WET SOIL CONDITIONS AND NITROGEN LOSS

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The southern-southeastern area of Iowa has experienced much above normal precipitation and continued wet soils this early spring. See the figures below for the precipitation and departure from normal for the April 17-May 16, 2010 period. What does this mean for nitrogen (N) loss, and is this a repeat of the last two years for that area of Iowa? While it has been wet, it has also been cooler than normal (see figure below). Why is that important – because cool temperatures slow nitrification and denitrification, both biological processes important for potential N loss. While the wet period does not bode well for retaining N, it may not be a repeat of the last two years as those were continued wet late in the spring and into early summer. Time will tell if the wet conditions persist this year and promote N loss.

Many soils in southern-southeastern Iowa have poor internal drainage. This means denitrification is a major N loss pathway with wet conditions. There are also areas of coarse-textured sandy soils with high internal drainage and high percolation rates. Those soils have leaching as the predominant loss pathway. In those soils, N in the nitrate form is easily leached with high rainfall events and fertilizer applied in the nitrate form or converted to nitrate could be lost already this spring. This is why split spring preplant or at planting N and sidedress application is an important management practice for those soils. That management can be helpful for poorly drained soils as well.

Nitrogen applications most at risk from the early spring wet conditions are early fall manure containing high percentage as ammonium (liquid swine manure), early fall DAP/MAP, early fall anhydrous ammonia, spring ammonium nitrate, and spring urea-ammonium nitrate (UAN 28 or 32 percent) solutions. Why these applications? With early fall application is the conversion to nitrate by early spring and with the spring application the materials already containing nitrate and faster nitrification. With the late harvest last fall, there was less fall N application than usual, which will help.

If the corn crop is severely damaged by excess water, application of N will not overcome that damage and lost yield potential – additional N would not be warranted. If you are concerned about N loss, and since the corn is still small, make two or three strip applications of additional N across representative fields and watch the corn growth and color. If there is noticeable improvement, then additional N could be warranted. Give the corn plenty of time to recover and roots to grow into N that may be deeper in the rooting zone (due to nitrate movement downward). The strips and adjoining non-treated corn can be harvested and yield compared to see the yield response to the additional N application. The ISU Extension publication PM 2026 (Sensing Nitrogen Stress in Corn) describes methods to implement these N strips and a method to compare the corn N status with a handheld SPAD chlorophyll meter. Canopy sensors are also available that can be used to determine corn N status at mid-vegetative growth stages. For use of these sensors, there needs to be reference areas – corn that does not exhibit N stress (non-limiting N); hence strips applied now with additional N can be used for reference areas across fields.

Following is a review of N conversion in soil and relation to N loss.

Nitrogen processing in soil

If applied N or mineralized organic matter N (conversion from organic to ammonium) would stay in the ammonium (NH_4^+) form, then losses would not occur because ammonium attaches to soil and does not leach (move through the soil with water) or denitrify (microbial conversion to N gases when soils become saturated). Unfortunately, that isn't the way it works. Ammonium is converted to nitrate (NO_3^-) via nitrification. Nitrate is the form that can be moved out of the soil profile by leaching or lost by denitrification. The conversion of ammonium to nitrate and the conversion of nitrate to N gases are both microbial processes. Hence, potential N loss is dependent upon factors that influence each – for nitrification soil temperature is very important (faster with warm soils, slower with cold soils); for denitrification soil temperature, soil moisture (only occurs when soils are saturated – anaerobic conditions) and readily available organic matter for an energy source. If fertilizer N is applied in the nitrate form, then that N is immediately subject to these loss pathways. Mineralization does occur when soils are saturated, so ammonium can accumulate in flooded soil and add to crop available N.

