Finding an off switch in wood formation

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The same process plants use to respond to environmental stress acts as an on/off switch for a key enzyme in wood formation, NC State researchers have found.

The discovery improves scientists' understanding of how lignin, which gives wood its strength and ability to transport water, is formed in plants and how it can be altered for biofuel, pulp and paper production, which require costly lignin removal with harsh chemicals. The findings from the Forest Biotechnology Group, led by Vincent Chiang and Ron Sederoff, appear in *Proceedings of the National Academy of Sciences*.

"After two decades we confirmed a new mode of regulating an important pathway in plant development," says lead author Jack Wang, a member of the Forest Biotechnology Group in the College of Natural Resources. "This finding gives us a better understanding of plants, especially how wood is formed, which will allow us to modify the process for economically important uses of wood."

"Plants use a process called protein phosphorylation to rapidly respond to external stimuli, such as threats from drought, pests or diseases," says Ling Chuang, co-lead author with the Forest Biotechnology Group. NC State chemists Philip Loziuk and David Muddiman played a critical role in developing a new mass spectrometry-based technique used in the study.

Researchers focused on an enzyme controlling six of 35 chemical reactions in the lignin biosynthesis pathway, all of which were shut

down, significantly altering lignin composition in black cottonwood.

The research could be used to help modify plant properties and physical traits, including engineering plants that will be better biofuel feedstocks or modifying them to be more resistant to pests.

The study found that about 97 percent of all plant species, including pines and grasses, are equipped with sites for phosphorylation, Wang says, though more research will be needed to unravel how it works.

"Phosphorylation-mediated control of wood formation seems to be a ubiquitous process in plants," he says. "It's probably a very ancient mechanism."

The current research builds on two seminal NC State studies published in 2014 that provide the equivalent of GPS directions for future research. New research findings are being incorporated into a predictive model created during that work, improving its accuracy.

More information: "Phosphorylation is an on/off switch for 5-hydroxyconiferaldehyde O-methyltransferase activity in poplar monolignol biosynthesis." *PNAS* 2015 112 (27) 8481-8486; published ahead of print June 24, 2015, DOI: 10.1073/pnas.1510473112

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