



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Pauline Victoria Estrada	Project Number J1808
Project Title Early Detection of Drought Stress in Bell Pepper (<i>C. annuum</i>) Using a Remotely Operated Vehicle with an Infrared Camera	
<p style="text-align: center;">Abstract</p> <p>Objectives Late detection of drought stress in plants could lead to irreversible damage and low yield. Older methods of monitoring plant water status are destructive and only detects plant drought stress late in the process. Inexpensive thermal imaging infrared (IR) thermography cameras have been developed that can be used for remote and non-destructive determination of the water status in plants. This is done by measuring the canopy temperature of plants and calculating the crop water stress index (CWSI). This study was conducted to determine if an ROV equipped with an infrared camera can effectively detect the early signs of stress caused by drought in bell pepper plants.</p> <p>Methods A field experiment on bell pepper with different irrigation levels was used in this study. An autonomous GPS enabled ROV with a 6-wheel drive chassis was built and mounted with an infrared camera. This allowed it to maneuver in the tight inter-rows of the crops, and at precise locations due to GPS, take images of bell pepper leaves using the infrared (IR) camera at a close distance to measure the temperature accurately. Soil moisture level for each plant was measured on the same day. The images were analyzed to determine the average canopy temperature and calculate the crop water stress index.</p> <p>Results The regression analysis showed that there is a very strong negative linear relationship between CWSI and soil moisture level. The coefficient of determination for the regression was 0.96 and future measurements can be closely predicted by the regression equation $y = -0.0052x + 0.465$. Also, the significant (p value = $0.02 < p < 0.05$) result of ANOVA showed that the variations in soil moisture level do affect the CWSI and that the linear relationship does exist between CWSI and soil moisture level.</p> <p>Conclusions This study showed that canopy temperatures obtained from infrared thermal images can accurately predict the moisture level and early signs of drought stress in pepper plants. This can have a big impact in the way irrigation is being managed in the field. By knowing the CWSI, farmers will have an idea when it is necessary to irrigate. Unnecessary irrigation can be avoided which will help farmers conserve precious water. This is not only good for the environment, but it also allows farmers to save money and to maximize their yield.</p>	
Summary Statement A remotely operated vehicle with an infrared thermography camera can accurately measure plant canopy temperatures to calculate the CWSI and detect early drought stress in bell pepper plants.	
Help Received The California State University - Fresno Agricultural Field was accessed in this study. I conceptualized, planned, conducted, and analyzed the project myself. I did not receive any mentorship from any faculty or staff from the university.	