



Grain Crops Update

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Nitrogen Loss associated with Saturated Soils

Excessive rain and saturated soils have generated considerable concern about nitrogen fertilizer loss. Nitrogen fertilizer is subject to considerable loss from excessive rainfall and wet, saturated soils. The loss resulting from saturated conditions and flooding occurs primarily through denitrification, particularly in heavy textured soils. Denitrification occurs when nitrate nitrogen is converted into nitrogen gas by microorganisms and escapes into the air. Two to three days of saturation are required for the process to begin.

The amount of nitrogen loss is very difficult to predict, and depends upon many factors. The primary factors affecting loss are likely fertilizer application timing, nitrogen source, and quantity applied, relative to the duration of saturated conditions and soil temperatures during this time. Essentially, seasonal nitrogen loss can be quite high, if a lot of nitrogen is exposed to numerous days of saturated conditions, particularly when soil temperatures are warm – in other words, early nitrogen application increases potential loss. This is why we strongly advocate applying nitrogen fertilizer to corn using split applications explained in previous issues.

Figure 1. Extended saturated conditions caused by excessive rainfall raise concern about potential nitrogen loss in corn fields. Considerable loss is likely where large amounts of nitrogen were applied in March and early April and have been saturated for several weeks this spring.



Warm soil temperatures accelerate the denitrification process. Research indicates denitrification rates range from 2-3% per day at soil temperatures from 55-65 F or 4-5% per day if soil temperatures exceed 65 F.

Timing of nitrogen application and nitrogen source affect the amount of applied nitrogen that will be in the nitrate form. This is important, because only the portion of nitrogen fertilizer present in the nitrate form is subject to denitrification. The following table estimates percentage of fertilizer present in the nitrate form for different nitrogen sources depending upon the time after application (adopted from “Evaluating Flood Damage in Corn”, Lee et al., Univ. of Kentucky, AGR-193).

Table 1. Percentage of nitrogen present in the nitrate form for different sources relative to fertilizer application time.

Nitrogen Source	Weeks After Application		
	0	3	6
	% of NO ₃ -N		
Urea	0	50	75
Urea (with N Serve)	0	30	70
UAN (28 and 32%)	25	60	80

For example, if a producer applied 200 pounds/a of N as UAN (32%) three weeks before the field became saturated and soil temperatures are about 60 degrees F, about 120 pounds N (200 x 60%) are present in the nitrate form. Each day of saturation after the initial two days results in an approximate nitrogen loss of about 3.6 lbs. of N per day (120 x 3%). Thus, if this field has been saturated for about 10-12 days, then anticipated N loss would be about 40 lbs./a.

If the crop survives the flooding, seasonal nitrogen need relative to corn productivity may be reduced due to restricted root growth, stunted vegetative development, and disease development, including crazy top, common smut and root rots. You should also be able to use more conservative rates than normal (about 1 lb. N or less per bu. of corn grain yield goal), because rapid nitrogen use is underway during late vegetative stages. Thus, supplemental nitrogen needs may not be as high as anticipated, particularly if you applied your seasonal allotment using best management practices.

Corn growers who have not applied their intended nitrogen allotment may need to aerially apply nitrogen, because crop height may prohibit utilization of ground equipment. However, we do not suggest applying nitrogen fertilizer when soils are completely saturated, flooded or ponded, because anaerobic conditions stunt crop growth/response and promote nitrogen loss. Two sources of granular nitrogen fertilizer are generally most feasible for mid-season topdress application on corn – ammonium nitrate and urea. Ammonium nitrate is generally the preferred nitrogen source because it is not subject to volatilize, compared to urea. Urea volatility can be substantial when temperatures are warm and rapid evaporation occurs, which will likely occur when rains cease. If you apply urea for this use, we recommend using urease inhibitors, such as Agrotain, to temporarily minimize surface volatility, until subsequent rainfall or overhead irrigation incorporate the urea-based N into the soil. Foliar nitrogen fertilizers and lower analysis nitrogen sources are not feasible for these situations because they cannot economically supply sufficient nitrogen to meet crop demand.

The primary limitation with applying granular nitrogen fertilizer during mid-season is leaf burn resulting from fertilizer granules falling into leaf whorls. Thus, **broadcast application should be limited to 100 to 150 pounds of granular nitrogen fertilizer material per acre on corn more than three feet tall.** Also avoid fertilizer application when leaves are wet with dew or rain, because moisture encourages fertilizer granules to stick to leaves and promote burn. Many will likely need to make at least two applications to attain the nitrogen needed for the crop, rather than applying one large application (200 to 300+ pounds of fertilizer material/a. – or about 70 to 150 lbs./a. of N). Delaying the second application a week or more will spread a reasonable amount of burn on different leaves, rather than causing severe burn on leaves in the whorl. This is important because the ear leaf and others, which supply much of the photosynthetic capacity to the grain, are in the whorl when the plant is four to five feet tall. Thus, we do not want to severely burn these leaves.

High clearance sprayers equipped with drops could also apply nitrogen to tall corn by dribbling UAN on the soil in the row middles. As with granular urea, we suggest using urease inhibitors, such as Agrotain, to temporarily minimize surface volatility for this use. Subsequent rainfall or overhead irrigation will be needed to incorporate nitrogen into the soil.

Figure 2. Top-dressing granular fertilizer will burn leaf tissue, so limit fertilizer applied depending upon size of the corn. If you need to apply a lot of fertilizer, we suggest making multiple trips, rather than a single heavy application, which would cause extensive burn on important leaves in the middle of the plant.



To add your address to the Corn and/or Wheat email list, please send a request to:
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