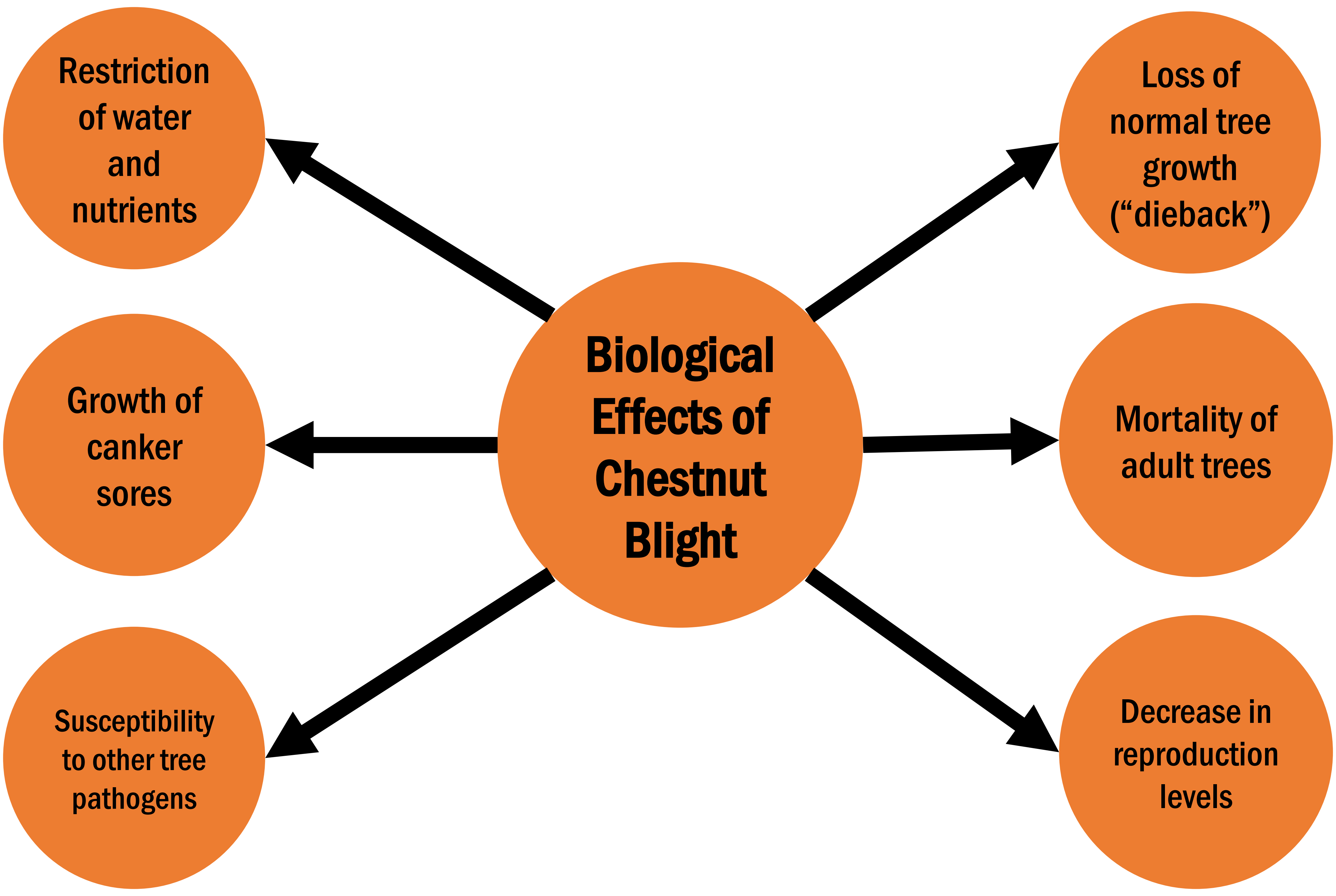
Species composition of hardwood trees from Maine to Florida (2015)



Change in the composition of hardwood forests from the 20th century to 2015.
Data source: Dalgleish et al., 2016

The Chestnut Blight

In 1904, however, a fungal pathogen was accidentally introduced from Asia through the import Of Chinese chestnut trees to America. This fungus, known as chestnut blight, causes harmful sores, or 'cankers' to grow on American chestnuts.



