VEGETATION MANAGEMENT

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The following discussion on fertilizer absorption and burn is in response to the many requests for fundamental information in these areas.

How are fertilizers absorbed?

All fertilizers, whether organic or inorganic, will eventually form soluble salts that separate in water to release the nutrient ions. Ions are atoms or groups of atoms that carry either positive or negative charges and *are the only form of nutrients that can be absorbed by plant roots.*

The process of nutrient absorption is not clearly understood, but it is believed that the positively or negatively charged ions are attracted to an opposite charge within the root membrane. Through this attraction the nutrient ion is passed across the membrane into the root cells. As long as the fertilizer remains in an uncharged state, it cannot be absorbed.

How are nutrient ions formed?

Inorganic fertilizers are composed of positive and negative ions that separate when the fertilizers dissolve in water. For example, when ammonium nitrate (NH_4NO_3) dissolves in water it releases the positively charged ammonium ion (NH_4^+) and the negatively charged nitrate ion (NO_3^-).

Fertilizer	Formula		Available Forms
ammonium nitrate	NH_4NO_3	*water*	$NH_4^+ + NO_3^-$
superphosphate	$Ca(H_2PO_4)_2$	*water*	$Ca^{++} + 2\,H_2PO_4^-$
potassium sulfate	K_2SO_4	*water*	$2\,K^+ + SO_4^=$

Organic fertilizers release the same nutrient ions found in inorganic fertilizers but the process is generally slower. Most organic fertilizers must be decomposed by soil microorganisms before the nutrients become available.

Fertilizer	Formula		Available Forms
organic nitrogen (segment)	-C-N-C-NH_2	*water microbial decomposition*	NH_4^+ NO_3^-

In general, inorganic fertilizers are considered quick-release and organic fertilizers slow-release because of the release rate of the nutrient ions. Inorganic fertilizers that are coated with an insoluble or slowly soluble material can also be considered slow-release since the coating slows down the release of the ions by inhibiting the penetration of water. The concept of slow-release is usually applied only to nitrogen fertilizers since, of the primary fertilizers, only nitrogen in the form of nitrate is rapidly leached from the root zone.

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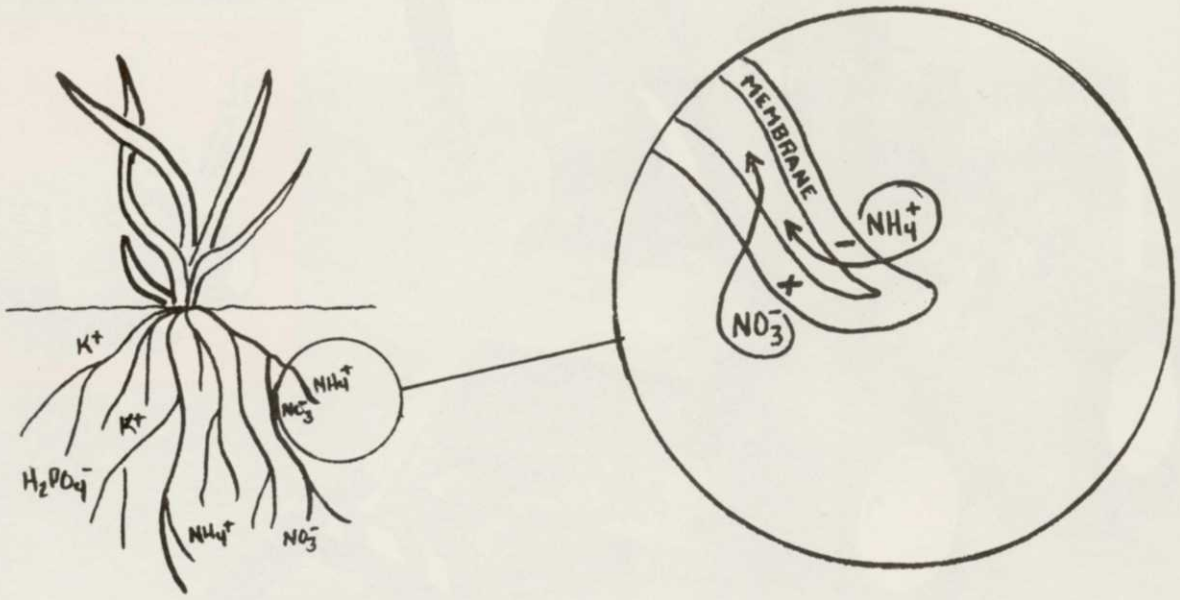

Ions of the dissolved fertilizer are absorbed through the root membrane when attracted to an opposite charge inside the root. A high concentration of salts in the soil around the roots can reverse the flow of elements, depriving the plant of nutrients and water.

How does a fertilizer burn?

The same soluble salts or nutrient ions that are absorbed by plant roots can also cause a type of physiological drought called "burn." Water is absorbed by plants through a process known as osmosis. As long as the root cells maintain a higher concentration of soluble salts than does the water in the surrounding soil, the root cells will absorb water. If, however, too much fertilizer is applied at one time and the salts in the soil water become too concentrated, the absorption of water is reduced. When the level of soluble salts in the soil is very high, water may actually be pulled out of the root tissue into the surrounding soil solution.

The degree to which a fertilizer increases the salt concentration of soil solution is measured by the Salt Index — the higher the salt index, the more rapidly the fertilizer releases soluble salts and the higher the "burn potential."

Fertilizer	Formula	Salt Index
potassium chloride	KC1	116.3
ammonium nitrate	NH_4NO_3	104.7
sodium nitrate	$NaNO_3$	100
urea	H_2NCONH_2	75.4
ammonium sulfate	$(NH_4)_2SO_4$	69
potassium sulfate	K_2SO_4	46
diammonium phosphate	$(NH_4)_2HPO_4$	34.2
natural organic		3.5

How does soil pH affect nutrient absorption?

The term pH expresses the relative concentration of hydrogen (H^+) and hydroxyl (OH^-) ions in solution. A pH of 7 means the hydrogen and hydroxyl ions are equal and the solution is said to be neutral. A pH below 7 means the solution contains more hydrogen ions than hydroxyl ions, and is said to be acid. Similarly, a pH above 7 means the solution contains more hydroxyl ions and is alkaline.

The presence of an element in the soil is no guarantee that it is in a *soluble* form available for absorption. The concentration of hydrogen and associated ions affects soil reaction and the formation of soluble and insoluble compounds. *All nutrients must be soluble to be available for root absorption.* Each nutrient has a pH range of maximum availability simply because within this range it forms a large proportion of soluble compounds.

Plant species differ in their response to the soil acidity because of differences in nutrient requirements. For most plants, the conditions of nutrient availability, without toxic amounts, are best near pH 6.5. **WTT**