Trial Type: Manure
Growing Season: 2023-2025

Project Objective: Evaluate the feasibility, agronomic benefits and calibration of variable rate applying liquid swine manure based on real-time NIR constituent analysis from the Manure Sense system.

Project Insights:

1. Improved nutrient models and hands-on-experience improved results.
2. Changes in manure application rates between the two systems were small.
3. Only one site showed a significant yield difference.
4. Tracking manure nutrient placement could improve variable rate applications.

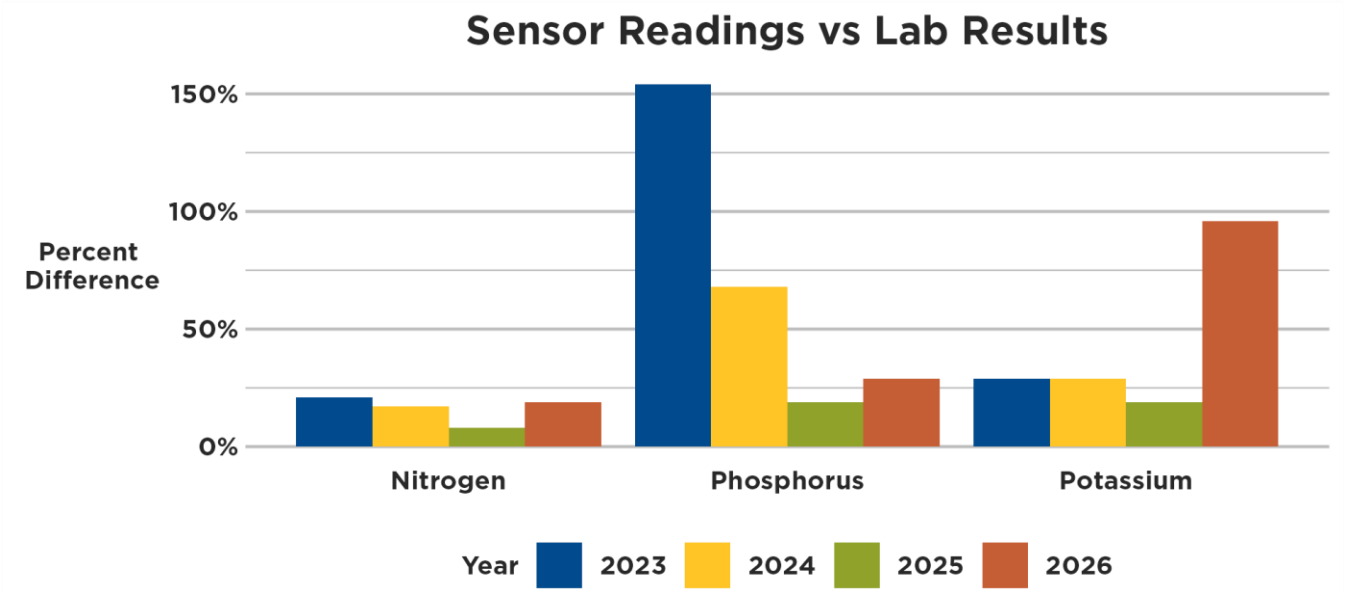

Figure 1. Yearly changes in accuracy for Nitrogen, Phosphorus and Potassium in manure calculated from lab results and monitor reading at time of sample collection.

Project Discussion

Over the past 3 years, Iowa Soybean Association (ISA) Research Center for Farming Innovation (RCFI) and Iowa State University (ISU) have worked with farmers and custom applicators to evaluate the consistency and accuracy of John Deere's HarvestLab 3000 Manure Constituent Sensing technology. This technology uses Near Infrared Reflectance (NIR) to calculate total and ammonium nitrogen, phosphorus, potassium, and dry matter content of the manure as it is being applied across the field. Using these real-time readings, the sensor can be used with the rate controller to control flow based on target N rate, while limiting P. Given how much nutrient variability can be seen in manure, the system offers a way to achieve a better accounting of nutrient distribution across the field.

Across the 3 years of testing, manure samples were collected during application directly from the applicator with monitor readings recorded to compare lab analysis with sensor readings to determine accuracy (Figure 1). In total, 118 samples were collected from 16 locations and analyzed.

When looking at N, P, and K sensing values in comparison to the lab tested samples, the system appeared to become more effective at sensing the correct nutrient content during the first 3 years of the project. Accuracy for N, P, and K improved to within 9, 11, and 16 lbs per acre, respectively. Updated models during this time and more hands-on experience using the equipment may have aided in these positive changes but then readings jumped for the 2026 samples. In discussing what may have occurred, issues with equipment and potentially using outdated models may have negatively impacted the accuracy during the Fall 2025 application.

Yield was also collected in 2023, 2024 and 2025 to compare the straight gallon per acre rate to the sensor-controlled rate based on nitrogen lbs/acre target (Fig 2). While yield is an important component to farmers' bottom line, for this work it is a small piece that should remain unaffected by the system used unless rates are dramatically changed. Across 9 site locations over the three years, only one site had a significant yield response between the Farmer Standard manure rate and ManureSense Controlled rate. At this site, the farmer's standard rate was 3950 gal/acre which was reading 185 lbs N/acre with the sensor. The farmer then set the controller to apply 200 lbs N/acre which averaged 4250 gal/acre. This was a relatively small change but resulted in a +6.2 bu/acre response. This site also represented one of the largest changes made with regard to nitrogen content between the two treatments. For most of the sites that yield was collected on, the change in nitrogen content between the farmer's standard rate and ManureSense controlled rate was less than 10%.

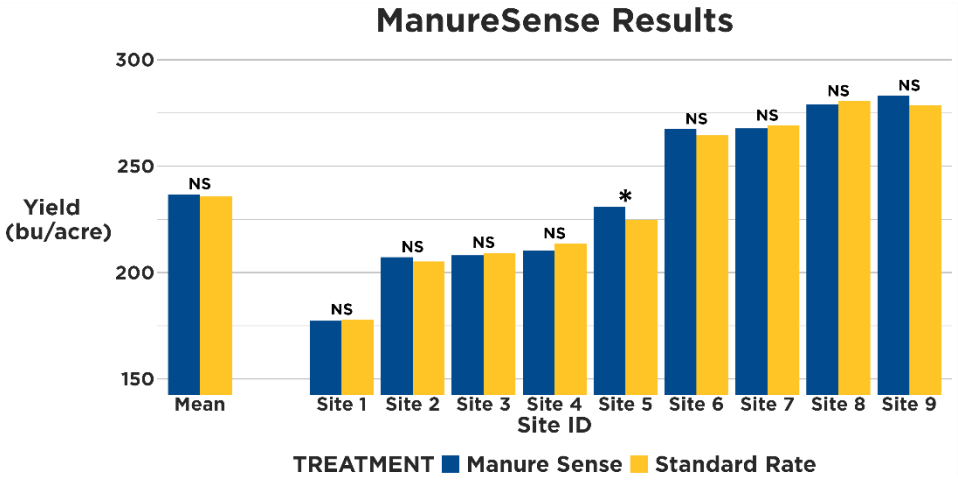

*Figure 2. Yield results for all sites from 2023-2025 comparing Manure Sense and Standard Rate manure application. Significant difference in yield represented by *, while results that are not significant are represented by NS.*

While the project has now concluded, this technology offers additional work that could be done to advance nitrogen and nutrient stewardship. Utilizing the as-applied maps, farmers could find use for in-season variable rate applications. This technology could offer additional benefits to variable rate nutrient applications, having a better idea of where the manure nutrients are being applied and where additional nutrient needs may be in the field.