Field Based High Throughput Phenotyping Enables the Discovery of Loci Linked to Senescence and Grain Filling Period

Alper Adak[1], Aaron J Desalvio[1], and Seth C Murray[1]

[1]Dept. of Soil and Crop Sciences, Texas A&M University

October 5, 2022

Abstract

Field Based High Throughput Phenotyping Enables the Discovery of Loci Linked to Senescence and Grain Filling Period

ORCiD: [Alper Adak; 0000-0002-2737-8041]

Keywords: Grain filling period, field-based high throughput phenotyping, days to senescence, temporal phenotype.

Senescence occurs progressively over time and is variable among different genotypes. To examine the temporal and genetic variation of senescence, 280 maize hybrids and 520 maize recombinant inbred lines (RILs) grown in 2017 and 2018 were investigated. Hybrids were grown in late and optimal planting trials; RILs were grown in irrigated and non-irrigated trials, both based on range-row design with two replications. Two types of Unmanned aerial systems (UAS, also known as UAV or drones) were flown over the germplasm between 14 and 20 times respectively. Temporal senescence of each row-plot in hybrids and RILs was scored visually according to percentile scoring using four to five rectified drone images between ˜90 and ˜130 days after planting. A mechanistic growth model was fit to each genotype using the temporal senescence scores, resulting in 0.94 and 0.97 R 2 for hybrids and RILs. Days to senescence (DTSE) and grain filling period (GFP) were calculated for each row plot using the developed mechanistic growth model. To predict the genotypic value for each RIL and hybrid, a mixed model with three-way interaction model (Genotype*Flight*Environment) was then run. Correlation was calculated ˜0.84 and ˜0.88 between grain yield and GFP and DTSE in hybrids. A major quantitative trait locus was also discovered on chromosome 1 (295.5 to 296.8 kb; 15% explained) linked to GFP in RILs. GFP is known to be physiologically important, UAS provided an easily scalable measure which can greatly increase the evaluation of variation in the field.

Field Based High Throughput Phenotyping Enables the Discovery of Loci Linked to Senescence and Grain Filling Period

***Alper Adak*[1], *Aaron J. DeSalvio*[1], *Seth C. Murray*[1]**

[1]*Dept. of Soil and Crop Sciences, Texas A&M University, College Station, TX, 77843-2474, USA*

ORCiD: [Alper Adak; 0000-0002-2737-8041]

Keywords: Grain filling period, field-based high throughput phenotyping, days to senescence, temporal phenotype.

Senescence occurs progressively over time and is variable among different genotypes. To examine the temporal and genetic variation of senescence, 280 maize hybrids and 520 maize recombinant inbred lines (RILs) grown in 2017 and 2018 were investigated. Hybrids were grown in late and optimal planting trials; RILs were grown in irrigated and non-irrigated trials, both based on range-row design with two replications. Two types of Unmanned aerial systems (UAS, also known as UAV or drones) were flown over the germplasm between 14 and 20 times respectively. Temporal senescence of each row-plot in hybrids and RILs was scored visually according to percentile scoring using four to five rectified drone images between ~90 and ~130 days after planting. A mechanistic growth model was fit to each genotype using the temporal senescence scores, resulting in 0.94 and 0.97 R^2 for hybrids and RILs. Days to senescence (DTSE) and grain filling period (GFP) were calculated for each row plot using the developed mechanistic growth model. To predict the genotypic value for each RIL and hybrid, a mixed model with three-way interaction model (*Genotype*Flight*Environment*) was then run. Correlation was calculated ~0.84 and ~0.88 between grain yield and GFP and DTSE in hybrids. A major quantitative trait locus was also discovered on chromosome 1 (295.5 to 296.8 kb; 15% explained) linked to GFP in RILs. GFP is known to be physiologically important, UAS provided an easily scalable measure which can greatly increase the evaluation of variation in the field.