

New hope for a vanished giant

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The American chestnut tree was among the tall stalwarts of the Appalachian forest for centuries. Its rot-resistant wood was used in barns, railroad ties and telephone poles; its nuts fed people, farm animals and wildlife; its canopy offered shade and mopped up a growing country's pollution.

Accounting for one out of every four hardwood trees in its Maine-to-Alabama range, it was a king of the forest: fast-growing, straight-grained, and in some areas, an economic lifesaver.

"The people in Canton, N.C., never knew the Depression. They were making money hand over fist," says Paul Sisco, president of the Carolinas chapter of the Asheville-based American Chestnut Foundation.

They worked for Champion Paper & Fiber Co., which was chewing up chestnut and spitting out not only pulp for paper but globally marketed tannic acid for tanning leather.

But by the mid-1940s, scarcely a mature tree was left standing: A blight that arrived from Asia about 1900 took a disastrous toll. It attacked through cracks in bark until it girdled a tree with a ring that nutrients could not penetrate. Roots remained, continuing to produce young trees that also were doomed.

The China option

The last big trees had hardly fallen before scientists and chestnut-loving lay people started looking to create a chestnut tree that could withstand blight. In the years since, various groups have planted more than a half-million experimental trees, usually mixing stock from the doomed young trees with that of blight-resistant foreign trees.

Now, two groups think they're close to success. They are the traditional cross-breeders of TACF, who in 2009 started planting their most advanced American-Chinese crosses in forests to propagate on their own, and biotechnologists, who hope that a genetically engineered Chinese-American seedling will prove its resistance by 2013.

Ornamental Chinese trees are short, bushy and slow-growing, but have resistance built up over centuries of coexisting with blight. TACF's goal was to create a tree with 94 percent commercially valuable American characteristics and a minimum of Chinese traits.

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Biotechnologists hope more is at stake than just recovering a piece of our ecological past

By providing a proving ground for the use of genetic engineering against one enemy of the forest, they say, the chestnut may show the way toward subduing others, such as the woolly adelgid now attacking Carolina hemlocks.

The current biotech effort, known as the Forest Health Initiative, brings together scientists from the U.S. Department of Agriculture, Clemson University, the State University of New York's College of Environmental Science and Forestry, the University of Georgia, and Pennsylvania State University. Dr. Ronald Sederoff, co-director of N.C. State University's Forest Biotechnology Group, is on the advisory committee. It's underwritten by nearly \$6 million from Duke Energy, the U.S. Forest Service and the U.S. Endowment for Forestry and Communities.

It builds on gene mapping done in American and Chinese chestnuts by scientists from Penn State, NCSU, Clemson, the Connecticut Agricultural Research Station, TACF and SUNY-ESF.

Those advocating both approaches are encouraged by what's happened so far.

The culmination of 25 years of TACF cross-breeding – 4,500 “final generation” trees – are now growing in national forests in Virginia, North Carolina and Tennessee.

As for the biotech advocates, “There are a lot of breakthroughs that we've gone through,” says SUNY's Dr. William Powell. “Just the ability to put genes in a tree took a long, long time.”

Yet neither group is ready to say it has found the Holy Grail.

“You can only declare continued optimism rather than victory at least for another 50 years or so,” says Dr. Fred Hebard, staff pathologist for TACF's research station in Meadowview, Va. “When those things are 100 feet tall, you can definitely declare victory.”

And biotech researcher Dr. Scott Merkle of the University of Georgia says of the Chinese genes that he hopes turn out to be the right ones: “We call them ‘candidate genes’ because we don't really know.”

By 2013, the biotechnologists expect some answers. American chestnut seedlings implanted with a Chinese gene are already in the field. A couple of years from now, they'll be inoculated with blight to test their resistance. Others, bearing some 20 other genes that researchers have isolated, are in the pipeline for planting.

Powell thinks at least three genes are involved in resistance, and “We think we can find the resistant genes within the first 30 that we test.” Clemson and Penn State researchers studying the 45,000 or so Chinese genes paved the way by narrowing the likely ones to 100 or so.

“Once we have a tree that we know is resistant, we will cross it with as many different wild parents as possible to increase diversity,” Powell says.

TACF's diversity search

The creation of TACF's national forest trees is being replicated on farms across the chestnut's former range, including 40 in North Carolina, as volunteer orchardists and researchers work to come up with trees suited to a variety of growing climates. The organization has 6,000 members in 20 states.

The trees in the national forests are too young to be massively attacked by blight, but Stacy Clark, who tends them for the U.S. Forest Service, says they show little sign of it so far and are generally doing well. Some are 12 feet tall.

But last year, a new problem showed up – one Clark hopes was brought in inadvertently from the nursery. It's *Phytophthora cinnamomi*, a root rot that thrives in poorly drained soil and warm climates. It's also an enemy of citrus, shortleaf pine, and even Fraser fir in some areas.

In Seneca, S.C., a retired orthopedic surgeon who has been growing TACF trees for years is fighting the new problem. Except that Dr. Joe James calls it a very old problem, one responsible for the chestnut's being considered a mountain tree.

His reading – prompted by the fact that all the chestnuts he planted on flat land promptly died – told him that chestnuts' range once included the Carolinas Piedmont. Their presence near Atlanta has been documented, and remnants of a chestnut forest remain on a Crowders Mountain ridge.

The thinking is that the root rot advanced through warm, wet areas, chasing the chestnuts into mountain areas where freezing temperatures could penetrate thin soil and prevent the rot from taking hold.

Thinking that Chinese trees, which historically coexisted with *Phytophthora* as well as blight, might carry resistance to both, James planted 12,000 Chinese-American seedlings. Some 4.5 percent proved resistant to root-rot.

James gave his results to FHI, which used them to map for resistant genes, one of which is being put into seedlings due for field-testing in 2013.

No one knows whether crossbreeding or biotech ultimately will prevail as the favored weapon against the enemies of the chestnut. Success could come even from a combination of the two approaches, James says.

“When (geneticists) get the maps worked out thoroughly, then we can start selecting trees based on their genetic analysis. That would speed up our breeding program tremendously,” he says. “We're going to join hands and cross the finish line together.”