

A SUMMARY OF MINERAL NUTRITION IN PLANTS

ELEMENT	PRINCIPAL FORM IN WHICH ELEMENT IS ABSORBED	USUAL CONCENTRATION in HEALTHY PLANTS (% dry weight)	IMPORTANT FUNCTIONS
<i>MACRONUTRIENTS</i>			
Carbon	CO ₂	~44%	Component of organic compounds
Oxygen	H ₂ O or O ₂	~44%	Component of organic compounds
Hydrogen	H ₂ O	~6%	Component of organic compounds
Nitrogen	NO ₃ ⁻ or NH ₄ ⁻	1-4%	Amino acids, proteins, nucleotides, nucleic acids, chlorophyll, and coenzymes
Potassium	K ⁻	0.5-6%	Enzymes, amino acids, and protein synthesis. Activator of many enzymes. Opening and closing of stomata.
Calcium	Ca ²⁺	0.2-3.5%	Calcium of cell walls. Enzyme cofactor. Cell permeability.
Phosphorus	H ₂ PO ₄ ⁻ or HPO ₄ ²⁻	0.1-0.8%	Formation of "high energy" phosphate compounds (ATP and ADP). Nucleic acids. Phosphorylation of sugars. Several essential enzymes. Phospholipids.
Magnesium	Mg ²⁺	0.1-0.8%	Part of the chlorophyll molecule. Coenzyme A.
Sulfur	SO ₄ ²⁻	0.05-1%	Some amino acids and proteins. Coenzyme A.
<i>MICRONUTRIENTS</i>			
Iron	Fe ²⁺ or Fe ³⁺	25-300 ppm	Chlorophyll synthesis, cytochromes, and nitrogenase.
Chlorine	Cl ⁻	100-10,000 ppm	Osmosis and ionic balance; probably essential in photosynthetic reactions that produce oxygen.
Copper	Cu ²⁺	4-30 ppm	Activator of certain enzymes.
Manganese	Mn ²⁺	15-800 ppm	Activator of certain enzymes.
Zinc	Zn ²⁺	15-100 ppm	Activator of certain enzymes.
Molybdenum	MoO ₄ ²⁻	0.1-5.0 ppm	Nitrogen fixation. Nitrate reduction.
Boron	BO ₃ ⁻ or B ₄ O ₇ ²⁻	5-75 ppm	Influences Ca ²⁺ utilization. Functions unknown.
<i>ELEMENTS ESSENTIAL TO SOME PLANTS OR ORGANISMS</i>			
Cobalt	Co ²⁺	Trace	Required by nitrogen-fixing organisms.
Sodium	Na ⁺	Trace	Osmotic and ionic balance, probably not essential for many plants. Required by some desert and salt marsh species. May be required by all plants that utilize C ₄ photosynthesis.