Sunland Analytical
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Nitrogen Plants Need

Like all living entities, plants require nitrogen. Most nitrogen taken in by plants is utilized to produce proteins and DNA, of course, an absolute necessities for life and growth. In soil, 95 percent of the nitrogen present is organic nitrogen, that is, nitrogen that is combined in some form with other elements such that it is not readily available (i.e. partially degraded proteins or components from other degrading organisms). To be incorporated into plants the nitrogen needs to be converted into Nitrate (NO_3^-). To convert the organic nitrogen to nitrate, a process described as mineralization, requires several steps resulting in the conversion of the organic nitrogen into ammonia (NH_4^+). Subsequently, in a two step process called nitrification, the ammonia is converted to Nitrite (NO_2^-) and ultimately into Nitrate that is then available to be taken up by the plant. Where there is excess nitrogen in the soil it usually accumulates as Nitrate.

1) Soil Organic Nitrogen >> Ammonia (Mineralization)

2) Ammonia + Oxygen + soil bacteria >> Nitrite + Oxygen + soil bacteria >> Nitrate (Nitrification)

As indicated above plants need nitrogen, if there is a nitrogen deficiency growth will slow and there will be a distinct "yellowing" of the leaves. Therefore, providing an adequate source of nitrogen in the soil for plant uptake is essential. Any source of nitrogen can work, but the steps required for it to be available to the plant as Nitrate must be considered.

1. **Organic Nitrogen** as manure, compost or other degrading organic material can provide a source for the plant nitrogen. Clearly the steps described above indicate the process. However, the extent to which it will be converted to usable nitrate will depend on soil temperature, soil moisture, soil oxygenation, soil pH, amount of specific soil bacteria and other factors. Thus, it is apparent that these materials will not provide a nitrogen source rapidly available. It will provide a good "slow release" of nitrogen which will be available to the plant slowly over time. Therefore, if these components are going to be used in the fertilization regime they should be incorporated during pre-plant preparation or applied well before there will be a significant demand for nitrogen by the plant.

2. **Special Case – Organic Nitrogen** – urea might be considered a special case because it must be mineralized to ammonia before nitrification. However, the ease and rate at which it is converted to ammonia makes it a readily available nitrogen source for plants and indeed urea is a common source of nitrogen in commercial fertilizers. Urea sold by itself is designated 42-0-0, recall the the percent nitrogen is the first number on fertilizer labels.

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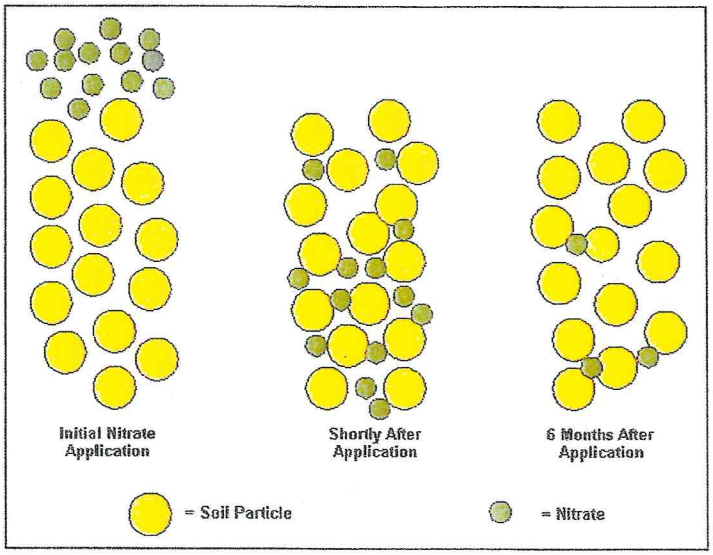

Figure 1. Nitrate Penetration into Soil

3. **Ammonia** – can be applied directly to the soil thus circumventing the entire process of mineralization and allow very rapid access of the nitrogen to the plant. Additionally, ammonia has a added feature that makes it an effective fertilizer for early application to growing sites, that is, it normally exists as the ammonium ion (NH_4^+) with a positive charge to it. Since soil particles are negatively charged the ammonium ion is bound to the soil particles and is not readily leached by irrigation or rainfall. Thus, it is available to be converted to nitrate over an extended period of time. One aspect of the chemical characteristics of ammonia is that if the pH of the soil is above 7.5 there is the ability of the ammonia to be volatilized into the atmosphere as ammonia gas. Thus, resulting in loss of availability for fertilization. Ammonia, as aqueous ammonia (82-0-0) is a typical product available for agricultural use. A more common ammonia fertilizer for other users is Ammonium Sulfate (Sulfate of Ammonia) (21-0-0) an inexpensive fertilizer available widely.

4. **Nitrate** - is great for immediate availability to the plant. There is no conversion to make it into the chemical form the plant uses. The downside to use of nitrate fertilizers is that they are readily leached through the soil profile (see Figure 1) so that after a period of time the nitrate is not available to the plant. This condition necessitates care in application and timing of subsequent applications. The most desirable approach is to apply enough that the plants can utilize it before it is leached below the root zone and then make another application before the plants run low on the available nitrate. A great goal, but one not usually accomplished. Nitrate fertilizers are available (less available today because of its explosive nature) as Ammonium nitrate (34-0-0) or Calcium nitrate (15-0-0).

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Ok nitrogen is available in different forms and with different rates of availability, so how much should be applied? Of course, the answer is "that depends". If you are growing corn you will likely need in excess of 200 pounds per acre, rice somewhere about 100 pounds per acre, or your home garden maybe a couple of pounds per 1000 sq.ft. This is where Sunland Analytical provides you the specific answers you need so that you get optimal returns for your efforts.