Towards Increased Genetic Gain: Utilizing Spectral Data in a Large Scale Wheat Breeding Program under a Drought Year

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Abstract

Multispectral imaging with unmanned aircraft systems (UAS) is a promising high-throughput phenotyping technology that has been shown to help understand the causal mechanisms associated with crop productivity. This imaging technology can accurately predict complex agronomic traits like grain yield within a given generation, creating the potential to fast-track selections in plant breeding and increase genetic gains. The objective of this study was to determine the effectiveness and efficiency of prediction on grain yield in an abnormal drought year across locations within a breeding program. Eleven spectral reflectance indices (SRI) including NDRE, NWI, NDVI, and percent canopy cover were used to evaluate Washington State University winter wheat breeding lines between 2018 and 2021. Data was collected using a DJI Inspire 2 drone, equipped with a Sentera Quad Multispectral Sensor, and collected at the heading date. Lines were observed from single location, single replication preliminary yield trials to multi-location, replicated advanced yield trials. Lines advanced in the breeding program were evaluated across 13 different location-year trials. The calculated SRIs and canopy cover were used individually and in combination as fixed effects in mixed model prediction for grain yield under drought conditions. Models were independently validated with 2021 data. Across locations, SRIs are shown to improve the prediction performance for grain yield under abnormal drought conditions by as much as 40% in the case of NDRE. This research is vital for plant breeders to understand the utility of UAS imaging in variety improvement when dealing with abnormal growing seasons.

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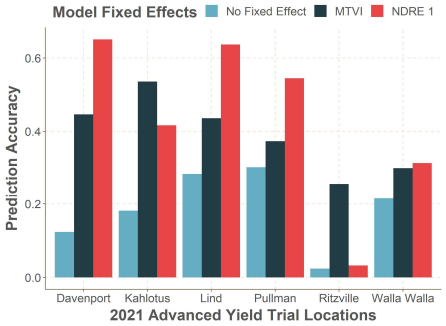
Question: Can spectral indices, when included used as fixed effects, improve model prediction accuracy of grain yield under abnormal growing conditions?



Preliminary Results: Across all 2021 locations indices were able to significantly improve prediction ability.

Next Steps: Incorporate indices into genomic prediction models.

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