

# Nitrogen Application

Nitrogen (N) management planning for corn production.

## At what rate should I apply Nitrogen?

Allocate nitrogen (N) to where it is needed most. If your N costs are high, or products are in short supply, then allocate more N to the areas with the greatest potential response to applied N. Table 1 gives suggested pre-plant corn N rates for various rotations. Research indicates that in many years N rates in the mid-to-lower part of the ranges given in Table 1 are adequate. Also, data from diagnostic tools such as the late spring soil nitrate and fall cornstalk nitrate tests or canopy sensing (visually or using sensors) may further clarify adequate rates.

Because corn is so responsive to N, if the fertilizer N supply is short it is probably better to apply a lower rate of N to all corn acres than to skip fields. Exceptions are 1) fields with adequate rates of manure, 2) first-year corn after alfalfa, and 3) fields receiving adequate rates of other forms of N such as by-products.

Table 1. Suggested N rates for corn production based on crop rotation.

Rotation	N Rate, pounds per acre
Corn after established alfalfa	0 – 30
Second-year corn after alfalfa	0 – 60
Corn after corn	150 – 200
Corn after soybeans	100 - 150

Adapted from Table 1 of ISU publication PM 1714, Nitrogen Fertilizer Recommendations for Corn in Iowa.

## What N sources are being applied?

Take into account all N being applied to cornfields. Nitrogen recommendations are for the total amount of N needed. Therefore,

### Key Points

- At what rate should I apply N?
- What N sources are being applied?
- What are alternative N sources?
- How can productivity be improved?
- How well is the N applied?
- Use the Late-Spring Nitrogen Test (LSNT).
- In-season N application.
- How late can I apply N?
- Cornstalk testing to evaluate N management.
- Summary.
- Reference materials.

add up the N coming from various fertilizers such as diammonium phosphate (DAP) and monoammonium phosphate (MAP), weed and feed urea-ammonium nitrate solution (UAN), and starters. These amounts should then be subtracted from the recommendations listed in Table 1.

## **Commercial N formulations:**

**Anhydrous ammonia** must be injected into the soil and can be applied from preplant to sidedress. Free ammonia may be toxic to seedlings, therefore proper placement (depth and location relative to the corn row) is important.

**Urea** rapidly converts to ammonium in the presence of moisture and urease enzyme (found in soil and plant residue). When banded, urea can cause root and seedling damage. Urea should not be placed with the seed. Urea left on the soil surface can be lost to the atmosphere (volatilization).

**Urea-ammonium nitrate solutions (UAN 28 or 32 percent N)** are comprised of approximately one-half urea and one-half ammonium nitrate. The urea component is subject to volatilization. UAN solutions should be either incorporated or injected into soil for greatest efficiency and reliability. Because of the nitrate component, UAN should not be applied a considerable time before planting.

**Ammonium nitrate and ammonium sulfate** materials have limited volatile loss potential and are good candidates for surface application. Because ammonium nitrate is one-half ammonium and one-half nitrate, it is more subject to immediate N loss by leaching or denitrification. It should therefore not be applied a considerable time before planting.

## **What are alternative N sources?**

Use alternative N sources such as manure, biosolids, and N-containing by-products (such as liquid ammonium sulfate). Closely measure the nutrient content of animal manure, and carefully apply agronomic rates (for more information, see NMEP 3, Manure Resources).

## **How can productivity be improved?**

Adopt proven crop management practices like soil conservation, integrated pest management (IPM), adapted high-yielding hybrids, crop rotations, and optimal soil pH, phosphorus and potassium levels. These agronomic practices help increase N use efficiency.

## **How well is N applied?**

Calibrate applicators, apply fertilizer products and manure accurately, and use the correct application method. When possible, inject or incorporate urea-containing materials into the soil to minimize loss to the atmosphere (volatilization).

## **Use the Late-Spring Nitrogen Test (LSNT).**

The LSNT is a tool that allows site-specific assessments of plant-available N before the crop begins rapid uptake of N. The LSNT can help determine the N needs of corn in-season, especially on manured fields. This allows adjustment of N applications at sidedress time. For the LSNT, sample the top 12 inches of soil when the corn is between six and twelve inches tall. Iowa State University Extension publication PM 1714, *Nitrogen Fertilizer Recommendations for Corn in Iowa*, gives more information on how to collect LSNT samples and interpret results.

