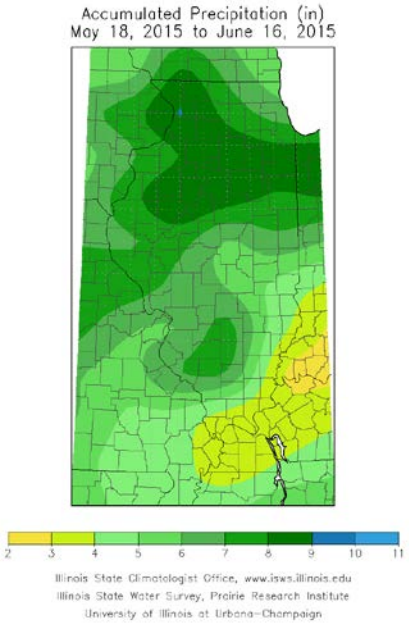

# *Nitrogen Management in Saturated Soils*

*6/18/2015*

*Our friend, Kevin Gale, an agronomist for AgriGold shared this article with his customers and happily gave us permission to share the information with you guys. It is very timely as he offers advice on how to better manage saturated soils.*

*He writes:*

Recent heavy and persistent rainfall events have caused many soils to become saturated and even some to the point of flooding. With the 10 day forecast continuing to show significant chances of rain in many areas, nitrogen management is becoming extremely important. Numerous acres have all of their nitrogen applied and are sitting with saturated soils, while the remainder has limited to no nitrogen applied. Each of these scenarios presents some opportunities as well as challenges to ensure the corn crop has adequate nitrogen to finish the crop. Here are some practical steps to help make some decisions:

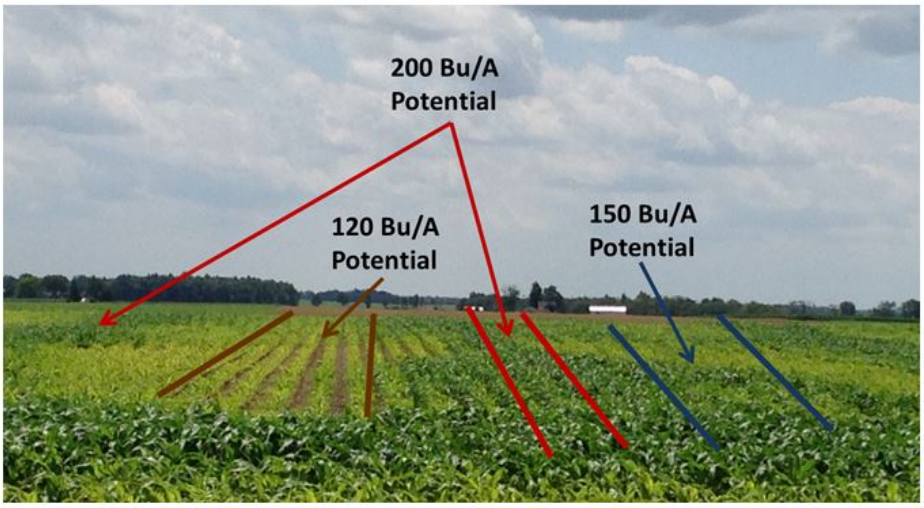


**Step #1 – Assessing yield potential:**

Assessing yield potential is extremely difficult and totally subjective, but experience and some basic information can lead to a better decision. When a grower is faced with saturated to ponded soils during the early stages of corn growth and development, nitrogen is not the limiting factor. Oxygen is the actual limiting factor at this stage. Corn roots are a respiring organ and thus “breathe” oxygen to survive. When the soil is saturated with water, all the oxygen has been forced out of the pore spaces and none is available for the plant roots, this can occur within 48 hours of the soil being saturated. Once oxygen is depleted, the corn plant is living on borrowed time. Most agree that corn can survive around 4 days of ponded water with relatively cool temperatures and less as the temperatures climb above 80°.

When corn plants are subjected to oxygen stress during ear development, the plant will lessen the number of kernels each plant will produce to compensate for the less than ideal growing conditions. But, even though once a corn plant has aborted kernels, there is no way to regain them, all hope is not lost. There is still a lot of time to make each kernel bigger and drive yield through kernel size instead of kernel numbers.

Below are some arbitrary numbers that represent real life scenarios that have been experienced under extended saturated soils. The numbers are only to help a grower decide how much yield potential their particular field may still have. This information allows more reliable decisions will be made.




