Research Taking Guesswork Out Of Fertilizer Applications

LEXINGTON, KY.

Wheat producers can look over their fields at specific times of the year and often tell from the crop's color whether or not it needs nitrogen. But it's an imprecise guess at best, dependent as it is on a number of factors including the angle of the sun and the perception of the farmer. That's why researchers in the University of Kentucky College of Agriculture are investigating a new method for determining nitrogen deficiency based on canopy reflectance.

Ole Wendroth, associate professor in the Department of Plant and Soil Sciences, is part of a team of researchers experimenting with a remote sensing platform that helps to analyze the visible and nonvisible wavelengths of light reflected off the surface of a plant. The idea is that producers can then use that information to determine the plant's need for nitrogen. It is work that not only improves the production efficiency but also is good for the environment.

"The farmer has to make the most efficient use of all the production capacities that his soil provides," Wendroth said. "So if the farmer has a good soil that has good growing properties, can store a lot of water and has good soil aeration for allowing microbial activity, the producer doesn't want to cause harm because some of the nutrients are deficient. So wheat growers really want to maximize yield and optimize nitrogen application."

Optimization of nitrogen is important for a number of reasons. Nitrogen is expensive, so over-application wastes money and erodes a producer's profit. Another reason is to avoid nitrogen losses through leaching into surface water or emission of nitrous gases into the atmosphere, which can contribute to greenhouse gases.

The high clearance remote sensing platform passes over the plants and uses both active and passive optical scanners to read reflectance off the crop at two different wavelengths. That reflectance provides a measurement that Wendroth said gives the producer the data he or she needs to determine the nitrogen need in any particular area of the field.

Typically, fertilizer recommendations are based on nitrogen response functions. A response function tells users that, with so many pounds of mineral nitrogen applied to a field in the appropriate time of the year, they can expect a yield of so many bushels an acre. According to Wendroth, those estimates assume that the response by the crop to the applied nitrogen will be uniform over an entire field crop.

"And this is a very arbitrary assumption that needs to be critically evaluated," he said. "We think, particularly since Kentucky landscapes are not flat, the soils vary with respect to their history and exposure to sunlight and the local hydrologic conditions, which allow more or less water availability for the crop. So all these tiny details cannot be considered in a typical response function."

Wendroth and the other team members, which include UK soils specialists Greg Schwab and Lloyd Murdock and crop physiologist Dennis Egli, want to keep the calculations flexible by taking into account the spatial differences in the field using quick measurements – such as canopy reflectance – that indicate how well the crop is doing.

"The local soil properties cannot be taken into account, because when it's time to fertilize, no one can take multiple soil samples down to a 3-foot depth with a hand auger or even with a machine auger, homogenize the samples, bring them to a lab, analyze them quickly and then make a recommendation. By the time the results come back, the wheat is ready for harvesting," Wendroth said. "So we need something quicker that tells the producer if the crop is suffering or whether it has enough nitrogen and we don't need to apply more. That is what we expect these sensors to tell us."

Currently, this type of agricultural technology is still very expensive, but Wendroth expects to see the prices gradually drop in the future, allowing more producers to manage their enterprises more efficiently – for the good of their business and the good of the planet.

"Farmers are more and more aware that they are managers of the environment and they carry a certain responsibility for conserving our resources, for avoiding nitrate losses into surface waters," he said. "I think we, as scientists, have full responsibility to support them with technology that helps them to get that goal accomplished." Δ