Analysis of Multispectral Pipelines

Savannah Pluma[1], Melinda Zubrod[2], and Arron Carter[2]

[1]University of California, Davis [2]Washington State University

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INTRODUCTION

A multispectral analysis pipeline is a specific set of methods and softwares used to collect, process, and analyze data from a multispectral sensor. As shown in **Figure 1**, a pipeline consists of image stitching, plot identification, radiometric calibration, soil background removal, vegetative index calculation, and statistical analysis. The incorporation of spectral data has shown to positively impact plant breeders as they can increase the efficiency of measuring routine traits while also providing breeders with previously infeasible trait data.

OBJECTIVE

A study comparing multispectral image analysis pipelines found that vegetative index values from the Washington State University (WSU) winter wheat breeding pipeline and Texas A&M University (TAMU) image analysis pipeline were statistically different. As such, the objective of this project is to determine if there is a correlation between the pipelines, if there is a rank change among varieties for specific predicted traits, and do the pipelines have the same predictive power.

METHODS

The data used in this study was collected during the heading stage of winter wheat in 2023 in Walla Walla Washington using a Sentera 6X multispectral sensor mounted on a DJI Inspire 2 roto copter. Radiometric calibration was carried out using panels with known reflectance.

- The indices compared were Normalized Difference Vegetation Index (NDVI) and Normalized Difference Red Edge (NDRE).
- In R, each pipeline was assessed for its effects on the rank and prediction power of different lines using ggplot2, ggpubr, cor, and moments.

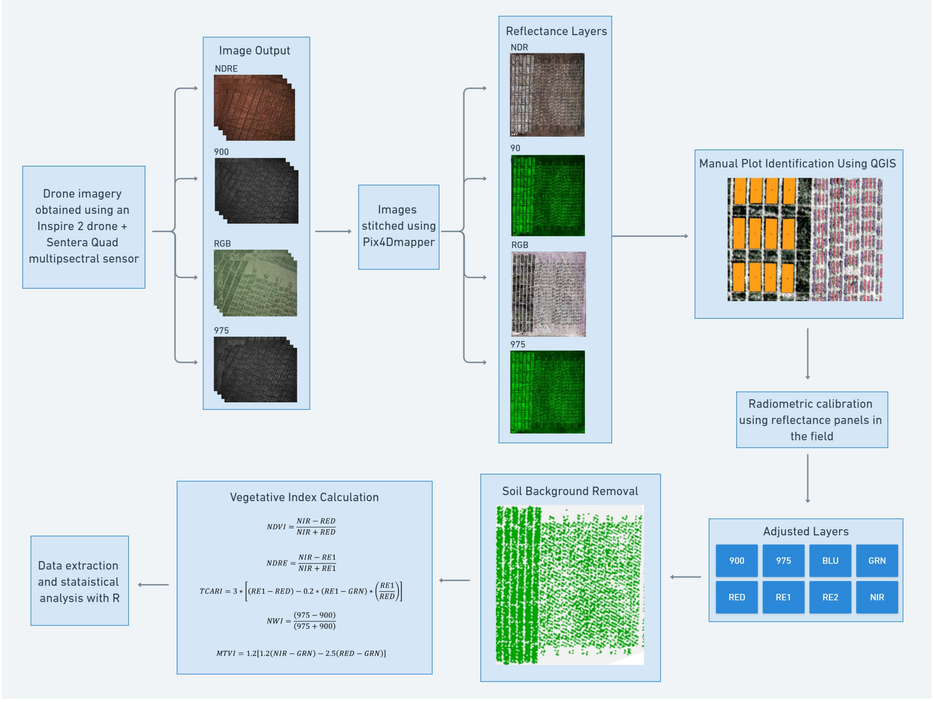

Figure 1. WSU Multispectral Pipeline

RESULTS

Using R, Pearson correlation coefficients were calculated to analyze similarities of index values from each pipeline resulting in a Pearson correlation coefficient of 0.95 for NDVI and 0.98 for NDRE. In **Figures 2** and **3,** Pearson correlation coefficients were calculated between each index and yield to assess the predictive power of the different pipelines which resulted in similar Pearson correlation coefficients across all treatments. These results suggest that the predictive power of the vegetative indices calculated from each pipeline is not affected by the pipeline. Index values may be scaled differently due to calibration processes of different pipelines producing values that are statistically different but have the same predictive power.

