# Area Crop Report 12/16 – 12/20

**Understanding the Nitrogen Cycle and All of its Components**

The nitrogen cycle is a complex understanding of multiple processes and microbial activity that change chemical compositions of nitrogen. Such processes consist of: mineralization, immobilization, soluble organic nitrogen, $NH_4^+$ fixation, ammonia volatilization, nitrification, and denitrification. In this week's crop report, I aim to go through these processes in hope to come away with a better understanding of each process. If you're a visual learner like myself, I attached a graphic that will help explain the entirety of the process.

***Mineralization:*** The conversion of organic nitrogen into mineral nitrogen ($NH_4^+$). This organic nitrogen comes from organic matter and soil organisms. (i.e. Organic N => Inorganic N)

***Immobilization:*** Uptake of nitrogen by microbes through decomposition, converting mineral forms into organic forms of nitrogen. This form of nitrogen is not plant available. (i.e. Inorganic N => Organic N)

***Soluble Organic Nitrogen:*** Form of nitrogen is largely taken up by microbes, however can be taken up by plants in a nitrogen-limited environment/systems. Only about 0.3 to 1.5% of the organic nitrogen in the soil is soluble.

***$NH_4^+$ Fixation by Clay Colloids:*** Positively charged $NH_4^+$ ions are attracted to the negatively charged clay ions, making our area of heavier found clay soils very relevant. For more information regarding ammonium fixation and ammonia volatilization, please refer to October 28th's crop report covering fall anhydrous application timeliness.

***Ammonia Volatilization:*** Found when $NH_4^+$ is in equilibrium with $NH_3$ ($NH_4^+ + OH^- \Leftrightarrow H_2O + NH_3$). Process is higher in soils with low CEC levels, and more pronounced in high pH environments. This is due to hydroxides driving the equation above right, causing more ammonium to volatilize. Incorporating manure and fertilizers in to the soil can limit volatilization

***Nitrification:*** The conversion of ammonium to nitrite (through nitrosomonas bacteria) to nitrate (through Nitrobacter bacteria) that causes acidification. In chemical composition terms:

- $NH_4^+ + 1.5\ O_2 \Rightarrow NO_2^- + 2H^+ + H_2O$ + 275 Kilojoule's of energy (Nitrosomonas bacteria)
- $NO_2^- + 0.5\ O_2 \Rightarrow NO_3^-$ + 76 Kilojoule's of energy (Nitrobacter bacteria)

Nitrification inhibitors suppress the activity of Nitrosomonas. Nitrite is toxic to roots, so you don't want to inhibit Nitrobacter.

***Denitrification:*** Occurs only in anaerobic (non-oxygen) environments. This is due to heterotrophic (can't make its own food) microbes removing oxygen and lowering the valence state of nitrogen.

