The Effects of Caffeine on Glycine max (Soybean) Proteogenomics

Abuelem, Jana (School: Pulaski Academy)

Glycine max holds significant global agricultural and economic values. Although caffeine is used as a soil fertilizer, it could inflict adverse effects on the seed, hindering the plant's overall growth. This study evaluated the effects of caffeine on Glycine max radicle morphology and proteogenomics. We hypothesized that if Glycine max seeds are exposed to higher caffeine concentrations, their protein and DNA levels should increase as a result of greater stress on the seed itself. An experimental design was used to split 360 seeds into four groups, each irrigated with caffeine solutions of 0 (control), 0.2, 0.4, or 0.8 mg/ml. After nine days, germinated seeds were studied morphologically and proteogenomically. Morphological analysis revealed a significant difference in water content across caffeine concentrations (p-value = 0.0049), and that radicle color is dependent on caffeine concentration (p-value < 0.0001), suggesting altered photosynthesis. Protein extraction and SDS-PAGE displayed a significant difference in the protein concentration (p-value < 0.0001) and protein levels (p-value < 0.0001) across the caffeine-concentration groups. DNA extraction further revealed a significant increase in DNA concentration in the highest caffeine-concentration group compared to the others (p-value < 0.0001), suggesting higher transcription upon exposure to higher caffeine concentrations. The qPCR showed a significant increase in the expression of Momilactone-A Synthase-like (stress) enzyme gene in the 0.2 caffeine-concentration group (p-value <0.001) compared to the control. Taken together, these results suggest that caffeine stresses Glycine max seeds, potentially due to increased levels of apoptotic proteins upon exposure to caffeine.

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