A Gene for Reduction of Lignin Content in Plants

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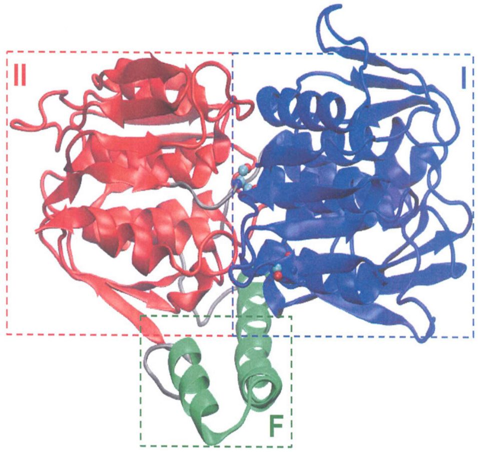

Technology Summary

One of the biggest challenges in making biofuels viable is finding the most economical way to extract the maximum amount of fuel from plant biomass. The volume of fuel that can be produced from a plant depends primarily on how easily the plant's cell walls can be broken down—or degraded. However, because cell walls are recalcitrant (i.e., resistant to degradation), a main factor in enabling economic conversion of plant biomass to biofuels is finding genetic solutions to recalcitrance. The same challenge is faced in animal feed crops where cell wall recalcitrance reduces the nutritional quality of forage crops. Researchers at ORNL used an innovative process called association genetics to quickly identify a gene that affects cell wall recalcitrance. This process allowed scientists to complete their task within a matter of weeks, compared with previous, more cumbersome methods that can take decades.

Researchers studied several varieties of Poplar trees grown throughout the United States to understand the genetics behind why there is such a wide variation in the biomass produced by the same type of trees grown in the same environment. To do this, they evaluated how the genetic makeup, or genotype, of the trees interacts with the natural environment to produce certain observable traits, or phenotypes. After data gathering and analysis, a gene was identified as one of those responsible for controlling recalcitrance-related phenotypes in Poplar trees.

The newly identified gene can be manipulated in Poplar trees, Eucalyptus, alfalfa, rice, and other plants to enhance plant performance without producing undesirable phenotypes. Such manipulation alters cell wall chemistry, resulting in reduced resistance to sugar release from cell wall components. In turn, this can lead to an advantageous conversion rate of plant biomass to cellulosic ethanol. The same benefits accrue in forage crops for animal feed with enhanced nutritional quality resulting from reduced lignin content. In addition, altering the expression of the identified gene can provide other benefits, including enhanced resistance to insects and microbial pathogens such as fungi and bacteria.

Advantages

- Enhanced plant performance without undesirable characteristics
- Ability to target multiple metabolic pathways with a single gene
- Enhanced nutritional quality

Potential Applications

- Bioenergy and bioproducts
- Cellulosic ethanol production
- Forage improvement
- Disease and insect resistance
- Tissue-specific gene expression
- Multiple pathway regulation

Patent

Wellington Muchero, Jay Chen, Lee E. Gunter, Sara Jawdy, Gerald A. Tuskan, Anthony Christian Bryan, Stephen Difazio, and Hao-Bo Guo. *An EPSP Enzyme Which Regulates Phenylpropanoid, Tyrosine and Tryptophan Pathways,* Provisional US Patent Application 62/008,434, filed June 5, 2014.

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