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 → NO_2 (nitrite)

Reduced →N_20_2 (Hypo nitrite) → NH_20H (Hydroxyl amine) → NH3 (ammonia) → amino acids → proteins

FORMS OF NITROGEN FERTILIZERS

A. NH_3^+ (ammonia gas) or aqua reacts with water → NH_4^+ (ammonium)

B. NH_4^+ (ammonium) ammonium sulfate $(NH)_2\ SO_4$
Ammonium phosphate $(NH_4)\ H_2\ PO_4$

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.

$2NH_4$	+	40_2	→	$2NO_3$	+	$2H_20$	+	4H	+	ENERGY
Ammonium nitrogen		oxygen		nitrate		water		hydrogen		organisms

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. Dentrification 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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