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

Moreta, Danilo E.*, Blahut, N., Kolkman, Judith M., Kaczmar, N., Gore, M., and Nelson, R.
Field of Plant Breeding & Genetics, School of Integrative Plant Science, Cornell University

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 (NLB_{art}) along with naturally occurring northern leaf spot (NLS_{nat}) and anthracnose leaf blight (ALB_{nat}) in near-isogenic inbred ($NIL_{inbreds}$) and single-cross hybrid ($NIL_{hybrids}$) lines in Aurora, NY in 2018 ad 2019. NLB_{art} and ALB_{nat} were also scored in a contiguous field with a population of maize hybrids with broad genetic base. Total disease severity (tDS_{ground}) was estimated from the sum of the scored diseases. Disease severity and grain yield (GY_{ground}) 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 (VIs_{air}) were extracted from UAS-derived orthomosaics. Goodness of fit (R^2) between VIs_{air} and tDS_{ground} were low (0-0.3) in the three germplasm groups. R^2 values between GY_{ground} and VIs_{air} were higher (0.2-0.8) than those between GY_{ground} and tDS_{ground} (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.