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Abstract

In recent decades, the field of phenomics has lagged behind the advances in genomics, which have become increasingly high-throughput and low-cost. In comparison, manually collected phenotypes are often time-consuming, labor intensive, and more costly to obtain. The development of high-throughput phenotyping platforms (HTPP) are bridging these gaps and enabling improved spatial and temporal resolution for researchers. We used imagery from unoccupied aerial vehicles (UAV) flown over multiple site years in Saskatchewan and Italy to gather data for crop height, area and volume in a lentil diversity panel. We found high correlations for our UAV-derived traits (height & volume) with our manually collected phenotypes (height & biomass). In addition, the high-throughput nature of the UAV allowed for the collection of time-series data which enabled the modelling of growth curves for volume, height and area, which would be impractical under traditional phenotyping procedures given the large population grown in multiple environments. Principal component analysis and hierarchical clustering revealed differential growth strategies amongst our diverse lentil population across contrasting environments. Our study demonstrates the potential for HTPP to obtain data that traditionally require destructive sampling, e.g., volume as a proxy for vegetative biomass, and improve the temporal quality of phenotype data enabling researchers to take their analysis beyond single time points, e.g., model growth curves. In addition, performing our analysis on data from contrasting environments, i.e., Saskatchewan and Italy, has helped elucidate optimal adaptation with regard to growth strategies in lentils.

NAPPN Annual Conference Abstract: Dissecting lentil crop growth across multi-environment trials using unoccupied aerial vehicles.

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In recent decades, the field of phenomics has lagged behind the advances in genomics, which have become increasingly high-throughput and low-cost. In comparison, manually collected phenotypes are often time consuming, labor intensive, and more costly to obtain. The development of high-throughput phenotyping platforms (HTPP) are not only bridging these gaps but also enabling improved spatial and temporal resolution for researchers. We used imagery from unoccupied aerial vehicles (UAV) flown over multiple site years in Saskatchewan and Italy to gather data for crop height, area and volume in a lentil diversity panel. We found high correlations for our UAV derived traits (height & volume) with our manually collected phenotypes (height & biomass). In addition, the high-throughput nature of the UAV allowed for the collection of time-series data which enabled the modeling of growth curves for volume, height and area, something which would be impractical under traditional phenotyping procedures in such a large population grown in multiple environments. A principal component analysis and hierarchical clustering revealed differential growth strategies amongst our diverse lentil population, across contrasting environments. Our study demonstrates the potential for HTPP to obtain data which would traditionally require destructive sampling, *e.g.*, volume as a proxy for biomass, and improve the temporal quality of phenotype data enabling researchers to take their analysis beyond single time points, to *e.g.*, model growth curves. In addition, performing our analysis on data from contrasting environments, *i.e.*, Saskatchewan and Italy, has helped elucidate crop adaptation with regards to growth strategies in lentil.