Genetically Rescued Organism (GRO), The tale of the American chestnut trees

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Abstract

The near extinction of the American chestnut tree (*Castanea dentata*), due to chestnut blight, is a classic example of the devastation that can be caused by invasive pests and pathogens. However, the chestnut is now poised to become an example of how the tools of genetic engineering, combined with classical breeding methods, can help rescue a keystone species. American chestnut trees have been genetically engineered to neutralize the primary virulence factor of the chestnut blight fungus, *Cryphonectria parasitica*, allowing the tree and pathogen to coexist. This was done using a gene common to many wild and agricultural plant species that encodes a detoxifying enzyme called oxalate oxidase. This is the first time an organism has been deliberately engineered for species and ecosystem restoration. This has been done despite many challenges, including a federal regulatory system initially not familiar with this application of biotechnology. The American chestnut is an ideal regulatory test case because of its high environmental, economic, and cultural values and a long history of efforts to restore the tree. These efforts include diverse methods such as fungicide applications, silvicultural practices, intraspecific and interspecific breeding, backcross breeding, radiation mutagenesis, and now genetic engineering. Therefore, the relative risks associated with each method can be compared to help regulators and practitioners make informed decisions. Success with American chestnut restoration will lay a foundation to save other plant species. It has been estimated that 41% of U.S. forest biomass is at risk of loss from just 15 exotic pests and pathogens, and global climate change will likely exacerbate this problem. Therefore, we need all available tools, including genetic engineering, to maintain and rescue forest ecosystems. Our work with American chestnuts is demonstrating a path forward using a variety of available tools.

Key words: Restoration*, Castanea dentata*, Conservation biotechnology, Chestnut blight, Genetic engineering pathogen resistance