Animal, Plant & Soil Science

D3-1

Soil Nutrient Functions

Interest Approach

- **Approach One:** Bring a variety of plants to class that show nutrient deficiencies. Ask students what they notice about the plants. After they comment that the plants look sick, ask what might be the cause of the illness. Guide the discussion toward nutrient deficiencies and the objectives of this lesson.

Interest Approach

- **Approach Two:** Do any of the students take vitamins on a daily basis? If so, ask why they take vitamins. What is the value of vitamins? Have a multivitamin bottle on hand and instruct a student to read aloud the minerals listed. Ask whether plants would benefit from vitamins and minerals? Steer the discussion into the lesson and state the learning objectives.

Objectives

- 1 **Define nutrient, discuss the role of nutrients in plant growth, and list the 16 essential nutrients.**
- 2 **Identify the non-fertilizer nutrients and describe their functions.**
- 3 **Identify the primary macronutrients and describe their functions.**
- 4 **Identify the secondary macronutrients and describe their functions.**
- 5 **Identify the micronutrients and describe their functions.**

Terms

- macronutrients
- micronutrients
- nutrient deficiency
- nutrient toxicity
- nutrients
- primary macronutrients
- secondary macronutrients

What are nutrients? What is their role in plant growth? What are the 16 essential nutrients?

- 1. Certain chemical elements, called ***nutrients***, are essential for plant growth and development. Sixteen nutrients have been identified as being essential for plant growth.

What are nutrients? What is their role in plant growth? What are the 16 essential nutrients?

- A. The following phrase can be used to help memorize the 16 essential elements for plant growth: "C. B. Hopkins Café Mighty Good Closed Monday Morning See You Zen." It represents the following: Carbon (C), Boron (B), Hydrogen (Hopkins), Oxygen (HOpkins), Phosphorus (HoPkins), Potassium (HopKins), Nitrogen (HopkiNs), Sulfur (HopkinS), Calcium (Café), Iron (caFé), Magnesium (Mighty good), Chlorine (Closed), Manganese (Monday), Molybdenum (Morning), Copper (See you = Cu), Zinc (Zen).

What are nutrients? What is their role in plant growth? What are the 16 essential nutrients?

- B. Nutrients are very important for plant growth and development. Sugars manufactured through photosynthesis are recombined with nitrogen and other nutrients to form many complex products. Some of these products include starches, pectin, lignin, cellulose, lipids or fats, proteins, pigments, hormones, vitamins, and alkaloids and tannins that protect plants from pests and diseases.

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- C. A ***nutrient deficiency*** occurs when a nutrient is not in sufficient quantity to meet the needs of a growing plant. Nutrient deficiencies most often result in an unhealthy plant appearance. Symptoms vary with the nutrient that is in short supply. Common symptoms of deficiencies include discoloration of the leaves, death of leaf tissue, and stunted growth. Because of the complex interactions of nutrients in plant processes, deficiency symptoms for different nutrients are often very similar. ***Nutrient toxicity*** occurs when a plant nutrient is in excess. Nutrient toxicity has a negative effect on plant growth or quality.

What are nutrients? What is their role in plant growth? What are the 16 essential nutrients?

- 1. One way to understand the differences in nutrient deficiency symptoms among plants is to recognize the functions and the relative mobility of nutrients within plants. Some nutrients, such as nitrogen, phosphorus, potassium, magnesium, chlorine, and zinc, can be easily remobilized within a plant from old plant parts to actively growing plant parts, such as young leaves. Other nutrients, such as sulfur, iron, copper, manganese, boron, and calcium, are not easily remobilized within a plant. Therefore, a deficiency of the mobile elements usually occurs initially with older leaves, while a deficiency of the immobile nutrients occurs with young leaves or stem tips.

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- 2. Five types of deficiency or toxicity symptoms are observed.
  - a. Chlorosis—Chlorosis involves the yellowing of plant tissue due to limitations on chlorophyll synthesis. This yellowing can be generalized over the entire plant, localized over entire leaves, or isolated between some leaf veins (e.g., interveinal chlorosis).

