COMPARISON OF DIFFERENT SCOUTING TECHNIQUES TO MONITOR THE EMERGENCE AND INTENSITY OF YIELD-LIMITING STRESS IN SOYBEANS

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ARKANSAS SOYBEAN PROMOTION BOARD

Introduction

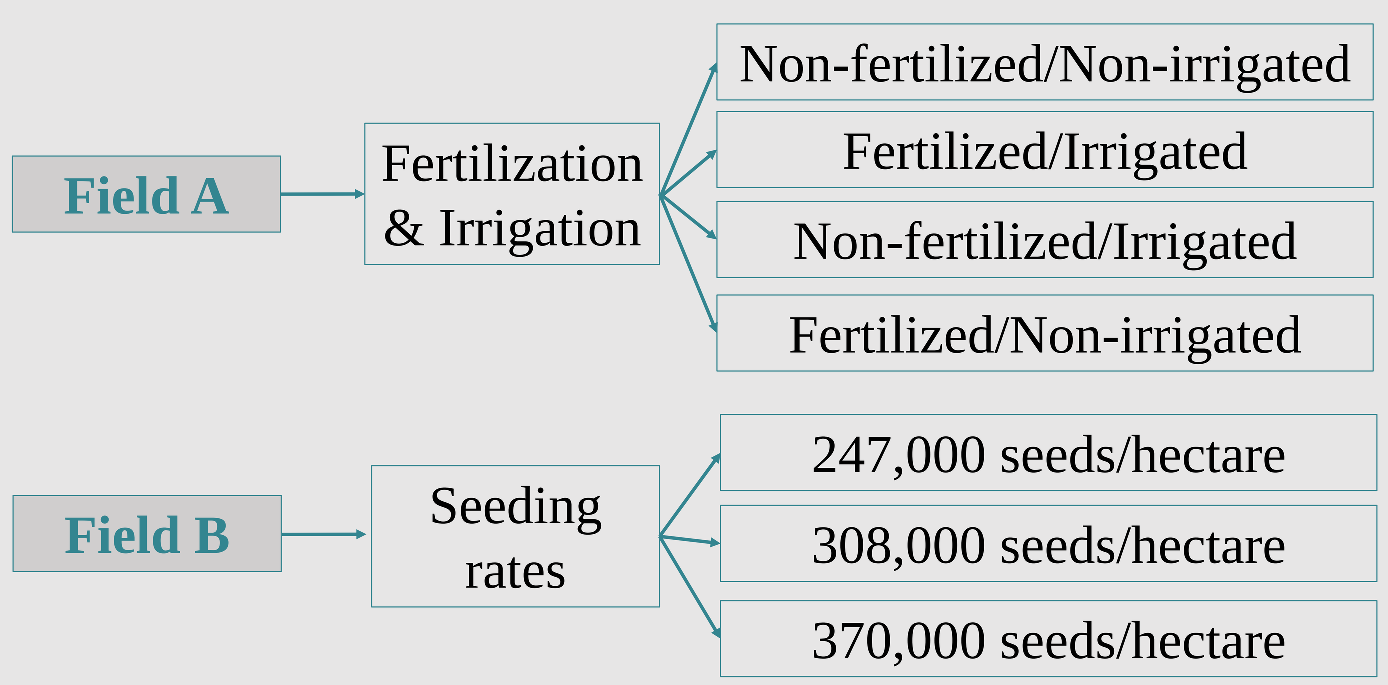
- Scouting with precision technologies has become a critical component of optimized crop management
- In-field changes in crop development and physiology can be monitored using proximal and remote sensing methods
- What are the preferred data collection methods and timing to identify yield limiting stress in production soybean?

