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NYFVI Project with NMSP and Industry Evaluates Sensor Technology for Nitrogen Management

By Lisa Fields

As advances are made in technology for farm producers to quickly gather crop and soil data for on-the go fertilizer decisions, research is important to the development process. In 2014, the Cornell Nutrient Management Spear Program (NMSP) led by Professor Quirine Ketterings initiated a project entitled "Greenseeker Technology for Greater Corn Yield and Enhanced Nitrogen Fertilizer Use for Corn."

The project, funded by the New York Farm Viability Institute (NYFVI) started out with two objectives. The first was to examine active sensors for in-season predictions of corn yield and N response. The second objective was to determine the best crop growth stage to use the sensors in New York. Meeting the objectives entailed on-farm N rate studies conducted in Western and Northern NY in collaboration with Agrinetix LLC, Henrietta, NY, along with Cornell Cooperative Extension educators. Active sensors were used to obtain a Normalized Difference Vegetation Index (NDVI). These sensors determine NDVI, an expression of greenness and leaf area, from the infra-red and near infra-red light reflected by the crop. The project resulted in a set of equations (algorithms) that can be used to translate NDVI into an estimate of end-of-season crop yield and N recommendations that can be applied "on-the-go."

Ketterings explained, "In 2014-2016 we used the GreenSeeker, an active sensor, to determine NDVI. An important step was to better pinpoint the crop growth stage that delivers meaningful scans that can be used to predict both yield and crop N needs. "

"In 2016, we were really fortunate to start working with Donald Specker, Field Agronomist with DuPont Pioneer," Ketterings added. Specker set up fully replicated N rate studies with four clients that year. Farm collaborators in 2016 were Lesch Farm in Fredonia, Rockefeller Farms in Phelps, East River Dairy in Cortland, and Rich Harvest Farms in Lima. The replicated field trials had five rates of N ranging from 0 to 200 lbs N/acre. Specker worked with the NMSP team on design and data collection that summer. One trial was harvested for silage, three for grain. The NMSP team also conducted trials where N was applied either at planting or as sidedress. Corn crop performance in terms of both yield and most economic rate of N (MERN) were determined for each of the trials.

"I was impressed with the results of the farm sites' GreenSeeker scans performed at V6 stage," Specker commented. "They were well aligned with the crop's yield response to additional N, and the farms I worked with are excited about the potential of the sensing tools. They fit well with precision fertilizer application equipment, and the ability to check in with the crop for in-season adjustments is a big plus."

Donald Specker, Field Agronomist with DuPont Pioneer.

Ketterings noted, "The research to date showed that V6 was the earliest time to use the GreenSeeker tool for in-season N management of corn. The NDVI readings and the predictions of yield and N need at that growth stage correlated well with actual yield and MERN results. The data so far look good, but we're continuing to evaluate the equations."

As part of the N rate trials led by Specker, recommendations generated by the EncircaSM Nitrogen software tool were evaluated. The tool was recently developed by DuPont Pioneer to aid in-season fertilizer management decisions. The EncircaSM Nitrogen service incorporates a simulation model that predicts changes in soil nitrogen in response to interactions between weather, soils, crop growth, and management.

"Encirca is working well in the Midwest as an in-season tool, and was developed for conditions there," Specker explained. "The producer inputs baseline data for each field include planting date, soil type, irrigation information, etc. Encirca's software factors in the growing season weather to date and makes adjustments based on weather. Satellite generated weather data need to come from nearby areas to get a good estimation of available soil N. Midwest soil types are more consistent over larger areas than they are in New York, and most crop acres in the Midwest don't receive manure, in contrast with New York farms. Encirca's algorithms that answer the question 'do I need to add more N or other nutrients to this field?' need to be evaluated and adjusted for New York soils, to account for nutrient inputs from manure and cover crops. I view it as in its infancy here with very good potential in the near future."

Ketterings added, "When new technologies are developed, it is really important to test their performance. This collaboration with Donald is vital. We're all learning together as we evaluate the use of models along with active and passive sensors."

The sensor evaluation project expanded in 2016 to include drones equipped with passive sensors. The objective was to examine weather impacts such as cloudiness during scans, as weather factors affect active and passive sensors differently. A Cornell Cooperative Extension student internship allowed Lindsay Chamberlain, then a rising senior in plant sciences at Cornell University, to join the NMSP. She worked with NMSP staff and Cornell Entomology Professor and drone pilot Elson Shields on evaluation of drone-generated NDVI images for predicting end-of-season crop yield and N responsiveness.

In contrast to the GreenSeeker derived NDVI, images generated by the drone gave mixed results in 2016. Factors affecting aerial photos' NDVI accuracy were cloudy conditions and sun angle during scans. In addition, the record drought of 2016 caused lower mid-day NDVI values as dry, curling leaves caused the appearance of low leaf density. This resulted in very low NDVI readings, skewing predictions of yield and crop N response. Specker said, "It was a tough growing season, but what we learned was valuable. It really illustrated the need for more field trials with increased intensity of drone flights to sort out the impact of weather effects on NDVI readings. "

A new NYFVI-funded project initiated in 2017, "Decision Agriculture: Managing Nitrogen and Yield in Corn and Forage Sorghum Utilizing Drone NDVI Imaging," allows the team to continue work on sensors through 2018.

Ketterings elaborated, "As we move forward with this project, we'll continue scans with the GreenSeeker and intensify the drone work with more frequent flights, timed with growth stage and different times of day to get a better sense of the impact of these factors on the usefulness of the results. It's exciting to work with this technology. We're learning about using sensing tools and their ability to improve N management. The weather variations from year-to-year give us real world conditions that truly put our work with these tools to the test."

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The **Nutrient Management Spear Program** (NMSP) is an applied research, teaching and extension program for field crop fertilizer and manure management on dairy and livestock farms. It is a collaboration among faculty, staff and students in the Department of Animal Science, Cornell Cooperative Extension, and PRO-DAIRY. Our vision is to assess current knowledge, identify research and educational needs, facilitate new research, technology and knowledge transfer, and aid in the on-farm implementation of strategies for field crop nutrient management including timely application of organic and inorganic nutrient sources to improve farm profitability while protecting the environment. An integrated network approach is used to address research, extension and teaching priorities in nutrient management in New York State. For more information on NMSP projects and extension/teaching activities, visit the program website (http://nmsp.cals.cornell.edu) or contact Quirine Ketterings at qmk2@cornell.edu or (607) 255-3061.