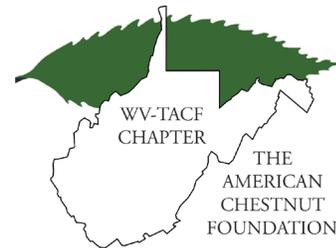




# The West Virginia Chapter of The American Chestnut Foundation NEWSLETTER



*In the heart of American chestnut's natural range*

March 2026

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## Recurrent Genomic Selection

In several of the latest chapter newsletters, there have been articles on TACF's breeding, Recurrent Genomic Selection or RGS. This program uses the 'Best X Best' trees in TACF's breeding program. The following article about RGS was taken from TACF's web page (TACF.org).

American chestnut is functionally extinct as it rarely reproduces in the wild. While there are still millions of American chestnuts throughout the native range, only a small number grow to maturity and produce nuts. TACF was founded in 1983 with the idea of crossing susceptible American chestnuts with resistant Chinese chestnuts. Offspring from those crosses were selected that appeared to have the best resistance to the chestnut blight fungus. To maintain the tall, straight form of American chestnut and its ecological function, these trees were backcrossed to native American chestnuts for three generations, each time selecting the most resistant trees, and those with American form (straight and tall).

Then a better way to breed came along. Advances in molecular biology allowed scientists to read a tree's DNA, making smarter selections. More than 5,000 backcross trees in orchards across the eastern U.S. were assessed using the following traits: 1) Is the main stem alive?; 2) Are cankers >15 cm?; 3) Are cankers sunken?; 4) % Canopy dead.; 5) Is there exposed wood?; 6) Is the fungus sporulating?; 7) Are there stump sprout? These traits are referred to a phenotypic traits. Also, DNA was extracted from leaves from these trees, yielding thousands of snippets of DNA (the genetic code) from each tree. These DNA snippets are called, markers. An organism's complete set of DNA, containing all the genetic instructions needed to build, function and maintain is referred to as the genome. The DNA data is then entered into a computer, and the model matches the genetic variation with physical signs of disease resistance, based solely on genotype. The computer model can do a better job examining thousands of trees and predicting those with the best disease resistance. The model also uses genetic markers to tell how much American ancestry there is in each tree. Using the genetic model, we can select trees with the highest levels of disease resistance with the highest levels of American ancestry.

These trees are then used in controlled pollination, taking pollen from the 'Best' trees and pollinating female flowers on other trees that have been designated as the 'Best'. Nuts from those controlled pollinations are collected, stratified and then grown in a greenhouse. DNA is then collected

from thousands of seedlings, and those with markers for the highest level of resistance are selected to be grown in orchards. Trees will be inoculated with the chestnut blight fungus when they are >1.5 cm. Trees that die will be culled. Those remaining will produce flowers in 5-7 years, and pollen from those trees will be used to advance the breeding program. The cycle will start all over again--that is why it is referred to as recurrent. TACF is using genetics to select the best parents in a repeating or recurrent cycle.



Controlled pollination using pollen from a 'Best' tree to pollinate a female flower on a 'Best' tree.

RGS is currently the global standard method to improve complex traits, such as crop yields, body size in chickens or milk production in cows, which are controlled by many unknown genes. Within 1-2 generations, TACF predicts that we can have American chestnut with high enough disease resistance to survive in the wild.

The WV chapter is fortunate enough to have two RGS orchards slated to be planted in May 2026. The two sites are in Burnsville with the U.S. Army Corps of Engineers and at the nursery bottom adjacent to the U.S. Forest Service office in Parsons.

## Germplasm Conservation Orchards

On the flip side of RGS orchards are germplasm con-

servation orchards or GCOs. In contrast to RGS orchards that have high levels of resistance, GCOs are orchards of native American chestnuts that have little-to-no resistance. While all trees in a GCO will become cankered and die from chestnut blight, about half of the trees will sprout, and those sprouts will produce flowers. American chestnut has a great propensity to send up shoots from dying trees. Prolific sprouting is one reason why American chestnut is not extinct.



