

BASICS SHORT COURSE

The nitrogen (N) chemistry of bands is affected by materials applied, rates of application, and by soil conditions such as pH, organic matter content, biological activity, exchange capacity, compaction, temperature and moisture content.

When fertilizers containing ammonia or urea are placed in bands in or on the soil, the first reactions to occur are conversion of ammonia to ammonium-N (Figure 1), and hydrolysis of urea to ammonium-N (Figure 2). Both of these reactions require water. Urea hydrolysis requires the action of an enzyme, urease. Speed of that breakdown is affected by temperature, pH, soil organic matter content, and type of crop residues.

FIGURE 1

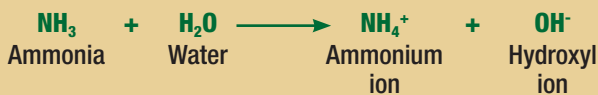
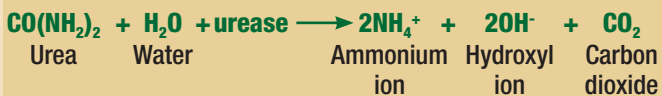


FIGURE 2



Both of these reactions create a higher pH in the band where they occur due to the production of the hydroxyl ions. If the soil is already high in pH, or if the rate of N application is high, the reaction in Figure 1 may be reversed (Figure 3) and free ammonia may remain present in the band for some time. Ammonium from urea is affected in the same way. If this occurs close to germinating seeds, ammonia toxicity results and the seedling dies.

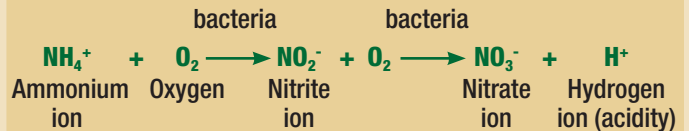
FIGURE 3



When soil conditions are right and microorganisms are present, the normal process is for ammonium ions to be rapidly converted to nitrate by nitrification (Figure 4). Rate is dependent on concentration of ammonium ions, soil temperature, soil pH, oxygen

availability, and presence of essential microbes. Reaction results in lowering of pH in the band.

FIGURE 4



Ammonium and nitrate ions are taken up and used by plants.

When phosphorus (P) is placed in these same bands, nitrogen chemistry can and does affect P reactions and availability. Normal P reactions in the soil are complex but all lead to the formation of compounds that are less available than the ammonium phosphates in which the P was applied. Those reactions are generally termed fixation and, depending on soil conditions, result from P reactions with calcium (Ca) and magnesium (Mg) in high pH soils (Figure 5) or iron (Fe) and aluminum (Al) in low pH soils (Figure 6).

FIGURE 5

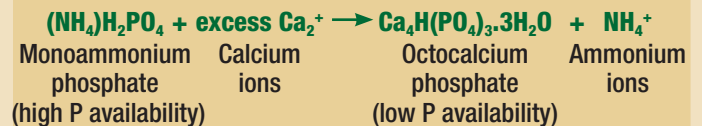
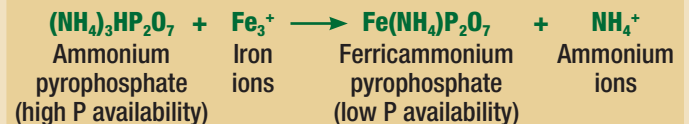


FIGURE 6



When high concentrations of ammonium ions are present in bands, such as in preplant banded UAN and 10-34-0 or in starters with added N, high concentrations of ammonium ions tend to inhibit these fixation reactions by driving them back to the left, maintaining the presence of ammonium phosphates and extending P availability. That makes P more mobile and allows it to move downward to a limited extent with soil moisture.