Transgenic American chestnuts show enhanced blight resistance and transmit the trait to T1 progeny

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Background

- Dr. William (Bill) Powell (SUNY) is leading a team of researchers who are attempting to increase the resistance of American chestnut (*Castanea dentata*) to the virulent fungal pathogen (*Cryphonectria parasitica*) that causes chestnut blight. The team is leveraging metabolomics research capabilities within the DOE PMI Science Focus Area at ORNL to validate the effects of transgenesis, ensure biosafety, and characterize disease resistance responses.

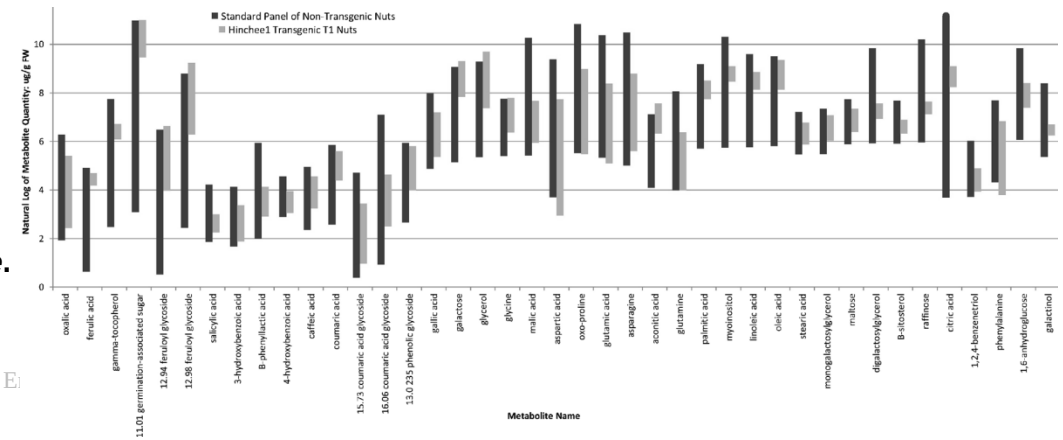
Science

- The 'Darling4' transgenic is intermediate in resistance between susceptible American and resistant Chinese chestnut.
- Stem and leaf assays both show enhanced blight resistance due to the two transgenes (oxalic acid oxidase and ESF39, an antimicrobial peptide) in transgenic American chestnut trees. These genes have been transmitted to the T1 generation, which have shown similarly enhanced blight resistance.
- Metabolomic analyses indicate that concentrations are within the range observed for a panel of control plants and that the nuts of transgenic chestnut plants are likely safe for consumption.

Significance

- The results of this study represents a major step toward the restoration of the majestic American chestnut.

Range comparison of metabolite values in non-transgenic and transgenic nuts



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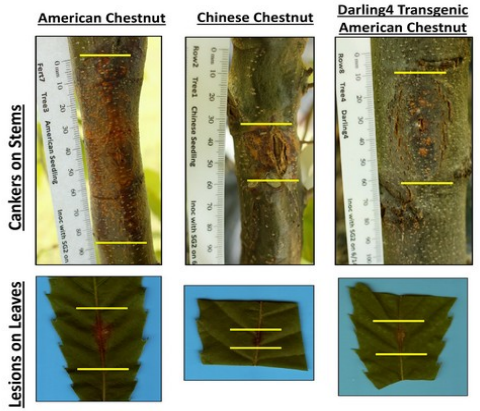
Chestnut blight lesion size



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Abstract

American chestnut (*Castanea dentata*) is a classic example of a native keystone species that was nearly eradicated by an introduced fungal pathogen. This report describes progress made toward producing a fully American chestnut tree with enhanced resistance to the blight fungus (*Cryphonectria parasitica*). The transgenic American chestnut 'Darling4', produced through an *Agrobacterium* co-transformation procedure to express a wheat oxalate oxidase gene driven by the VspB vascular promoter, shows enhanced blight resistance at a level intermediate between susceptible American chestnut and resistant Chinese chestnut (*Castanea mollissima*). Enhanced resistance was identified first with a leaf-inoculation assay using young chestnuts grown indoors, and confirmed with traditional stem inoculations on 3- and 4-year-old field-grown trees. Pollen from 'Darling4' and other events was used to produce transgenic T1 seedlings, which also expressed the enhanced resistance trait in leaf assays. Outcrossed transgenic seedlings have several advantages over tissue-cultured plantlets, including increased genetic diversity and faster initial growth. This represents a major step toward the restoration of the majestic American chestnut.

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