B-180

High-throughput phenotyping of soybean iron deficiency chlorosis using unmanned aerial vehicles

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Many field tasks in a soybean breeding program are labor intensive, time consuming, and subjective. These tasks include the phenotyping of thousands of plots for traits such as plant health, height, maturity, and lodging. In recent years, there has been a growing interest in the use of aerial high throughput phenotyping (HTP) platforms to assist in making field scoring faster, more accurate, and more objective. The goal of this project is to use unmanned aerial vehicles (UAVs) to improve field screening for resistance to iron deficiency chlorosis (IDC). During the summer of 2016, nearly 3,500 plots were visually scored for IDC resistance. Images were captured using a digital camera equipped to a DJI Phantom UAV platform flown at 30 meters. Canopy area of each plot as well as the mean red, green, and blue values from the plant leaves explained over 70% of the variation in IDC. A pipeline was created for image capture, orthomosaic generation, processing, and analysis. Field plots during the summer, 2017 were flown with a DJI Inspire 1 platform equipped with a modified dual camera system. This camera system allows for image capture in the NIR and better detection of plant health. All results obtained show promise in utilizing UAVs for efficient IDC field screening. Future work will expand our HTP efforts to additional traits and increase the frequency at which we image fields to capture important phenology and disease resistance data at a higher temporal resolution than has been possible before.