Flowering American chestnut in a Parsons GCO.

Flowers from trees in GCOs can then be used in controlled pollinations with advanced hybrid trees like those in RGS orchards to select trees that have high resistance to the chestnut blight fungus, the form of American chestnut and adaptability to WV.

## Phytophthora and Chestnut Blight

Membership in TACF and specifically the WV chapter varies greatly. There are many who have been members for more than a decade, while others joined just this month. Therefore, there is a wide gap in understanding basic terminology. This article will explain two of the major disease problems associated with American chestnut--Phytophthora and chestnut blight.

Many are familiar with the potato famine in Ireland

that took place 1845-1852. It was a period of mass starvation and disease. During this period, Ireland lost more than half its population due to starvation or those who fled the country. The Great Famine was caused by *Phytophthora infestans*, a destructive plant disease. There are hundreds of species of *Phytophthora* world-wide that thrive in wet conditions. They infect the root systems, crowns and foliage of many crops, trees and ornamentals, ranging from pineapple, and avocado to white oaks, azaleas and boxwoods. They are often called 'plant destroyers' because they cause significant economic and environmental damage, spreading through water and soil.

An important disease of American chestnut is Phytophthora root rot or PRR. The causal agent is *Phytophthora cinnamomi*, very similar to *P. infestans*. Both are water molds and travel through the soil infecting roots. In the photos below, infected chestnut roots (left) have little-to-no roots while uninfected roots (right) have plenty of lateral, secondary roots.



**PRR-infected roots (left) have almost no root system, compared to a non-infected healthy root system on the right. Photos are courtesy of Paul Sisco.**

Notice in the color difference of the roots in the above photos. PRR-infected roots/stems are almost black. The common name for PRR is ink disease due to the dark pigmentation caused by *P. cinnamomi*.

The photo on the right shows a fruiting structure of the ink disease fungus. The PRR organisms travel through water and attach to the root system of American chestnut.



Phytophthora species are plant pathogens that are part of a group of microorganisms known as Oomycetes, which are fungus-like organisms but not true fungi. It is thought that *P. cinnamomi* was introduced to North America in the late 1700s or early 1800s, much earlier than the chestnut blight fungus.

It was thought that PRR was strictly a southern U.S. disease problem. However, as climate change is promoting warming, PRR has been moving northward into Ohio and Pennsylvania. We have a number of chestnut sites in WV that are impacted by PRR. For that reason, soils should be checked for PRR prior to any new plantings. We have documented PRR at the Summit Bechtel Reserve in Fayette County, at the Waddell orchard in Preston County and at the WVU chestnut orchard in Monongalia County.



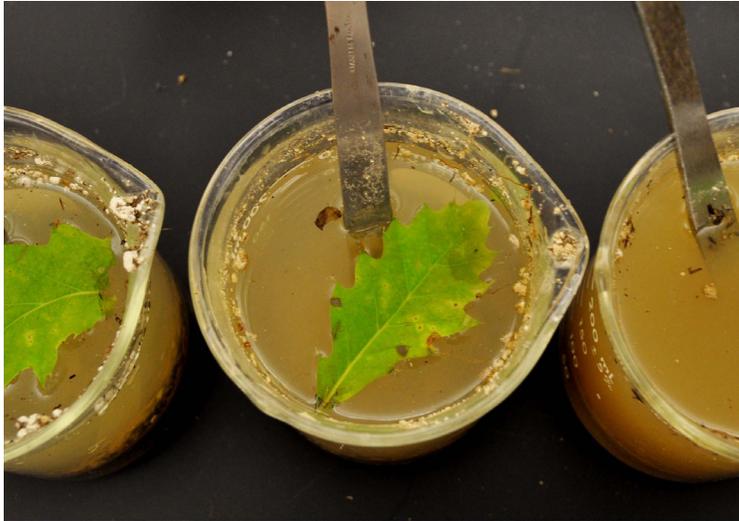
**PRR seedlings often die quickly, as seen in this photo from Morgantown. With declining root systems, seedlings quickly turn brown. When the seedlings are dug up, there is virtually no root system.**

Roots can be tested to prove PRR is caused by a *Phytophthora* species. Soil is removed from around suspected trees.



