IWYP International Wheat Yield Partnership
Research to Deliver Wheat for the Future

IWYP SCIENCE BRIEF

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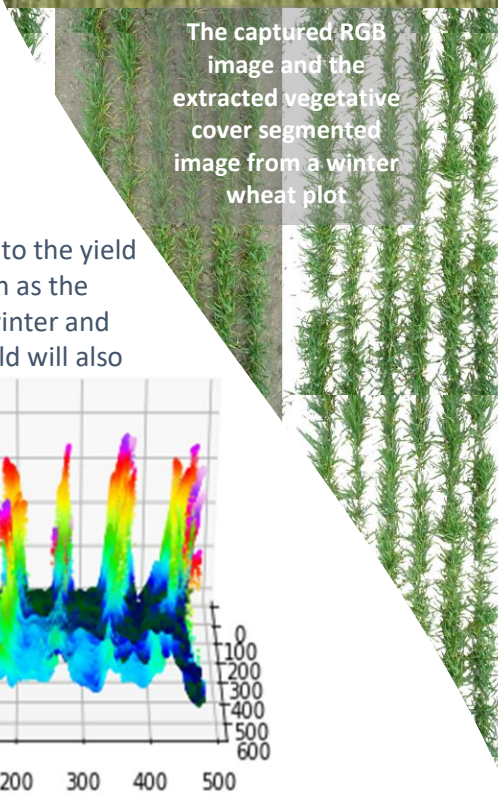
Multi-Omics Approaches to Determine Wheat Yield Stability

It is well established that the interaction of genotype by environment affects the final yields of crop plants. An AAFC-IWYP Project "**Leveraging Phenomics and Genomics Approaches for Efficient Allele Mining and Deployment to Increase Yield in Wheat**", led by Andrew Burt at Agriculture and Agri-Food Canada (AAFC) with other colleagues in Canada and the United Kingdom aims to use phenomics and genomics methods to systematically evaluate spring and winter wheat breeding panels across diverse environments in Canada and the UK to determine the stability of traits relating to high yield and superior agronomic performance. Specifically the project will identify those yield traits or alleles that can be widely deployed across varied growing environments with stable higher-yielding results and conversely identify favorable alleles best for deployment in specific environments.

The PlotCam in spring wheat plots, July 2019



The captured RGB image and the extracted vegetative cover segmented image from a winter wheat plot

What Solutions have been Identified?

- Since 2019, two spring wheat and two winter wheat populations have been tested for yield in a total of twenty-three environments (site x years).
- In-depth physiological data across the growing seasons have been collected on seven population x environments via image capture and phenomics-based analyses.
- Yield stability is being modeled using parametric and PCA-based methods, and by combining the coefficient of variation with mean yield.
- Genotyping is complete for one population and underway for the other three. Genotypic data will be used to determine the effects of individual loci on the different models of yield stability.
- Analysis of the physiological data throughout the growing season has been applied to the yield data, reinforcing established models for important yield components in wheat, such as the correlation of establishing and maintaining a large crop canopy with yield in both winter and spring wheat types. Alleles for those traits that consistently correlate with grain yield will also be determined for use in breeding as they have higher heritability than grain yield per se.

Anticipated Impact of this Research

- 290 spring and winter wheat breeding lines and cultivars have been shared among 3 winter wheat and 4 spring wheat breeding programs. Each has evaluated these lines in their target environment, identifying germplasm suitable to be deployed directly or incorporated in local breeding programs.
- The relative contribution of physiological traits to yield is being determined for each breeding program's target environments, which may result in new selection targets or changed emphases in selection indices.

Fig. 1. This figure shows a wheat canopy height point cloud and is one of the types of data collected by the PlotCam. Data generated from measuring plot heights is used to determine Estimated Biomass (EBM) which has been shown to be a reliable covariate for estimating yield.

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