Mid-Season High-Resolution Satellite Imagery for Forecasting Site-Specific Corn Yield

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Abstract: A timely and accurate crop yield forecast is crucial to make better decisions on crop management, marketing, and storage by assessing ahead and implementing based on expected crop performance. The objective of this study was to investigate the potential of high-resolution satellite imagery data collected at mid-growing season for identification of within-field variability and to forecast corn yield at different sites within a field. A test was conducted on yield monitor data and RapidEye satellite imagery obtained for 22 cornfields located in five different counties (Clay, Dickinson, Rice, Saline, and Washington) of Kansas (total of 457 ha). Three basic tests were conducted on the data: (1) spatial dependence on each of the yield and vegetation indices (VIs) using Moran's I test; (2) model selection for the relationship between imagery data and actual yield using ordinary least square regression (OLS) and spatial econometric (SPL) models; and (3) model validation for yield forecasting purposes. Spatial autocorrelation analysis (Moran's I test) for both yield and VIs (red edge NDVI = NDVIre, normalized difference vegetation index = NDVIr, SRre = red-edge simple ratio, near infrared = NIR and green-NDVI = NDVIG) was tested positive and statistically significant for most of the fields ($p < 0.05$), except for one. Inclusion of spatial adjustment to model improved the model fit on most fields as compared to OLS models, with the spatial adjustment coefficient significant for half of the fields studied. When selected models were used for prediction to validate dataset, a striking similarity (RMSE = 0.02) was obtained between predicted and observed yield within a field. Yield maps could assist implementing more effective site-specific management tools and could be utilized as a proxy of yield monitor data. In summary, high-resolution satellite imagery data can be reasonably used to forecast yield via utilization of models that include spatial adjustment to inform precision agricultural management decisions.

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