**Phytophthora expert, the late Dr. Mannon Gallegly, digs around a chestnut seedling suspected of succumbing from PRR. The soil is added to water in a slurry, and young leaves from susceptible plants are floated on top of the slurry.**

Spores from *Phytophthora* attach to the leaves and begin to cause lesions. Microscopic examination of the leaves confirms the presence of the organism.



Young oak leaves in a soil slurry to bait the *Phytophthora* organism.

The chestnut blight fungus (*Cryphonectria parasitica*) acts totally differently from PRR. As opposed to a root destroyer like PRR, the chestnut blight fungus is a canker pathogen, destroying the vascular cambium of a chestnut tree. A spore of the chestnut blight fungus can enter through wounds in a tree's bark--(bird talons, frost crack, dead branch, etc.) where the spore germinates and begins to grow around the circumference of the tree.



Chestnut blight canker on an American chestnut stem. Note that the canker looks sunken. All the water/nutrient vessels under the bark have been killed, hence the sunken nature of the canker.

The chestnut blight fungus was introduced much later than the PRR organism. While probably introduced into New York City in the 1890s, the disease was first detected in 1904 in the Bronx Zoological Park in NYC. Browning

of branches was noticed during the summer of 1904, but the cause was thought to be the drought in 1903. It wasn't until 1905 when the cause of the dying trees was confirmed to be the chestnut blight fungus.

The fungus produces threads, called hyphae or collectively, mycelium. As the fungus grows under the bark, it produces 'fans'. These fans emit organic acids and these acids kill the life-saving tissues (xylem and phloem). After the fungus has completely grown around a branch or main stem, everything distal to that is dead.



Fungal fans of the chestnut blight fungus are seen after bark is removed from the leading edge of a canker.

American chestnut is classified as 'functionally extinct', so most of these trees in our forests are less than 30' tall. Infection by the chestnut blight fungus is visible in the crowns of trees as seen in the photo below.



As cankers girdle a branch, all the leaves on that branch turn brown as the water/nutrients are cut off. Small stems in the U.S. can be heavily cankered as seen

in the photo below.



Two American chestnut stems. The stem on the left is totally dead while the stem on the right has three cankers (orange areas).

The chestnut blight fungus evolved over millenia with Asian chestnut species. Thus, Japanese and Chinese chestnut developed resistance to the fungus. There is a misunderstanding that Asian species do not become infected. That is false; Asian species can become cankered, but they can generally withstand the infections. American chestnut did not evolve with the fungus, and therefore has no resistance.

TACF's backcross breeding program is working to breed resistance for both PRR and the chestnut blight fungus. Susceptible American chestnuts are combined with blight-resistant Chinese chestnuts in a multi-generational process that involves crossing, backcrossing to American chestnuts to retain native traits, selecting resistant hybrids, and using advanced techniques like genomic selection to develop genetically diverse, regionally adaptable trees with sufficient resistance for forest restoration.

**What is involved in breeding?** Both PRR and chestnut blight are comprised of complex traits influenced by several genomic regions, primarily inherited from the Chinese chestnut.

The chestnut blight problem seems to be more complex

than that of PRR. It is believed that there are more than 50 genes responsible for resistance in Chinese chestnut. These resistance genes can be found on 9 of 12 American chestnut chromosomes.

Conversely, while still complex, resistance genes are found on three chromosomes (1, 5 and 11) associated with PRR. Chromosome 05 has been identified as explaining a significant proportion of the variance in PRR survival.

