AGRONOMY

Nitrogen Losses

When nitrogen fertilizer is applied to the soil, some of the nitrogen is lost. Because of simple, unpredictable things like water flow and weather, the plant isn't able to use 100 percent of the applied nitrogen. However, if we understand what affects nitrogen fertilizer, we can better manage and minimize these causes of nitrogen loss.

The four primary sources of nitrogen loss are volatilization, immobilization, denitrification and leaching.

Volatilization

Volatilization is similar to evaporation, the process of changing from liquid to vapor. When ammonium in the soil is converted to ammonia, it can be lost as a gas. The process works just like a common household cleaner works. Ammonium is odorless; the ammonia we smell is actually the ammonium in the cleaner being released as ammonia gas. Soil ammonium can escape from the soil surface in the form of ammonia gas in the same way. Let's look at an example.

We've just surface-applied UAN liquid nitrogen. Unfortunately, if the soil has a high pH, the ammonium (NH4) in this fertilizer can volatilize as ammonia gas (NH3). This is just like applying anhydrous ammonia to the top of the soil. The urea in this fertilizer is also converted to ammonium by enzyme activity in the soil and can be lost in the same way.

Here are some solutions for minimizing volatilization:

- Apply fertilizer in cold weather when soil-enzyme activity is low
- Inject the fertilizer into the soil
- Apply when rain is predicted; the rain leaches the fertilizer, and the soil then traps it
- When applying urea, also apply a soil-enzyme inhibitor (e.g., Agrotain®)

Immobilization

Just like humans need protein and carbohydrates, plants need carbon and nitrogen from nitrate or ammonium for energy. In order for soil microbes to decompose plant residue, the microbes must be fueled by the same nitrogen that feeds crops. When decomposition nears completion and the number of microbes declines, nitrogen will once again become available. Thus, immobilized nitrogen is only lost temporarily. We can minimize this problem by over applying nitrogen when heavy residue is present or by applying the nitrogen below the ground where there is no residue to decompose.

Denitrification

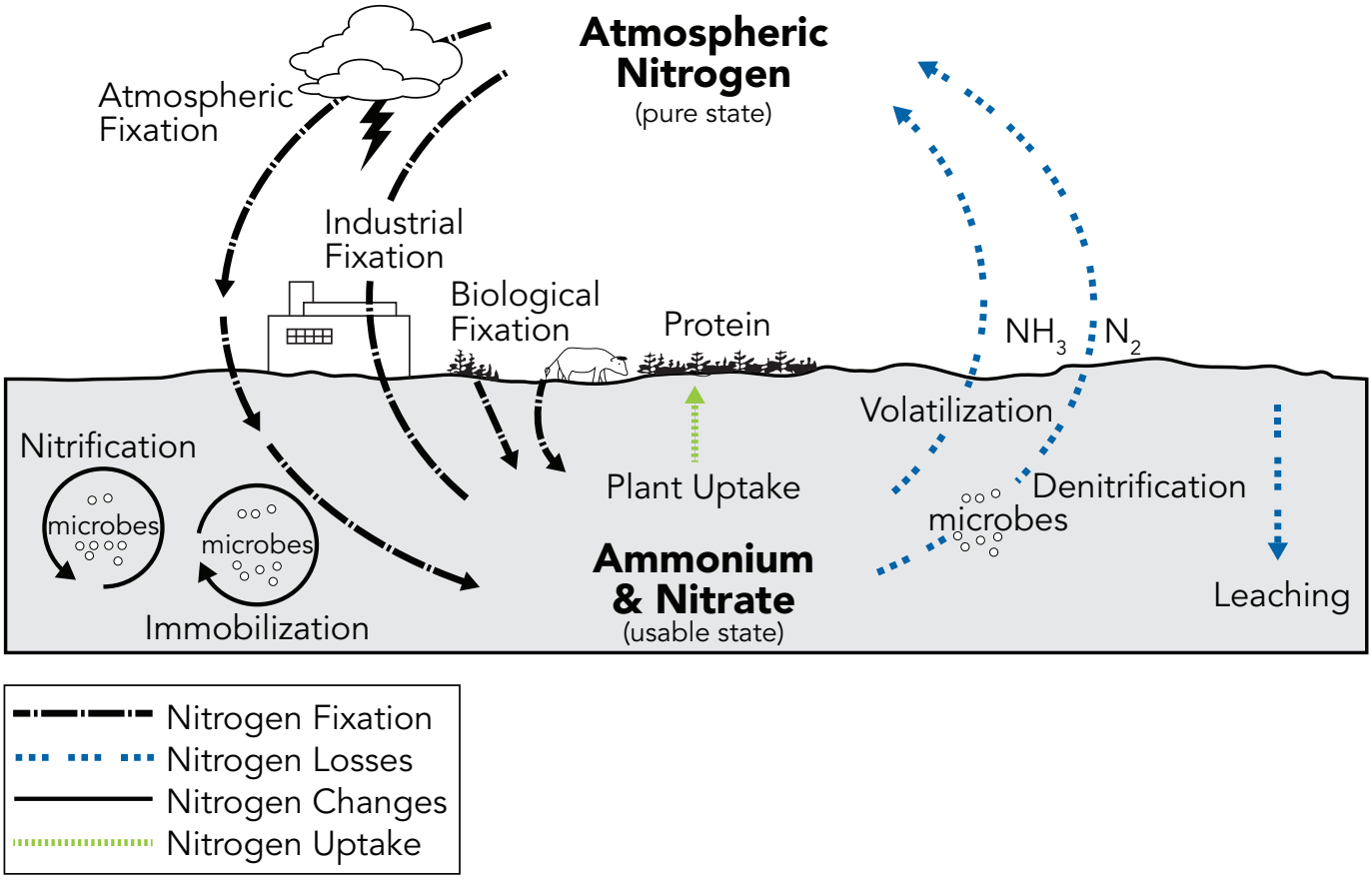
In addition to food, microbes need air to breathe. Normally, this isn't a problem, but if the soil is very wet, less oxygen is available. When the soil is waterlogged, the soil microbes will find another source for the oxygen. The soil microbes will strip the oxygen from the nitrate molecule. With the oxygen stripped from the nitrate, the remaining nitrogen is lost as a gas.

Leaching

When water passes through soil, nitrate is moved below the root zone where it cannot be utilized by crops. This is especially a problem in areas that have both sandy soils and high rainfalls. Here are three techniques for minimizing leaching:

- Apply sources of nitrogen in ammonia form
- Use nitrogen stabilizers to keep the nitrogen in its ammonium form
- Apply multiple applications of nitrogen (spoon-feed)

Figure 1.



Summary

Each of these four types of nitrogen loss (Figure 1) can be categorized as either physical or biological. The physical processes (such as leaching and volatilization) occur regardless of the microbial activity. Biological processes, however, are dependent on microbial activities which, in turn, are dependent on the soil temperature, oxygen, moisture, and residue (food).

Oxygen, moisture, and adequate amounts of food are needed ingredients to sustain a population of microbes to cause denitrification and immobilization. Processes such as denitrification and immobilization are usually insignificant when temperatures are less than 50°F because microbial activity is slow at cold soil temperatures. Typically, biological losses of nitrogen occur in late spring through early fall; physical losses of nitrogen can occur year-round.