Development of a Novel AI Drought-Stress Assessment (AIDA) Model in Bell Pepper (Capsicum annuum) Plants Using a Custom-Built Robotic RGB + Infrared (IR) Camera

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Drought impacts 40% of the world's population, and an estimated 55 million people globally are affected every year. It is the most serious threat to crops in nearly every part of the world, especially in California. Drought induces stress in plants which negatively impacts crop yield. There are limited methods to assess drought stress in plants. The Crop Water Stress Index (CWSI) is commonly used and is an old, complex calculation using variables that are only indirect indicators of drought stress. To address this problem, the AI Drought Assessment (AIDA) model was created to predict drought stress quickly and more accurately in bell pepper plants using variables that are all direct stress indicators. A robotic RGB + IR camera was constructed and used to capture radiometric IR and RGB plant canopy images. Radiometric IR values, and red, green, and blue light reflectance values, as well as soil moisture readings, were used to develop the AIDA model using the "train from scratch method". Eighty percent (80%) of the data was used as training samples and the remaining 20% was used to validate the AIDA model. Three "Dense" neural net layers were used to derive the appropriate weights and biases from the five variables collected utilizing the "Adam" optimizer. Results showed a very close prediction by the AIDA model output to the true values of CWSI from the test dataset with a very low mean absolute error rate of just 0.00048 achieved in only 28 "Epochs". It can be concluded that the AIDA model rendered through machine learning is a reliable, quick and robust way of predicting drought stress in bell pepper plants. Utilizing the AIDA model to predict drought stress in pepper plants will help farmers conserve our precious water while optimizing their yield.

Awards Won:

First Award of $5,000

Gordon E. Moore Award for Positive Outcomes for Future Generations