Project SENSE*: Demonstrating and Encouraging Sensor Based Nitrogen Management

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Introduction

- There is evidence in Nebraska of a plateau in gains in nitrogen use efficiency (NUE) in corn production. (Ferguson, 2015)
- Applying nitrogen (N) fertilizer before or early in the growing season exposes N to losses due to little to no crop N demand.
- Determining efficient rates prior to the growing season may result in excessive N rates.
- Crop canopy sensors, used to direct in season applications, may help in increasing NUE while maintaining yields. (Samborski, 2009)
- Active crop canopy sensors work by emitting a light and use filters to read the reflectance in visible and near infrared wavelengths. These wavelengths are used to calculate a vegetation index this calculated index is compared to a reference index and used to calculate a nitrogen rate by use of an algorithm specific to which index was calculated.
- Project SENSE is a component of the Nebraska On-Farm Research Network to encourage adoption of in-season N application, particularly with sensor-based management

Research Objectives

1. Compare N rates and yields obtained by using producer management to crop canopy sensor-based management.
2. Compare NUE from producer N management strategies to NUE from crop canopy sensor-based N management.
3. Increase awareness of crop canopy sensors as a technology for directing N fertilization and encourage adoption of this technology.

Methods

Treatments:

- **Sensor management (SENSE):** Producers applied 84 kg N ha^{-1} near the time of planting. Ag leader® OptRx® sensors mounted on a high clearance applicator (Figure 1) were used to direct a one time application of N fertilizer between V8 and V12 growth stages.
- **Producer management:** N fertilizer was applied using the respective producer's selected rate and timing.

Treatments were applied in a randomized complete block design with six replications. Harvest data was collected by the farmers' yield monitor in their combine. Yield data was cleaned and adjusted to 0.155 kg kg^{-1} moisture content using Yield Editor (v 2.0.7). As applied N rate was recorded for SENSE treatments; N rates for grower treatments were reported by the cooperator. Yield and N application points were averaged for each treatment strip. Data was analyzed and summarized using ArcGIS 10.3.1, and Proc GLIMMIX (SAS 9.4). Means were separated using Fisher's LSD.

Figure 1: High clearance applicator with crop canopy sensors and drop nozzles used to apply the SENSE treatments.

Results and Discussion

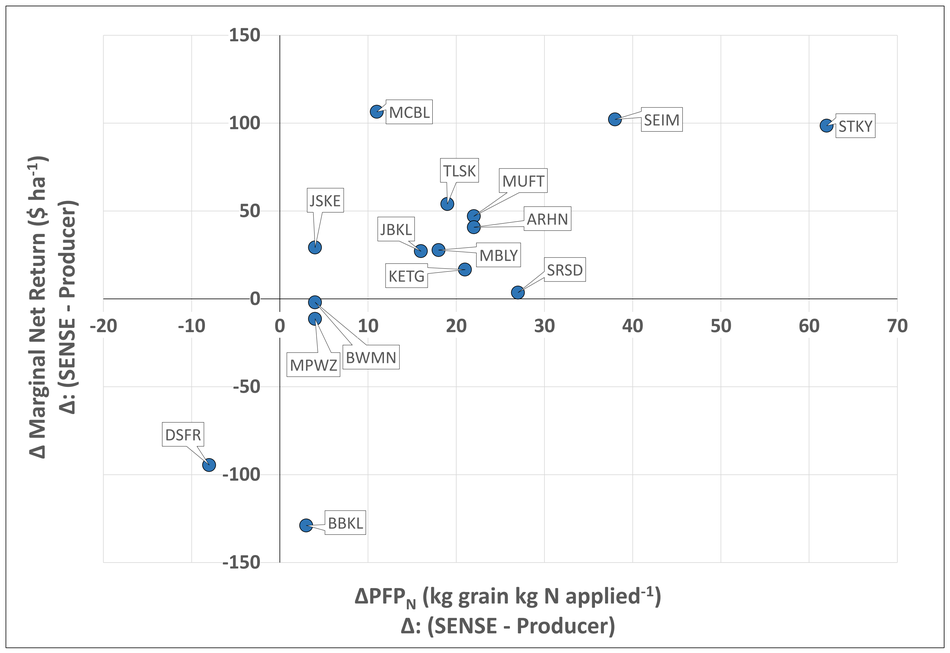
- SENSE treatments yielded less, had less applied N, while increasing NUE and marginal net return across all sites (Table 1).
- 11 of 15 sites were more profitable and increased NUE for SENSE treatment (best case) (Figure 2).
- 1 site was less profitable and decreased NUE (worst case) (Figure 2).
- SENSE treatments received less applied N for each site (Figure 3).

