Improving & Restoring Chestnut Trees

The American chestnut tree was once widely used for home construction, furniture, fencing, railroad ties, firewood, paper, and nuts for humans, livestock, and wildlife. Chestnut trees were also widely appreciated for their beauty and shade. However, chestnut blight devastated the American chestnut tree in the first half of the 20th century, killing approximately four billion trees in the eastern United States. Blight, as well as other pests, diseases, and stressors like climate change, continue to be serious threats to chestnut trees in the United States.

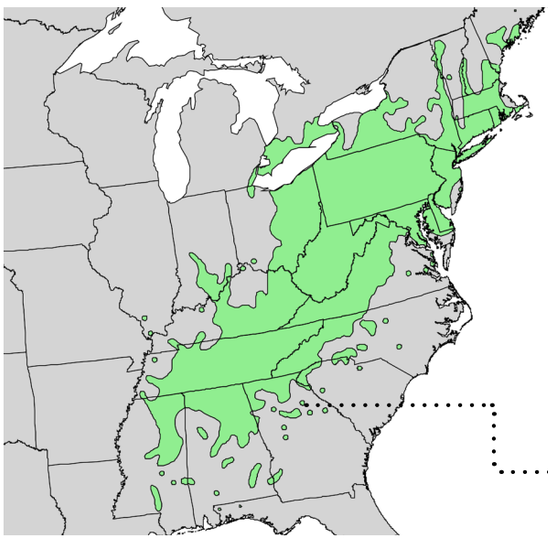
Research is bringing back American chestnut trees.

Since 1982, scientists at land-grant universities have coordinated chestnut research and recommendations for chestnut production and restoration. In recent years they have focused on:

- Developing disease-resistant chestnut trees using a variety of traditional breeding methods and innovative molecular approaches.
- Finding biological and genetic ways to manage chestnut blight fungus and other threats.
- Identifying factors that influence chestnut reestablishment in orchard and forest settings.

Chestnut blight fungus causes cankers, which girdle and kill tree tissue. Signs include bark discoloration, cracking, and swelling and dying limbs and leaves.

Phytophthora root rot is caused by a soilborne microbe. Signs include dead and decayed roots, lesions on the lower trunk, and yellow, wilting leaves.



As a collaboration between land-grant universities, the USDA, and The American Chestnut Foundation, this project brings together researchers from multiple disciplines and states to share expertise and resources. Regular meetings and access to diverse genetic resources and planting sites across the chestnut's native range are essential for efficient and effective research and restoration efforts.

Project members have produced and shared numerous technical and popular articles, presentations, international symposia, and more. Project members are renowned for their work, and their data have helped leverage funding for all aspects of chestnut research and restoration.

The American chestnut tree's native range is shown in green on the map.

Impacts

New discoveries, techniques, and tools are being used by scientists, foresters, orchardists, homeowners, and others to support increased production and restoration of the iconic American chestnut tree.

Project Funding & Participation

Project participants include Clemson University, The Connecticut Agricultural Experiment Station, University of Georgia, University of Kentucky, University of Maryland, Mississippi State University, University of New England, The State University of New York College of Environmental Science and Forestry, Pennsylvania State University, Rutgers University, Shenandoah University, University of Tennessee-Chattanooga, West Virginia University, the USDA Forest Service and The American Chestnut Foundation. Previous and ongoing iterations of this project may include other participants. This project is supported in part by USDA NIFA through Hatch Multistate Research Fund allocations to State Agricultural Experiment Stations at participating land-grant universities. Learn more about the project: bit.ly/NE1833

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Multistate Research Fund IMPACTS

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RESEARCH HIGHLIGHTS

This project developed tools and resources to facilitate chestnut research and breeding.

Project members maintained American chestnut, exotic species, and hybrid species in multiple states. These orchards are an important source of wild-type American chestnut pollen and nuts for future breeding and preservation purposes.

Researchers developed techniques to regenerate chestnuts from embryogenic cultures, which is a significant accomplishment for a tree that is difficult to root, and initiated over 100 new embryogenic culture lines from nuts collected from large surviving American chestnut trees in different parts of the native range.

Project members produced large quantities of transgenic pollen and distributed vials to collaborators. They also created and sent out practice pollination kits designed to familiarize volunteer citizen scientists with chestnut flower morphology and the controlled pollination process.

Researchers are developing and evaluating disease-resistant chestnut trees.

Through traditional breeding and genetic mapping, selection, and engineering, researchers are developing chestnuts with resistance to chestnut blight and Phytophthora root rot.

Researchers are also developing effective ways to cross genetically engineered chestnut varieties with wild-type trees so that trees with engineered resistance reflect the full diversity of chestnut and are adapted for growth across their native range.

Researchers evaluated biological approaches for managing chestnut blight.

Scientists identified chestnut blight fungus genes associated with the ability and power to cause disease and identified fungus strains with reduced ability to cause disease.

Researchers developed a CRISPR/Cas9 method for making genetic modifications to the chestnut blight fungus.

Project members identified viruses that attack the blight fungus and identified which ones are most suitable for long-term blight management in forest settings. Researchers also engineered strains of blight fungus that might more easily pass these viruses from tree to tree.

Studies documented species of invertebrates and microorganisms in blight cankers that could potentially be harnessed to affect cankers.

Researchers explored ways to manage pests that infest and damage chestnut trees.

Scientists studied how to use native parasites to manage gall wasps and identified chestnut tree varieties that are less susceptible to gall wasp infestations and damage.

Project members investigated chestnut reestablishment in orchard and forest settings.

Project members worked with European colleagues to show that differences in blight management in Europe and North America are partly due to differing forest management practices, greater competition from other hardwood species in North America, and a larger number of blight fungus strains in North America.

Earlier research found that exotic chestnut species do not grow well in native forests. This finding was part of the motivation that led to backcrossing resistance from exotic chestnut species into American chestnut. Tens of thousands of backcross hybrid chestnut trees have been planted throughout the native range of American chestnut.

This project's efforts have applications beyond chestnuts.

For example, laboratory and field techniques developed for the American chestnut have shown promising results and are currently being fine-tuned for restoring the Ozark chinquapin.

Photo captions & credits

Page 1: chestnut leaves and nuts, iStock; chestnut blight furrows in bark, USDA Forest Service; bark discoloration from chestnut blight, William Powell, The American Chestnut Foundation; blister-like pustules caused by *Cryphonectria parasitica*, Misha Zitser, iNaturalist; root rot, Steven Jeffers, Clemson University; map of the American chestnut's native range, USGS and USDA Forest Service. Page 2: chestnut trial orchard, The American Chestnut Foundation; American chestnut pollen, Timothy Van Vliet, Wikimedia; canker showing resistance to chestnut blight, The American Chestnut Foundation; gall wasp, iStock; chestnut trees, iStock; chestnut leaves, nut, and catkins, iStock.