The chestnut blight fungus killed more than 4 billion American chestnut trees over the course of 50 years, from the early 1900's until the 1950s. The American Chestnut Foundation has been working since 1983 to breed resistance into our native chestnut. We have made significant progress in 43 years, and much has been learned throughout this time frame. The backcross breeding program was the idea of **Dr. Charles Burham**, a plant breeder from Minnesota who use this method of breeding in corn. At the time, it was thought that backcross breeding could be successful if only 2-3 genes were responsible for resistance in Chinese chestnut. The genetics of chestnut has been found to much more complex.

**When did resistance breeding begin?** In 1988, then-TACF president, **Phil Rutter**, spoke to interested individuals at Scientist Cliffs on the southwest coast of the Chesapeake Bay (owned by **Flippo Gravatt**, plant pathologist). **Jennifer and Cheri Wagner**, owners of property in Meadowview, VA were in attendance at that meeting, and they thought chestnuts might be an alternative to tobacco on their property. Rutter's most fulfilling accomplishment came when he and the Wagners came to terms to lease 20 acres from their family farm in Meadowview, VA. That was the start of backcross breeding for TACF, and the reason that TACF's research farm is located in Meadowview, VA.

In 1989, TACF hired its first full-time employee, **Dr. Fred Hebard**, to begin the task of breeding. For a while, Fred was the only employee, responsible for planting and maintaining the chestnut orchards. While Fred was the first employee, TACF has expanded greatly its number of employees over the years. Currently, TACF has a director of sci-

ence (**Dr. Jared Westbrook**), a director of research and restoration (**Dr. Vasiliy Lakoba**), a land manager (**Dan McKinnon**), along with orchard manager (**Lucinda Wigfield**), nursery manager (**Brian Henrich**) and a technician (**James Tolton**).

Breeding a tree like chestnut is not similar to breeding a crop like corn that is grown annually. American chestnuts takes on average 5-7 years before they are old enough to produce flowers. Trees are hand-pollinated using ladders and bucket trucks. Each bagged flower has to be carefully labeled, and those labels have to follow the nuts that are harvested, knowing both the male and female parents. Breeding is continually choosing trees that have sufficient resistance to both PRR and the chestnut blight fungus, along with the form of American chestnut. The data keeping can be enormous. In the early days, Fred Hebard, took all data by hand and logged it into an old Apple computer. Now, trees are tagged digitally for better records. Over the course of 40+ years, TACF has planted, pollinated and rouged about 120,000 trees on several properties in Meadowview, VA. This has been a monumental task, and everyone in TACF chapters should be thankful for the countless hours by staff and volunteers that worked on this task over the last four decades.

For those who have the opportunity to visit the Meadowview Farm, it sits just off Interstate 81 in Southwest Virginia at 29010 Hawthorne Drive in Meadowview. In addition to the original farm leased from the Wagner sisters, TACF has added two additional farms in the area along with a large solar-heated greenhouse, laboratory and nursery facilities.



Trees are hand-pollinated at TACF's Meadowview Research Farm.

A great deal has been accomplished at TACF since 1983. We have moved from paper data collection to high-powered computer programming that assesses genes on chromosomes. While there is still a great deal of work to be done, hope is on the horizon. Work to restore American chestnut is a generational process. The following quote attributed to a Greek proverb remains apropos for American chestnut: *A Society grows great when old men plant trees whose shade they know they shall never sit.*



Aerial view of some of the Meadowview chestnut orchards.



Hundreds of seedlings are grown in TACF's greenhouse in Meadowview. Each seedling is carefully labeled to ensure the data is correct, as some of these seedlings will be rouged if they do not have sufficient resistance. Others will be outplanted if they possess sufficient resistance for both PRR and chestnut blight.

## WV Chapter Spring Meeting

The WV chapter hosts two meetings each year. The Spring meeting this year will be held on Saturday, **March 21, 2026** at the Mineral County Health Department, 541 Harley O. Staggers Drive (also known as Water Street), Keyser, WV in a new building across from Boggs Supply Hardware Store. The meeting will begin at 1:00 pm, led by WV chapter president, **Bernie Coyle**.

