Cellulose Binding Domains: Novel Implications in Agriculture and Biofuel Production

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Recent exponential increases in the world population have necessitated advances in agricultural methodology and greater efficiency for alternative energy technology. Cellulose binding domain (CBD), the non-catalytic domain of a novel family of carbohydrate-binding hydrolases, has the potential to address both issues. CBD-treated V. radiata, the common mung bean, were grown over an 8 day period with a 12h photoperiod. Data indicated CBD increased the mass of sprouts as well as the concentration of free glucose ($p<0.05$), effecting a six-fold increase in total free glucose at the highest concentration ($p<0.05$). In plants treated with CBD, length, diameter, and material stiffness increased ($p<0.05$) and root hair frequency decreased ($p<0.05$). CBD demonstrated countertoxic effects in a silver nitrate model, increasing the mass of the plant when exposed to the toxin ($p<0.05$). SEM demonstrated microfibrils of treated plants to be qualitatively more rough and amorphous; TEM determined the presence of secondary cell wall in treated plants and its absence in untreated plants. Toluidine blue-O stain elucidated the composition of the cell wall, with unlignified middle lamella, lignified tracheary elements and lignified sclerenchyma increasing in a dose-response fashion ($p<0.05$). Multiple-dose adnterministration of CBD rendered a heightened response than single-dose across all assays ($p<0.05$) except root hair prevalence, which significantly decreased ($p<0.05$). The data suggests that CBD may be interfering with intermicrofibrillar interactions, increasing amorphousness of the cell wall and allowing for accelerated growth and development under turgor pressure. The data indicates that CBD application represents a promising avenue for increasing agricultural yield and biofuel efficiency.

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