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Crop Nutrient Considerations for Wet or Flooded Fields

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INTRODUCTION

Many South Dakota fields have standing water with saturated soil conditions this spring. These wet soil conditions can have implications for existing soil nutrients and for nutrients applied for this season.

POTENTIAL NUTRIENT LOSSES

Nutrient losses due to surface runoff can occur in two ways: (1) Nutrients that have been recently applied and have not incorporated can dissolve in water and move by flood and/or runoff water into pools, ponds, streams, and rivers, and (2) fast-moving floodwater can physically wash away soil (this is called *scouring erosion*) that contains nutrients. Therefore, manure or fertilizer should not be spread on snow or frozen soils that could be prone to flooding or water runoff.

Soil nitrogen, in the nitrate form, can readily move with water through the soil (*leaching*) and could move below the effective rooting depth of crops. Leaching of nitrate-N usually occurs when the soil profile becomes saturated and additional precipitation enters the soil as snowmelt or rainfall. A rule of thumb is that a silt loam soil can hold approximately 2 inches of water per foot of soil. Therefore, a saturated silt loam soil would contain approximately 8 inches of water in a 4-foot root zone. Any additional water would begin to leach water and nitrate-N out of the root zone.

Coarse soils (sands, sandy loams) hold less water and require less precipitation for nitrogen leaching to occur. Because many soils are saturated, precipitation that enters the soil after spring thawing and before planted crops begin to use significant amounts of soil water (usually late March thru mid-June) could move water and available nitrate-N below the root zone. Only a 2-foot soil sample and a nitrate-N analysis can indicate carryover N levels. If leaching is suspected and previous soil tests indicated significant nitrate-N (>40 lb N/a in a 2-foot sample), then a resample and a retest should be done on several fields to determine the amount of possible leaching. This is more likely to occur on coarse-textured soils. Typically, fertilizer N applied in late fall or early spring has not yet converted to nitrate-N during this leaching period, unless spring temperatures have been exceptionally warm.

Soil N in saturated soils is prone to *denitrification*. Denitrification occurs under anaerobic conditions when bacteria convert nitrate-N to oxygen and nitrogen gas, which is then lost to the atmosphere. Denitrification occurs only if the nitrogen is in the nitrate-N form, the soil stays saturated for at least 7–10 days, and the soil temperature is warm enough (65–70°F) for significant anaerobic bacteria activity. Soils typically will not reach these temperatures until after mid-June in South Dakota; therefore, most denitrification occurs in

late spring and summer within low areas containing standing water.

Another potential nitrogen loss would be from *volatilization*. Volatilization occurs when urea nitrogen is exposed to the atmosphere. The urease enzyme (on soils and residues) converts urea to ammonia (NH₃), a gas that can be lost into the atmosphere. Ammonia loss can be significant if the urea is spread on the soil surface without incorporation, especially when large amounts of residue are present and soils are moist and warm. Ammonia loss can vary from no loss to almost all of the nitrogen applied, depending on the conditions.

A rainfall of at least 0.25 to 0.50 inches soon after application will move the urea into the soil where ammonia loss is minimal. It is recommended that non-incorporated urea be applied in early spring when temperatures are cool and chances of rainfall are higher. However, after 4–6 days from application, even cool temperatures do not guarantee minimal N loss when the surface soil remains wet. Banding the N on the surface and use of liquid N (28–32% N) will also limit volatilization. Producers applying urea or urea products to the surface may also want to consider a urease inhibitor (NBPT) to be added with the fertilizer. This product will inhibit the urease enzyme up to 14 days, depending on temperatures, giving more time for rainfall to occur. A poly-coated urea product will have a similar effect of delaying urea conversion to ammonia. If a producer delays N application because of wet soils until sidedress time, injecting the urea product below the soil is the surest way to avoid volatilization losses.

