Lignin is a biopolymer located within the plant cell, accounting for 20%-30% of all terrestrial plant biomass. It has been known that the lignin polymer acts as the glue, binding together the lignin-hemicellulose-cellulose complex to generate the cell wall matrix. The last step in the biosynthetic pathway of plant lignification, is the oxidative radical coupling of lignin monomeric units. Previous reverse genetic studies, gene expression profiles, and plant tissue localization have linked many class III plant peroxidases (CIIIIPRXs) to plant lignification. However, because of the high number of CIIIIPRX isoymes within a species, it has been challenging to decipher the exact role of individual CIIIIPRX isoymes in plant lignification.

Our lab has recently determined the crystal structure of one of the switchgrass CIIIIPRXs, PviPRX4, linked to plant lignification (Figure 1). We aim to acquire complex structures with candidate lignin monomeric units for the purpose of understanding isoyme CIIIIPRX substrate specificity towards lignin monomeric units. Additionally, we aim to use kinetic and product analysis to decipher the role of individual CIIIIPRX isoymes in terrestrial plant cell wall lignification. Outcomes of our research will shed new light on understanding the overall function of these CIIIIPRXs during the lignification process, and can potentially be used to manipulate switchgrass lignin content for more energy efficient ethanol extraction.

Figure 1. Preliminary data generated for crystal structure of PviPRX4. A. PviPRX4 crystal. B. Electron density with modeled heme and proximal His166. C. Model of PviPRX4 with heme and conserved CIIIIPRX residues.