

## Improving Nitrogen Use Efficiency in Sustainable Corn Production Through Use of Remote Sensors to Direct Site-Specific Nitrogen Application

**Project Titles:** Improving Nitrogen Use Efficiency in Sustainable Corn Production Through Use of Remote Sensors to Direct Site-specific Nitrogen Application

**Coordinators:** Dean Stevens

**Location:** Falls City, Nebraska

**SARE Grants:** \$15,000

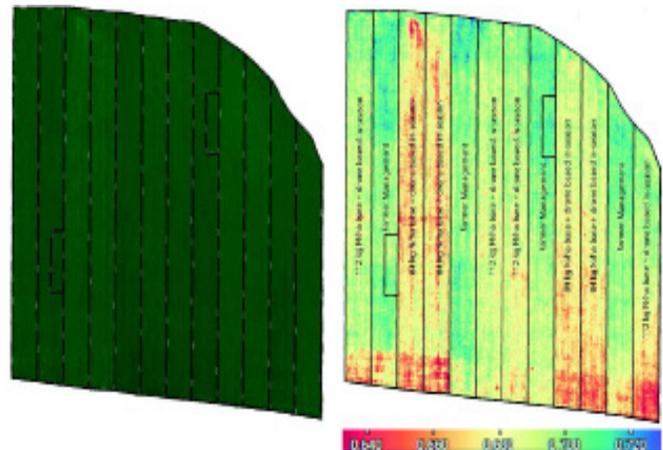
**Duration:** 2017-2019

To read the full project reports, go to <https://projects.sare.org/> and search for project number FNC17-1100.

From shooting photos from small planes, to using a powered parachute with the help of a sport pilot license, Dean Stevens has been taking to the sky to catch a glimpse of his family's southeast Nebraska farm fields for the better part of 30 years. With recent support from a \$15,000 NCR-SARE Farmer Rancher grant, he's taking aerial observation to the next level, using multi-spectral sensors carried on drones to inform his nitrogen (N) management.

Stevens says there are advantages associated with in-season N applications, but due to the rolling topography in their location, where contour and terrace farming techniques are practiced, ground-based, in-season N application is not common due to the risk of crop damage. Some farmers in the area do aerial N applications, but they aren't able to take advantage of the crop canopy sensor technology that is commonly available for high clearance applicators. Stevens wanted to be able to apply N fertilizer aerially during the growing season and then be able to monitor the crop with sensors.

Working with his daughter, a University of Nebraska-Lincoln Extension Educator, Laura Thompson, his son-in-law Nathan Thompson (both of whom are FAA licensed drone pilots), and Dale Yoesel, a farmer in Rulo, Nebraska, Stevens put



These two images depict the same field in June 2017. The true color image (left) and the NDRE (normalized difference red edge index) (right) show differences that are hard to see with the naked eye. Blue indicates a higher NDRE value while red indicates a lower NDRE value.

together a project. They would conduct airplane-based aerial N applications, and then evaluate the fields with sensors mounted on drones to enable crop sensing to occur from the air.

The sensors they used collected Normalized Difference Red Edge (NDRE) values from three sites before and after in-season N application. Among other things, NDRE technology shows users the chlorophyll content in leaves. High values of NDRE represent high levels of leaf chlorophyll content, so, for instance, yellowed leaves would have the lowest

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values (red), while healthy plants have the highest values (blue). In conjunction with the NDRE data, the team used algorithms and UNL's Hybrid-Maize models to calculate the optimal in-season N rate. They also evaluated two different N base rates to attempt to identify the optimum base rate for in-season N sensing and application. They used the data to evaluate final crop yield, N use efficiency, and net return. At all three sites, less N was applied when the drone and sensor method was used, than when the farmer's traditional method was used. With drone-based sensing, N savings were 25 lb N/ac, 35 lb N/ac, and 27 lb N/ac for the site in 2017, site 1 in 2018, and site 2 in 2018 respectively.

While yields were not different between the drone and sensor method and the farmer's traditional method, N use efficiency was greater for the drone and sensor method than the traditional method. Basically, it allowed them to target areas that needed more N.

“Drone sensors can be used successfully to monitor corn nitrogen needs in-season,” said Stevens. “The varying N requirements can be met on entire corn fields with variable rate equipped planes. This is an excellent way to avoid pre-applying more N than a corn crop would be able to utilize if conditions became unfavorable during the pending growing season.”

For more information on Steven's NCR-SARE Farmer Rancher grant project, visit the SARE project reporting website. Simply search by the project number, FNC17-1100, at <https://projects.sare.org/>, or contact the NCR-SARE office.

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