

# 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 <sub>2</sub>	Component of all organic molecules
Oxygen (O)	45	Air, soil, water	CO <sub>2</sub> , O <sub>2</sub> , H <sub>2</sub> O	Component of all organic molecules
Hydrogen (H)	6	Water	H <sub>2</sub> O	Component of all organic molecules; protons used in chemiosmosis and cotransport
Nitrogen (N)	1.5	Soil	NO <sub>3</sub> <sup>-</sup> , NH <sub>4</sub> <sup>+</sup>	Component of proteins, nucleic acids, chlorophyll, coenzymes, and alkaloids
Potassium (K)	1.0	Soil	K <sup>+</sup>	Has essential role in cell ionic balance
Calcium (Ca)	0.5	Soil	Ca <sup>2+</sup>	Component of cell walls; messenger in signal transduction
Magnesium (Mg)	0.2	Soil	Mg <sup>2+</sup>	Component of chlorophyll; activates some enzymes
Phosphorus (P)	0.2	Soil	HPO <sub>4</sub> <sup>2-</sup>	Component of nucleic acids, ATP, phospholipids, and some coenzymes
Sulfur (S)	0.1	Soil	SO <sub>4</sub> <sup>2-</sup>	Component of proteins, some coenzymes, and defense compounds
<i>Micronutrients</i>				
Chlorine (Cl)	0.01	Soil	Cl <sup>-</sup>	Required for water splitting in photosystem cell ion balance
Iron (Fe)	0.01	Soil	Fe <sup>3+</sup> , Fe <sup>2+</sup>	Enzyme cofactor; component of cytochromes
Manganese (Mn)	0.005	Soil	Mn <sup>2+</sup>	Enzyme cofactor
Boron (B)	0.002	Soil	B(OH) <sub>3</sub>	Enzyme cofactor; component of cell walls
Zinc (Zn)	0.002	Soil	Zn <sup>2+</sup>	Enzyme cofactor
Sodium (Na)	0.001	Soil	Na <sup>+</sup>	Required to generate PEP in C4 and CAM plants
Copper (Cu)	0.0006	Soil	Cu <sup>+</sup> , Cu <sup>2+</sup>	Enzyme cofactor
Molybdenum (Mo)	0.00001	Soil	MoO <sub>4</sub> <sup>2-</sup>	Enzyme cofactor
Nickel (Ni)	0.000005	Soil	Ni <sup>2+</sup>	Enzyme cofactor