Objective

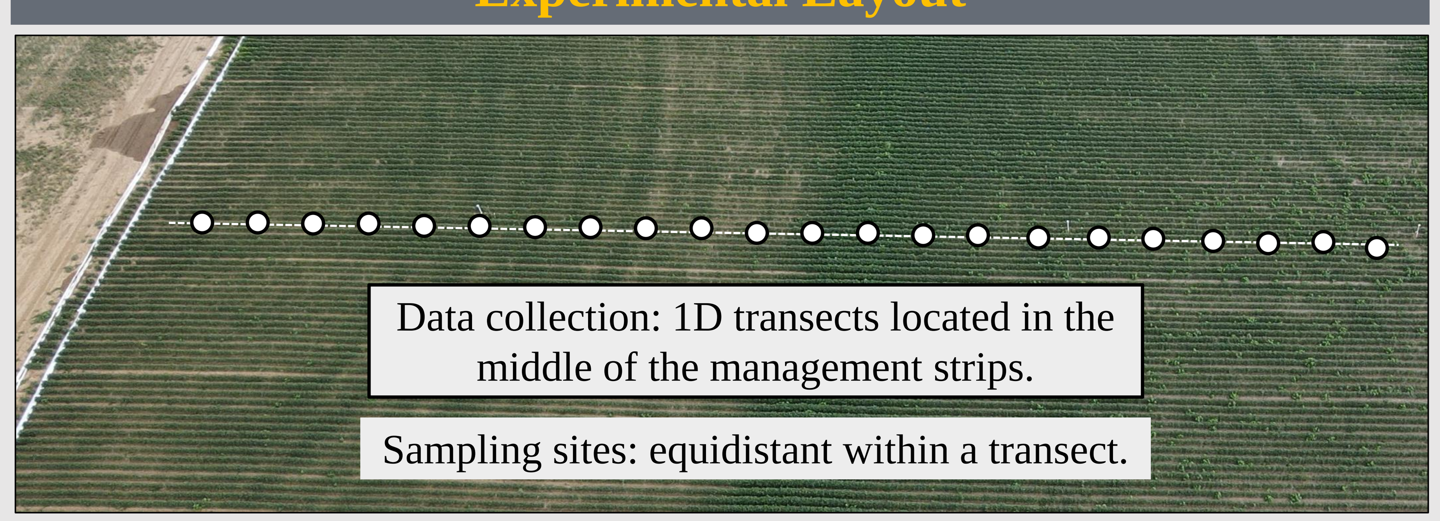
Assess the performance of remote and proximal sensing-based scouting method in two Arkansas production systems.

Experimental Setup

Management Strategies



Experimental Layout



Dataset

- Yield data
- Four vegetative indices (NDVI, GNDVI, NDRE, SAVI) computed from Sentinel-2 satellite imagery (10 x 10 m, 5 days)
- Stomatal conductance & chlorophyll fluorescence (average of three measurements)
- Dates converted into Growing Degree Days (GDD)
- No spatial dependencies obtained along the transects

Data Analysis

Data Analysis Steps

- Linear regression analysis was computed to predict yield from parameter values, and residual analysis was performed to compare the predicted yield to the observed yield.
- Model goodness of fit was quantified using adjusted R^2. Prediction accuracy was evaluated with the estimated slope and percentage of predicted yield values that fell within +/- 15% of the yield (PP15).
- Separate models were fitted by parameter, transect, date.
- Only results from models with significant correlations between response and explanatory variable (P=0.10) were provided in tables 1 & 2.