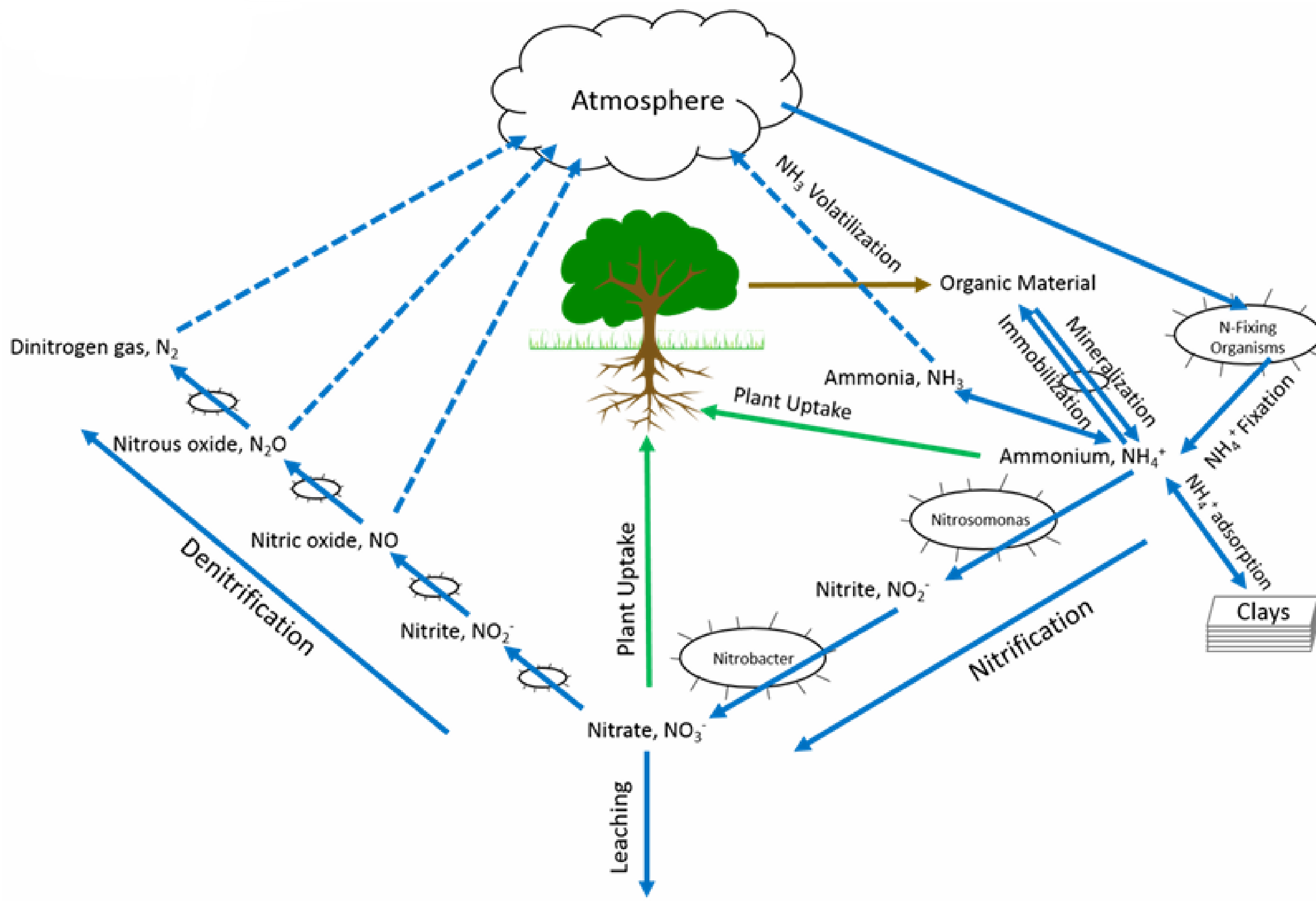
- $2\ NO_3^- \Rightarrow 2\ NO_2^- \Rightarrow 2\ NO \Rightarrow N_2O \Rightarrow N_2$

Each step above is performed by heterotrophic bacteria under anaerobic conditions. Nitric oxide (NO), a greenhouse gas, and nitrous oxide ($N_2O$) in the atmosphere can cause nitric acid, or acid rain. Nitrous oxide can also cause destruction of the ozone layer if it moves into the stratosphere.

Nitrogen is a critical component of proteins, nucleic acids, and chlorophyll. When plant foliage appear yellow or light green in color, has stunted growth, or thin and spindly leaves, it is likely you are seeing a nitrogen deficiency, otherwise known as chlorosis.

**"*And if you think tough men are dangerous, wait until you see what weak men are capable of.*"**

**Jordan Peterson**



Atmosphere
NH3 Volatilization
Organic Material
N-Fixing Organisms
Immobilization
Mineralization
Dinitrogen gas, N2
Ammonia, NH3
Plant Uptake
NH4+ Fixation
Nitrous oxide, N2O
Ammonium, NH4+
Nitrosomonas
NH4+ adsorption
Nitric oxide, NO
Denitrification
Plant Uptake
Nitrite, NO2-
Clays
Nitrite, NO2-
Nitrobacter
Nitrification
Nitrate, NO3-
Leaching