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Characterizing variants of Serine Hydroxymethyltransferase (SHMT) to further elucidate mechanism of resistance against soybean cyst nematode (SCN) infection

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Soybean cyst nematode (SCN) infection is a billion dollar problem annually in United States agriculture. Soybean cyst nematode is a parasitic roundworm which infects soybean plants by targeting roots and establishing permanent feeding sites. Infection can lead to stunted growth, yellowing, and general decrease in crop yields. Currently, resistant cultivars are used to combat SCN infection. However, nematodes are becoming increasingly resilient against these cultivars, and the exploration of a novel path to combating SCN infection is crucial. Pioneering research from the lab of Dr. Melissa Mitchum uncovered that a variant of the enzyme Serinehydroxymethyltransferase (SHMT), found in the soybean genotype Peking, is resistant to SCN infection due to two point mutations. Soybeans contain 18 different SHMT genes, with SHMT8 being the only family member associated with SCN resistance. The SCN susceptible cultivar of SHMT8, called Essex, varies from the SCN resistant cultivar, called Forrest, by just two point mutations. In order to explain the mechanism of resistance found in SHMT8, sequences from the SHMT family were studied to identify similarities and differences. I have identified 12 SHMT sequences from the UniProtKB database and conducted a multiple sequence alignment to examine relationships. Pairwise differences were calculated to quantitate amino acid similarity and a homology tree was constructed to visualize sequence relationships. Additionally, structural models have been created using Swiss-Model to simulate how amino acid differences may affect the structure of the protein. In the next phase of the study, further analysis of the structures and sequences of the SHMT family will be done to elucidate how secondary structure differs and which key catalytic residues are affected. These observations will provide further insight into the mechanism of resistance of SHMT8 Forrest against SCN infection and perhaps contribute to the solution to SCN infection.