Altered Life Cycle

Since its introduction, the chestnut blight has forced the American chestnut species into near-extinction by altering its life cycle. Once young chestnut trees reach maturity, the infection quickly takes hold, slowly killing the tree and preventing it from reproducing. Some chestnuts are able to redevelop as small systems of sprouts, but these will inevitably die back when they reach maturity and are reinfected with the blight.

Mature, healthy chestnut tree

Blight-infected tree

Chestnut tree dies

Blighted juvenile sprouts from dead tree

Blight Treatment Strategies

Over the past few decades, researchers, biologists, and forest managers have been hard at work in determining an effective treatment for the chestnut blight fungus. A variety of different treatments have been suggested and applied in the field, but **each comes with its own benefits and potential downsides.**

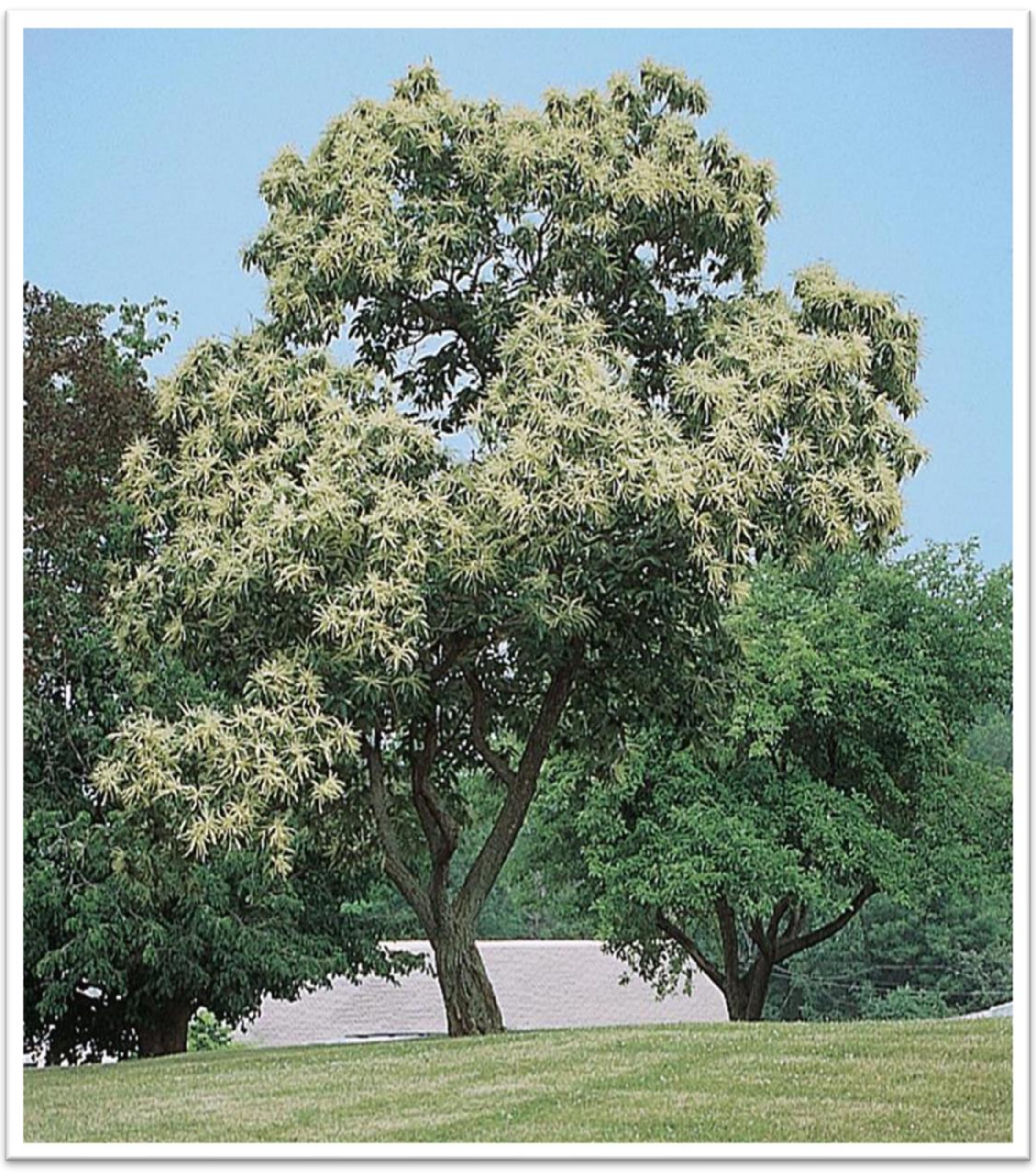
Researchers from the SUNY College of Environmental Science and Forestry stand with a crop of blight-resistant American chestnut seedlings.
Image source: Syracuse.com

Cross-Pollination

One of the first attempts at treating American chestnuts for chestnut blight was the idea of adapting resistance through cross-pollination. Through this practice, American chestnut trees would be selected to cross with the blight-resistant Chinese chestnut trees, and hopefully integrate this resistance into the American variety.

