An Innovative Approach to Promoting Lignin Biosynthesis in S. lycopersicum Using Sound Waves

McHale, Caroline (School: Wiregrass Ranch High School)

Lignification and lignin biosynthesis is an innate immune response in plants to pathogens attempting to enter the cell wall. When pathogens successfully penetrate the cell wall, it damages the plant and deprives it of nutrients, which results in several crop diseases. Plants receive sound as a mechanical force, and the use of sound waves has already been shown to have physiological impacts on plant cell functions. Thus, it is important to explore if the use of sound can mechanically trigger lignification and immune response pre-infection of disease. This was done by exposing the plants to varying frequencies (0-1,000 Hz), then using the Klason Lignin Method to extract the lignin from the cell. The final lignin samples were weighed, and averages of the trials were calculated. Current data collected was found statistically significant using a One-Way ANOVA and Tukey HSD (p-value 0.0044). The test concluded S. lycoperscium exposed to 1,000 Hz showed the only statistically significant increase in lignin ash content from both the control and lower frequencies. Further testing will be conducted to add validity to the results. The current data suggests the frequency of 1,000 Hz was able to replicate the mechanical force pathogens have on the cell wall, triggering lignin biosynthesis. These conclusions lead to the possibility that higher frequencies (1,000+ Hz) are needed in order to induce lignification with sound. This research provides a potential starting point in using sound as an alternative prevention/treatment option that is safer, cheaper, and more effective than pesticides.

Awards Won:

Air Force Research Laboratory on behalf of the United States Air Force: Glass trophy and USAF medal for each recipient

Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Regeneron ISEF Category, FOR 2023 ONLY: EBED WILL HAVE TWO