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- b. Necrosis—Necrosis is the death of plant tissue, sometimes in spots.
- c. Accumulation of anthocynanin, resulting in a purple or reddish color
- d. Lack of new growth
- e. Stunting or reduced growth—New growth continues but is stunted or reduced compared to normal plants.

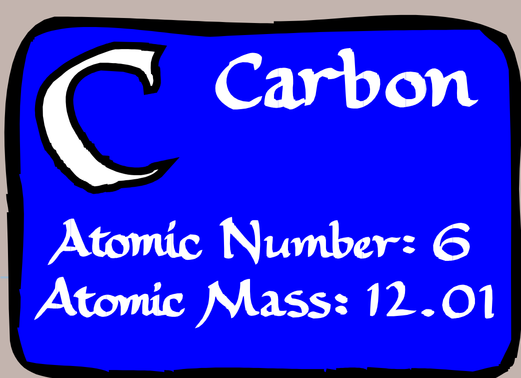
What are the non-fertilizer nutrients and what are their functions?

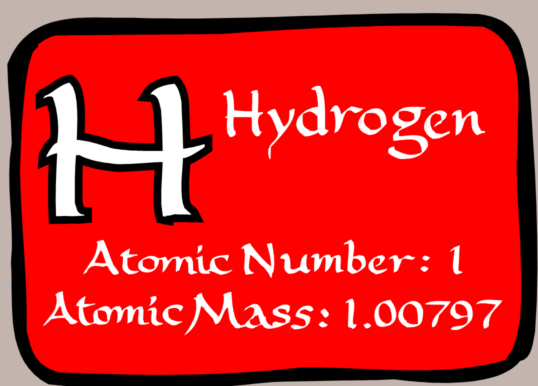
- II. Three nutrients make up 89 percent of a plant's tissues. They are carbon, hydrogen, and oxygen.

Nutrient	Influence/Function
Carbon	Building block for carbohydrates, proteins, fats, nucleic acids
Hydrogen	Building block for carbohydrates, proteins, fats, nucleic acids
Oxygen	Building block for carbohydrates, proteins, fats, nucleic acids

What are the non-fertilizer nutrients and what are their functions?

- A. Carbon and hydrogen are considered non-fertilizer nutrients because they are not given to plants as fertilizer. Plants obtain these nutrients from air and water. Carbon comes from carbon dioxide; hydrogen from air and water; and oxygen from air, water, and carbon dioxide.

