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Unraveling Genetic and Biochemical Mechanisms-Induced Growth-Promoting Endophytes Involved in Cell Walls Synthesis to Improve Sorghum for Sustainable Bioenergy Systems in Tennessee

Abstract

In the United States of America (USA), Sweet Sorghum is considered a leading candidate for lignocellulosic biofuel feedstock, partly because of its high biomass production, wide adaptation, low agronomic input requirements, and accumulation of sugars in its stalks. Other agronomic traits, such as its short-life cycle of about four months and low cost of cultivation are especially helpful for its adoption as a biofuel feedstock; however, sorghum itself is recalcitrant to genetic manipulation and is threatened by various diseases limiting its growth and production. To address this, we used four selected naturally-occurring growth-promoting endophyte Biological Control Agents (BCAs) to enhance sorghum growth-promotion and its biomass traits. Specifically, we aim to unravel key molecular mechanisms that control plant cell walls (PCWs that represent 70-80% of plant lignocellulosic biomass) formation/synthesis during the sweet sorghum interaction with BCAs. We will employ whole transcriptomics and biochemical approaches to decipher these molecular mechanisms that underpin the interaction between BCAs and PCWs in two varieties of sweet sorghum Dale and Topper 76-6 that are well-known to be adopted in Tennessee. The three objectives to investigate are: i) Phenotypical characterization of BCA-host sorghum plants interaction. ii) Elucidation of genetic pathways that play crucial roles in the production of sugar and lignin accumulation in sweet sorghum. iii) Biochemical identification of BCA-related regulators specific for cellulose and lignin biosynthesis underlying BCA-host sorghum plants interaction. Preliminary results show that four isolated, eco-friendly BCAs augment plant biomass by up to 36-42% increase along with changes in lignin up to 12-17% increase and total sugars up to the 1.7-2.6-fold increase in both sorghum Dale and Topper. These efficiencies match or exceed any results published thus far, suggesting that BCAs play a critical role in the PCW synthesis and that the novel *Bacillus* spp. isolates have exciting potential as new biological control products.