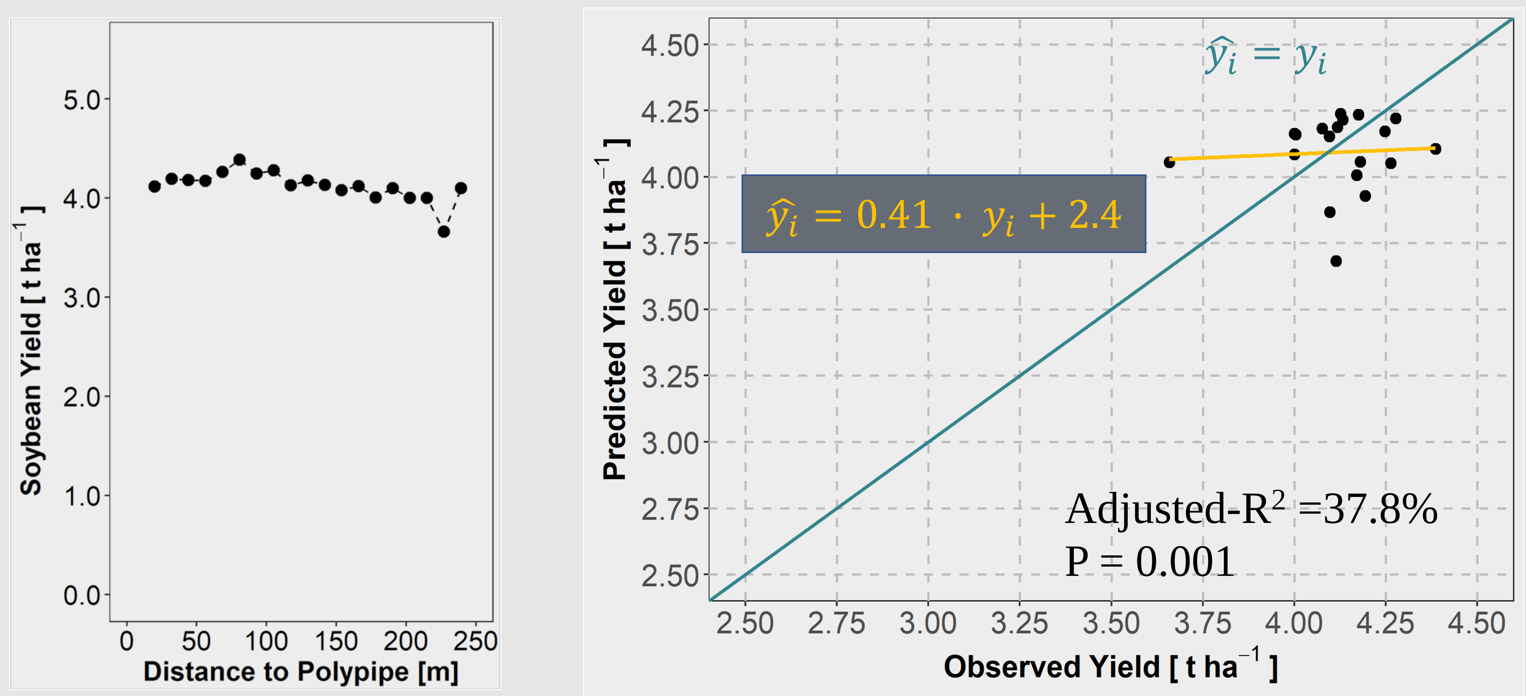


Figure 1. Yield along transect and linear regression of yield predicted from GNDVI for GDD = 1990 for transect B - 308K.

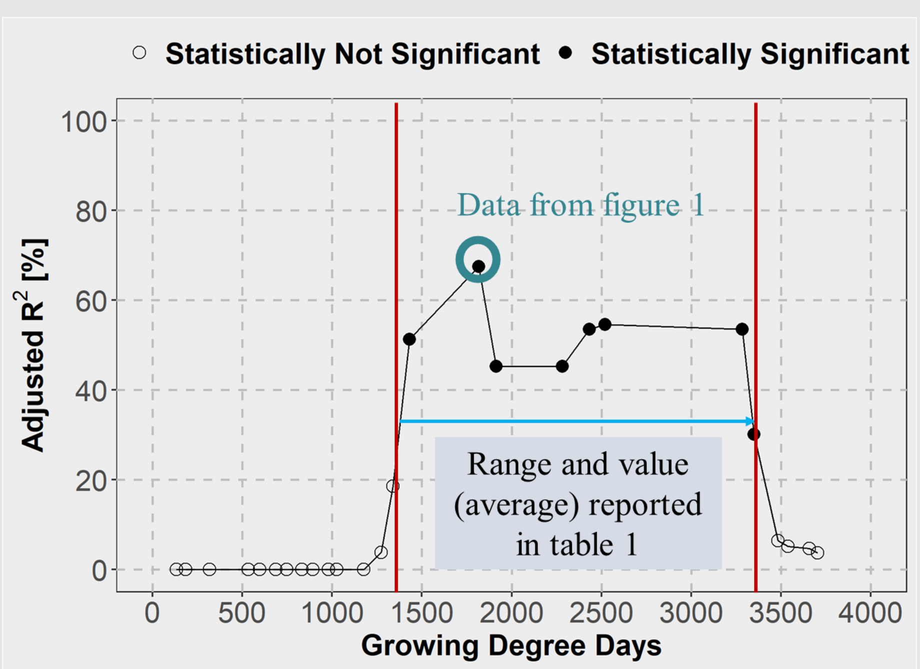


Figure 2. Adjusted R^2 values as a function of GDD for GNDVI for transect B – 308K. The greater the Adjusted R^2 values, the better the goodness of fit. Results showed that GNDVI was a better predictor of yield in B – 308K from 1450 to 3350 GDD (as reported in summary).

