



PROFESSIONAL PRODUCTS

BALANCING SOIL NITROGEN

Nitrogen in the soil can come from the atmosphere, fertilizer, plant residue, organic matter and animal waste. All must be converted to either ammonium  $\text{NH}_4^+$  or nitrate  $\text{NO}_3^-$ . Ammonium is a positive ion and nitrate is a negative ion. It is generally accepted that **C** is the dominating form found in most well aerated soils. (Hull, 2005).

Putting green root zones are more than 90% sand and nitrate is present only for a short time before it is leached, consumed by microbes, or taken up by the root. Therefore, most of our soil tests show low levels of nitrate in greens.

Ammonium forms of nitrogen must be converted by bacteria to nitrate (nitrification). This only happens in warm soil. Denitrification is where nitrate converts to a gas and is lost. In sandy soils, this only happens when the sand is waterlogged.  $\text{NH}_4^+$  is a little like slow release nitrogen and if it is converting to  $\text{NO}_3^-$  then the balance of the two ions is a benefit to plants. If the soil is dominated by  $\text{NH}_4^+$  the problems can occur.

Excess ammonium in the soil can strongly inhibit the uptake of nitrate. And can be toxic if accumulated inside plants.  $\text{NH}_4^+$  can limit the uptake of K, Ca and Mg and this may be one reason for problems with low levels of these cations in plants.

Also, excess potassium ( $\text{K}^+$ ) in the root zone inhibits the uptake of  $\text{NH}_4^+$ . This is because both are a positive ion. Continual applications of ammonium, urea, and non-nitrate forms of nitrogen should be avoided during times when soil temperatures are below 60F.

Even though plants absorb both forms of nitrogen, nitrate must be converted to ammonium *inside* the root before it can be formed into amino acids and other organic compounds. This is a high energy reaction and requires several enzymes. If the enzymes are not sufficient, the root will store nitrate in the vacuole for later use. Ammonium is not stored in the plant and if excess ammonium is present in the root, or leaf, a toxicity affect occurs.

*It is very important to manage the amount and form of nitrogen present in the root zone.*

The ratio of ammonium to nitrate has a profound effect on rooting. Applications of nitrogen with a ratio of 1:3 (Nitrate: ammonium) produces the healthiest plant and best root system on newly sodded bentgrass. (Glinski, et al., 1990). Ammonium has long been linked to darker green color response in turfgrass. Nitrate fertilizer does not product the dark green color. So, don't expect great dark green grass when using nitrates. Use iron to product dark green color.



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Soil tests should be taken for total nitrogen, nitrate nitrogen, ammonium nitrogen, and organic matter every spring and fall. You need to know the status of the soil before developing a program. Healthy soils should have about 20-30 lbs/acre of total nitrogen. Hopefully, at least 50% of the total is in the nitrate form. Less than 6 lbs per acre is seriously deficient. (Gelenter)

Under normal conditions, ammonia-based fertilizers *should* convert to nitrate but because many green root zones are too cool, or have low oxygen levels, the accumulation of ammonium is likely to occur. This can happen at any time of the year.

Soils with higher levels of organic matter and clay, such as fairway and rough soil, usually have higher nitrate levels and total nitrogen. As the organic matter decays, carbon, nitrogen and water are released into the soil, thus contributing to rising nitrogen concentrations. Organic matter contains between 3-5% nitrogen. Each percent of organic matter releases about 20 lbs/acre of nitrogen per year.

We highly recommend monthly nitrogen monitoring on greens for nitrate-nitrogen levels. Samples must be air dried over night or dried in a 100F oven. If you don't do this, the ammonium will convert to nitrate in warm climate of the post office!

If you think that your water source may be high in nitrogen, a seasonal analysis for total nitrogen (ammonium and nitrate) can also be very important.

A proper fertilizer program can be designed after the nitrogen totals and balance are known.

Planet Turf has several types of nitrogen fertilizers:

Soil test 3 times during the year  
SPRING-SUMMER-FALL to  
determine nitrogen content of  
the soil

1. Kick 10-2-4 – 1.13% Nitrate 8.87% urea
2. Nitrain 14-0-22 – 100% Nitrate
3. Rocket N 28-0-0 – 6% nitrate, 7% ammonium, 15% Urea
4. 18-2-18 granular – 15% Nitrate, 85% urea

### References Cited:

D.S. Glinski, H.A. Mills, K J . Karnok, and R.N. Carrow. 1990. Nitrogen Form Influences Root Growth of Sodded Creeping Bentgrass. HORTSCIENCE 25(8):932-933.

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