Dressing the Seed: A Comprehensive, Wide-Scale Approach to Food Insecurity

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Increases in world population have required improved agricultural yields. Cellulose binding domain IV (CBD), the non-catalytic domain of a novel family of carbohydrate-binding hydrolases, has potential in addressing this issue. Vigna radiata was grown hydroponically for 8d in solutions of CBD (0-0.1 mg/mL). Previous research showed CBD increased plant biomass and free glucose dose-responsively ($p<0.05$). Current research demonstrated that CBD increases drought resistance dose-responsively ($p<0.05$), confers countertoxic potential in plants exposed to $AgNO_3$ ($p<0.001$), and does not affect viability of human cells. HPLC revealed increased levels of vitamins B1, B3, B9, and C in treated plants ($p<0.05$). CBD spread over multiple doses rendered an amplified response compared to single-dose across all assays ($p<0.05$). SEM and TEM elucidated cell wall amorphousness in treated plants, and toluidine blue-O stain indicated CBD accelerated maturation. Immunofluorescent staining confirmed extracellular localization of CBD protein, while assays showed that levels of auxin, gibberellin, abscisic and salicylic acid, cytokinin, and antioxidant potential increased in treated plants ($p<0.05$). RT-qPCR indicated that CBD increased expression of WAK1, PR1, and MPK3 and decreased expression of MPK6. Data suggests that CBD induces amorphogenesis, freeing oligogalacturonides that signal onset of maturation. The study culminated in development of a CBD-chitosan seed coating that displayed greater sprout mass ($p<0.05$) and diameter ($p<0.01$) compared to CBD alone and conferred antimicrobial potential ($p<0.05$). The data indicate that CBD has potential in improving agricultural yield, with CBD-chitosan seed coatings an effective path to non-GMO commercial scalability for solving global food insecurity.

Awards Won:

Second Award of $2,000