



Nitrogen losses from soil

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Nitrogen (N) can be lost from the field through three principal pathways: denitrification, leaching and surface volatilization. The form of N a farmer chooses should depend on how serious a problem he has with the above N losses. Cost of N, labor, equipment and power availability are other considerations when choosing a fertilizer source.

Denitrification occurs when nitrate N (NO_3^-) is present in a soil and not enough oxygen (O_2) is present to supply the needs of the bacteria and microorganisms in the soil.

If O_2 levels are low, microorganisms strip the oxygen from the nitrate, producing N gas (N_2) or nitrous oxide (N_2O), which volatilizes from the soil. Three conditions that create an environment that promotes denitrification are wet soils, compaction and warm temperatures.

Leaching losses of N occur when soils have more incoming water (rain or irrigation) than the soil can hold. As water moves through the soil, the nitrate (NO_3^-) that is in soil solution moves along with the water. Ammonium (NH_4^+) forms of N have a positive charge and are held by the negative sites on the clay in the soil; therefore, NH_4^+ forms of N leach very little in clay. Ammonium forms of N can leach in coarse-textured sands and some muck soils. These are the only soils where ammonium leaching may be significant.

One way to minimize N leaching and denitrification is to minimize the time the N is in the soil before plant uptake. This cuts down on the time when conditions are favorable for losses. Most of the N is needed by corn after the plant is 3 to 4 weeks old (June 1). Surface volatilization of N occurs when urea forms of N break down and form ammonia gases and where there is little soil water to absorb them. This condition occurs when urea forms of N are placed in the field but not in direct contact with the soil. This situation can occur when urea is spread on corn residues or 28 percent is sprayed on heavy residues of corn-stalk or cover crop. The rate of surface volatilization depends on moisture level, temperature and the surface pH of the soil. If the soil surface is moist, the water evaporates into the air. Ammonia released from the urea is picked up in the water vapor and lost. On dry soil surfaces, less urea N is lost. Temperatures greater than 50 degrees F and a pH greater than 6.5 significantly increase the rate of urea conversion to ammonia gases. Applying urea-type fertilizers when weather is cooler slows down N loss. If the surface of the soil has been limed within the past three months with 2 tons or more of limestone per acre, DO NOT apply urea-based fertilizers unless they can be incorporated into the soil. To stop ammonia volatilization from urea, the urea must be tied up by the soil. To get the urea in direct contact with the soil requires enough rain to wash the urea from the residue or placement of urea-based fertilizer in direct contact with soil by tillage, banding or dribbling. If the residue is light (less than 30 percent cover), 0.25 to 0.5 inch of rain is enough to dissolve the urea and wash it into the soil. If the residue is heavy (greater than 50 percent cover), 0.5 inch or greater of rainfall is required.

Ammonia volatilization of N may also occur when ammonium forms of N—ammonium sulfate (AS), ammonium nitrate (AN), diammonium phosphate (DAP), monoammonium phosphate (MAP) and ammonium polyphosphate (APP)—are surface applied to calcareous soils (soil pH greater than 7.5). The extent of loss is related to the reaction products formed when ammonium fertilizers react with calcium carbonate.

Ammonium fertilizers that form insoluble precipitates (AS, DAP, MAP and APP) are subject to greater ammonia volatilization losses than AN, which forms a soluble reaction product. To prevent ammonia volatilization, ammonium fertilizers should be knifed in or incorporated on calcareous soils.



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