

Chapter 37

Nutritional resources of plants

Essential elements

- Play many roles in plant metabolism
- often function as enzyme factors

Macronutrients

- required in amounts of at least 1g per 1kg of dry plant mass

Micronutrients

- trace elements
- required in amounts at or less than 0.1g per 1kg of dry plant mass

Limiting factors

- resources that can limit plant growth
 - too little or too much
- carbon dioxide
- water
- other mineral nutrients

Table 37.1 Plant Essential Nutrients

Element (chemical symbol)	Percent of plant dry mass	Major source	Form taken up by plants	Function(s)
<i>Macronutrients</i>				
Carbon (C)	45	Air	CO ₂	Component of all organic molecules
Oxygen (O)	45	Air, soil, water	CO ₂ , O ₂ , H ₂ O	Component of all organic molecules
Hydrogen (H)	6	Water	H ₂ O	Component of all organic molecules; protons used in chemiosmosis and cotransport
Nitrogen (N)	1.5	Soil	NO ₃ ⁻ , NH ₄ ⁺	Component of proteins, nucleic acids, chlorophyll, coenzymes, and alkaloids
Potassium (K)	1.0	Soil	K ⁺	Has essential role in cell ionic balance
Calcium (Ca)	0.5	Soil	Ca ²⁺	Component of cell walls; messenger in signal transduction
Magnesium (Mg)	0.2	Soil	Mg ²⁺	Component of chlorophyll; activates some enzymes
Phosphorus (P)	0.2	Soil	HPO ₄ ²⁻	Component of nucleic acids, ATP, phospholipids, and some coenzymes
Sulfur (S)	0.1	Soil	SO ₄ ²⁻	Component of proteins, some coenzymes, and defense compounds

Micronutrients

Chlorine (Cl)	0.01	Soil	Cl ⁻	Required for water splitting in photosystem cell ion balance
Iron (Fe)	0.01	Soil	Fe ³⁺ , Fe ²⁺	Enzyme cofactor; component of cytochromes
Manganese (Mn)	0.005	Soil	Mn ²⁺	Enzyme cofactor
Boron (B)	0.002	Soil	B(OH) ₃	Enzyme cofactor; component of cell walls
Zinc (Zn)	0.002	Soil	Zn ²⁺	Enzyme cofactor
Sodium (Na)	0.001	Soil	Na ⁺	Required to generate PEP in C ₄ and CAM plants
Copper (Cu)	0.0006	Soil	Cu ⁺ , Cu ²⁺	Enzyme cofactor
Molybdenum (Mo)	0.00001	Soil	MoO ₄ ²⁻	Enzyme cofactor
Nickel (Ni)	0.000005	Soil	Ni ²⁺	Enzyme cofactor

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