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Active remote sensing and grain yield in irrigated maize

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Abstract

Advances in agricultural technology have led to the development of active remote sensing equipment that potentially optimize N fertilizer inputs. The objective of this study was to evaluate a hand-held active remote sensing instrument to estimate yield potential in irrigated maize. This study was done over two consecutive years

on two irrigated maize fields in eastern Colorado. At the six- to eight-leaf crop growth stage, the GreenSeeker™ active remote sensing unit was used to measure red and NIR reflectance of the crop canopy. Soil samples were taken before side-dressing from the plots at the time of sensing to determine nitrate concentration. Normalized difference vegetation index (NDVI) was calculated from the reflectance data and then divided by the number of days from planting to sensing, where growing degrees were greater than zero. An NDVI-ratio was calculated as the ratio of the reflectance of an area of interest to that of an N-rich portion of the field. Regression analysis was used to model grain yield. Grain yields ranged from 5 to 24 Mg ha^{-1}. The coefficient of determination ranged from 0.10 to 0.76. The data for both fields in year 1 were modeled and cross-validated using data from both fields for year 2. The coefficient of determination of the best fitting model for year 1 was 0.54. The NDVI-ratio had a significant relationship with observed grain yield ($r^2 = 0.65$). This study shows that the GreenSeeker™ active sensor has the potential to estimate grain yield in irrigated maize; however, improvements need to be made.

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Fig. 1

Fig. 2

Fig. 2 caption equations shown in plot:
$$Yield = -1.49 + 1598\ (INSEY)$$
$$MSE = 3.004$$
$$R^2 = 0.58$$
$$p < 0.001$$

△ Site-year I
○ Site-year II
▲ Site-year III
● Site-year IV

In-Season Estimated Yield (INSEY)

Observed Grain Yield (Mg ha^{-1})

Fig. 3

Plot showing Observed Grain Yield ($Mg\ ha^{-1}$) versus NDVI Ratio with fitted curve: $Y = -1.1 + 5.74(\text{NDVI Index}) - 2.83(\text{NDVI Index})^2$, $R^2 = 0.65$, $p < 0.05$. Legend: Site-Year I, Site-Year II, Site-Year III, Site-Year IV.
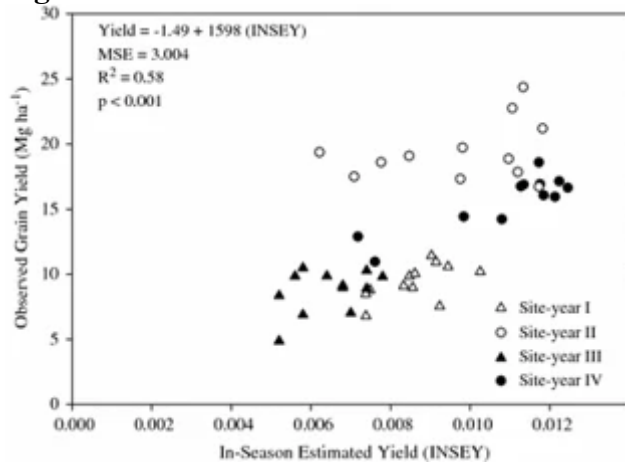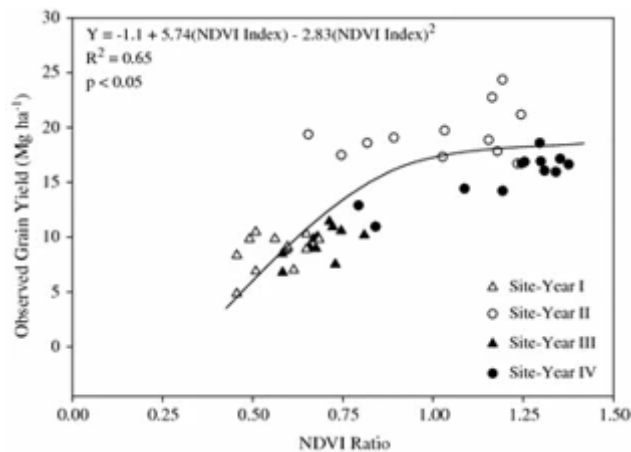
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