Pros: Transfers resistant genes, cheap and cost-effective.

Cons: Creates genetically different "hybrids", relies on environmental factors for the desired cross.



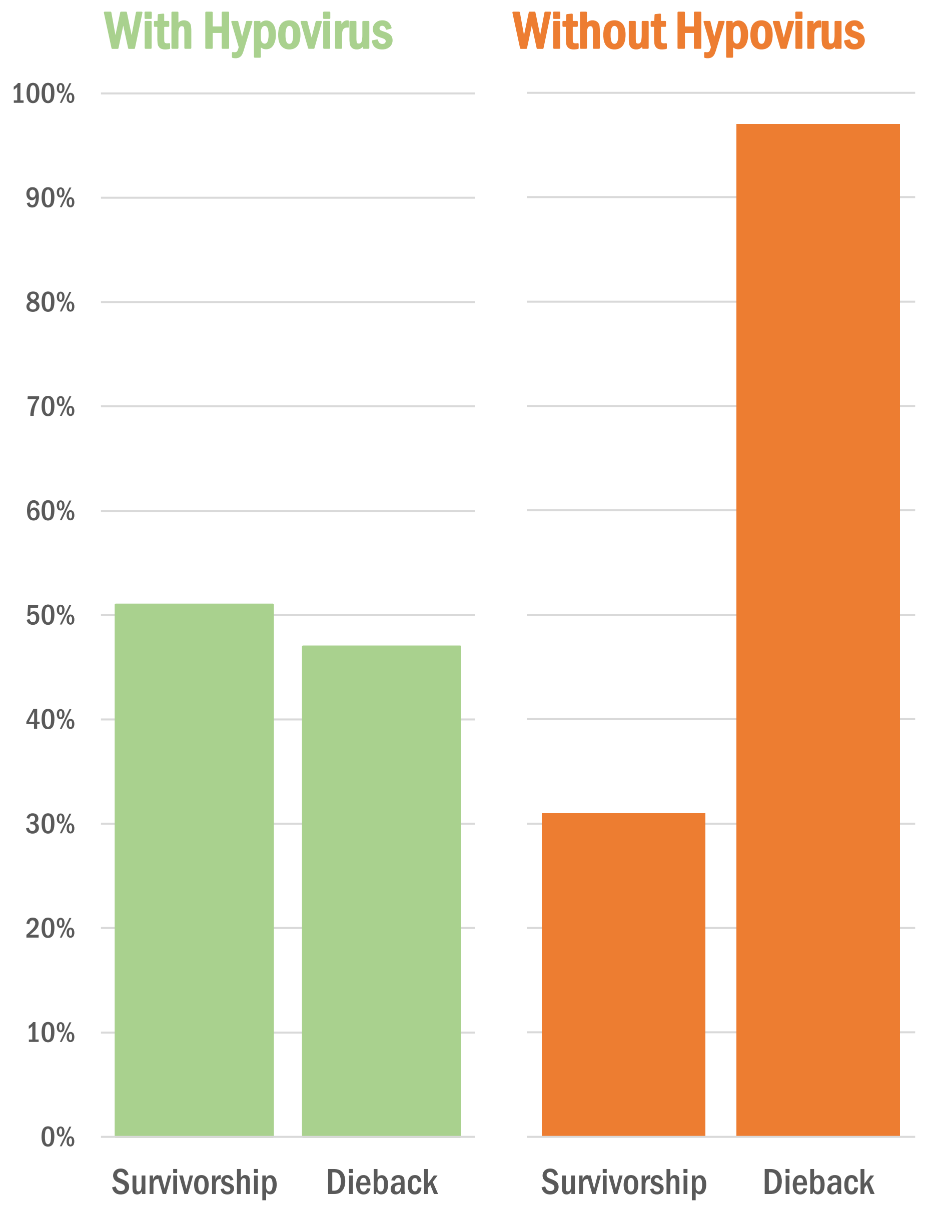
A blight-resistant Chinese chestnut tree.
Image source: Stark Bros Nursery & Orchards

Hypovirus Introduction

One of the most effective methods of controlling chestnut blight in Europe was found to be the introduction of a hypovirus. A hypovirus is a weakened strain of a pathogen (in this case the chestnut blight) that works like a vaccine. Chestnut trees with a weakened hypovirus applied are often able to develop a resistance to other infections by the blight.

