INTEGRATION OF GROUND- AND UAS-PLATFORMS FOR THE EVALUATION OF CULTIVAR PERFORMANCE (PHENOTYPING) AND EXPERIMENTAL TREATMENTS

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Abstract

The purpose of this project was to develop and link components of remote sensing programs and assist plant breeders, agricultural researchers, and crop managers to identify best performing genotypes, evaluate experimental treatments, and make informed crop management decisions, respectively. The components of the programs include; (1) ground- and UAS-based remote sensing platforms, (2) data analysis and visualization acquired from both platforms, and (3) interpretation of the data and its applications for agriculture. The coordinated operation of these three components is essential to maximize its synergetic effects and to generate usable, user-friendly applications for agriculture.

Sensors used in the ground-based platform include an ultrasonic sensor used to determine plant height, a multi-spectral sensor used to estimate Normalized Difference Vegetation Index (NDVI), and an infrared sensor used to measure canopy temperature. Plant height is an important component of canopy cover and interception of incoming solar radiation. NDVI is a parameter that takes into account the reflectance of infrared (~ 0.87 µm) and red (~ 0.65 µm) wavelength by plants. Healthy vegetation reflects very well in the near-infrared (NIR) spectrum. Canopy temperature is an important indicator of the current plant water status. The UAS platform is equipped with multiple sensors that capture images in 4 spectral bands (Blue, Green, Red, and NIR). Images acquired from the UAS are processed to generate fine spatial resolution orthomosaic images and dense 3D point cloud data. Geospatial data products derived from the UAS platform provided valuable information on seasonal changes in plant growth rates, canopy cover development, NDVI, and canopy temperatures at spatial and temporal scales that have not been possible previously via other traditional remote sensing methods. At the end of the season, the estimation of open boll size and their number within each plot – that were extracted from fine spatial resolution orthomosaic data – showed great potential to estimate lint yield without harvesting.

Preliminary results indicate that (1) canopy cover estimates are an important seedcotton yield component; (2) NDVI and canopy temperature can help fine tune selection of elite genotypes or the performance of experimental treatments; (3) growth analysis of plant height and canopy cover development appears to be a promising diagnostic tool, and (4) open boll analysis can be an important variable to facilitate cultivar selection and/or the effects of experimental treatments.