Plant nutrition

Beyond water and CO_2

Nutrition outline

- Essential nutrients
- Soil
- Important symbioses with bacteria and fungi
- Strange plants

What does a plant want?

- 17 ESSENTIAL nutrients
- **Macronutrients**
  - Required in large amounts
- **Micronutrients**
  - Required in very small amounts
- Which type are more important?

Macronutrients

Table 37.1 Macronutrients in Plants

Element (Form Primarily Absorbed by Plants)	% Mass in Dry Tissue	Major Function(s)	Early Visual Symptom(s) of Nutrient Deficiencies
Macronutrients			
Carbon (CO_2)	45%	Major component of plant's organic compounds	Poor growth
Oxygen (CO_2)	45%	Major component of plant's organic compounds	Poor growth
Hydrogen (H_2O)	6%	Major component of plant's organic compounds	Wilting, poor growth
Nitrogen (NO_3^-, NH_4^+)	1.5%	Component of nucleic acids, proteins, and chlorophyll	Chlorosis at tips of older leaves (common in heavily cultivated soils or soils low in organic material)
Potassium (K^+)	1.0%	Cofactor of many enzymes; major solute functioning in water balance; operation of stomata	Mottling of older leaves, with drying of leaf edges; weak stems; roots poorly developed (common in acidic or sandy soils)
Calcium (Ca^{2+})	0.5%	Important component of middle lamella and cell walls; maintains membrane function; signal transduction	Crinkling of young leaves; death of terminal buds (common in acidic or sandy soils)
Magnesium (Mg^{2+})	0.2%	Component of chlorophyll; cofactor of many enzymes	Chlorosis between veins, found in older leaves (common in acidic or sandy soils)
Phosphorus ($H_2PO_4^-$, HPO_4^{2-})	0.2%	Component of nucleic acids, phospholipids, ATP	Healthy appearance but very slow development; thin stems; purpling of veins; poor flowering and fruiting (common in acidic, wet, or cold soils)
Sulfur (SO_4^{2-})	0.1%	Component of proteins	General chlorosis in young leaves (common in sandy or very wet soils)

How do we know they're required?

- Hydroponics

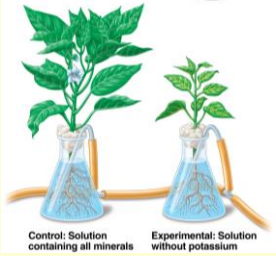


Fig. 37.8

The primary resource

- SOIL
- Horizons compose a profile

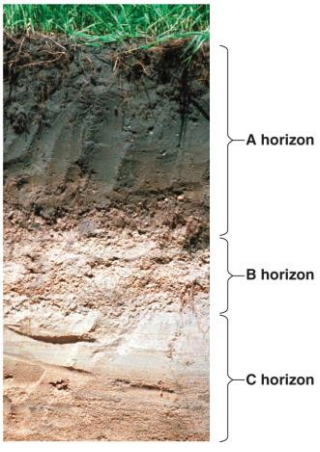


Fig. 37.2

Cation exchange

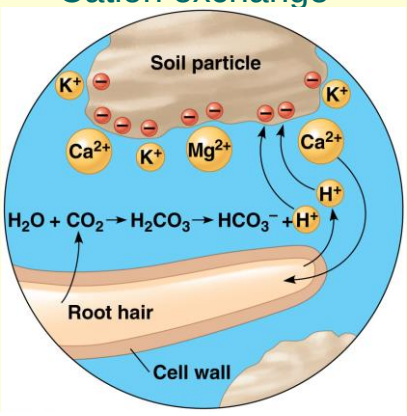


Fig. 37.3

Fig. 37.4

Humans vs. soil

"Somebody told me it was frightening how much topsoil we are losing each year, but I told that story around the campfire and nobody got scared."

Jack Handey

Fig. 37.6

A little help from my friends

- Bacteria and N working together in the **rhizosphere**

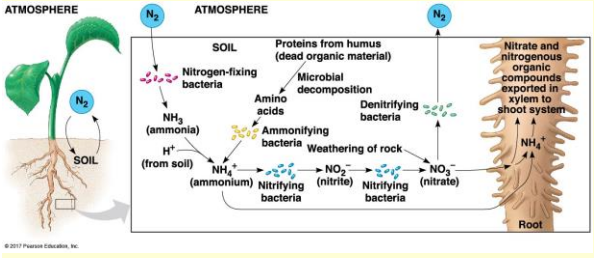


Fig. 37.12

Legumes + *Rhizobium* cause nodules

Fig. 37.13

Ectomycorrhizae

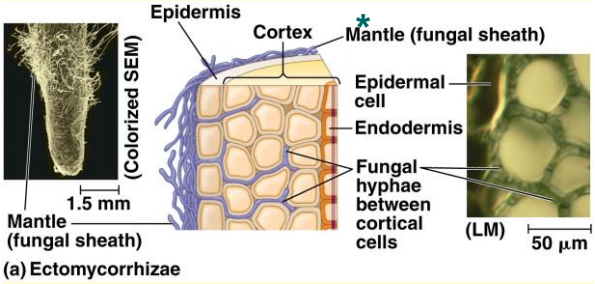


Fig. 37.15 top

Endomycorrhize

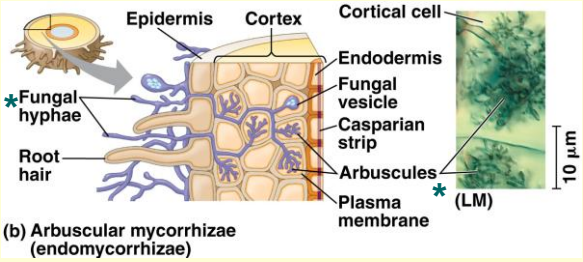


Fig. 37.15 bottom

Some strange plants

- **Epiphytes**
- Parasites
- Carnivores

Parasitic plants

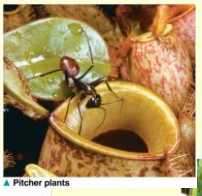
▲ Mistletoe, a photosynthetic parasite

▲ Dodder, a nonphotosynthetic parasite (orange)

▲ Indian pipe, a nonphotosynthetic parasite of mycorrhizae

Fig. 37.16

Carnivorous plants



▲ Pitcher plants

▲ Sundews

Fig. 37.16

▲ Pitcher plants