Pros: Provides biological resistance, ensures genetic integrity of American chestnuts.

Cons: Not cost-effective on a wide scale, largely reliant on the environment to determine whether or not the hypovirus will "take".



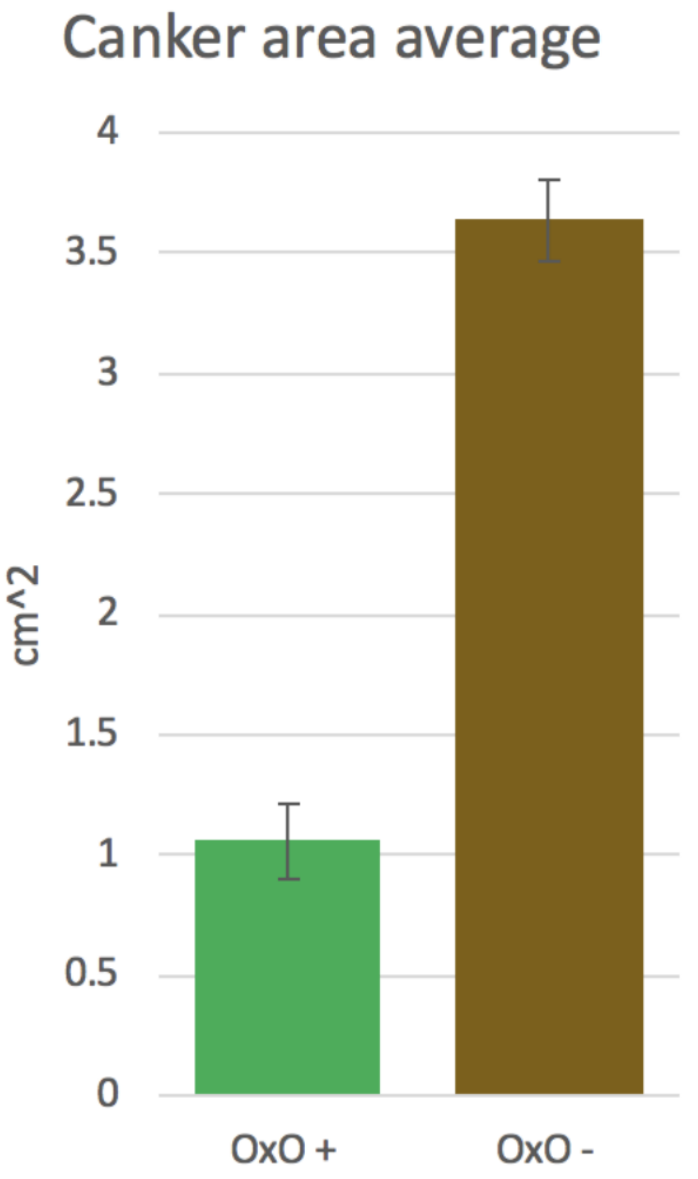
Evaluation of two Wisconsin American chestnut stands over two decades, one with hypovirus introduced and one without (Double et. al). "Dieback" represents a decrease in existing growth or size class.

