Precision Agriculture Lab

UNIVERSITY OF MARYLAND EXTENSION

COLLEGE OF AGRICULTURE & NATURAL RESOURCES

Real-Time Crop Water Stress and Irrigation Mapping Using Multispectral Imagery

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Introduction

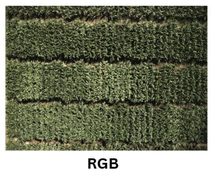
Uniform irrigation across a field often fails to account for variations in crop water needs, leading to over- or under-irrigation. Such inefficiencies can reduce plant health and waste valuable water resources, especially in regions facing water scarcity. This project aims to address this challenge by developing a real-time UAV-based multispectral imaging workflow to generate site-specific irrigation recommendations.

MicaSense RedEdge-P camera

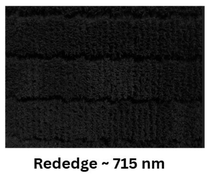
Data Acquisition

Multispectral imagery was collected throughout the growing season using a UAV equipped with a MicaSense RedEdge camera. The Camera captured the images across the red band, blue band, NIR, Green band and RGB.

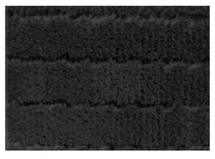
Spectral Band Images Captured by the MicaSense RedEdge Sensor



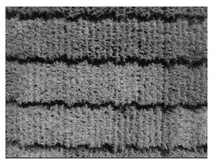
RGB



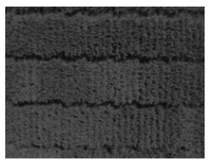
Rededge ~ 715 nm



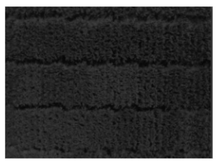
Red band ~650nm



Near-Infrared ~ 840



Green band ~ 550



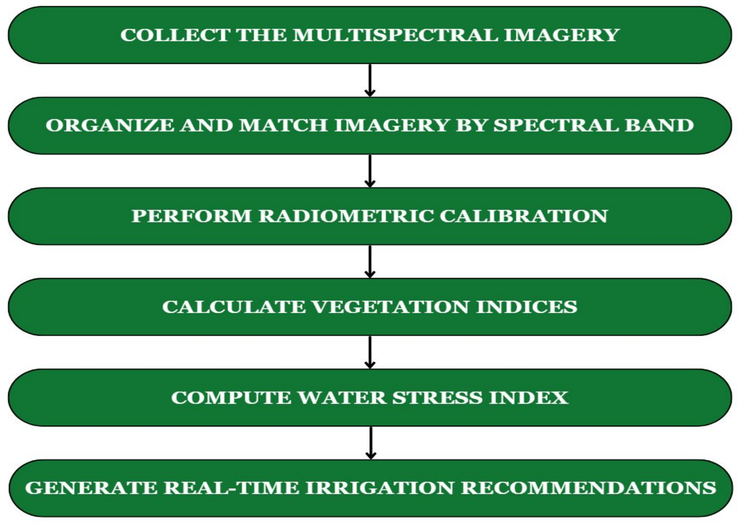
Blue band ~ 475

Hypotheses

- Vegetation indices from multispectral imagery can indicate crop water stress at field scale.
- Real-time UAV mapping enables on-the-spot analysis and site-specific variable rate irrigation recommendations.

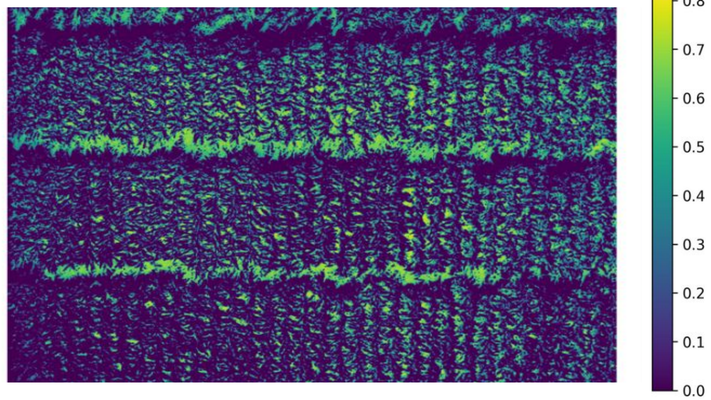
Methodology

From the multispectral imagery acquired, the red, near-infrared (NIR), and blue bands were radiometrically calibrated to convert raw digital numbers into surface reflectance values. The calibrated imagery was then used to compute the normalized difference vegetation index (NDVI), normalized difference water index (NDWI), and water stress index (WSI). These indices form the basis for assessing crop water status and generating site-specific irrigation recommendations. The workflow is being designed for near–real-time implementation, enabling imagery captured during flights to be processed and analyzed on-site for immediate decision-making.

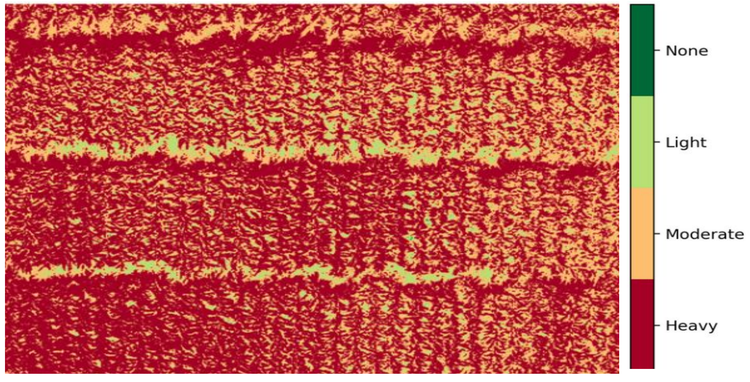


Results

NDVI Heatmap



Recommended Irrigation



Summary

- A workflow was developed to process UAV multispectral imagery and compute vegetation and water stress indices.
- Here we propose a method for generating real-time, site-specific irrigation recommendations.
- Our next steps include field validation and integration into an automated decision-support system.

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