# Forest Health Initiative Phase 2

Year 1 Report: January 2013 – December 2013

## Executive Summary

**Background:**
The Forest Health Initiative (FHI) is exploring whether there is an appropriate and valuable role for biotechnology in protecting and restoring North America's increasingly threatened forest ecosystems. FHI's focus on biotechnology was driven by the need for new tools to fight a growing number of pests, diseases, and pollutants. Climate change is compounding these problems and speeding the onslaught of many forest health threats. Conservative estimates put millions of forested acres in danger from current and imminent forest health threats.

FHI believes the best way to fully explore the many scientific, environmental, social and regulatory challenges surrounding the use of biotechnology to protect forests is to develop a test case that responds to an existing threat to forest health. Toward that end, FHI is supporting an effort to revive and restore the American chestnut by developing and testing a genetically engineered (GE) variety that could provide a safe and effective way to rapidly achieve resistance to the blight that has rendered this species nearly extinct in North America. The project is unique in that it is organized around three fully coordinated groups to simultaneously pursue solutions to these challenges. This braided approach includes a Science Group, a Social/Environmental Group and a Policy/Regulatory Committee.

During Phase I, a path was laid to have trees ready for planting in 2013. These trees will express genes identified under FHI as having potential for enhancing resistance to chestnut blight and Phytophthora root rot. The project has identified more than 30 resistance candidate genes from the Chinese chestnut genome and is inserting them into American chestnut embryos. The embryos will be grown into seedlings to allow testing of their resistance attributes.

The plantable trees are being grown in contained field trials. This represents the first GE tree to start the regulatory process toward landscape use that is non-proprietary, in the public interest, and is solely for forest health purposes. A biological review paper for American chestnut, an intellectual property review, and NEPA overview for GE trees were commissioned to inform regulators and guide the research community as testing of the trees proceeds. In addition, a Forest Health Roadmap project guided by the Social/Environmental Group provides a framework to support civil discourse and inform decisions about how to respond to current and potential forest health threats. Its emphasis is on deciding if and how to intervene, with a focus on when genetic approaches to improving tree resistance might be productive.

While the phase I work of the FHI continues to develop a plantable tree, and determining if it is appropriate from scientific, social, and regulatory standpoints, the second 3-year phase of the FHI envisions what would be necessary to develop a tree ready for planting in a forest landscape. Areas to be investigated for these landscape-ready trees include:

- Determine which disease resistance gene(s) work, leading to their optimization and improved selection.
- Determine how these gene(s) can best be used to step up to larger scale plantings while ensuring accommodation of genetic diversity.
- Work with the three regulatory agencies (APHIS, EPA, FDA) that are necessary for landscape use of the biotech trees.
- Work with restoration organizations on a plan to test and use GE American chestnut trees, creating at least 3 field tests over 3 years.
- Conduct social science research to determine the extent and conditions under which the public might support a role for biotechnology in battling threats to forest health.

**Year 1 Accomplishments Overview:**

Biological Science:

- ~ 40 genes or combinations of genes assembled into constructs.
- 37 of these constructs have been successfully transformed into chestnut events.
- In total, there are 344 events in the pipeline.
- 1324 transgenic American chestnut trees are in the ground in 8 locations
- 9 35S-OxO events demonstrating high levels of resistance according to leaf assays
- 5 VspB-OxO events demonstrating intermediate levels of resistance according to leaf assays
- 3 Chinese chestnut laccase-like gene events demonstrating intermediate levels of resistance according to leaf assays
- 2 Chinese chestnut proline-rich protein gene events demonstrating intermediate levels of resistance according to leaf assays
- 1 Chinese chestnut lipid transfer protein gene events demonstrating intermediate levels of resistance according to leaf assays
- 49 TACF OP B3F3 somatic seedlings from cultures started in 2010 and 2011 were transferred to Virginia Tech cooperators in two batches (May and October 2013) and planted out at Powell River and Kentland field tests in 2013
- 89 somatic seedlings from Virginia Department of Forestry hybrid chestnut material (76-5 x OP) were transferred to Virginia Tech cooperators in May 2013 and planted out at Powell River field test in 2013
- 30 somatic seedlings from ACCF LSA crosses (Ragged Mountain x Thompson and reciprocal somatic seedlings) were transferred to ACCF cooperator Carol Croy (USDA Forest Service) for planting out on Jefferson National Forest on 10/29/13.
- 179 transgenic somatic seedlings with 5 CGs (4-15 events per CG, with at least 2 trees per CG) in pots were transferred to Virginia Tech Cooperators on 10/29/13 for planting at Kentland site
- Transgenic somatic seedlings representing approximately 70 events with 15 candidate genes, are currently dormant in pots and will be planted at UGA's Whitehall Nursery in March 2014
- Planted 24 transgenic American chestnut somatic seedlings engineered with *Gastrodia* antifungal protein (GAFP) gene or resistance to Phytophthora (RPH1) gene from Chinese chestnut in Phytophthora resistance screening tubs at Joe James' Chestnut Return Farm on 7/06/13 (Fig. 4); tubs inoculated with *P. cinnamomi* on 7/30/13; planting inspected by APHIS on 8/16/13; no results reported by Dr. James to date
- Somatic seedlings with additional Phytophthora resistance candidate genes and different combinations of Phytophthora resistance candidate genes are currently in production
- Collected monthly growth, morphology, health, and blight/root-rot resistance data from first growing season of the June 2013 PRP cohort.
- Collected data on initial conditions of trees planted at Kentland farm in November 2013.

Social Science

- An extensive literature review has been done and a draft literature review has been prepared.
- Three two-hour electronic focus group meetings consisting of 27 stakeholders were held between November 18 and 22, 2013. Data from these focus groups are currently being analyzed.

Regulatory and Management

- Prepared a movement variance, planting permits for two sites, revisions to permits as required and submitted these to USDA APHIS for approvals.
- Advised the Science Team on movement procedures and permit requirements for transport of GE trees.
- Supervised planting at Kentland site and submitted the planting report.
- Worked with the Science Committee and the Science Advisory Committee to prepare a science plan for the next phase of the FHI, which includes demonstration plots, and field trials of produced materials.
- Recruited three new members to the Science Advisory Committee that included one social scientists and one restoration ecologist.
- Prepared a RFP for social science work to be done in FHI Phase 2. This has been awarded and work started.
- Worked with the Science Committee and the Science Advisory Committee to prepare a concise biological science plan that outlines successes to date and unmet needs. This piece is to be used to define and layout what is needed to fulfill the vision of the FHI for Phase 2. This will be used to recruit additional sponsors for the FHI.
- Planned and organized a half-day meeting in DC to provide a summary of Phase 1 research, status of current work, and presentation of essential remaining work to potential new sponsors. This was held Nov 18, 2013.