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What about N losses in 2000?

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Abstract
It has been a dry spring in Iowa--too dry in places. Therefore, nitrogen (N) losses are generally not an issue this year. However, some areas have been wet, especially in eastern and northeastern Iowa, in addition to locations that have recently received heavy rainfall. With another warm fall and open winter, producers in these areas may be wondering whether this is a scenario for repeating the last several years' N losses. Some have recently noted N-deficiency symptoms in cornfields.

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Waterlogged soils/yellow N-deficient corn areas..

Enlarge [1]

Estimating N loss

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 if they become saturated. Deciding whether losses are substantial enough to warrant supplemental application must therefore take into consideration the following factors:

- amount of nitrate present, which is affected by time of N application, form of N applied, rate applied, and use of a nitrification inhibitor;
- when during crop development and the length of time soils are saturated;
- leaching; and
- loss of yield potential from water damage.

In addition is the recognition that water movement into soil, leaching, and denitrification are not uniform across the landscape. Thus, the potential for N losses is variable. For example, if rains are sudden and heavy, then runoff occurs and not all of the water soaks into the soil. Instead, rain in excess of infiltration moves to the lower landscape where it may form ponds in fields or spill over stream banks into floodplains. This variability adds to the difficulty in making decisions about the amount of loss or whether additional N should be applied.

An important consideration is the conversion to nitrate. With the long warm period from last fall through this spring, conversion to nitrate would be expected to be high, and therefore fall and early spring N applications could be at risk. This is especially true if excess rainfall occurred in late spring (late May to June) before rapid corn uptake.

If an N fertilizer form was applied that has more rapid nitrification than anhydrous ammonia or

ammonia plus a nitrification inhibitor (urea or ammonium sulfate) or contains part of the N in the nitrate form (ammonium nitrate or UAN solution), then conversion would be faster and more N would be present as nitrate and subject to loss. Conversely, if an ammonium-containing fertilizer (anhydrous ammonia, urea, or ammonium sulfate) was applied shortly before a wet period, then loss would be negligible because little nitrification to nitrate would have occurred (nitrification does not occur in saturated soils and cannot resume until soils dry and become aerobic).

Conversion to nitrate does not equal loss. It just means the N is susceptible to loss. Most areas of Iowa this year had no N losses because of dry soils, subsoils not fully recharged, and no excessive rainfall. Losses occur only with excess leaching (a predominant problem on sandy soils) or with saturated soils (a predominant problem on heavier textured soils).

Research conducted in Illinois (reported in the 1993 Integrated Crop Management Conference proceedings, pp. 75-89, and in Torbert et al., 1993, "Short-term excess water impact on corn yield and nitrogen recovery," Journal of Production Agriculture 6:337-344) indicated approximately 4 to 5 percent loss of nitrate-N by denitrification per day that soils were saturated. An all-nitrate fertilizer was applied when corn was in the V1 to V3 growth stage. Soils were brought to field capacity moisture content and then an excess 4 inches of water (above ambient rainfall) was applied evenly over a 3-day period, which maintained saturated soils for 3 to 4 days on the heavier textured soils, or an excess of 6 inches of water was applied over an 8-day period (with saturated soils for an additional 3 to 4 days). The excess water application resulted in loss of 60 to 70 pounds N/acre on silt loam and clay loam soils, due to denitrification loss. On a sandy soil, virtually all nitrate was moved out of the root zone by leaching. On the heavier textured soils, addition of 50 pounds N/acre after the excess water was applied was sufficient to increase corn yields to approximately the same level where no excess moisture was applied. This was not the case on the sandy soil because more N was lost through leaching. When 8 inches of precipitation plus irrigation was received in May and June on the sandy soil, yield was reduced by 20 percent.

After the excess rain in the spring of 1995, four fields with a full rate of fall-applied N in Boone County, Iowa, had additional N sidedress injected with anhydrous ammonia. The data showed an average yield increase of 15 bushels/acre from addition of 50 to 75 pounds N/acre (A. M. Blackmer, 1996 Integrated Crop Management Conference proceedings, pp. 55-59). In similar studies, significant yield responses in some fields to additional N (UAN injected when corn was 1-foot in height or surface banded at the R1 growth stage) were measured in 1999 after the warm fall-winter and wet spring (Ellsworth et al., 1999, Integrated Crop Management Conference proceedings, pp. 301-304).

