Rescue Nitrogen Applications to Corn

Introduction

- Nitrogen (N) is essential to plant growth, but can be easily lost from the soil by leaching or denitrification with excess rainfall.
- Wet conditions in May and June can delay planned sidedress applications and promote loss of previously applied nitrogen.
- Producers should evaluate how much N remains in the soil and if that will be enough to meet crop needs; if not, a rescue N application may be needed.

Evaluating N Loss Using Soil Tests, Optical Sensors and "Estimating"

- **Soil Tests** – The Pre-Sidedress Nitrate Test (PSNT), a.k.a. the Late Spring Soil Nitrate Test (LSNT), is most common.
- Sampling 12+ inches deep will give a more accurate measure of the remaining nitrate in the root zone after a heavy rain (the critical level may need to be adjusted above 25 ppm).
- **Optical sensors** can help assess N deficiency and the amount of N needed to optimize crop response.
- As the N applicator traverses the field, sensing, rate calculations and N application all occur at once.
- In addition, aerial imagery and chlorophyll meters are also good tools for evaluating the N needs of a growing corn crop.
- To **estimate the quantity of N** in the nitrate form when rainfall occurred, one must know the following:

  1. When was N applied? **2.** What fertilizer was used?

  3. Quantity of N applied? **4.** Field conditions after application?

- Greater quantities of N fertilizer are converted to nitrate as time goes by and soil temperatures increase.

N Source	Week After Application		
	0	3	6
	% Fertilizer as Nitrate-N		
Anhydrous ammonia (NH_3)	0	20	65
NH_3 with N-Serve	0	10	50
Urea	0	50	75
UAN	25	60	80
Ammonium nitrate	50	80	90

Table 1. Amount of nitrogen fertilizer in the nitrate-N form 0, 3 and 6 weeks after application.

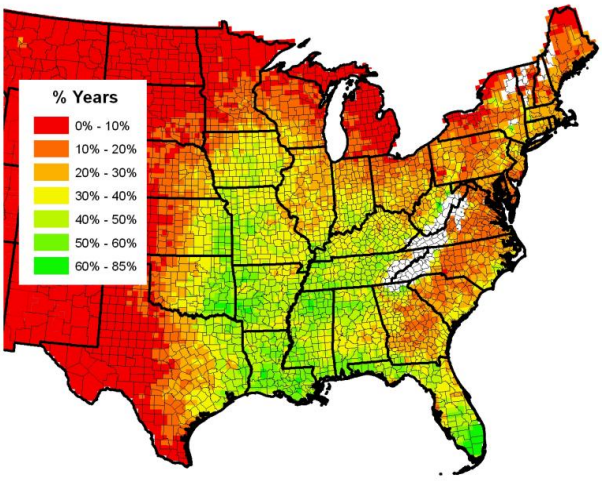

Figure 1. Percent of years with greater than 14 inches of precipitation from April through June. Spring N losses are more common in higher rainfall areas (green on map[1]).

- The nitrate form of N is more susceptible to loss from rainfall; however, it is not <u>always</u> lost during heavy rains.
- <u>Soil temperature</u> and <u>duration of soil saturation</u> are two key factors affecting **denitrification.**
- The warmer the soil and the longer it is saturated, the more denitrification losses are increased (Table 2).

Soil Temp (°F)	Days Saturated	Nitrate-N Loss (% of total N applied)
55-60	5	10
	10	25
75-80	3	60
	5	75
	7	85
	9	95

Table 2. Estimated denitrification losses as influenced by soil temperature and days of saturation.

Rescue N Application Methods

- **Equipment availability** and **N source** are the two most important factors to consider, as well as **risk of leaf injury** and the potential for **NH_3 volatilization** from urea application.
- If a high-clearance sprayer is available, <u>banded</u> applications of urea ammonium nitrate (UAN) solution can be made.
  - To reduce leaf burn, weight the hoses to help keep them on the ground.
  - Banding will also help minimize urea hydrolysis and volatilization.