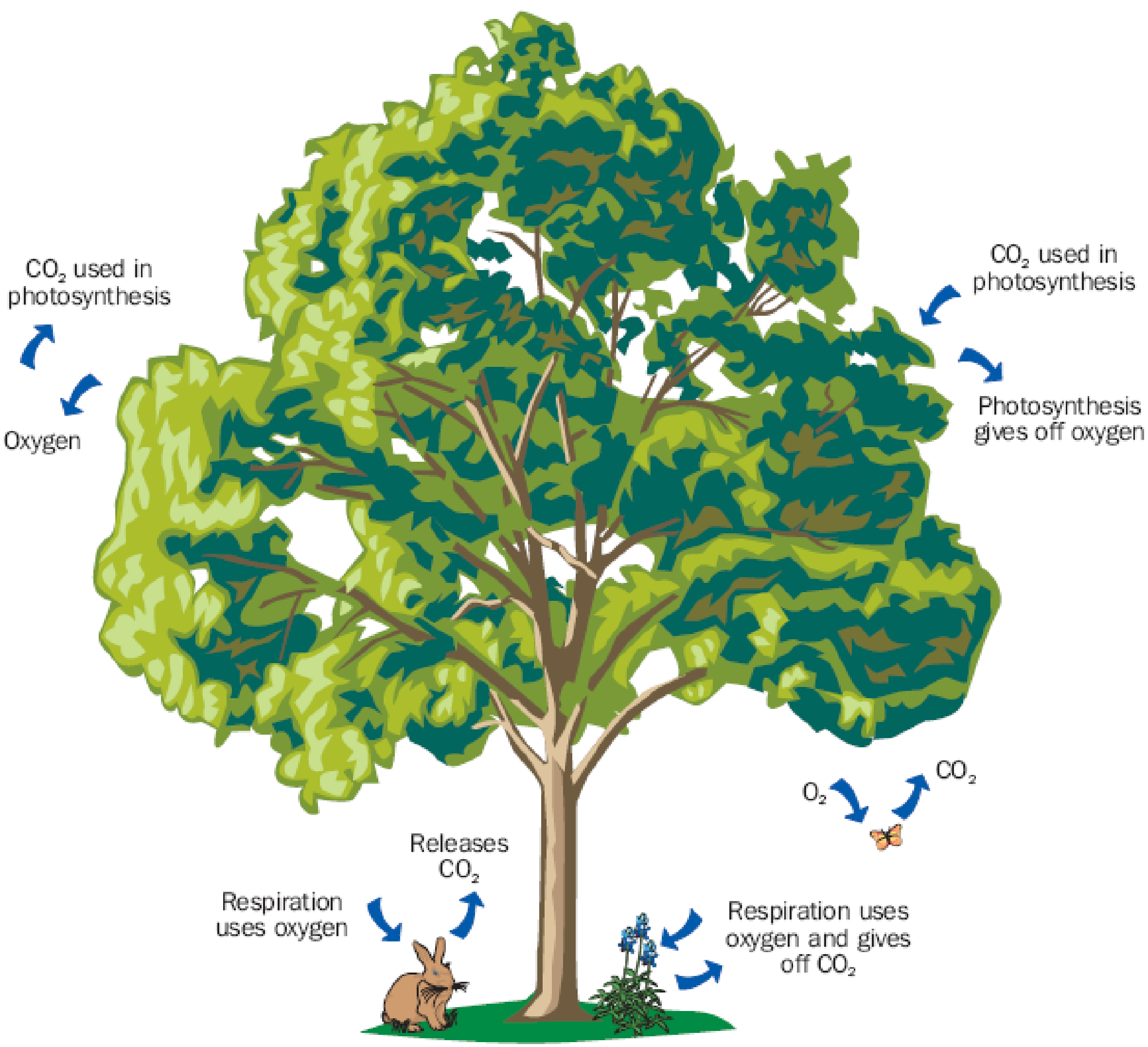




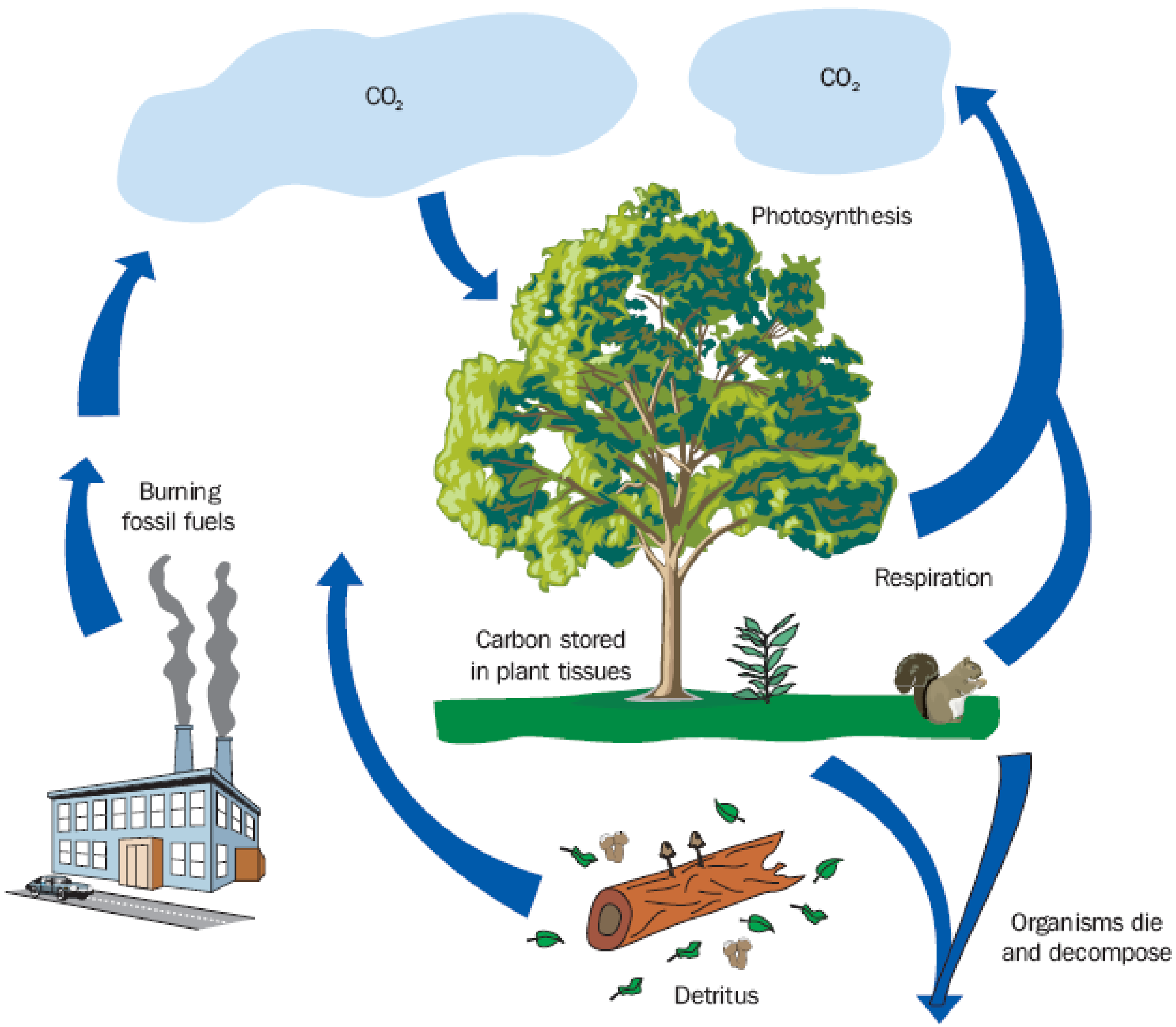
What are the non-fertilizer nutrients and what are their functions?

- B. These nutrients are the building blocks for carbohydrates, proteins, fats, nucleic acids, and many other compounds found in plants.

THE OXYGEN CYCLE



THE CARBON CYCLE



What are the primary macronutrients and what are their functions?

- III. ***Macronutrients*** are those elements used in great quantities by plants. The six macronutrients are carbon, hydrogen, oxygen, nitrogen, phosphorus, and potassium. Nitrogen, phosphorus, and potassium are called ***primary macronutrients*** because they are fertilizer elements used in the largest amounts.

What are the primary macronutrients and what are their functions?

- A. Nitrogen is one of the most abundant and mobile elements on earth. It is found in the air and the soil.

- 1. Nitrogen is a part of chlorophyll and is therefore very important in photosynthesis.
- 2. Plants lacking in nitrogen take on a yellowish color, and their growth appears stunted.

What are the primary macronutrients and what are their functions?

- B. Phosphorus plays a crucial role in the reproduction of seed plants. It is an important element for DNA. It promotes rapid root growth.

- 1. Unlike nitrogen, phosphorus is very immobile in soil. However, since a large portion of a plant’s phosphorus is found in seeds and fruit, the soil must be replenished annually.
- 2. Symptoms of deficiency include a purple tinge to the leaves.

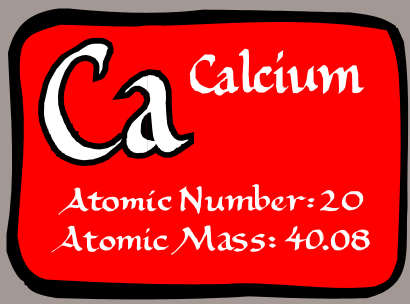
What are the primary macronutrients and what are their functions?

