As above, so below? Quantification of naturally occurring maize diseases using ground-based visual assessments and UAS-based high-throughput phenotyping

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Abstract

Ground-based visual assessments of co-occurring foliar diseases are time-consuming, laborious, and subjective due to the spatiotemporal overlapping of different lesion types and patterns. We took advantage of this scenario to explore the feasibility of unmanned aircraft systems (UAS)-derived multispectral vegetation indices to measure the variable incidence and severity of a mix of diseases. We rated separately the disease severity (as percent DLA or AUDPC) of artificially inoculated northern leaf blight (NLBart) along with naturally occurring northern leaf spot (NLSnat) and anthracnose leaf blight (ALBnat) in near-isogenic inbred (NILinbreds) and single-cross hybrid (NILhybrids) lines in Aurora, NY in 2018 ad 2019. NLBart and ALBnat were also scored in a contiguous field with a population of maize hybrids with broad genetic base. Total disease severity (tDSground) was estimated from the sum of the scored diseases. Disease severity and grain yield (GYground) were recorded from replicated 2-row plots. Two or three asynchronous UAS flights (no overlapping with ground-based visual estimates of each disease severity) were conducted in each crop season and plot-level vegetation indices (VIsair) were extracted from UAS-derived orthomosaics. Goodness of fit (R^2) between VIsair and tDSground were low (0-0.3) in the three germplasm groups. R^2 values between GYground and VIsair were higher (0.2-0.8) than those between GYground and tDSground (0.1-0.4). Our preliminary results highlight the challenges of dealing with a realistic field situation where the uncertain dynamics of a mix of pathogens and the contrasting perspectives (air vs. ground) involved in the disease screening add complexity that needs to be studied.

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