SOIL TEST

Fields or field areas affected by possible leaching, flooding, or that were under saturated conditions for a long period of time should be sampled for nitrate-N levels. Fields or field areas that were severely eroded by floodwaters should also be tested for general fertility (P, K, pH) as well. Organic matter, zinc, and sulfur levels should also be checked. Soil-sampling instructions are given on FS935 (“Recommended Soil Sampling Methods for South Dakota”), which can be found

at Extension offices, in pdf form online at <http://agbiopubs.sdstate.edu/articles/fs935>, or online at the SDSU Soil Testing Laboratory website at <http://plantsci.sdstate.edu/soiltest/>.

Because some fields may not have been sampled last fall, they may be too wet to sample this spring before fertilization or planting. Phosphorus, potassium, pH, and zinc soil test levels will not change dramatically, and soil tests from the past year or two can be used for making these nutrient recommendations. For nitrogen needs (for corn), a pre-sidedress nitrate-N soil test can be used for making N recommendations. For this test, a composite sample of 15–20 cores should be taken to a depth of 12 inches when corn is 6–12 inches tall. Iowa State University (1) has suggested a nitrogen recommendation based on this test: N recommendation (lb/a) = (25 – Nitrate test in ppm) x 8. For example, if the pre-sidedress nitrate test comes back from the laboratory as 10 ppm, then (25-10) x 8 = 120 lbs N/a.

RECOMMENDATIONS FOR FERTILIZING WET FIELDS

Before considering any fertilizer application program, a good soil test is required for the most accurate recommendations. If soil nutrient tests are in the medium category or higher for phosphorus and zinc, lower rates can be applied without negatively affecting crop yield. For P and K, applications slightly before or at planting are recommended. Broadcasting and incorporation can be done if soil conditions permit. With many modern air planters, much of the recommended nutrients can be applied during planting. Most of the nutrients are injected between the rows, keeping a safe distance between the high rates of fertilizer and the germinating seed.

With wet (and usually cool) soils, it is recommended that a phosphorus starter be used. This will enhance early plant P uptake even with limited root growth in cool soils. Usually, 15–20 lbs of phosphate per acre is adequate for a starter (plant growth) effect, with the remainder of the recommended P either broadcast or band applied. For the maximum starter effect, the starter should be applied either with the seed or within

a couple inches of the seed. The recommended rate allowed with the seed is affected by crop, row spacing, soil type and moisture level, and fertilizer material. A decision aid for determining seed-placed fertilizer rates is available at the SDSU Soil Testing Laboratory website at <http://plantsci.sdstate.edu/soiltest/> (select the “Seed Placed Fertilizer Decision Aid” along the left side of the webpage). Nitrogen application options were discussed above in the “potential nutrient losses” section.

PREVENTED PLANTING CONSIDERATIONS

For some fields, the prevented planting insurance option might be the only choice. These fields could dry out later in the season and permit equipment passage. If this occurs, the growth of a forage/cover crop would benefit the soil. For livestock producers, the value of the forage should be considered. For crop producers, a cover crop would enhance nutrient cycling and protect the soil surface from wind and water erosion. In addition, a growing crop could lessen soil com-

paction issues, help dry the soil, and decrease salt accumulation on the soil surface.

The growth of a cover crop would also limit the effects of *fallow syndrome* on the next crop. Fallow syndrome is a phosphorus deficiency that is caused by fallowing and not having living root material in the soil. Fallow reduces populations of the beneficial soil mycorrhizal fungi. These fungi act as root extensions and facilitate nutrient (especially P) uptake. Cover crops should contain other species besides brassicas, as this crop family does not host these organisms. Even weed growth is better than no growth in these wet areas. If the soil is left bare and has little or no plant growth, the addition of starter P for next year’s crop is recommended to help prevent fallow syndrome.

REFERENCES

“Nitrogen Fertilizer Recommendations for Corn in Iowa.” 1997. Pm-1714. Iowa State University Extension. Ames, Iowa.



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