High-Throughput Phenotyping Enables Indirect Selection for Leaf Spot and Groundnut Rosette Disease Resistance in Peanut Breeding Program In Uganda

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Late leaf spot (LLS) caused by *Cercosporidium personatum* (Berk. & Curt.) and groundnut rosette disease (GRD) (genus *Umbravirus;* family *Tombusviridae*) present the most important biotic constraints to groundnut production in Uganda. Acquisition of high-quality phenotypic data is important for effective selection for resistance for LLS and GRD in groundnut breeding. The application of traditional phenotyping methods like visual scores and manual counts for assessing the incidence and severity of disease symptoms is resource-intensive and subjective. Remote sensing methods for high-throughput phenotyping are readily available for the identification of stress symptoms in plants but have not been tested for effective deployment for LLS and GRD resistance selection in groundnut breeding. In this study, we evaluated whether high-throughput phenotyping (HTP) can replace visual assessments of LLS and GRD disease symptoms. HTP involves the use of advanced technologies for fast and accurate collection and extraction of phenotypic data by automation. A field experiment of 50 genotypes was planted under rain-fed conditions across two breeding locations; NaSARRI, Serere, and Nakabango, Jinja; both locations are LLS and GRD hotspots. Data was collected using both visual assessment and HTP sensors; red-green-blue (RGB) camera for the images, GreenSeeker for normalized difference vegetation index (NDVI), and FLIR thermal camera for canopy temperature (CT). Results from the Pearson correlation analysis indicated that NDVI (r = -0.88), Greener area (GGA) (r = -0.75), and Green area (GA) (r = -0.7) were negatively correlated with LLS scores. CSI (r = 0.87) and CT (r = 0.69) were positively correlated with the LLS scores. NDVI, GA, and GGA (r = -0.69, -0.69, -0.68, respectively) were negatively correlated with GRD percentage disease index (PDI), and a*, u*, CT, and CSI (r = 0.7, 0.7, 0.65, 0.6 respectively) were positively correlated with GRD PDI. Our findings indicated that HTP indices are highly correlated with LLS and GRD visual scores and can be applied for indirect selection for GRD and LLS resistance in groundnut breeding. Further studies will aim at the development of prediction models using the HTP indices to be applied for routine selection in the peanut breeding program in Uganda.