

# Syringyl lignin production in conifers: Proof of concept in a Pine tracheary element system



## Objective

The objective of this study was to produce hardwood-like lignin containing syringyl (S) units in conifers by metabolic engineering of the phenylpropanoid pathway.

## Approach

- Genes that encode F5H, COMT, and SAD, which are enzymes involved in the synthesis of sinapyl alcohol (denoted by green boxes in the figure), were transformed into *Pinus radiata* undifferentiated callus cultures.
- Transgenic cell lines were induced to differentiate into lignified tracheary elements (TEs).
- The expression patterns for *F5H*, *COMT*, *SAD* and other endogenous lignin-related genes were analyzed during TE differentiation.
- Pyrolysis-GC/MS and 2D-NMR spectroscopy were used to chemically analyze wild-type (WT) and transgenic TE cultures for the presence of S lignin.

## Result/Impacts

- *F5H*, *COMT*, and *SAD* were successfully expressed in several transgenic TE lines.
- Pyrograms of TEs from all transgenic lines showed the presence of S lignin and pathway intermediates.
- Although no S lignin was observed in WT TE preps, NMR analysis of transgenic lines showed diagnostic signatures for S lignin.
- This study shows that metabolic engineering can be used to introduce S monomers into conifer lignin, which has the potential to improve the processing of conifer-derived biomass in the biofuel and chemical pulping industries.