Potential for N losses

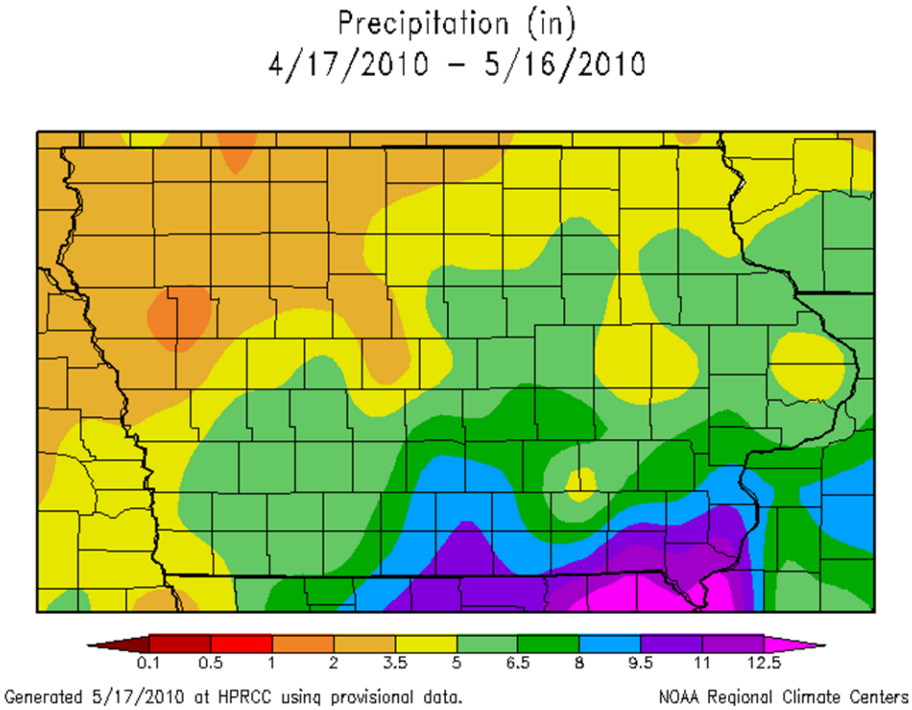
Greater losses occur when soils enter the spring season with recharged subsoil moisture, when more N is in the nitrate form, and when soils are warm. Deciding if losses are substantial enough to warrant supplemental N application, the following factors should be considered:
(1) amount of nitrate present, which is affected by time of N application, form of N applied, rate applied, and use of a nitrification inhibitor;
(2) when and the length of time soils are saturated;
(3) subsoil recharge, leaching rate, and drainage – water amount moved through the soil; and
(4) loss of crop yield potential from water damage.

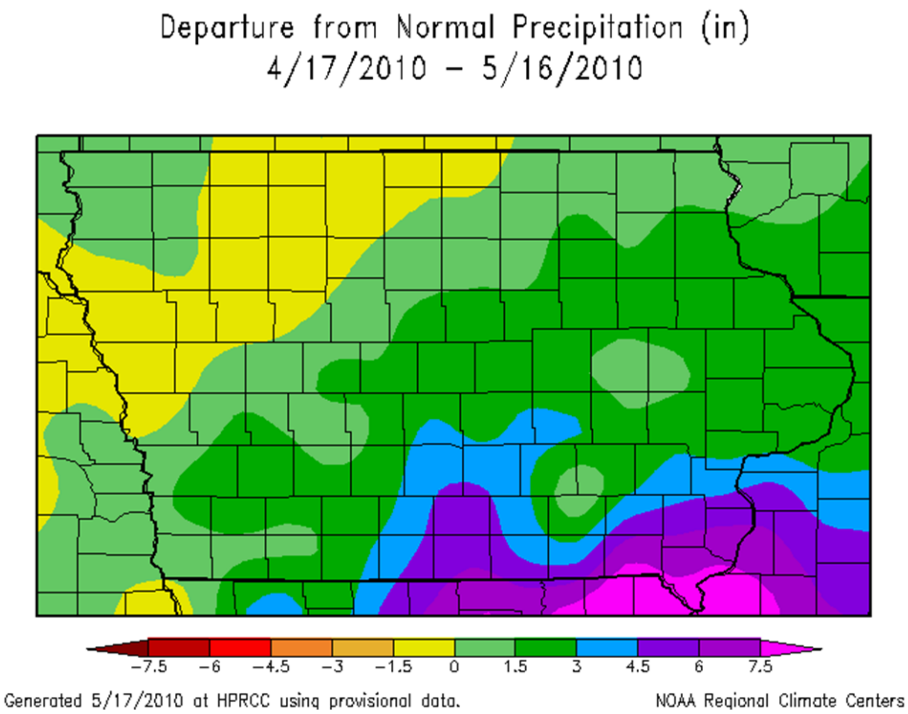
Leaching and denitrification are not uniform across the landscape. Thus, the potential for N loss is variable and difficult to predict. For example, with high intensity rains, runoff occurs and not all of the water soaks into the soil. Instead, water in excess of infiltration moves to the lower landscape where it may form ponds or spill over stream banks into floodplains.