**Corn fields showing no symptoms of water damage, but have had prolonged saturated soils may not have a significant yield loss, but may be limited at the end of grain fill due to the loss of nitrogen.**

**Step #2 - Understanding the different fates on nitrogen sources:**

| Product | Formula | N Source | Initial N Form |
|---|---|---|---|
| **Anhydrous Ammonia** | $NH_3$ | Ammonia | $NH_4^+$ |
| **Urea** | $CO(NH_2)_2$ | Urea | $NH_4^+$ |
| **UAN (28%)** | Urea (30%)<br>+ $NH_4NO_3$ (40%)<br>+ $H_2O$ (30%) | 30% Ammonium<br>30% Nitrate<br>40% Urea | 70% $NH_4^+$<br>30% $NO_3^-$ |
| **Ammonium Sulfate** | $(NH_4)_2SO_4$ | Ammonium | $NH_4^+$ |

Nitrogen or NO3- has a negative charge and since the soil also has a negative charge, the two repel each other and nitrate N is very mobile in the soil solution. The majority of N loss is associated with the nitrate form.

Ammonium or NH4+ is a very stable for of N. It has a positive charge and it therefore attaches to the soil. Ammonium N will be converted to Nitrate N in the soil, and the speed of that process depends mainly on the soil temperature.

**Step #3 – Determining amount of nitrogen that is in the Nitrate form:**

| The amount of applied fertilizer that is in the nitrate nitrogen form 0,3 and 6 weeks after application | | | |
|---|---|---|---|
| N Source | Weeks after application | | |
| | 0 | 3 | 6 |
| | % Fertilizer as $NO_3^-$ | | |
| Anhydrous Ammonia (AA) | 0 | 20 | 65 |
| AA with N-Serve* | 0 | 10 | 50 |
| Urea | 0 | 50 | 75 |
| Urea with N-Serve* | 0 | 30 | 70 |
| UAN (28%) | 25 | 60 | 80 |
| UAN (28%) with Instinct** | 25 | 45 | 75 |

*Nitrification inhibitor that slows transformation of ammonium to nitrate.
**Not part of original study, Interpolated data from AgriGold Agronomist
Adapted from Bremner and Shaw, 1958

To determine the amount of nitrogen that has been converted to nitrate nitrogen, multiply the total units of nitrogen applied by the percentage that best fits your nitrogen source and timing from the graph above.

**Step #4 - Estimating how much of the applied nitrogen has potentially been lost:**

| Estimated denitrification losses as influenced by soil temperature and days of saturation | | |
|---|---|---|
| Soil Temp (F°) | Days Saturated | % Nitrate-N Loss |
| 55-60 | 5 | 10 |
| | 10 | 25 |
| 75-80 | 3 | 60 |
| | 5 | 75 |
| | 7 | 85 |
| | 9 | 95 |

First determine how many units of nitrogen that have been applied are in the nitrate form from step #3. Then multiply the amount of nitrate nitrogen by the % nitrate loss in the adjacent graph.

Example: 160 Units applied 3 weeks ago using UAN (28%) and the soils have been saturated for 5 days:
160 Units x 60% Converted to Nitrate = 96 units of nitrate nitrogen
96 Units of nitrate nitrogen x 75% loss = 72 units lost

Meaning with 160 units applied – 72 units lost = 88 Units left to grow the corn crop.

**Step #5 - How to adjust nitrogen program to maximize performance:**

When the growing season gets challenging and the corn crop is looking tough, growers tend to want to give up on the crop. But, when nitrogen is the limiting yield factor, there is some amazing hope. Two studies completed by Purdue University demonstrated that corn can recover from significant nitrogen deficiencies all the way to V15:

- 2010 study demonstrated that a V15 application of nitrogen yielded 100 bushels more than the starter only control and yielded only 13 bushel less than the V7 application of the same amount of nitrogen.
- 2007 study showed a 64 bushel advantage when the nitrogen was applied at V13 versus the starter only control and yielded 18 bushel less than the V3 sidedress application.

**Late application guidelines and strategies:**

- Plan on providing at least 1 pound of nitrogen per expected bushel of corn with the combination of residual nitrogen plus any rescue treatments.
- As a general rule, if the soil are saturated and considerable nitrogen has potentially been lost the across the board recommendation is to add an additional of 30-50 units.
- When using UAN (28%) drops are a must. Any UAN that is applied to the corn foliage will be burned and if a significant amount of the plant is burned there is a proportional yield loss associated with it.
- When applying urea broadcast, 100-125# of product will provide the least amount of foliage burn, higher rates will increase burn and could harm yields. The addition of ammonium sulfate in a broadcast application is also beneficial for its stability and ability to provide some much needed sulfur.
- The use of controlled released urea is not recommended in a rescue situation due to the delay between application and the release of the nitrogen to the corn crop.

- In a nitrogen rescue situation where yields have been lowered due to water damage, the addition of any stabilizers and/or Urease Inhibitors may not provide any economic returns and the cost/benefits should be weighed before using them.

**The take home message** is not to give up on a corn crop, but to ensure that everything is being done to help it maximize and to provide the highest return possible.

***For fertility questions don't hesitate to call your AgriEnergy Resources representative.***