The American Chestnut: A Case Study
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Ever since I was in elementary school, I vividly remember being inundated with references to the American chestnut tree. Whether learning about it when studying tree identification, or in music class while singing Christmas carols, reading poems, street signs, building namesakes, it’s safe to say that this tree is an icon of American heritage. It’s also been used for food, fuel, and furniture, and plays an important role in forest ecosystems. But, how many of us have actually seen one?

In the 1870s, a shipment of foreign chestnuts from Japan harbored chestnut blight, a fungal pathogen to which Asian trees had long evolved resistance – while their American relatives had not. Since its discovery in the Bronx in 1904, this pathogen has eradicated 3-5 billion trees, which now only exist as small saplings and stumps. The fungus releases oxalic acid, which causes cankers to grow, restricting flow of vital water and nutrients through the plants’ vascular system.

Over the past few decades, the American Chestnut Foundation hosted a Backcross Breeding Program. The idea is that one could breed the American Chestnut with its much smaller relative the Chinese chestnut, and then back-cross the resulting hybrid to another American tree to create a dominant percentage of American genetics. To picture this, the American chestnut has approximately 45,000 genes; backcrossing would introduce 1/16 Chinese chestnut genes, or 2,800 non-native genes to the modified tree. While the variance that exists in this breeding method would promote biodiversity, the lack of precision could result in a dwarfed, smaller tree that lacks the ability to compete for resources in the ecosystem it will be introduced to.

An alternative program at SUNY College for Environmental Science and Forestry utilizes transgenic breeding techniques. Co-directors Bill Powell and Chuck Maynard have identified that the single oxalate oxidase gene found in wheat can be used to “detoxify” oxalic acid released by the cankers of infected trees, raising blight resistance. This gene is already eaten by billions of people daily.

This type of research, as discussed extensively yesterday, is not without questions of ethical, legal, and social implications. To start, the SUNY-ESF team is currently navigating the Coordinated Framework of regulation, including the USDA, EPA, FDA. This highlights some interesting questions when drawing comparisons between the regulation of the transgenic tree, and the lack-there-of with the backcrossed, conventionally bred variety. This case study also highlights some interesting conversations we could have on intellectual property and biopiracy: The researchers explicitly state they have no intentions of profiting, and are therefore not looking to patent – but need a way to protect themselves and their research institution from risk. They are considering a trademark.

The American Chestnut Restoration project represents a group of scientists who are well aware of the political environment they're working under, and the need to prioritize public engagement. The project represents new efforts of transparency compared with much biological research. The project has deliberately received extensive local media coverage over the past two decades, and increasingly, national coverage. The lab's directors themselves engage in social media, and they even raised over $100,000 in the last few months through a crowd-funding campaign to support their "publicly funded" research. If one made a donation of $100 or more, they received unmodified, wild-type American chestnut seeds to grow at home; if successfully grown to maturity, they can become "mother" trees to be crossed with the blight resistant trees following approval, to aid in maintaining genetic diversity. It's apparent that these researchers want people to know about it, but there are questions of the motivations.

While a fascinating case study, there remain a slew of risk and social implications associated with this technology. Tree biotechnology presents risks unique to other plants and crops, including in time required to mature; gene flow once released in the wild; losing the American chestnut from its native ecosystem caused negative changes, as we've shown … but what controls exist to ensure its reintroduction does not have unforeseen consequences for this evolved ecosystem?

Examples of social implications Powell and his colleagues have encountered thus far include resistance over its partnership with Oak Ridge National Lab (site of the Manhattan Project); resistance by Native American populations who see trees as sacred; and, not surprisingly, a common consumer response draws on fear of the wheat gene and its potential for association with Celiac Disease. Others critics question its framing as a "good" GMO, worrying that the American chestnut restoration is capitalizing on the narrative of saving this heritage tree as a gateway or Trojan horse for future biotechnologies.

A majority of these concerns are not scientific at all, nor do they have scientific answers. This is how we think about public interfaces, and will hopefully inspire good discussion here today. Many of them are moral, or the "Don't mess up mother nature" imperative, or just gut reactions, but some are also about unintended side effects of risky emerging technologies, and we need to not only distinguish between them, but also consider them.