Early Detection of Drought Stress Through a Novel AI Drought Assessment (AIDA) Model in Field Grown Tomato (Solanum lycopersicum) Plants Using a Custom-Built "Spectra-Rover"

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Drought is the most serious threat to global food production and sufficiency. Late detection of drought stress in plants leads to irreversible crop damage and yield loss. The standard method of detecting drought stress, the Crop Water Stress Index (CWSI), uses mainly indirect meteorological indicators. It cannot detect the stay green phenomenon, an early indicator of drought stress. The Artificial Intelligence Drought Assessment (AIDA) model was developed to address this problem, using field data and variables that are physiologic and direct indicators of drought stress. A custom-built Spectra-Rover was constructed with infrared (IR) and RGB cameras to capture radiometric IR and RGB plant canopy images. IR temperature, red, green, and blue light reflectance values, and soil moisture were used to train the AIDA model. Eighty percent (80%) of the data was used in the training dataset and the remaining 20% was used in the validation dataset. The AIDA model validation output was very close to the actual CWSI values with a low mean absolute error rate of 0.0058 achieved in only 27 epochs. A prediction output program (POP) was coded and appended to the AIDA model to output an AIDA score for any tomato plant not included in the training and validation datasets. This accurately approximated the manually calculated CWSI values. This novel AIDA model with an AIDA score is an effective way of detecting early drought stress in plants. If used on all tomato farms in California, approximately 26 billion gallons of irrigation water can be saved each season.

Awards Won:
First Award of $5,000