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**Suppression of the lignin biosynthetic gene *CCR1* results in decreased lignin recalcitrance and increased digestibility**

Maize *ccr1* mutant plants display normal growth, increased “zip-lignin” content, and improved sugar release.

**The Science**

In this study, we examined features of a lignin biosynthetic mutant in maize that we hypothesized could result in an increase in the levels of more readily cleavable ester bonds (“zip-lignin”) in the lignin backbone. The maize *ccr1* mutant displayed reduced total lignin content with no growth penalties, higher zip-lignin levels, and higher levels of sugar release.

**The Impact**

Suppressing *CCR* and thereby increasing available pools of substrate for zip-lignin production may be a viable lignin biosynthetic method for reducing recalcitrance and improving sugar release in various biofuel crops.

**Summary**

The cell wall polymer lignin provides structural support and rigidity to plant cell walls and the plant body. However, the recalcitrance associated with lignin impedes the extraction of polysaccharides from the cell wall for use in making plant-based biofuels and biomaterials. To build on recent success of the zip-lignin approach in which readily cleavable ester linkages are introduced into lignin, here we investigate maize plants with a mutation in the first gene in the lignin-specific biosynthetic pathway, *CINNAMOYL-CoA REDUCTASE* (*CCR*). Downregulation of the *CCR1* gene was previously shown to result in a pool of feruloyl-CoA and its derivatives in dicots, a condition we hypothesize could result in higher zip-lignin levels in grasses. Here we analyzed a maize *ccr1* insertion mutant. As anticipated for a mutation in the first lignin-specific gene in the phenylpropanoid pathway, the *ccr1* mutation resulted in reduced monolignol biosynthesis and lower total lignin content; however, the reduced lignin phenotype did not negatively impact growth of the mutant plants. These *ccr1* mutant plants revealed three- to five-fold higher levels of monolignol ferulates (or zips) compared to wild type. Furthermore, digestibility, as measured by glucose release, was significantly higher in *ccr1* mutants than in wild-type plants. Increasing the pool of feruloyl-CoA available for conjugation with monolignols therefore could be a viable method for reducing recalcitrance and improving sugar release for other biofuel crops.

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**Publications**

Smith, R. A. *et al.* “Suppression of *CINNAMOYL-CoA REDUCTASE* increases the level of monolignol ferulates incorporated into maize lignins**.”** *Biotechnology for Biofuels* **10**, 109 (2017) [DOI: 10.1186/s13068-017-0793-1].

**Related Links**

<https://biotechnologyforbiofuels.biomedcentral.com/articles/10.1186/s13068-017-0793-1>

**PM Recommendation for SC Web Publication**