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Bill & Missy Bauer
B&M Crop Consulting, Inc.
Nitrogen Timing & Placement

Missy Bauer
Nitrogen Management

Improving Nitrogen Efficiency
Increasing Yields
Reducing the Environmental Effect
The 4R’s
Nitrogen Management

Right Product
Right Rate
Right Timing
Right Placement
Improving Nitrogen Efficiency
The Nitrogen Cycle

Atmospheric nitrogen

Atmospheric fixation and deposition

Animal manures and biosolids

Industrial fixation (commercial fertilizers)

Crop harvest

Volatilization

Runoff and erosion

Denitrification

Leaching

Input to soil

Loss from soil

Organic nitrogen

Ammonium (NH₄⁺)

Plant residues

Nitrate (NO₃⁻)

Plant uptake

Biological fixation by legume plants

Immobilization

Mineralization

Source: IPNI
Nitrogen
• Immobilization
• Mineralization
• Losses
  – Volatilization
  – Denitrification
  – Leaching
Carbon Penalty
Carbon Management

• Carbon-to-Nitrogen Ratios
  – Soybean = 30/1
  – Corn = 60/1
  – Wheat = 100/1

• Takes more nitrogen to breakdown corn residue vs. soybean residue

• Microbes are responsible for the breakdown to 8/1 ratio (Microbes C/N is 8/1)

• Need nitrogen in order to do this

• Immobilization
Immobilization

• A temporary reduction in the amount of plant-available N can occur from immobilization (tie-up) of soil N.
• Bacteria that decompose high carbon-low N residues need more N to digest the material than is present in the residue. (Wheat/Corn)
• The actively growing bacteria that immobilize some soil N also break down soil organic matter to release available N during the growing season.
• There is often a net gain of N during the growing season, because the additional N in the residue will be the net gain after immobilization-mineralization processes.
• Apply broadcast N to help compensate for immobilization.

Source: University of Minnesota, FO-03770, Understanding Nitrogen in Soils.
Paying The Carbon Penalty

100 lb N Sidedress

WF fb SD Sidedress

WF Sidedress

No Starter Starter Starter Starter
Mineralization

• Organic N that is present in soil organic matter, crop residues and manure is converted to inorganic N through the process of mineralization.

• In this process, bacteria digest organic material and release ammonium (NH$_4^+$) nitrogen.

• Formation of NH$_4^+$ increases as microbial activity increases.

• Bacterial growth is directly related to soil temperature and water content.

Source: University of Minnesota, FO-03770, Understanding Nitrogen in Soils.
Nitrogen Rates

• How much nitrogen do I need?
• Depends on:
  – Mineralization
  – Timing & placement
  – Crop rotation
• Rate Studies
Nitrogen

• Losses
  – Volatilization
  – Denitrification
  – Leaching
Nitrogen Loss

• **Volatilization**
  
  – Surface applied N
  
  – Fertilizer products containing Urea (Urea, UAN 28-32%)
  
  – 15 ~ 20% of the urea-based nitrogen may volatilize within a week after application under warm conditions

Source: University of Minnesota, FO-03770, Understanding Nitrogen in Soils.
Nitrogen Loss

• Denitrification
  – A process by which bacteria convert $\text{NO}_3^-$ to N gases that are lost to the atmosphere.
  – Takes place where there is waterlogged soil and where there is ample organic matter to provide energy for bacteria.
  – Heavy Soils, poor drainage
  – Can proceed rapidly when soils are warm and become saturated for 2 or 3 days.
  – Volatilization of the nitrogen gas can result in N losses of as much as 5% of the available nitrate-N per day.

Source: University of Minnesota, FO-03770, Understanding Nitrogen in Soils.
# Nitrogen Loss Through Denitrification

<table>
<thead>
<tr>
<th>Days Saturated</th>
<th>Temperature</th>
<th>Percent Loss</th>
</tr>
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<tbody>
<tr>
<td>5</td>
<td>55-60</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>55-60</td>
<td>25</td>
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<tr>
<td>3</td>
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<td>75-80</td>
<td>75</td>
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<tr>
<td>7</td>
<td>75-80</td>
<td>85</td>
</tr>
<tr>
<td>9</td>
<td>75-80</td>
<td>95</td>
</tr>
</tbody>
</table>
Nitrogen Loss

• **Leaching**
  – Leaching is the **loss** of soluble \( \text{NO}_3^- \) as it moves with soil water, generally excess water, below the root zone.
  – Coarse-textured soils have a lower water-holding capacity and, therefore, a higher potential to lose nitrate from leaching when compared with fine-textured soils.

