New relationship between lignan biosynthesis and lignin distribution in secondary cell wall structure in *Arabidopsis*

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Background

Lignin and lignans differ primarily in their degree of polymerization; lignans exist as dimers, whereas lignin is highly polymerized.

Both lignans and lignin share a common "building block," coniferyl alcohol, yet lignans are not known to be associated with secondary wall structure and little is understood about how coniferyl alcohol is allocated *in planta* for lignin or lignan biosynthesis.

Approach

Dimerization of coniferyl alcohol gives rise to pinoresinol, a simple lignan which is sequentially reduced to lariciresinol and secoisolariciresinol. This process is mediated in *Arabidopsis* by reductase genes *PrR1* and *PrR2*, originally thought to be redundant.

Genes co-expressed with *PrR1* and *PrR2* in different *Arabidopsis* tissues were investigated using a cell wall co-expression database.

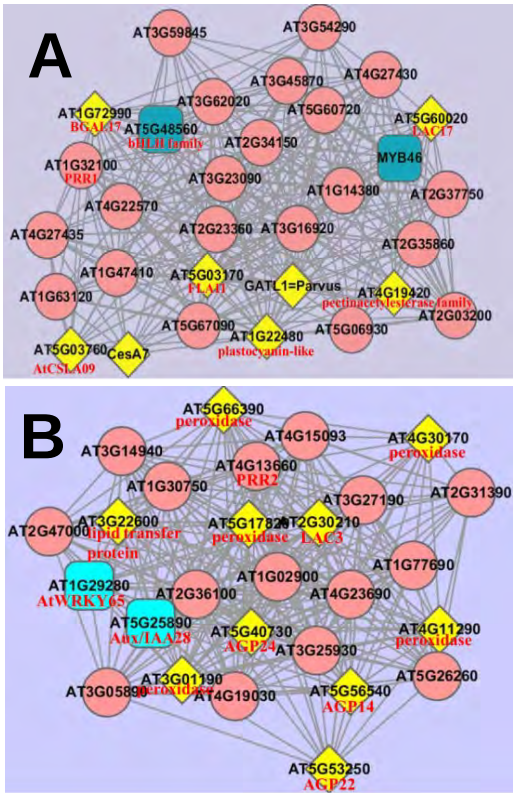
Outcome

PrR1 is co-expressed with many characterized genes involved in secondary cell wall biosynthesis throughout the plant, whereas *PrR2* expression clusters with a different set of genes and is root-specific.

Mutants with loss of function of *PrR1* showed an increase in pinoresinol levels in aerial tissue and a decrease in lignin in fiber cells but not in xylem, indicating that *PrR1* plays a role in **both** lignin and lignan biosynthesis.

Significance

Provides new evidence for a relationship between lignan synthesis and the role of lignin in secondary plant cell wall structure, which may shed light on evolution of plant secondary wall structure. Further analysis of this relationship may provide strategies for reducing recalcitrance of lignocellulosic biomass while enhancing plant defense.



Gene co-expression networks for *Arabidopsis PrR1* and *PrR2*. (**A**) *PrR1* is co-expressed with many known secondary cell wall biosynthetic genes. (**B**) *PrR2* is co-expressed with an entirely different set of genes.

Zhao, *et al*., "Pinoresinol reductase 1 impacts lignin distribution during secondary cell wall biosynthesis in *Arabidopsis*," *Phytochemistry,* S0031-9422(14)00278-7 doi: 10.1016/j.phytochem.2014.07.008.

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