Extension Responds: Flood

Evaluating Nitrogen Losses Following Excessive Rainfall

By Larry G. Bundy, Professor of Soil Science, University of Wisconsin-Madison, Extension Soil Scientist, **608-263-2889** **lgbundy@wisc.edu**

Most areas of Wisconsin have received large amounts of rain over the past several weeks that have caused concerns about nitrogen (N) losses from cropland and raised questions about the need for additional or supplemental N applications. It seems likely that significant losses have occurred in at least some situations. The major N loss processes of concern are leaching of available N below the crop root zone and gaseous loss of available N through denitrification in saturated or flooded soils. The exact extent of N losses through leaching and/or denitrification following the heavy rains is unknown. Both of these loss processes occur through the nitrate form of N, so the potential for significant loss is determined by the amount of the crop N supply that was in the nitrate form when the excess rainfall occurred. Losses depend on many factors such as when the N was applied, the forms of N applied or expected to provide N for the crop, soil characteristics, and how wet the soil is/was. In general, leaching losses are more likely on sandy soils where water can move through the profile quickly. Denitrification is more likely on medium and fine textured soils that are not well drained. These soils tend to become saturated with water and/or retain flooded areas for several days following excess rain.

Where fertilizer N was applied before planting, the timing of the application and the form of N used are important in determining the risk of loss. Keeping in mind that losses occur through the nitrate form of N, the timing of nitrate formation is an important consideration in evaluating potential losses. Fall-applied fertilizer N has a high risk for loss following excess rainfall because most or all of the N would be in the nitrate form by mid-May. For spring preplant applications, ammonium forms of N such as anhydrous ammonia or urea are converted to nitrate-N in about 4 to 6 weeks. Urea usually is converted to nitrate more rapidly than anhydrous ammonia. Nitrogen solutions (28% UAN) contain half of the N as urea and the remainder as ammonium nitrate. Essentially, this fertilizer contains 75% of the N as ammonium and 25% as nitrate when it is applied. Urea-containing fertilizers are converted to ammonium-N in 3 to 5 days after application, and this conversion occurs even in saturated or flooded soils.

Denitrification losses can occur within a few days if the soil remains saturated or flooded and nitrate-N is present. Warm temperatures and extended periods of saturated conditions favor high losses. Work in Illinois suggests that 4 to 5% of the nitrate-N present can be lost each day the soil remains saturated. The following table from the University of Nebraska provides some estimates of denitrification losses at various temperatures and times of saturated soil conditions.

Estimated denitrification N losses as influenced by soil temperature and days saturated†

Soil temperature (°F)	Days saturated	N loss (% of applied)
55-60	5	10
	10	25
75-80	3	60
	5	75
	7	85
	9	95

† Shapiro, University of Nebraska.

If part or all of the crop N requirement is expected to be provided from organic sources such as manure and/or previous legume crops, losses through leaching and denitrification are expected to be relatively small at this point in the growing season. This is because most of the N from organic sources has not yet been converted to nitrate. Rapid nitrate production from manures and previous legumes usually begins in mid-June and continues for several weeks during the growing season. The availability of N from organic sources can be checked using the preplant soil nitrate test (PSNT) described below.

Determining the need for additional N

A key decision for corn producers is whether additional N should be applied to compensate for N losses that may have occurred. Several decision aids or diagnostic tests are available to help determine the need for supplemental N and are summarized below.

Presidedress soil nitrate test (PSNT)- At this stage of the corn growing season, the PSNT offers a diagnostic method for evaluating the N supply for the crop. The test is particularly useful for those cases where previous legumes or manure applications are providing part or all of the crop's N need. It can also be used to confirm the extent of fertilizer N loss in the soil depth sampled. Since soil samples for the PSNT are taken to a 1-ft depth, nitrogen that has leached below this depth will not be reflected in the test. To use the PSNT, soil samples should be collected to a 1-ft depth when corn plant are between 6 and 12 inches tall. The details of performing the PSNT can be seen at the following web site. http://ipcm.wisc.edu/pubs/cards/a3630.htm

Nitrogen loss score sheet - Several years ago, Minnesota soil scientists Michael Schmitt and Gyles Randall developed a worksheet to help decide if more N should be applied for corn where N losses are suspected. That worksheet is generally appropriate for use in Wisconsin and it is duplicated below. The "Nitrogen Score Sheet" is intended to assess the need for additional N applications on a field-by-field basis during June.

Nitrogen Score Sheet

		Points
When was the N applied?		
Fall with soil temp. above 50° F		5
Fall with soil temp. below 50° F		4
Fall above 50° F, with N-Serve		4
Fall below 50° F, with N-Serve		3
Early spring (March or April)	3	
During May		2
What was the predominant May soil moisture status?		
Normal or drier than normal		1
Wetter than normal		3
There was/is water standing in field		4
How does the crop look?		
Taller than 12-16", but chlorotic (yellow)		5
Shorter than 12-16" and chlorotic		3
Shorter than 12-16" and normal green color		2
Taller than 12-16" and green		1
Total Score		_____

Interpretation:

Score = 7 or less - No additional N needed.
Score = 10 or more - Apply 50 to 100 lb N/acre.
Score = 8 or 9 - Re-evaluate in one week (if sidedressing is still an option).

Several additional factors should be considered in interpreting the score sheet results and in determining the rate of supplemental N to apply if the score is 10 or more. For sandy or coarse-textured soils, the rate of supplemental N should be toward the high end of the 50-100 lb N/acre range, because extensive leaching is likely on these soils. Where most or all of the crop N need is expected to be provided by manure or legumes, the supplemental N rate should be about 50 lb N/acre, because the organic N sources will continue to release available N during the growing season.

Options for applying supplemental N when it is needed include traditional sidedressing with anhydrous ammonia or N solutions. Where the entire crop N requirement has not yet been applied, sidedress or other postemergence applications should contain the balance of the crop N requirement plus 25-50% of the N that was already applied. Urea-ammonium nitrate solutions (28%) can also be applied as a surface band or as a broadcast spray over the growing crop. Dry

N fertilizers such as urea or ammonium nitrate can also be broadcast applied to the crop. Leaf burning from solution or dry broadcast applications should be expected. Applying the dry materials when foliage is dry will help to minimize burning. Several precautions should be followed in making broadcast fertilizer applications over growing corn, and these suggestions are summarized in Extension Pub. A3340 "Corn Fertilization" which can be viewed at http://cf.uwex.edu/ces/pubs/pdf/A3340.PDF. Basically, broadcast N rates should be limited to 90 lb N/acre for corn with 4 to 5 leaves and to 60 lb N/ acre for corn at the 8-leaf stage. Under N deficient conditions, corn will respond to supplemental N applications through the tassel stage of development if the N can be applied.

For more information: Larry G. Bundy**, 608-263-2889, lgbundy@wisc.edu**