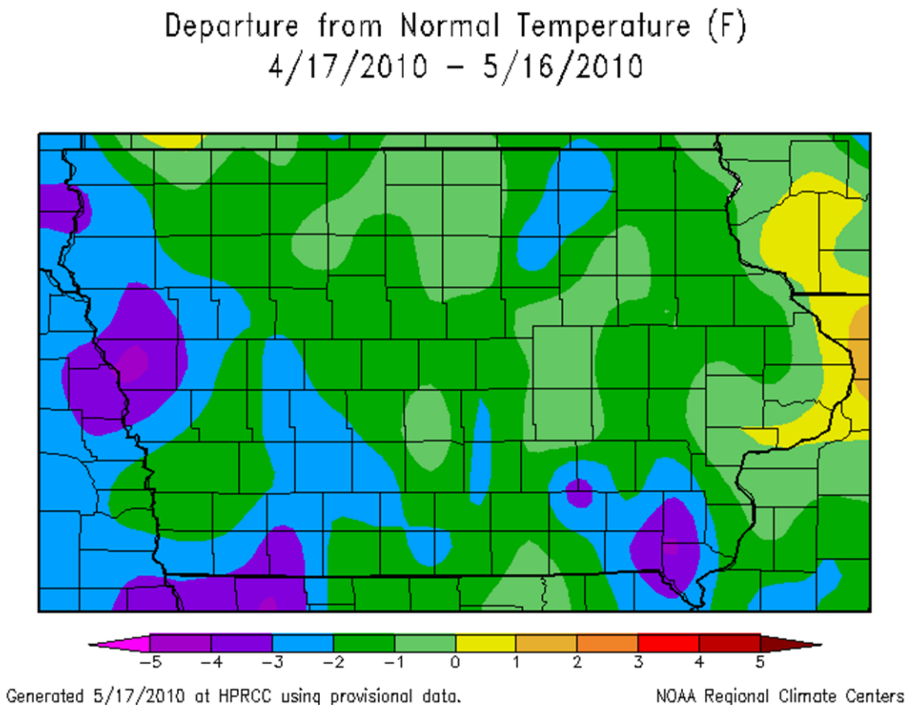
If an N source was applied in the spring that has more rapid nitrification than anhydrous ammonia (urea, ammonium sulfate, ammonium in manure) or contains part of the N in the nitrate form (ammonium nitrate or UAN solutions), then conversion to nitrate would be faster. Conversely, if an ammonium-containing fertilizer (anhydrous ammonia, urea or ammonium sulfate) or manure was applied shortly before a wet period, then loss would be negligible because little nitrification to nitrate would have occurred because nitrification does not occur in saturated soils and will not resume until soils dry and become aerobic.

Conversion to nitrate does not equal loss; it just means the N is susceptible to loss. Rapid and large losses occur only with excess leaching (predominant concern with sandy/coarse-textured soils) or with saturated soils (predominant concern with heavier textured, poorly drained soils).

Precipitation and air temperature figures from the High Plains Regional Climate Center, Applied Climate Information System (http://www.hprcc.unl.edu/maps/).






Departure from Normal Temperature (F)
4/17/2010 – 5/16/2010
−5 −4 −3 −2 −1 0 1 2 3 4 5
Generated 5/17/2010 at HPRCC using provisional data.
NOAA Regional Climate Centers