Enhanced Nitrogen Sources

Fall applications of nitrogen (N) have long been popular for their convenience, allowing producers to find a window of good weather for application and avoid the chances of having fertilizer application add further delays to planting in a wet spring.

There are conditions under which fall application of N works well. In areas of the Corn Belt where soils reliably freeze through the winter, anhydrous ammonia applied when soil temperatures remain below 50 degrees F, deep enough in the soil and in soil conditions that are neither too wet nor too dry—or too coarse or too poorly drained—can overwinter and be available for corn in the spring.

However, if soils warm in the fall or early in the spring, nitrifying bacteria in the soil can convert ammonium-N to nitrate-N, which is prone to leaching or further conversion into a gas—a process called denitrification. Water infiltrating into the soil and sinking to the water table can carry nitrate with it. If heavy winter rains fill the soil with water and the soil warms up, denitrification can convert nitrate into nitrogen gas, which floats away into the atmosphere.

Whether by nitrification or denitrification, a significant percentage of fall-applied nitrogen can be moved out of the field before the crop even has a chance to reach for it. That is a waste of money. It can also be a significant source of water pollution as nitrate is leached into groundwater or drained through soil or tile lines into rivers, streams and lakes.

Protecting N

A growing array of products is coming online to minimize the conversion of applied nitrogen to mobile forms in the soil. As a result, they can help make fall applications more economically and environmentally sustainable.

During the Indian Creek Watershed Project, several stabilized-nitrogen fertilizers were compared with each other and with conventional forms of N. Among them were:

Agrotain®, a urea granule that contains a urease inhibitor, which slows the activity of the enzyme that converts urea into carbon dioxide and ammonia gas.

ESN®, a urea granule coated with a polymer to delay its exposure to soil bacteria. Moisture enters the polymer shell, dissolves a portion of the granule, and diffuses into the soil to become available to plants. The process delays the release of the urea to better match crop demand while protecting it from leaching.

SUPERUTM, a urea-based granule formulated with urease blockers and denitrification inhibitors to reduce loss from nitrate leaching, denitrification and volatilization.

Several demonstration plots also assessed the performance of MicroEssentials® (MESZ), a nutritionally balanced MAP granule formulated with zinc and sulfur.

Many Variables

A wide range of variables come into play when assessing the value of enhanced forms of nitrogen. Temperature, rainfall and soil conditions impact the rate at which nitrogen is converted by soil microbes or how quickly external coatings are permeated. The timing of nutrient uptake is also strongly influenced by hybrid choice. Different hybrids will demand different rates of nitrogen on different days.

Demonstration Plot Results

In all, stabilized nitrogen fertilizers performed about as well as or better than conventional fertilizer sources across a wide range of rates and application timings.

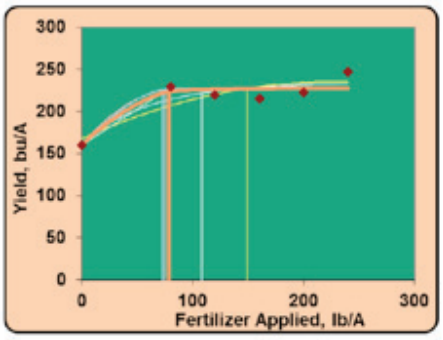
	Yield Average 4 Reps Bushel per Acre			
N Rates	ESN	Spring NH3	Super U	Urea
0	222.5	229.2	209.1	199.6
80	261.3	238.7	264.6	274.2
120	245.5	211.2	257.2	247.7
160	241.5	195.3	254.0	245.3
200	189.0	181.5	203.4	217.5
240	195.8	171.8	190.4	198.7

In a 2013 replicated trial comparing various nitrogen sources, spring-applied at five rates on the farm of Terry Bachtold in the Indian Creek watershed, pre-plant urea yielded the most corn at three rates (80, 200 and 240 pounds per acre). SUPER U was the top performer at rates of 120 and 160 pounds of N per acre.

However, it is also important to look at the nitrogen use efficiency (NUE) of enhanced nitrogen vs. conventional forms. A 2014 trial in the Indian Creek watershed demonstrated that the most efficient N rate

for SUPER U was 78 pounds of N per acre, compared to 184 pounds of N per acre for urea (see charts below). The most striking result is that the extra 106 pounds of N applied as urea yielded only six more bushels of corn. Clearly, farmers could have made greater profits—and, extrapolated to similar soils across the watershed, applied 1 thousand tons less fertilizer that season—by using the enhanced nitrogen product.

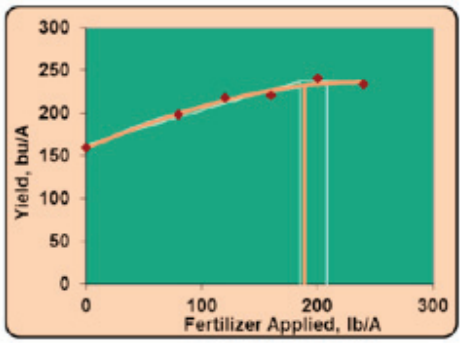
Super U



Super U	
Rate	Yield
0	160
80	229
120	220
160	215
200	223
240	247

Best Rate (lb/A):	79
Yield at Best Rate (bu/A):	224

Urea



Urea	
Rate	Yield
0	160
80	198
120	218
160	221
200	241
240	234

Best Rate (lb/A):	189
Yield at Best Rate (lb/A):	232

A trial on Herb Steffen's farm—a low-phosphorus site in the Indian Creek watershed—allowed plot organizers to compare the benefits of di-ammonium phosphate (DAP) against MicroEssentials (MESZ), a mono-ammonium phosphate (MAP) granule formulated with sulfur and zinc.

In 2012, drought compromised yields dramatically. However, the Steffen plots responded significantly to the addition of P. Applying 70 pounds of phosphorus as DAP increased corn yield by up to 5 bushels per acre. Applying 70 pounds of phosphorus as MicroEssentials increased yields by 15 to 18 bushels of corn per acre over the no-P plots. The extra impact may be attributable for increasing incidences of sulfur and zinc deficiencies in corn in the Midwest.

Enhanced fertilizer formulations can play a valuable role in both improving nutrient efficiency in the field and minimizing off-target movement of crop nutrients. Results in the Indian Creek Watershed Project—which is promoting best management practices in the majority of its watershed and investigating their impacts on water quality—indicate that these products may be very useful tools.

The Indian Creek Watershed Project

The Indian Creek Watershed Project is a locally led program that provides educational, technical, financial and social support for producers to develop, implement and maintain comprehensive conservation systems.

It combines on-farm research, demonstration projects, a support network for area farmers, public and private technical resources and an outreach strategy to communicate about best management practices (BMPs) to farmers and the wider public.

A wide range of conservation systems, demonstrated and implemented on a local level, allow farmers to assess BMPs in real-world, field-scale conditions. In all, new conservation practices have been adopted on more than 60 percent of the watershed's farmland since the project began in 2010. A water quality monitoring program will track the impact of BMPs on the watershed scale on water quality in Indian Creek.

Produced by the Conservation Technology Information Center (CTIC) www.ctic.org
Funding provided (in part) by the Illinois EPA through Section 319 of the Clean Water Act.