

- **Plant nutrition** is the study of the chemical element and compound necessary for plant growth, plant metabolism and their external supply. In its absence the plant is unable to complete a normal life cycle.
- The effect of a nutrient deficiency can vary from a subtle depression of growth rate to obvious stunting, deformity, discoloration, distress, and even death.
- “Plant nutrition” specifically does not refer to photosynthesis.

## Classification of Minerals

- **Mineral** : An inorganic element acquired mostly in the form of inorganic ions from the soil
- **Nutrient**: A substance needed to survive or necessary for the synthesis of organic compounds
- On the basis of the amounts found in plants:
  - Macrominerals:
  - Microminerals:
- On the basis of the amounts found in plants:
- Macronutrients are generally present in plant tissues in large amounts (in excess of 10 mmole Kg<sup>-1</sup> of dry matter). The macronutrients include carbon, hydrogen, oxygen, nitrogen, phosphorous, sulphur, potassium, calcium and magnesium. Of these, carbon, hydrogen and oxygen are mainly obtained from CO<sub>2</sub> and H<sub>2</sub>O, while the others are absorbed from the soil as mineral nutrition.
- Micronutrients or trace elements, are needed in very small amounts (less than 10 mmole Kg<sup>-1</sup> of dry matter). These include iron, manganese, copper, molybdenum, zinc, boron, chlorine and nickel

## Essentiality of mineral nutrients

**Essential:** Universal for all plants

- Absence prevents completion of life cycle
- Absence leads to deficiency and growth retardation.
- Required for some aspect of mineral nutrition
- The element is part of an essential molecule

**Beneficial:** Often limited to a few species

- Stimulates growth and development
- May be required in some species
- Examples: Na, Si, Se

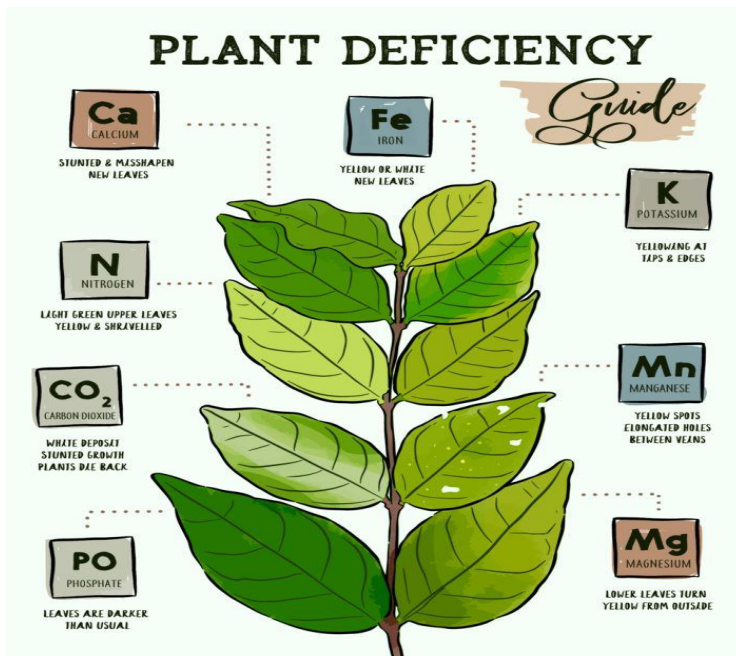
## Deficiency Symptoms of Essential Elements

The kind of deficiency symptoms shown in plants include chlorosis is the loss of chlorophyll leading to yellowing in leaves. This symptom is caused by the deficiency of elements N, K, Mg, S, Fe, Mn, Zn and Mo. Likewise, necrosis, or death of tissue, particularly leaf tissue, is due to the deficiency of Ca, Mg, Cu, K. Lack or low level of N, K, S, Mo causes an inhibition of cell division. Some elements like N, S, Mo delay flowering if their concentration in plants is low.

### Mobility of minerals

Mineral elements classified on the basis of their mobility within a plant and their tendency to retranslocate during deficiencies

Mobile	Immobile
Nitrogen	Calcium
Potassium	Sulfur
Magnesium	Iron
Phosphorus	Boron
Chlorine	Copper
Sodium	
Zinc	
Molybdenum	



### How are mineral nutrients acquired by plants?

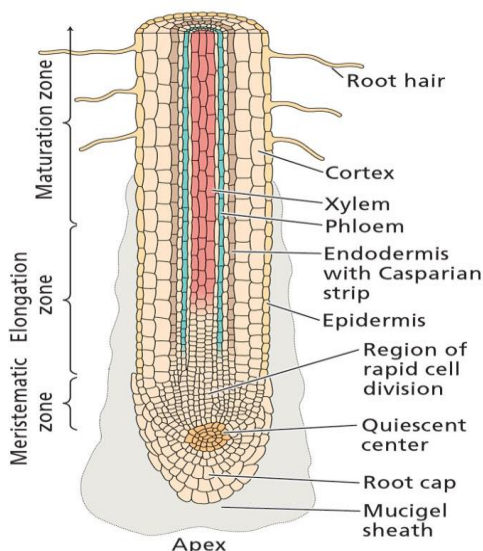
- Uptake through the leaves artificial called foliar application. Used to apply iron, copper and manganese.
- Associations with mycorrhizal fungi  
Fungi help with root absorption
- Uptake by the roots

## Plant roots – the primary route for mineral nutrient acquisition

- **Meristematic zone**
  - Cells divide both in direction of root base to form cells that will become the *functional root* and in the direction of the *root apex* to form the *root cap*
- **Elongation zone**
  - Cells elongate rapidly, undergo final round of divisions to form the *endodermis*. Some cells thicken to form *casparian strip*
- **Maturation zone**
  - Fully formed root with *xylem* and *phloem* – *root hairs* first appear here

## Root absorbs different mineral ions in different areas

- **Calcium**
  - Apical region
- **Iron**
  - Apical region (barley)
  - Or entire root (corn)
- **Potassium, nitrate, ammonium, and phosphate**
  - All locations of root surface
  - In corn, *elongation zone* has max K accumulation and nitrate absorption
  - In corn and rice, *root apex* absorbs ammonium faster than the *elongation zone* does
  - In several species, *root hairs* are the most active phosphate absorbers



PLANT PHYSIOLOGY, Third Edition, Figure 5.8 © 2002 Sinauer Associates, Inc.