2015 Results	Producer	SENSE
Yield (Mg ha^{-1})	14.3 a	14.0 b
N Rate (kg N ha^{-1})	219 a	174 b
PFP$_N$ (kg grain kg N ha^{-1})	58.0 b	71.4 a
Marginal Net Return ($ ha^{-1})*	1733.45	1759.01

Table 1 (above): Comparison of yield, N rate, PFP$_N$, and marginal net return across all sites. Letters that are different indicate significant differences using Fischer's LSD with an alpha = 0.05.

*Grain price of $14.4 Mg^{-1} and $1.43 kg N^{-1} were used to calculate marginal net return.

Figure 2 (right): Compares the relative difference in financial return (marginal net return) vs. nitrogen use efficiency (PFP$_N$). Where delta equals the producer treatment subtracted from the SENSE treatment (i.e. SENSE - Producer). Labels refer to each site.



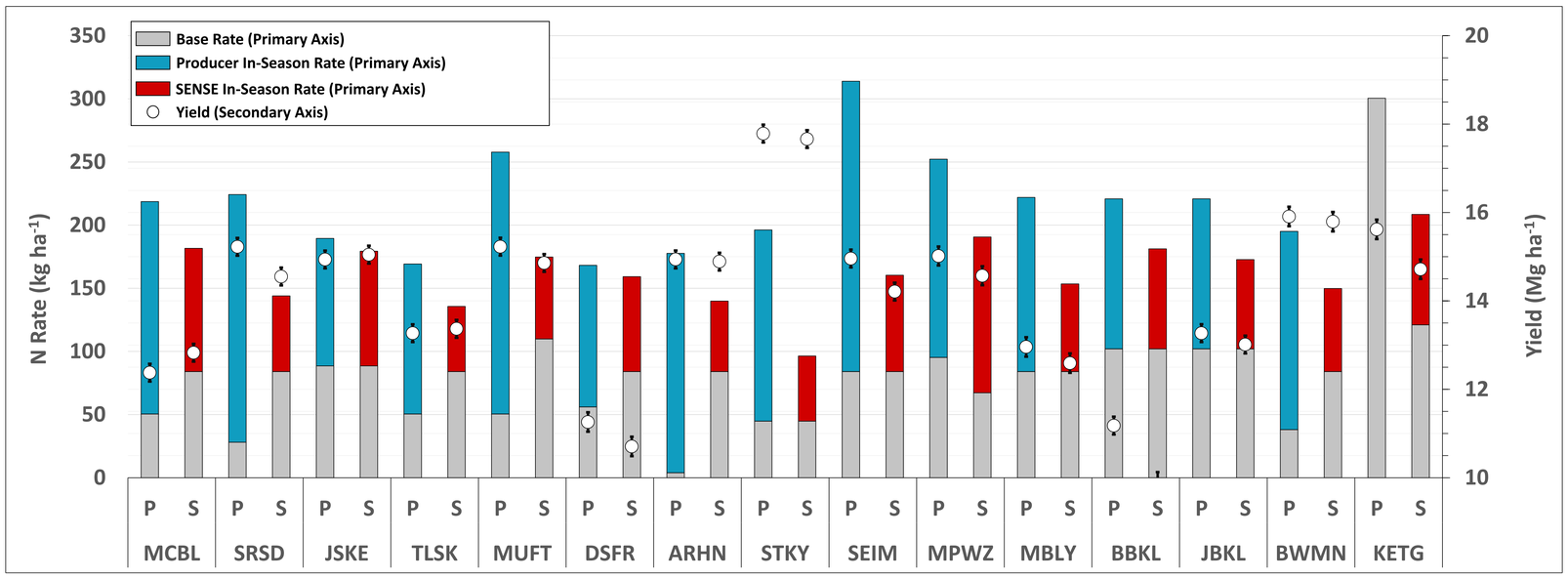


Figure 3: Individual yield and applied N rate for each site by treatment where P is producer management and S is SENSE management. Nitrogen application rate using the primary axis is broken into applied base rates (near time of planting) represented by gray shaded bars, and the in-season application rate represented by the red or blue shaded bars. Yield for each site is represented along with standard error bars for comparison using the secondary axis.

Conclusions

- Sensor based N applications reduce N rates overall compared to producer practices in 2015.
- Canopy sensor-based application increased PFP$_N$ compared to producers' management in 2015.
- At 4 sites in 2015 producer management was more profitable than sensor-based management. More detailed research is underway to explore ways to improve the accuracy of sensor on crop canopy sensor applications.

References

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Acknowledgements

This project's funding is from the Nebraska Corn Board, USDA-NIFA, Upper Big Blue, Central Platte, Lower Loup, Lower Platte North, and the Little Blue Natural Resources Districts

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