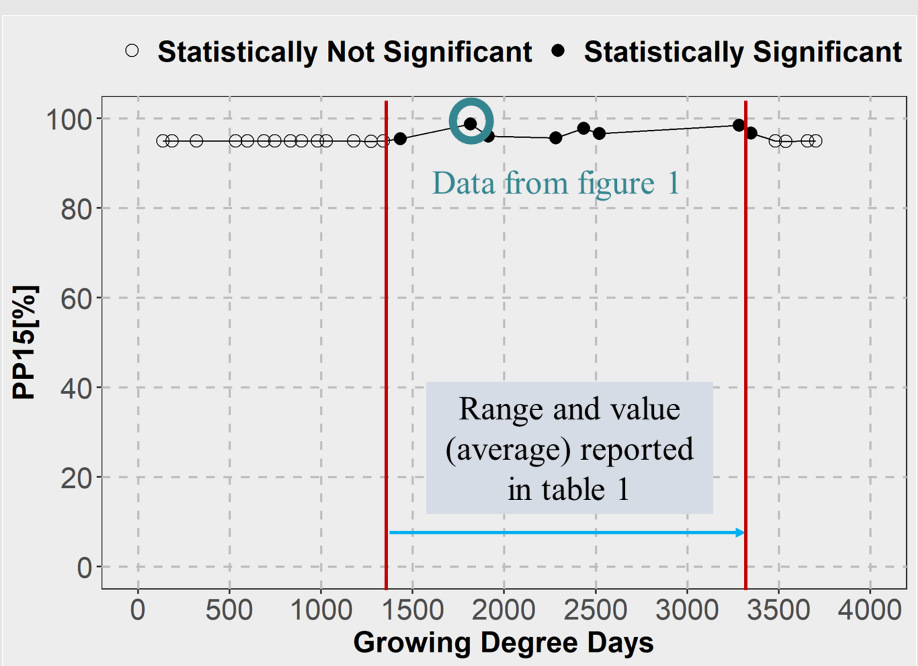


Figure 3. Percentage of predicted yield values that fall within +/- 15% of the observed yield (PP15) as a function of GDD for transect B – 308K. The greater the PP15 value, the most accurate the prediction. PP15 values are elevated even when the model is not providing the best fit because of small yield variability.

Summary of Results and Key Findings

Table 1. Performance of the vegetative indices with significant correlations observed. Optimum GDD is the period when indices performed better. The GNDVI performed better than the other. In several transects, no indices were found to correlate with yield.

Index	Transect	Optimum GDD	Adj. R^2 (%)	Slope	PP15(%)
NDVI	A- NF/NI	1500 to 3650 (harvest)	82.9	0.84	64.6
	B- 308K	1450 to 3300	46.8	0.50	98.6
	B-247K	1800 to 3350	31.1	0.35	87.1
	B-370K	1800 to 3700 (harvest)	22.3	0.26	90.0
NDRE	B-308K	1800 to 2500	40.1	0.43	97.5
	B-247K	1800 to 2500	24.2	0.28	84.8
	B-370K	1450 to 3700 (harvest)	19.4	0.24	88.9
GNDVI	A- NF/NI	1150 to 3650 (harvest)	76.6	0.78	50.0
	B- 308K	1450 to 3350	52.4	0.55	96.6
	B-247K	1800 to 3350	31.7	0.35	89.8
	B-370K	1800 to 3350	27.1	0.31	89.8
SAVI	A-F/NI	2950 to 3650 (harvest)	50.9	0.55	40.4
	A-NF/NI	3050 to 3650 (harvest)	83.9	0.85	69.3
	B- 308K	1450 to 3300	46.8	0.50	98.6
	B-247K	1800 to 3350	31.2	0.35	87.1
	B-370K	1450 to 3700 (harvest)	19.4	0.24	88.9

Table 2. Performance of the stomatal conductance and chlorophyll fluorescence (expressed as yield of Photosystem II) measured using a proximal sensor. Optimum GDD is the period when indices performed better. The two indices did not provide a satisfactory estimation of soybean yield along any of the transects.

Index	Transect	GDD	Adj. R^2 (%)	Slope	PP15(%)
Stomatal conductance	A-NF/NI	1400	30.0	0.34	23.5
		1800	32.7	0.37	35.3
	A-NF/I	1850	26.0	0.13	93.3
Yield of PSII	A-NF/I	1850	22.6	0.28	93.3
	B-247K	1600	14.6	0.19	89.5
	B-370K	2150	32.0	0.36	90.0

Future works

- Fields with more in-field spatial variability need to be assessed for better comparison of the scouting methods.
- Satellite images with finer resolution and different proximal sensing parameters will also be considered.
- Other treatments will be tested to represent a variety of management practices representative of Arkansas crop production systems.

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