Using the late spring soil nitrate test

A procedure to measure additional N need is to use the late spring soil nitrate test. However, it is too late to sample with this test (1-foot soil samples should be collected when corn plants are 6 to 12 inches in height). If samples were collected at the appropriate time, then the following information can assist with interpretation of results. See ISU Extension publication PM 1714, Nitrogen Fertilizer Recommendations for Corn in Iowa [2], for full interpretation and use of this test.

For fields where less than full rates of N were preplant applied, a suggestion is to lower the critical concentration from 25 ppm to 20-22 ppm when rainfall from April 1 to time of sampling is more than 20 percent above normal. When full rates of N were applied preplant (fall or

early spring) as anhydrous ammonia, or with manured soils, the suggested critical concentration is 15 ppm if May rainfall exceeds 5 inches (refer to Table 3 of PM 1714 to interpret test results). In these fields, if tests are between 16 and 20 ppm you may want to consider a small N application. These adjustments take into account nitrate that may have moved below the 1-foot soil sample, but remains within the effective rooting depth. In situations where manure or full rates of N were applied preplant, a suggestion would be to limit additional N application to 90 pounds N/acre, even if the test result is 10 ppm or less.

Taking chlorophyll meter readings. The corn plant expresses N deficiency through reduced leaf greenness that can be measured with a chlorophyll meter (SPAD meter). To effectively know whether deficiencies are occurring, readings need to be compared with adequately fertilized (non-N-limiting) reference areas or strips. A relative value less than 95 percent is often suggested as indicating N deficiency. This comparison reduces bias due to different growing conditions, soils, hybrids, or factors affecting leaf color other than N deficiency. Chlorophyll meter readings (values relative to the reference area) do not indicate an amount of N loss or additional need, but do give an indication of the severity of deficiency; that is, the lower the relative value the greater the N deficiency. Chlorophyll readings should be helpful in confirming suspected N-loss situations and need for supplemental N. The later into the growing season these readings are taken, the more they can indicate small N deficiencies and the more they relate to total crop N need.

Assessing the corn crop

Before a decision is made to apply supplemental N, you should consider the potential productivity remaining after soils have dried. Has the stand been damaged, will the plants recover, is the area planted late or replanted, and is the yield potential reduced because of conditions other than N loss? It is possible that the combination of N remaining in the soil, plus N mineralized during the rest of the growing season, can supply adequate N. If corn at approximately the V6 to V8 stage is showing N-deficiency symptoms (due to N losses and not just due to waterlogged soils restricting root activity and growth), but otherwise has a good stand and appears to be growing well, then application of additional N should be beneficial.

The magnitude of yield recovery depends upon the crop stage when N deficiency occurs and the severity of deficiency. When slight-to-severe deficiencies are corrected early (by approximately V8 growth stage), or slight deficiencies are corrected late in the season (by approximately VT to R1), then full yield potential is possible. Large N deficiencies corrected late in the season may show yield increase but not recover fully.

It is important to be as certain as possible that additional N is needed. If extra N is applied, but is not required, then excess N could remain in the soil at the end of the season. Applying strips of N at several locations across fields can provide reference strips to evaluate response to additional N. If these reference strips indicate corn is responding (for instance, indicated by SPAD chlorophyll meter readings in the nonstrip-treated areas that are 95 percent or less of the values in the N-treated strips), then additional N can be applied to the rest of the field.

How to apply needed N

When conventional application equipment can be moved through the field (the soils are dry

enough and the corn is short enough), then injection of anhydrous ammonia or UAN solutions would top the list of best options. Next would come dribble UAN between corn rows, then broadcast urea. Broadcast UAN solution should be avoided because it can burn corn foliage, especially with large corn. If injection or conventional broadcast application is not possible (as is likely the situation due to the large corn in most of Iowa at this time), then UAN could be applied with high-clearance equipment with drop nozzles that direct the solution onto the ground, or urea could be aerially applied.

How late can I apply N?

It is best to get the N on as early as possible. However, yield responses that return income greater than the costs for application and fertilizer materials have been observed for N applied up to and slightly beyond the tassel stage. The magnitude of yield increase is dependent upon the severity of N deficiency and the ability of the crop to recover and respond to applied N (the growth and yield potential left after water damage and early season N deficiency). Any surface application is dependent upon rainfall to move applied N into the root zone, otherwise it cannot benefit the corn crop.

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