Genetic Modification

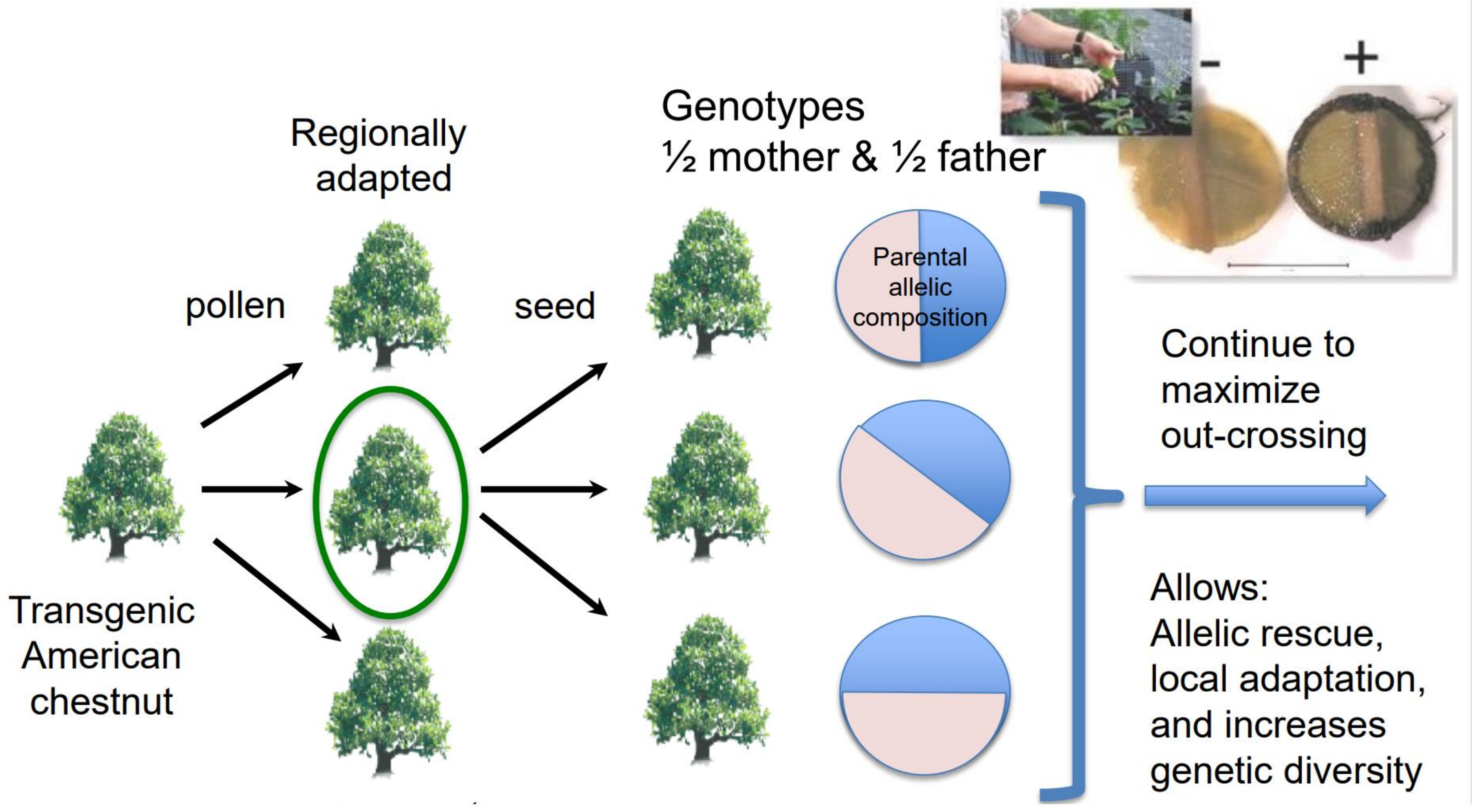
Recently, geneticists have discovered that inserting the OxO, or oxalate oxidase gene from certain grain plants into American chestnuts has beneficial effects. The presence of the OxO gene within the chestnut gene prevents the formation of fatal blight cankers on the tree, and ultimately leads to the formation of a blight-resistant tree that retains American chestnut genetic integrity. Scientists are currently in the process of having these genetically modified organisms examined by regulators.

Pros: Creates blight-resistant, genetically identical American chestnuts

Cons: Must pass GMO regulation and receive approval before implementation



Comparison of canker area average between genetically modified American chestnuts bearing the OxO gene (Oxo +) and American chestnuts without the gene (OxO -). (Newhouse, 2018.)



Blight resistance can spread naturally from genetically modified American chestnut trees to infected members of the natural populations (Newhouse, 2018).

