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Currently, biofuels, such as ethanol are produced largely from starch that comes from grains, but it represents only a little proportion of sugar polymer availability on Earth. Large quantities of sugar from polysaccharides that are not utilized thus far are cellulose and hemicellulose, which are the main constituent of plant cell walls. The energy efficiency of starch-based biofuels is however not optimal, while plant cell walls (lignocellulose) represent a huge resource for BioEnergy since plant cell walls are composed of 95-70% of sugar. The rest of the plant cell walls (5-30%) is mainly composed of lignin, which is a very strong phenolic polymer recalcitrant to degradation and inhibits efficient extraction of sugars from the cell wall thus prevents cost-effective lignocellulosic ethanol production. Unfortunately, lignin provides compressive resistance to plant cells and cannot simply be genetically removed without incurring deleterious consequences on plant productivity. Lignin gives a strong structural support to the plant but also protects the plant against biotic (e.g. pathogens) and abiotic stress (e.g. UV, wind). Therefore, it is important to understand to which extent plant lignin content and composition can be modified in useful ways without deleterious consequences to plant growth and development. Since lignin cannot be removed, a better control of lignin deposition and cross-linking within the cell wall may increase sugar recovery from the cell wall polysaccharides. Another approach would be to replace the “hard bounds” (e.g. ether, carbon bonds) in the lignin polymer with easily cleavable ones (e.g., amide or ester bonds) and thus would facilitate removal of lignin with processes that are much more cost effective than current processes. In order to be able to modify lignin deposition, polymerization and cell wall cross-linking, a better knowledge of the enzymes (oxidases) that participates in the polymerization of lignin and cross-linking to other cell wall components is required. Similarly, to be able to control monolignol export into the appoplast, monolignol transporters need to be identified and characterized. Therefore, we are currently developing a strategy using yeast complementation to try to indentify protein involved in lignin deposition. Plant cDNA libraries, a complete Arabidopsis MDR transporters library and selected genes will be heterologous expressed in yeast and tested for their ability to detoxify phenolic compounds by export or polymerization.

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