- C. Potassium is necessary for the manufacture of starches and sugars.
- 1. Potassium assists in a plant's disease- and pest-fighting mechanisms. It also plays a role in the opening and closing of stomata.
- 2. Symptoms of deficiency include a leaf tip burn and yellow or white streaks in the veins of the leaves.

What are the secondary macronutrients and what are their functions?

- IV. Three macronutrients used to a lesser degree than nitrogen, phosphorus, and potassium are calcium (Ca), magnesium (Mg), and sulfur (S). Calcium, magnesium, and sulfur are said to be ***secondary macronutrients*** because moderate amounts are needed.

What are the secondary macronutrients and what are their functions?



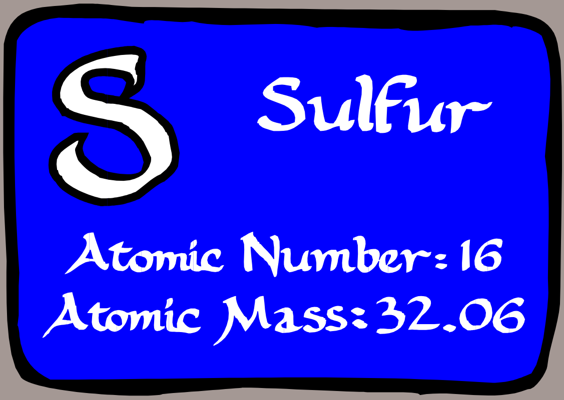
- A. Calcium is needed for the formation of strong cell walls. It is instrumental in young, growing cells, especially in the root system. It also aids plants in using other nutrients. Calcium deficiencies appear as deformed, curled leaves.

What are the secondary macronutrients and what are their functions?

- B. Magnesium is used in chlorophyll and is important to photosynthesis. It activates many plant enzymes. It is involved in the production of starches and fats and the movement of other nutrients throughout the plant. Deficiency symptoms include a yellowing of lower leaves and thin stems.

What are the secondary macronutrients and what are their functions?

- C. Sulfur is needed for protein formation. It also stimulates root growth. Young leaves with a light green color are symptomatic of sulfur deficiency.

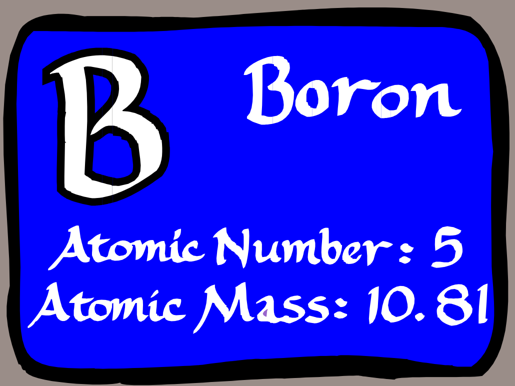


What are the micronutrients and what are their functions?

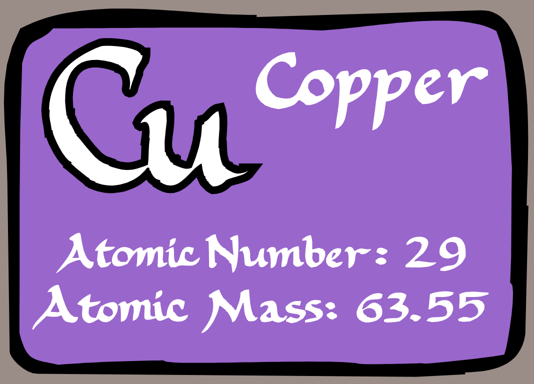
- V. The nutrients that are needed in smaller amounts by plants but are still essential to plant growth are called ***micronutrients***. The micronutrients are boron (B), copper (Cu), chlorine (Cl), iron (Fe), manganese (Mn), molybdenum (Mo), and zinc (Zn).

What are the micronutrients and what are their functions?

- A. The exact role of boron is unclear, but it appears to be essential for pollination and reproduction, cell division, and the transport of sugars. Young leaves look yellow and thick when boron is lacking.



