## Delineation of the Relationship between RGB-based Indices and Conventional Scores for Early and Late Leaf Spot Diseases in Peanut Lines

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The use of photogrammetry as a field-based high throughput plant phenotyping (HTPP) technique offers a non-invasive approach for simultaneously collecting many data points per observation, and on several genotypes within a short period. In Ghana, we have successfully applied RGB-based HTPP on a population of short duration peanut genotypes and found consistent relationships between the variable atmospheric resistance index (VARI), and normalized green red difference index (NGRDI) and the area under disease progress curve (AUDPC) for early leaf spot (ELS) and late leaf spot (LLS) diseases. However, the direction of the relationship between canopy cover (CaC) estimated using photogrammetry and the AUDPC for ELS, and LLS was not consistent. The relationship was positive at early stages and negative at latter stages. It has therefore become important to understand the dynamics of the relationship between photogrammetry indices and the AUDPC for ELS and LLS. This would assist in determining the ideal time to apply these tools when phenotyping for tolerance to leaf spot diseases. In this study, we used photogrammetry techniques to monitor peanut performance from the beginning flowering (R1) to beginning maturity (R7). The number of indices used to assess plant performance were increased from three to six and include NGRDI, VARI, canopy cover (CaC), green area (GA), greener area (GGA) and crop senescence index (CSI). ELS and LLS severity were manually recorded at beginning seed (R5) and R7. The disease severity scores were respectively converted into AUDPC which is a quantitative summary of the scores recorded at R5 and R7. Relationships were established between the photogrammetry indices estimated at the various stages and the AUDPC for ELS and LLS. Results showed that the relationship between photogrammetry-derived vegetation indices and AUDPC for ELS, and LLS depended on the time of disease onset, the level of tolerance among the genotypes, and the physiological traits the indices were associated with. In 2020, when the disease was observed to have set in late, at the beginning seed stage (R5), NGRDI and VARI derived at beginning pod (R3) had a positive relationship with the AUDPC for ELS, and LLS. On the other hand, NGRDI and VARI derived at R5 and R7 had negative relationship with AUDPC for ELS, and LLS. In 2021, when the disease was observed to have set in early (at R3), a negative relationship was observed. We found a consistently negative relationship between NGRDI, and VARI and AUDPC for ELS, and LLS within the short duration population in both years. Canopy cover (CaC), green area (GA), and greener area (GGA) only showed negative relationships with AUDPC for ELS and LLS when the disease caused yellowing and defoliation of leaves. The rankings of some genotypes changed for NGRDI, VARI, CaC, GA, GGA and crop senescence index (CSI) when lesions caused by the infections of ELS and LLS became severe, although that did not affect groupings of genotypes when analyzed with principal component analysis. Nevertheless, genotypes that were consistently considered less disease susceptible based on the HTPP indices were also the best when ranked based on traditional observations of ELS, LLS tolerance, haulm and pod yield across locations. This proves that the indices were effective in capturing true genetic effects amid environmental contribution to phenotype.