- **Urea is the product of choice for broadcasting rescue N**
  - Broadcasting ammonium nitrate (NH_4NO_3) and UAN solution can cause *extensive leaf burning* and possible yield loss.
  - Urea is much safer to broadcast, usually resulting in only minimal crop injury (Figure 3).
  - Urea is subject to NH_3 volatilization in the presence of urease, a naturally occurring soil and plant enzyme.
  - The use of a urease inhibitor (e.g., Agrotain® N stabilizer), can help delay urea hydrolysis and reduce NH_3 volatilization.
  - Banded applications also will help minimize N loss.
- Late applications of controlled-release urea are not recommended because of the delay between application and the N being released and available to the corn.

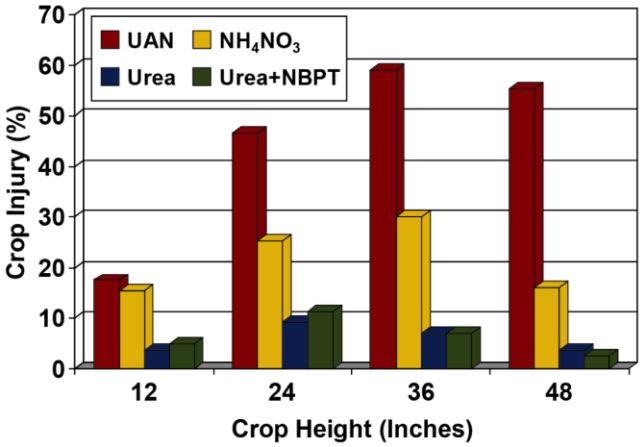

Figure 3. Leaf injury caused by broadcast application of nitrogen sources to corn at different plant heights (Nelson et al., 2010).

Considerations When Applying Rescue N

- Corn is more responsive the sooner N is applied. The greater the N deficiency and the longer it goes uncorrected, the greater the potential for yield loss.
- Early-season N stress can result in irreversible yield loss (Binder et al., 2000).
  - Due in part to a reduction in the number of kernel rows per ear, which is generally determined between V5 and V8.
- If prolonged soil saturation and/or ponding lowered corn yield potential, full N rates may no longer be needed.
- **Denitrification is greatest in low-lying areas;** therefore, a whole-field rescue application may result in unnecessary costs and potential future losses of excess N.

Corn Response to Rescue N Applications

- Pre-tasseling rescue N applications have proven effective at recovering yield, as these and other research studies show:
  - An Illinois study found that an intentionally flooded plot, with 50 lbs/acre of supplemental N applied after flooding, produced similar yields to the non-flooded plots (Torbert et al., 1993).
  - In an Indiana study, 70 lbs N/acre applied at V13 resulted in an economic yield response (Emmert, 2009).
  - Grain yield of corn receiving N at V15 was not significantly different than the yield of corn receiving 200 lb N/acre at planting in northwest Indiana in 2010 (Nielsen et al., 2011).
  - Missouri studies have shown that yield can be recovered with N applications as late as tasseling.
- Under severe N deficiency, a positive response was demonstrated to applications of low rates of N (30 to 60 lbs/acre) as late as three weeks after pollination (Thomison, 2010).
- Recent DuPont Pioneer and university research gives new insights into the timing of N uptake:
  - Corn takes up about 37% of its total N requirement during the grain-fill period (R1 to R6). In high yield environments, post-flowering N uptake can range from 85 to 130 lbs N/acre.
  - N for grain development originates from both remobilized N from vegetative tissues and continued N uptake from the soil.
  - Approximately 62% of grain N content is supplied by continued N uptake after flowering.
- This new research underscores the importance of adequate N supply throughout the reproductive period to maximize yield.

Management Practices

- When use of ground equipment is prevented by wet field conditions, **aerial application of urea** is still an option.
  - Use of a urease inhibitor can help prevent urea hydrolysis and subsequent NH_3 volatilization.
  - To avoid severe corn tissue damage, do not use UAN solution, ammonium nitrate or ammonium sulfate.
- Maintain an **advance plan** in case rescue application is needed. A quick response to N-deficiency stress is often required to minimize yield loss.
  - Could include finding a service provider for high-clearance or aerial applications well ahead of the potential need.
- When N is lost and plants are deficient, rescue applications should be made as soon as possible, preferably by silking.
  - However, because corn takes up and uses N throughout the reproductive period, consider remediating deficiencies with moderate (40 to 80 lbs/acre) amounts of N as late as four weeks post-pollination.