

## **N Management: Striking a Balance**

### **Improve economic returns while reducing environmental impact.**

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Last year's spike in nitrogen (N) prices sent chills up many growers' spines. While prices have stabilized, experts say there's still plenty of reason to adopt an "apply-only-what's needed" approach to N fertilization.

"Proper N management not only makes good financial sense, it is good for the environment," says Dr. Larry Bundy, professor and extension soil scientist for the University of Wisconsin at Madison. "It's always wise to avoid unnecessary applications."

He adds that managing this elusive nutrient can be challenging, however. By understanding its characteristics and implementing basic N management practices, growers can ensure both the crop *and* the environment prosper.

### **The Ironic, Important Nutrient**

There's no question: N is essential to plant growth. Yet, the huge supplies of this element in the atmosphere are simply unavailable to non-legume plants.

"Despite N being one of the most abundant elements on earth, its deficiency is probably the most common nutritional problem affecting plants worldwide," says Dr. Don Eckert, professor of natural resources at The Ohio State University.

"Most plants take N from the soil continuously throughout their lives, and demand usually increases as plant size increases," he says. "Providing adequate N allows an annual crop, such as corn, to grow to full maturity, rather than delaying it."

## Uptake of Nutrients by Various Crops

Crop	Yield Per Acre	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Mg	S
Alfalfa	8 tons	450	120	480	40	40
Corn	180 bu.	240	100	240	58	30
Coastal Bermuda	10 tons	460	120	500	33	55
Soybeans	60 bu.	315	58	205	24	20
Wheat	80 bu.	166	54	184	17	20

(Source: PPI)

Nitrogen is an important component of many important structural, genetic and metabolic compounds in plant cells, including:

- chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide (i.e. photosynthesis).
- amino acids, the building blocks of proteins.
- energy-transfer compounds, such as ATP (adenosine triphosphate), which allow cells to conserve and use the energy released in metabolism.
- nucleic acids such as DNA, the genetic material that allows cells (and eventually whole plants) to grow and reproduce.

N deficiencies generally result in small, slow-growing plants that may appear pale green or yellowish. Older leaves often turn brown and die as the plant moves N from less important older tissues to more important younger ones.

### Reining in the Elusive Element

Fortunately, N-based fertilizers have played a critical role in boosting the world's agricultural productivity over the years. At the same time, however, producers have been faced with the challenge of managing a nutrient that just doesn't want to stay put.

“The nitrogen cycle contains several routes by which plant-available nitrogen can be lost from the soil,” Eckert says. “However, nitrate-nitrogen is usually more subject to loss than is ammonium-nitrogen.”

According to Bundy, losses due to leaching remain at the heart of two important issues of environmental concern: 1) N leaching into ground water, and the resulting negative impact on drinking water; and 2) the Hypoxia situation in the Gulf of Mexico, caused in part by surface water losses of N carried south by the Mississippi River.

In addition to leaching, N also can be lost from the soil by denitrification and volatilization. Research also has documented that N can be lost directly from the crop leaves as ammonia.

“Achieving maximum economic yield, while minimizing environmental impact, is possible if growers rely on Best Management Practices (BMPs),” Bundy says. These practices have been proven to provide optimum production potential, input efficiency and environmental protection for a specific site.

#### **N Use Efficiency Comparison in Wheat Production**

<b>Type System</b>	<b>Yield bu/acre</b>	<b>N Used lb/acre</b>	<b>N Efficiency bu/lb N</b>	<b>Soil N After Harvest lb/acre</b>	<b>Cost per acre</b>
BMP	85	140	0.61	29	\$2.43
Old	50	105	0.48	40	\$3.19

**Growers using proven Best Management Practices (BMPs), compared to those relying on less efficient management techniques, increased yields 35 bu/acre, used nitrogen (N) fertilizer much more efficiently, and lowered the cost of producing the wheat by \$0.76/bu.**

Bundy and Eckert offer a few BMPs for N management:

- 1) Start with a good rate recommendation and make adjustments for other N sources.** Bundy says a good starting point is to use a sound N recommendation for the local production conditions. From there, growers should make adjustments for N that might be coming from non-fertilizer sources, like manure and legumes, by

assigned “book value” credits based on research. Finally, diagnostic tests like the preplant or sidedress soil nitrate test (PSNT) can help fine-tune N-rate decisions.

“While there are many factors contributing to excess N use, the most apparent is inadequate accounting for legume and manure N contributions,” he says. “The frequently stated reason for inadequate N crediting is that farmers fear economic loss due to N deficiencies if recommended optimum N rates are used. Results of 10 years of research in Wisconsin have shown that making appropriate adjustments for organic N inputs was consistently more profitable.”

- 2) **Time N applications to avoid losses.** N should be applied to avoid periods of significant losses and to provide adequate N when the crop needs it most, Eckert says.

“Wheat takes up most of its N in the spring and early summer, and corn absorbs most N in mid-summer, so ample availability at these times is critical,” he says. “If losses are expected to be minimal, or can be effectively controlled, applications before or immediately after planting are effective for both crops.”

Bundy adds that on sandy soils, growers should avoid preplant applications and use delayed or sidedress applications.

- 3) **Avoid N losses due to volatilization and leaching.** Producers may need to consider using a nitrification inhibitor with fall or spring N applications where leaching losses are likely, Bundy says. And if growers are using an N fertilizer that contains urea, applying on the surface without incorporating can result in fertilizer loss due to ammonia volatilization and reduced efficiency.

“In this situation, the blanket suggestion would be to inject urea or urea-containing fertilizers where possible,” he says. “Where high volatilization losses are expected,

and there are no alternatives to surface application, growers might consider using a non-volatile source, like ammonium nitrate or ammonium sulfate.”

### **Balanced fertilization increases N-use efficiency**

The presence (or absence) of other nutrients can impact N-use efficiency, as well, says Dr. Cliff Snyder, southeast director for the Potash & Phosphate Institute.

“Recent soil testing summaries for North America indicate that phosphorus (P) and potassium (K) needs are not being met on many farms, a situation that may lead to reduced N uptake by the plant,” he claims.

The Soil Test Summary, recently published by PPI for the 2001 crop year, reported that 47 percent of the North American soil samples tested medium or below in extractable P. Forty-three percent of the North American soil samples tested medium or lower in K.

Snyder warns that this snapshot of the unbalanced soil fertility situation reveals that productivity in North America is at risk.

“Crop yields may be limited by the element that is in shortest supply,” he says. “Because P and K actually improve N uptake, deficiencies will have a negative effect on crop yields. So, it’s critical to supply all essential nutrients in the proper balance.”

Bundy agrees: “If you are limiting your crop’s use of N because of P and K deficiencies, a negative outcome surely will result.”

Farmers do not have to be at a loss, so to speak, when it comes to N management. By taking advantage of BMPs, growers can enhance N-use efficiency, improve their return on fertilizer investment, and reduce environmental impact.