Nitrogen Reactions

- Biological fixation (symbiotic)

$$\text{Atmospheric } N_2 \xrightarrow[\textit{(Rhizobia)}]{} \text{Legume Plant N}$$

(Soil Temp. > 50 degrees F)

Nitrogen Reactions

- Biological fixation (symbiotic)
- Chemical / industrial fixation

$$\text{Atmospheric } N_2 + \underset{\textit{natural gas}}{CH_4} \longrightarrow \underset{\textit{ammonia}}{NH_3}$$

$$\underset{\textit{ammonia}}{NH_3} \longrightarrow \text{N fertilizers}$$

Nitrogen Reactions

- Biological fixation (symbiotic)
- Chemical / industrial fixation
- **Mineralization (ammonification)**

$$\text{Soil Organic N} \longrightarrow NH_4^+$$

ammonium

(Soil Temp. > 50 degrees F)

Nitrogen Reactions

- Biological fixation (symbiotic)
- Chemical / industrial fixation
- Mineralization (ammonification)
- **Nitrification**

$$\underset{\textit{ammonium}}{NH_4^+} \xrightarrow[\textit{soil bacteria}]{} \underset{\textit{nitrite}}{NO_2^- + H^+}$$

$$\underset{\textit{nitrite}}{NO_2^-} \xrightarrow[\textit{soil bacteria}]{} \underset{\textit{nitrate}}{NO_3^-}$$

(Soil Temp. > 50 degrees F)

Nitrogen Reactions

- Biological fixation (symbiotic)
- Chemical / industrial fixation
- Mineralization (ammonification)
- Nitrification
- **Immobilization**

$$\underset{\textit{inorganic N}}{NO_3^- \text{ or } NH_4^+} \xrightarrow[\textit{soil bacteria}]{} \text{Organic N}$$

(Soil Temp. > 50 degrees F)

Carbon:Nitrogen Ratio Effects on N Release

Expected N Effect	C:N Range
Release N	< 20
Variable (depends on composition)	20 - 50
Immobilize (tie-up) N	> 50

Carbon:Nitrogen Ratios of Organic Materials

Material	C:N Ratio
Soil microorganisms	8
Soil organic matter	10
Alfalfa	12
Rotted manure	20
Corn residue	60
Grain straw	80
Sawdust	300

Release N

Tie-up N

Nitrogen Reactions

- Biological fixation (symbiotic)
- Chemical / industrial fixation
- Mineralization (ammonification)
- Nitrification
- Immobilization
- **Denitrification**

$$\underset{\textit{nitrate}}{NO_3^-} \xrightarrow[\textit{wet soils, low oxygen}]{\textit{soil bacteria}} \underset{\textit{gases lost to air}}{N_2 + N_2O}$$

(Soil Temp. > 50 degrees F)