## **In-season N application.**

If conventional soil injection equipment can be used, the preferred N applications are either injected anhydrous ammonia or urea-ammonium nitrate (UAN). If not, dribble UAN solution between corn rows or

broadcast urea fertilizer. Broadcasting a UAN solution should be avoided because it can burn corn foliage, especially on large corn. If injection or conventional broadcast application is not possible due to the height of the corn or soil moisture, then UAN could be applied using high-clearance equipment with drop nozzles. Urea can also be aerial applied.

### **How late can I apply N?**

It is best to apply the N as early as possible in the growing season. However, a yield response that returns income greater than the costs of fertilizer application (depending on the severity of N deficiency) have been observed up to the tassel stage. The success of any surface application depends on timely rainfall to move N into the root zone.

### **Cornstalk testing to evaluate N management.**

The N status of a corn crop can be assessed by measuring nitrate concentrations in the lower portion of cornstalks at the end of the growing season. Iowa State University Extension publication PM 1584, *Cornstalk Testing to Evaluate Nitrogen Management*, gives more information on how to collect cornstalk samples and interpret results.

### **Summary.**

Several corn N management options can assist in providing economical and environmental benefits:

1. Be realistic in selecting N application rates.
2. Account for the crop rotation.
3. Plan for available N from manure applications.
4. Avoid fall application of N fertilizer, or wait until soil temperatures at four inches are at or below 50 degrees Fahrenheit and cooling before injecting anhydrous ammonia.
5. Spring pre-plant, side-dress, or pre-plant-side-dress split applications typically provide the least risk from loss and are preferable N application timings.
6. Side-dress or in-season application allows for small pre-plant or starter N applications, and adjustment to overall N rates from information gained through soil N testing or in-season corn monitoring.
7. Consider using N diagnostic tools like the LSNT and end-of-season cornstalk test to make adjustments in N rates and in monitoring of

N management systems.

8. Account for all N applications.

Careful assessment of N needs and application options will help minimize expenses and increase overall return on fertilizer N investments. Applying these practices and management options can help increase returns from dollars spent on N. It will also reduce N lost from fields to surface waters, thereby improving water quality.

### **Reference materials.**

Contact your ISU county Extension office for a copy of:

PM 1714, *Nitrogen Fertilizer Recommendations for Corn in Iowa*.

PM 1584, *Cornstalk Testing to Evaluate Nitrogen Management*

---

Best Management Practices, or BMPs, utilize the most effective and practical means available to reduce or prevent water pollution from farm operations. BMPs are selected based on assessment, analysis of the impact of alternative practices and their economic considerations. They are implemented using current available technologies, management skills and available resources. BMP information sheets available from ISU Extension include:

- NMEP 1, *Soil Testing*
- NMEP 2, *Phosphorus Application*
- NMEP 3, *Manure Resources*
- NMEP 4, *Residue Management*
- NMEP 5, *Crop Rotation*
- NMEP 6, *Crop Yields*
- NMEP 7, *Nitrogen Application*
- NMEP 8, *Nutrient Management Plan*
- NMEP 9, *Equipment Calibration*
- NMEP 10, *Conservation Reserve Program*
- NMEP 11, *Conservation Practices*

Prepared by John Sawyer, associate professor of agronomy, Department of Agronomy, Iowa State University; and John Creswell, coordinator of the nutrient management education project, Iowa State University Extension.

*This publication has been funded in part by the Iowa Department of Natural Resources through a grant from the U.S. Environmental Protection Agency under the Federal Nonpoint Source Management Program (Section 319 of the Clean Water Act).*

## IOWA STATE UNIVERSITY

University Extension

**Helping Iowans become their best.**



**... and justice for all**

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Many materials can be made available in alternative formats for ADA clients. To file a complaint of discrimination, write USDA, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Stanley R. Johnson, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.