## WV Tree Farmers of the Year

The 2026 West Virginia tree farmers of the year for 2026 are **James and Jeff Kochenderfer**. This father and son team have been involved for years in practicing good stewardship in the area of forestry. James was featured in the WV chapter film where older individuals recalled chestnut in the recent aftermath of the chestnut blight pandemic. James began working with the USDA Forest Service in 1956 where he served as a Research Forester in Parsons. James has authored more than 70 research publications, and he is recognized as an expert in forestry Best Management Practices. James has provided many guest lectures for students at West Virginia University, and has led training in forest hydrology and forest access at WVU's Summer Forestry Camp.

Jeff is currently the north zone silviculturalist on the Monongahela National Forest based in Petersburg. Jeff oversees a germplasm conservation orchard, and he also is responsible for assisting with the recurrent genomic selection planting of 100 of TACF's best trees in May this year at the nursery bottom in Parsons.

James and Jeff have managed 223 acres of hardwood forestland since 1996 in Randolph and Tucker Counties. They high-graded and harvested to a 12-inch stump diameter in 1979, and through dedicated effort, they restored and enhanced the property using sound, science-based forest management practices. The Kochenderfers are active members of the National Woodland Owners Association, the Society of American Foresters, the WV Forestry Association and The American Chestnut Foundation (where Jeff serves as the WV chapter secretary). Their forest management efforts have been featured in magazine articles highlighting best forestry practices and woodland stewardship.

**Award Criteria:** The award, often presented in partnership with the West Virginia Tree Farm Committee and the American Tree Farm System, recognizes landowners who demonstrate excellence in sustainable forest management, including wildlife habitat, water quality protection, and timber management.

**Significance:** The award honors, as indicated in Senate Resolution 24, dedicated efforts in restoring and enhancing forestland through science-based practices.



**Jeff and James Kochenderfer**

Congratulations James and Jeff--a well-deserved honor.

## Mountwood Park Planting

WV chapter member, **Brian Smith** of Friendly, is working on a 100-tree germplasm conservation orchard at Mountwood Park outside of Parkersburg. Mountwood is a large, country park known for its extensive network of hiking and mountain biking trails, camping and historical ties to the 19th-century oil boomtown of Volcano, which once stood on the site. The park offers diverse recreational activities and a museum detailing the area's oil industry.

Brian will plan a workday for WV-TACF members along with The Friends of Mountwood, to direct-seed nuts, make cages and install tree shelters. The date will be announced to chapter members.

## Spring Potting in Morgantown

A few volunteers gathered at the greenhouse in Morgantown on Saturday 28 February to pot more than 1,600 chestnuts. Those assisting came from far and wide--from Pittsburgh, PA to Keyser in the eastern panhandle to Elk River in southern WV. We ordered 22 bags of BK55 potting mix from Griffin Greenhouses in Massachusetts. We had many D40 pots returned from last year's potting, so we only had to order a few hundred pots from Steuwe and Sons in Oregon. Those assisting were: **Bernie and Linda Coyle, Amy Metheny, Rob Eckenrode, Jerry**

**Legg, Patty Gundrum, Kristen Wickert, and Mark, Mindy and Sara Double.** Potting took place on three long greenhouse tables. Since nuts were collected from individual trees, each bag of nuts was labeled with a code for the mother trees, and each bag was labeled with specific color tape that matched the labels on the pots. That helps reduce any errors. The D40 pots were filled nearly to the top; the nut was added and then the tube was topped off with more potting mix. The tubes were watered thoroughly and groups moved onto the next bag of nuts. The crew began potting around 9:30 am, and finished at 1:30 pm. We now wait on the shoots to emerge.



**Amy Metheny, Rob Eckenrode and Kristen Wickert fill D40 pots with BK55 potting mix.**



**Radicles emerging from nuts.**



**Bernie and Linda Coyle man one of three potting tables.**



**WV chapter board vice president, Jerry Legg, potting nuts.**



**Some of the volunteers stand in front of >1600 pots.**