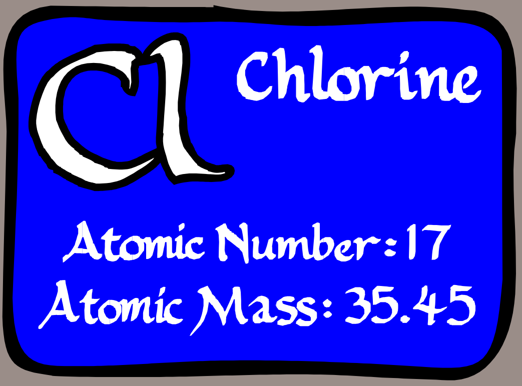
What are the micronutrients and what are their functions?



- B. Copper regulates several chemical processes, including chlorophyll synthesis and respiration. A shortage results in the yellowing of leaves, with the younger leaves affected first.

What are the micronutrients and what are their functions?

- C. Chlorine is involved in light reactions of photosynthesis. It aids root and shoot growth. Deficiency symptoms have not been recognized.



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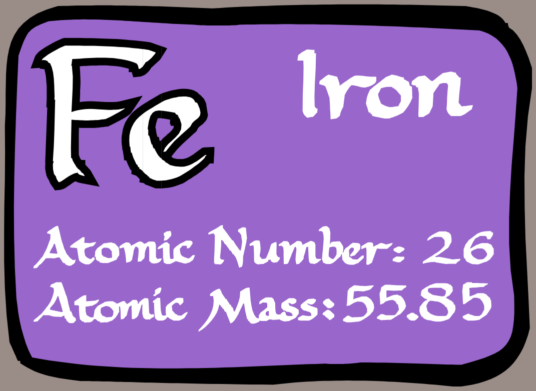
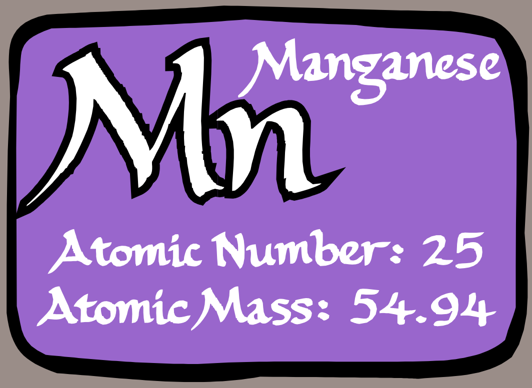


- D. Iron is important in chlorophyll formation and is a component of enzymes involved in photosynthesis, respiration, and nitrogen fixation. Young leaves yellow first. The veins remain green.

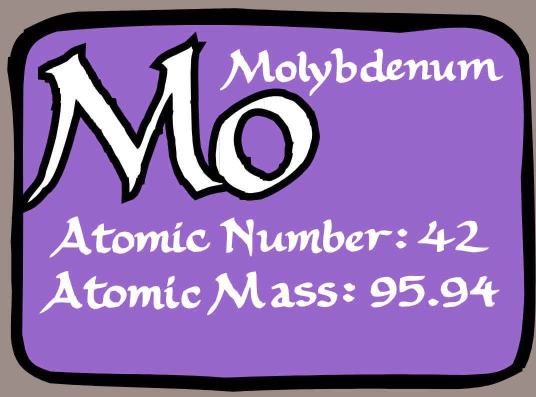
What are the micronutrients and what are their functions?

- E. Manganese is important in chlorophyll formation. It is part of the enzymes involved in respiration and nitrogen metabolism. A symptom of deficiency is the yellowing of young leaves, while the veins remain green.



What are the micronutrients and what are their functions?

- F. Molybdenum is part of the enzymes involved in nitrogen metabolism. It aids nitrogen fixation and protein synthesis. Deficiency symptoms appear as yellow older leaves and the stunting of growth.



What are the micronutrients and what are their functions?

- G. Zinc is important in chlorophyll, auxin, and starch formation and is part of the enzymes involved in respiration. The yellowing of older leaves and stunted growth are deficiency symptoms.

REVIEW

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