Source: University of Minnesota, FO-03770, Understanding Nitrogen in Soils.
N Timing and Placement

• Residue break down, feed microbes, reduce immobilization
  – **Broadcast** nitrogen
    • Fall or early spring
    • NH4+ - (25-30 lb N/ac)
  – **Weed-n-Feed/Preplant broadcast**
    • Just prior to planting or pre-emergence
    • 28% or Urea/AMS
    • Stabilizers/inhibitors
Early Season Sulfur Deficiency

Need sulfur somewhere in your program
N Timing and Placement

• Residue break down, feed microbes, reduce immobilization
  – Broadcast nitrogen
    • Fall or early spring
    • AMS - (125-150 lb./acre, ~25-30 lb. N/acre)
  – Weed-n-Feed/Preplant broadcast
    • Just prior to planting or pre-emergence
    • 28% or urea/AMS
    • Stabilizers/inhibitors

• Starter Fertilizer Band or Strip-till Band
With Starter Fertilizer – 30 lb. N in 2x2 Band

No Starter Fertilizer

60  45  30  0

Weed-n-Feed
28% UAN Pre-Emerge
Broadcast
N Timing & Placement

• Residue break down, feed microbes, reduce immobilization
  – Broadcast nitrogen
    • Fall or early spring
    • AMS - (125-150 lb./acre, ~25-30 lb. N/acre)
  – Weed-n-Feed/Preplant broadcast
    • Just prior to planting or pre-emergence
    • 28% or urea/AMS (30-35 lb N, instead of 45 to 60 lb N)
    • Stabilizers/inhibitors

• Starter Fertilizer Band or Strip-till Band
• Sidedress Band
Sidedress for Tip Fill

SD: 95
SD: 60
SD: 30
SD: 0
Late V11-V12 Application

96 lb N Base
Managing Nitrogen

• Front End
  – AMS
    • 25-30 lb N (timed with P&K applications)
  – Weed-n-Feed/Pre-emerge/Pre-plant
    • 30-35 lb N
  – Starter Fertilizer (2x2)
    • 30-35 lb N

• Back End
  – Sidedress
N Timing & Placement

• Residue break down, feed microbes, reduce immobilization
  – Broadcast nitrogen
    • Fall or early spring
    • AMS - (125-150 lb./acre, ~25-30 lb. N/acre)
  – Weed-n-Feed/Preplant broadcast
    • Just prior to planting or pre-emergence
    • 28% or urea/AMS
    • Stabilizers/inhibitors

• Starter Fertilizer Band or Strip-till Band
• Sidedress Band
• Later applications? – Fertigation, Y Drop
Fertigation
Add one more fertigation?
Based on tissue & soil samples
Apply through brown silk
N Timing & Placement

- Residue break down, feed microbes, reduce immobilization
  - **Broadcast** nitrogen
    - Fall or early spring
    - AMS - (125-150 lb./acre, ~25-30 lb. N/acre)
  - **Weed-n-Feed/Preplant broadcast**
    - Just prior to planting or pre-emergence
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- **Starter Fertilizer Band** or Strip-till Band
- **Sidedress Band**
- Later applications – Fertigation, Y Drop
2015
Don’t Leave the Corn Hanging
Vegetation and Digital Images

2015
Accumulated Precipitation (in): Departure from Mean
June 1, 2016 to June 30, 2016

June 2016

Source: Midwestern Regional Climate Center
June 2017

Source: Midwestern Regional Climate Center
July 2017
Green Leaves at Harvest – 302 Bu/ac
Nitrogen Management
Summary

• Your nitrogen program should be designed to keep the crops needs met all the way to black layer
• Early season nitrogen deficiencies lead to loss of yield potential
• Late season deficiency leads to yield loss
• From emergence to thigh high--inches matter--placement is crucial
• Banding is more efficient than broad casting
• Know your risk of loss
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Bill & Missy Bauer

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