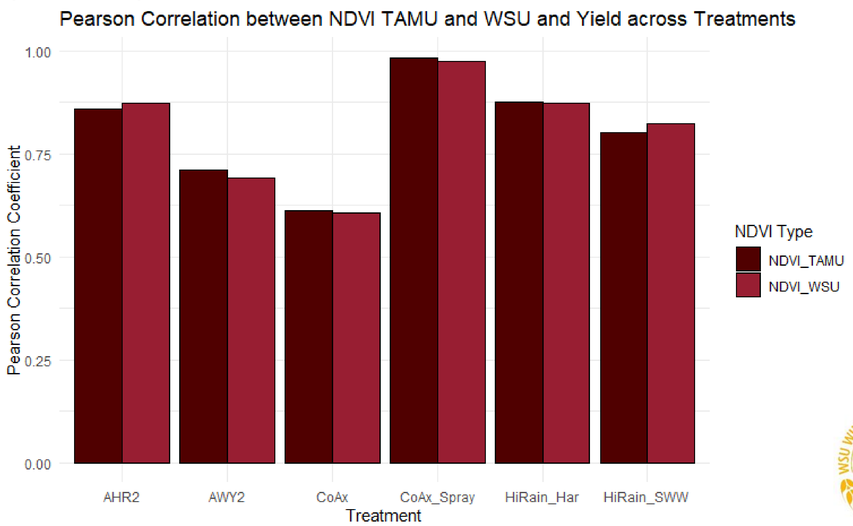

Figure 2. Pearson Correlation between NDVI and Yield

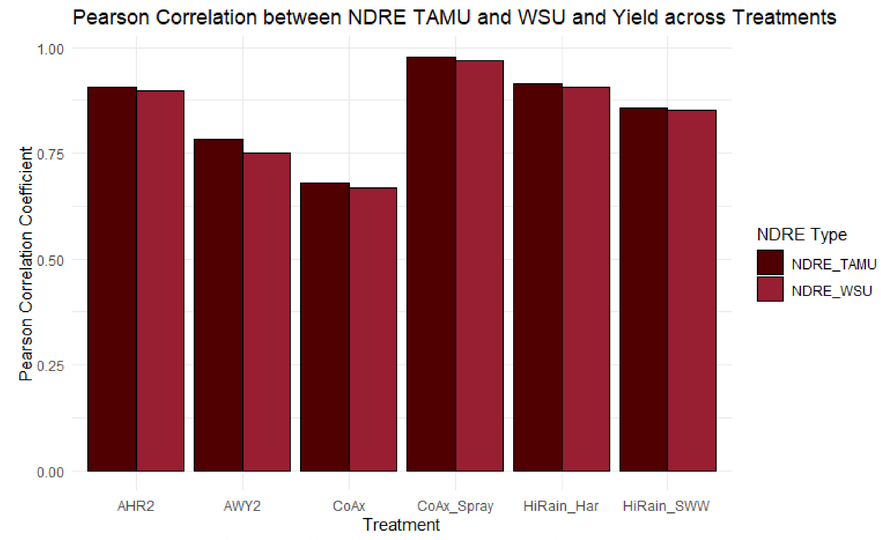

Figure 3. Pearson Correlation between NDRE and Yield

Figure 4 illustrates the Spearman correlation for the rank change between vegetative indices obtained from the 10 best varieties across 6 different treatments using both WSU and TAMU data. These findings imply that the variety exhibiting the highest vegetative indices in the WSU pipeline is often the variety exhibiting the highest vegetative indices in the TAMU pipeline.

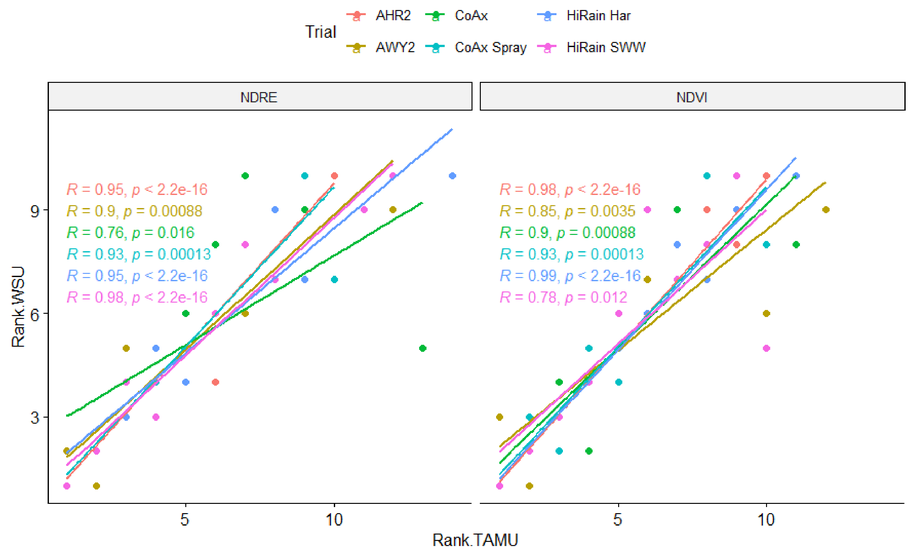

Figure 4. Spearman Rank Correlation for NDRE and NDVI

NEXT STEPS

- Perform Analysis: Conduct the same analytical procedures used for vegetative index values obtained from WSU and TAMU pipeline for Pullman data.
- Evaluate compatibility: Assess if index values from WSU and TAMU pipeline can be used in the same genomic prediction model.

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