Characterization of maize responses to differential nitrogen rates using image-based phenotyping

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Plant Scientists are striving to improve crop response to abiotic stress under adverse environmental conditions. Many bio-physical , biochemical, and physiological traits are difficult to quantify due to the low throughput and destructive nature for their measurements. This study aims to characterize biophysical and physiological traits of maize plants using RGB and hyperspectral imaging in greenhouse condition. Single hybrid Maize genotype with four different treatment combination of water and nitrogen were tested. Plants were imaged, harvested, and measured at several growth stages range from V6 to R5 stages. Images were analyzed and correlation was established between manually measured plant traits and pixel level information extracted from the plants. RGB images are processed to determine projected plant area which are correlated with destructively measured plant shoot fresh weight, dry weight, and biomass area. Hyperspectral images are processed to extract plant leaf reflectance and correlated with leaf nitrogen/chlorophyll content. PLSR models are calibrated to estimate corn leaf nitrogen/chlorophyll content from image-generated hyperspectral data, as well as the leaf hyperspectral data from a handheld ASD spectrometer and their performance will be compared. Biological science, computer vision, mathematics and engineering can be integrated as a holistic approach for quantifying the overall growth, development, and response of maize plants under differential nitrogen rates.

Keywords: High throughput Phenotyping, Breeding, RGB, Hyperspectral, Computer vision, Nitrogen, Crop improvement