

NITROGEN (N) FERTILITY

Plant growth is limited by nitrogen (N) more than any other substance except water. Most fruit trees need 50-200 lbs. Of actual N/acre/year

N REQUIREMENTS IN FRUIT TREES

- 5 % loss from flower shedding
- 30-40% loss in leaf shedding
- 20% loss in crop – more in heavy crop year
- 30% translocated back to wood from leaves in the fall

N SOURCES

- a. Nitrate NO_3^-
- b. Nitrite NO_2^-
- c. Ammonium salts NH_4^+
- d. Urea $CO(NH_2)_2$
- e. Organic matter (amino acids from proteins)
- f. Ammonia (gas or aqueous) NH_3

UPTAKE OF N and REDUCTION IN PLANTS

Absorbed by roots in 2 forms: NITRATE and/or AMMONIUM

- A. Nitrogen moves from roots to leaves transported primarily in xylem as nitrate NO_3^- . It is then reduced in leaves to amino acids and proteins for plant growth.
- B. Some plants reduce nitrogen in roots and xylem transports amino acids and amides.
- C. Many plants also absorb and transport the ammonium form small quantities of nitrogen.

Nitrate reduction in the plant

Nitrate NO_3^- (absorbed by plant) reduced \rightarrow NO_2^- (nitrite)

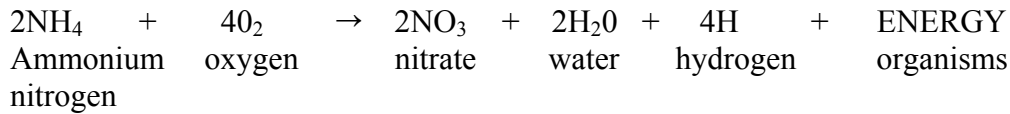
Reduced \rightarrow N_2O_2 (Hypo nitrite) \rightarrow NH_2OH (Hydroxyl amine) \rightarrow NH_3 (ammonia) \rightarrow amino acids \rightarrow proteins

FORMS OF NITROGEN FERTILIZERS

- A. NH_3 (ammonia gas) or aqua reacts with water \rightarrow NH_4^+ (ammonium)
- B. NH_4^+ (ammonium) ammonium sulfate $(NH_4)_2 SO_4$
Ammonium phosphate $(NH_4)_2 H_2 PO_4$
- C. $CO(NH_2)_2$ [neutral charge] (Urea)
- D. (Manure) (Blood Meal) Proteins broken down to amino acids (aminization) and ammonia NH_3 (gas) (ammonification)
- E. NO_3^- (nitrate) ammonium nitrate $NH_4 NO_3$ - Calcium nitrate - Sodium Nitrate $Na(NO_3)_2$

NITROGEN MOVEMENT IN SOIL

- A. Ammonium form + (positive) charged and held at surface 2-3 inches strongly as a colloid on clay or organic matter particles. It takes 1-2 weeks to convert ammonium forms to nitrate forms, called nitrification. This is done by microorganisms when adequate temperatures, oxygen, moisture and pH are present.



- B. Urea 0 (neutral) charged and very soluble; moves with water. One day later hydrolyzed by enzymes to the ammonium form and behaves like ammonium after that, eventually converted to nitrate; just like other ammonium forms of N.
- C. Nitrate form is – (negative) charged and so is the soil, so it freely moves with no attraction to clay or organic matter particles. Moves wherever water goes, and must be very careful not to leach into water sources. It is readily absorbed by plants.
- D. Surface applied materials must be irrigated in or incorporated or else will eventually convert back to free nitrogen and will be lost back into the atmosphere.
- E. Denitrification occurs under compacted soil or wet soil conditions (anaerobic). NO_3 (nitrate) is converted to nitric oxide and free nitrogen being lost back into the atmosphere as a gas.
- F. Nitrogen fixation, various soil organisms live in nodules on roots of legumes and convert free nitrogen gas into nitrate and ammonium forms. Lightning also fixes nitrogen and rain carries it into the soil.
- G. Organic matter, as it breaks down from proteins to amino acids to ammonium releases nitrogen slowly.

High carbon organic matter that is raw and has not been broken down ties up available nitrogen in the soil, which is used by microorganisms to break down complex proteins, waxes, and carbohydrates. This is done by various soil fungi, bacteria, and protozoa.

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