Name(s)
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Project Number
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Project Title
Comparison of Plant Chlorophyll Measurement Utilizing a Ground SPAD Meter vs. a Low Altitude Multispectral Camera

Abstract

Objectives/Goals
Measuring the chlorophyll content using a SPAD meter is tedious, laborious, expensive, and can potentially spread pests and diseases in the field. The aim of this study is to systematically obtain quantitative data to compare the efficacy of multispectral imaging techniques with ground-based SPAD meter readings and see if the vegetation indices obtained through small UAS photogrammetry correlate well with the standard ground-based chlorophyll measurement.

Methods/Materials
A field experiment on different N-fertilizer rates on Broccoli plants (Brassica oleracea cv. Marathon) was used in this study. A small unmanned aircraft system (UAS), commonly called a drone with a GPS-enabled multispectral camera was built. The UAS was flown autonomously at a low altitude (100 feet) and light reflectance values from the broccoli plants were recorded. These were used to calculate the vegetation indices: GNDVI, NDVI and CVI. The chlorophyll content of the broccoli plants on the ground were also measured using a standard SPAD 502 meter on the same day the images were taken. The vegetation indices were compared to SPAD measurements using regression analysis.

Results
The regression analysis showed that there are strong positive linear correlations between GNDVI, NDVI, and CVI with the SPAD readings. GNDVI, however, had the highest correlation (R2 = 0.92) compared to the other vegetation indices, NDVI and CVI, with R2 values of 0.74 and 0.7 respectively.

Conclusions/Discussion
This study showed that all three vegetation indices obtained using a UAS mounted camera and the technique developed in this study to exclude the soil pixels from plant pixels can reliably estimate the chlorophyll content in broccoli plants. It has the advantage of speed in obtaining measurements over large areas and avoids the potential spread of pests and diseases. By knowing the estimated chlorophyll content of the plants, farmers will know when and where it is necessary, and how much fertilizer to apply which can save money and protect our environment by avoiding ground water contamination.

Summary Statement
This project showed that a drone-mounted multispectral camera to calculate vegetation indices is as effective as a standard SPAD meter in measuring the chlorophyll content of broccoli plants.

Help Received
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