Vegetation Indices Enable Indirect Phenotyping of Peanut Physiologic and Agronomic Characteristics.

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Identification of sources of resistance to biotic and abiotic stress is key for the development of improved cultivars, but direct phenotyping is slow. Vegetation Indices (VIs) derived from aerially-collected canopy reflectance in the red, green, and blue (RGB) and near infra-red (NIR) spectra enable indirect phenotyping. Accessions of the US mini-core peanut (*Arachis hypogaea* L.) germplasm collection were grown in RCBD replicated trials in 2017 and 2018 at the Tidewater Agricultural Research and Extension Center, in Suffolk, VA. Phenotyping included the following: stand count; plant height; lateral branch growth; normalized difference vegetation index (NDVI); canopy temperature depression (CTD); wilting; thrips damage; tomato spotted wilt virus (TSWV) (caused by *tomato spotted wilt virus*, genus *Tospovirus*; family *Bunyaviridae*); southern stem rot (SSR, caused by *Athelia rolfsii* (Curzi) C.C. Tu & Kimbr.), Sclerotinia blight (caused by *Sclerotinia minor* Jagger), Cylindrocladium black rot (CBR, caused by *Calonectria ilicicola* Boedijn & Reitsma); post digging in-shell sprouting, and yield. These characteristics were evaluated at 4, 5, 6, 7, 9, 10, 11, 12, 14, and 16 weeks after planting (WAP). A total of 48 VIs including reflectance in red, blue, green, and NIR, RGB color space indices and combinations of them, taken by an octocopter drone at the same time with the ground measurements were correlated with the physiologic and agronomic characteristics. Correlation coefficients up to 0.8 were identified for several VIs, indicating their suitability to indirect phenotyping. Broad-sense heritability (H^2) was further calculated to assess the suitability of particular VIs to enable genetic gains. For example, the normalized difference CIELab (NDLab) and CIELuv (NDLuv) indices were significantly correlated with yield within all botanical types in the mini-core collection in 2017, i.e. N = 104; r = 0.43 to 0.57 ($p \leq 0.001$). But while H^2 for yield was 0.14, H^2 for the NDLab and NDLuv evaluated during pod development ranged from 0.43 to 0.54, showing that the vegetation indices could be used successfully as surrogates for the physiological and agronomic trait section in peanut.