Science Societies

Novel Approach to Large- Scale Crop Modeling

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An unmanned aerial vehicle flies over a maize field in Aurora, NY, part of an experiment conducted through the Genomes-to-Fields Initiative. Photo by Nicholas Morales.

The ability to model crop growth at scale has the potential to improve understanding of plant–environment interactions and identify breeding targets for climate resilience. Phenotypes extracted from multispectral images (MSIs) present a high-throughput method for collecting plant growth and development data throughout the growing season, enabling routine evaluations of genetic factors affecting growth and plant–environment interactions. Previous studies have used multi-trait mixed models to account for correlations between phenotypes collected throughout the growing season; however, these models often fail when phenotypes are collected at many time points.

A team from Cornell University examined the use of random regressions for modeling crop growth, which easily scale to high-dimensional temporal datasets. They applied random regression models using Legendre polynomials and linear splines to vegetative indices (VI) computed from MSI collected on maize from the Genomes-to-Fields Initiative. The researchers found that Legendre polynomials fit using normalized difference vegetation index (NDVI) and that cumulative NDVI provide the best fit with growth curve parameters showing high genetic correlations with grain yield.

These modeling approaches will enable large-scale growth modeling in plant-breeding programs and provide a foundation for more dynamic modeling of plant–environment interactions in future studies.

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