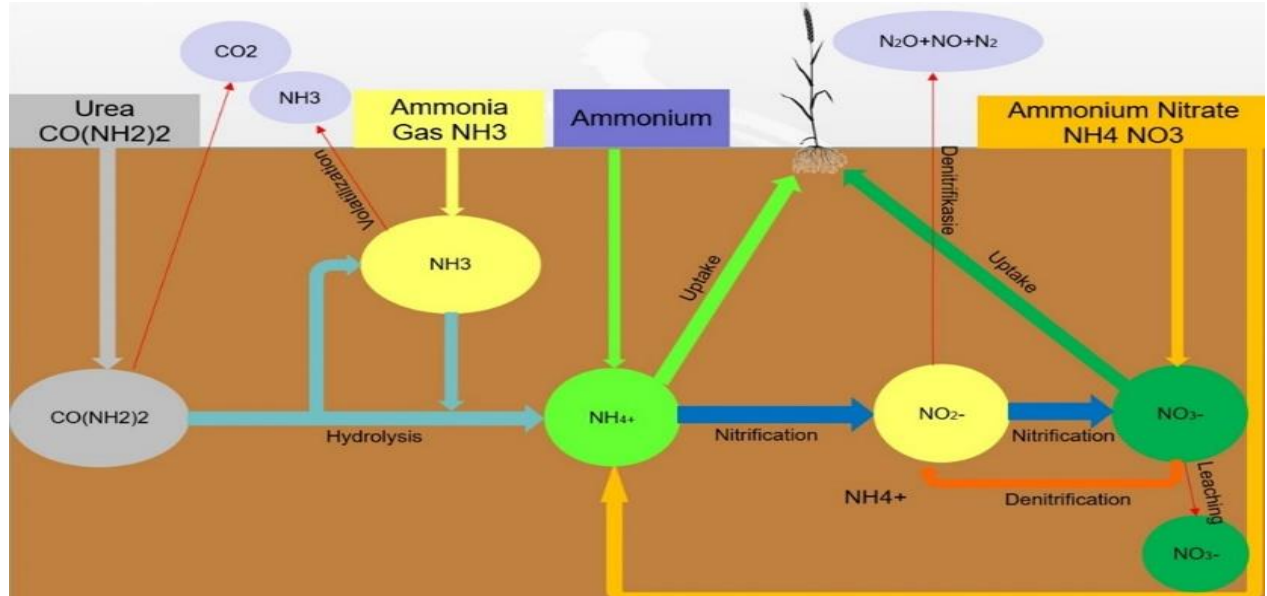


The Nitrogen Cycle

Martin Harris

Nitrogen cycles of different nitrogen sources:

The above schematic shows how different nitrogen sources react when applied to soils. Every source of nitrogen has advantages and disadvantages. From the above diagram, all inorganic nitrogen sources end up as nitrate which is prone to leaching. Timing of the application of nitrogen sources is of utmost importance.



The importance of the understanding the cycle.

In these challenging times of higher fertilizer prices, it is important to understand the cycle of nutrients that are applied. Nitrogen is one of the nutrients that is expensive to apply. Huge amounts of energy is needed to produce nitrogen.

Urea $\text{CO}(\text{NH}_2)_2$ (46% Nitrogen)

Advantages

- Cheaper source of nitrogen with a high concentration of nitrogen.
- Application via pre-planter, planter and/or spreaders is relatively easy.
- Urea can be coated with urease and nitrification inhibitors.
- Urea hydrolyses to ammonium, a cation that is absorbed by clay particles.
- Plants can take up nitrogen in the ammonium form.
- The reduction of ammonium to proteins in plants is a low-energy process. Thus, plants do not need to spend more energy to convert ammonium to proteins

Disadvantages

- If urea is applied to the soil surface and not incorporated into the soil, there is a risk of volatilization.
- Urea could leach out of soil directly after application if high volumes of water pass through the soil after application.
- When urea is hydrolyzed in soils there is a temporary pH spike which can damage plant roots. Care needs to be taken if urea is band placed close to seeds.
- After urea has been hydrolyzed into ammonium, the process of nitrification starts. In this process hydrogen, H^+ is released into the soil and thus acidification of soils occurs.
- 3.2kg lime needed to neutralize 1kg of nitrogen.

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Ammonia Gas NH₃ (82% Nitrogen)

Advantages

- Cheapest source of nitrogen per kg nitrogen.
- Ammonia hydrolyses to ammonium, a cation that is absorbed by clay particles.
- Plants can take up nitrogen in the ammonium form.
- The reduction of ammonium to proteins in plants is a low-energy process. Thus, plants do not need to spend more energy to convert ammonium to proteins.

Disadvantages

- Specialized equipment and handling is needed to apply ammonia.
- Soil moisture conditions are vital to the application of ammonia.
- After ammonia has been hydrolyzed into ammonium, the process of nitrification start. In this process hydrogen, H⁺ is released into the soil and thus acidification of soils occurs.
- 3.2kg lime needed to neutralize 1kg of nitrogen.

Ammonium Nitrate (28% Nitrogen, 14% Ammonium and 14% Nitrate)

Advantages

- Application via pre-planter, planter and or spreaders is relatively easy.
- Application with spreader is safe because there is no risk of volatilization.
- Ammonium which is a cation and is absorbed by clay particles.
- Plants can take up nitrogen in the ammonium and nitrate form.
- The reduction of ammonium to proteins in plants is a low-energy process. Thus, plants do not need to spend more energy to convert ammonium to proteins.

Disadvantages

- More expensive form of nitrogen.
- The nitrate N source is immediately at risk of leaching.
- When ammonium is applied the process of nitrification start. In this process hydrogen, H⁺ is released into the soil and thus acidification of soils occurs.
- 2.5kg lime needed to neutralize 1kg of nitrogen.

Ammonium Sulfate (NH₄)₂SO₄

(21% Nitrogen)

Advantages

- Supplies sulfur as well as nitrogen to plants.
- Application via pre-planter, planter and or spreaders is relatively easy.
- Ammonium which is a cation and is absorbed by clay particles.
- Plants can take up nitrogen in the ammonium form.
- The reduction of ammonium to proteins in plants is a low-energy process. Thus, plants do not need to spend more energy to convert ammonium to proteins

Disadvantages

- More expensive form of nitrogen.
- Low in nitrogen content.
- When ammonium is applied the process of nitrification start. In this process hydrogen, H⁺ is released into the soil and thus acidification of soils occurs. Ammonium Sulfate is the most acidifying nitrogen source.
- 6.4kg lime needed to neutralize 1kg of nitrogen.

