Lignin valorization- plant cell walls fight back

Background

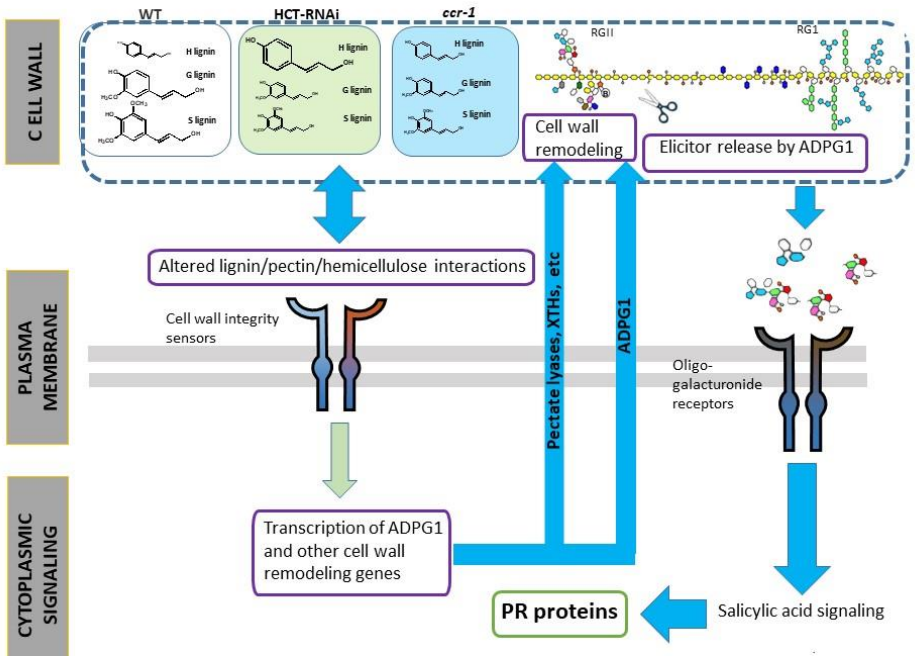
- Modifying the amount or composition of lignin in plant cell walls can facilitate bioprocessing of lignocellulose to liquid biofuels, or tailor the polymer itself for conversion to materials and/or bioproducts. However, lignin modification often results in dwarf plants in which significant resources are directed from growth towards defense in the absence of a pathogen.

Conclusions

- Cell wall changes resulting from altered lignin content or composition are recognized by plasma membrane receptors that trigger activation of genes encoding cell wall remodeling enzymes. These include ADPG1, which is normally only expressed in cleaving of anthers or seedpods.
- The cell wall remodeling releases latent elicitors of defense genes
- ADPG1 forms active compounds or elicitors of Pathogenesis Response (PR) genes by catalyzing the hydrolysis of inter-galacturonic acid bonds in complex pectins such as rhamnogalacturonan 2 (RGII).
- The cell wall remodeling also contributes to the reduced recalcitrance of the genetically modified biomass

Significance

- Understanding how plants "perceive" alterations to their cell walls will enable us to decouple cell wall polymer engineering from its negative impacts on growth and development.



Model for the activation of *PR* genes in HCT-RNAi and *ccr1* Arabidopsis plants.
Changes in lignin content in xylem cells of HCT-RNAi or *ccr1* Arabidopsis are perceived initially by the cell through activation of plasma membrane-localized cell wall integrity receptors. This results in initiation of a signaling cascade that induces the expression of cell wall remodeling genes, including *ADGP1*. ADPG1 activity may contribute to solubilization of pectin, but is necessary for release of elicitor fragments, most likely from RGII. The soluble elicitors activate expression of *PR* defense response genes through a signaling pathway involving salicylic acid .

Gallego-Giraldo, L., Liu, C., Pose-Albacete, S., Pattathil, S., Peralta, A.G., Young, J., Westphaling, J., Hahn, M., Rao, X., de Meester, B., Knox, J.P., Boerjan, W. and Dixon, R.A. (2020). ARABIDOPSIS DEHISCENCE ZONE POLYGALACTURONASE 1 (ADPG1) releases latent defense signals in stems with reduced lignin content. *Proceedings of the National Academy of Sciences* USA. 117: 3281-3290. https://doi.org/10.1073/pnas.1914422117

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