Reservoir Populations & Antifungals

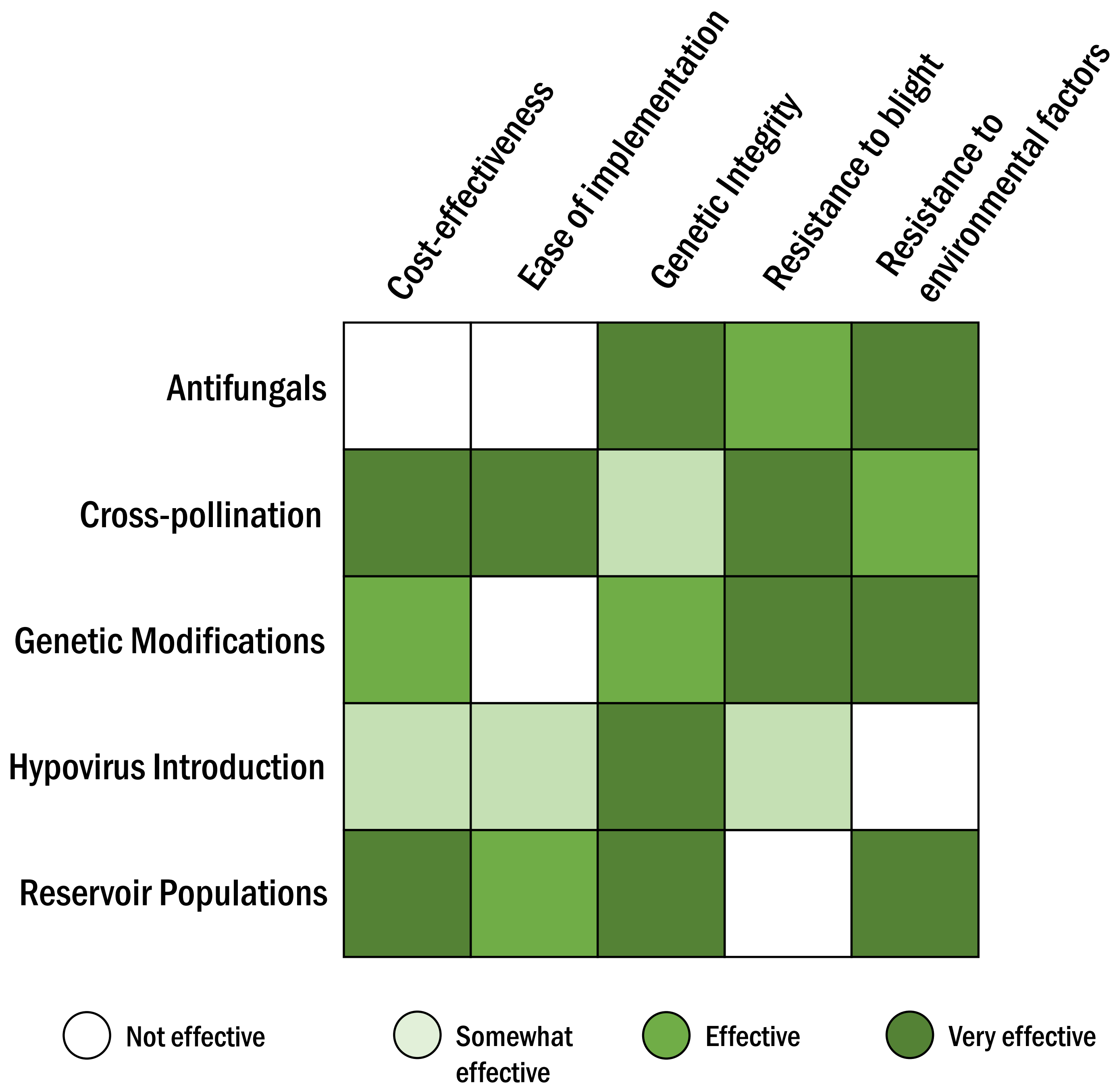
Several other methods for ensuring American chestnuts' return to the wild exist, though they vary in effectiveness.

Reservoir populations are populations of American chestnuts planted in areas outside of their natural range in hopes that can establish in a blight-free location. Reservoir populations are limited in effectiveness, however, as chestnut blight could always be naturally or inadvertently introduced into them.

Several **antifungal treatments** have been shown to work in killing the chestnut blight, but antifungals are unlikely to be the solution to the blight. Antifungals must be applied constantly to individual chestnut trees to prevent canker growth, an expensive and time-consuming process. Such treatment would be impractical on a stand-wide basis.

An American chestnut canker treated with antifungal medication.
Image source: American Chestnut Foundation

Chestnut treatment and restoration strategies considered by criteria of effectiveness



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