

Objective : understand the importance of water and minerals to plant growth .

Resources : book pages 162 / 163

Mineral salts :

Minerals :

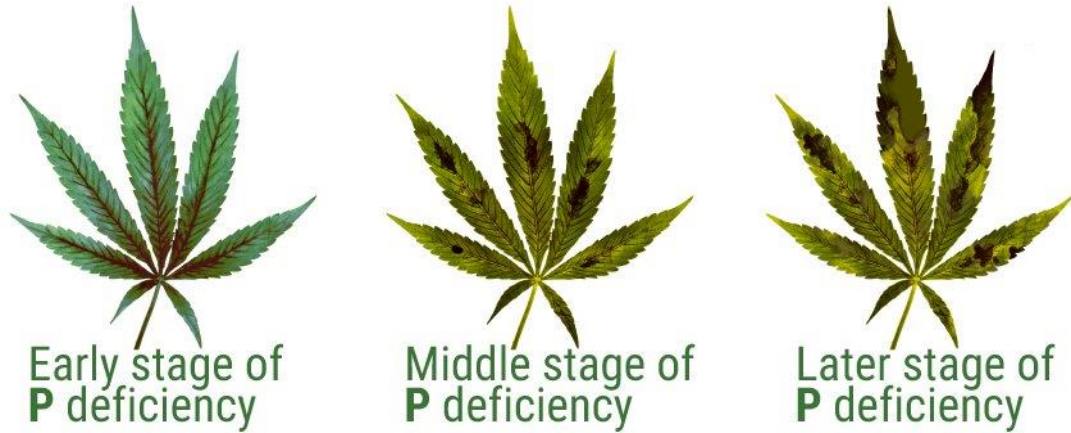
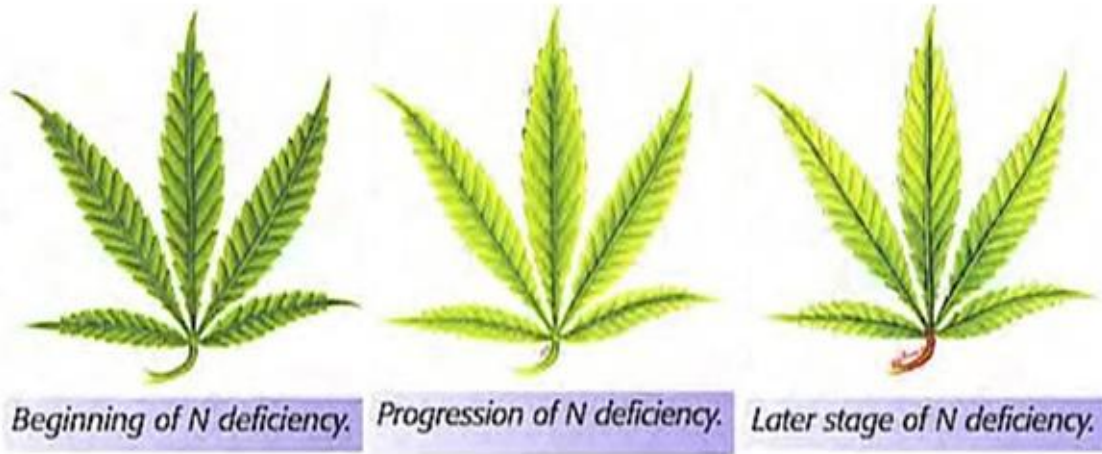
When plants take in water from soil , they also take in essential minerals , these minerals come from dissolved rocks , decaying plants and animals or artificial fertilizers .

Essential minerals :

To find out which minerals plants need , scientists start with a mixture of minerals and take one away at a time . Each mineral contains a different element . Together the elements provide everything a plant needs for healthy growth .

A control group is given a complete mixture of minerals . Test groups are given mixtures with different minerals missing .

Mineral element	How the plant uses it	Deficiency symptoms
Nitrogen	Used to make proteins to build new cells .	Older leaves turn yellow
Potassium	Used during photosynthesis and respiration .	Poor flower and fruit growth . Older leaves wilt and begin to lose colour .
Phosphorus	Involved in energy transfer during photosynthesis and respiration .	Poor root growth . Leaf tips turn brown and older leaves turn purple .
Magnesium	Used to make chlorophyll .	Older leaves turn yellow between the veins .



TYPICAL APPEARANCE OF Mg DEFICIENCY SYMPTOMS. HEALTHY LEAFLET OF RUBBER AT LEFT AND LEAFLETS SHOWING SYMPTOMS OF INCREASING Mg DEFICIENCY.

Photo: RRIM/Kuala Lumpur

13.3

Plant growth

Water

These strawberry plants are growing in water-filled pipes high above the ground. As their leaves lose water by **transpiration** (page 88), more water moves up through xylem vessels from their roots to replace it. The roots take in fresh water from the pipes.

Growing plants like this is called **hydroponics**.



↑ The roots of these plants take water from the pipes they grow in.

Minerals

When plants take in water from soil, they also take in essential minerals. These minerals come from dissolved rocks, decaying plants and animals, or artificial fertilisers. Different soils contain different amounts of each mineral. For example, sandy desert soils do not usually contain much nitrogen.

In hydroponic systems, growers can add just the right amount of each mineral to the water.

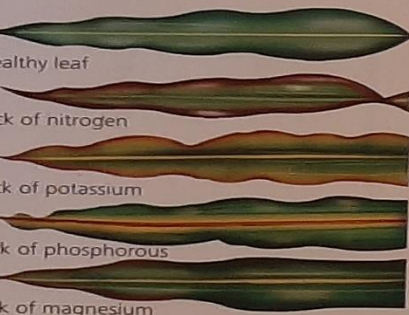
Essential minerals

To find out which minerals plants need, scientists start with a mixture of minerals and take one away at a time. Each mineral contains a different element. Together the elements provide everything a plant needs for healthy growth.

A control group is given a complete mixture of minerals. Test groups are given mixtures with different minerals missing.

Mineral element	How the plant uses it	Deficiency symptoms
nitrogen (in nitrates)	used to make proteins to build new cells	older leaves turn yellow.
potassium	used during photosynthesis and respiration	poor flower and fruit growth. Older leaves wilt and begin to lose colour.
phosphorus (in phosphates)	involved in energy transfer during photosynthesis and respiration	poor root growth. Leaf tips turn brown and older leaves turn purple.
magnesium	used to make chlorophyll	older leaves turn yellow between the veins.

Evidence from many investigations like this confirms that the most important minerals are the ones that contain nitrogen, potassium, phosphorus, and magnesium.



The top maize leaf was grown in fertile soil. The others were grown in soil lacking one essential mineral.

Aeroponics



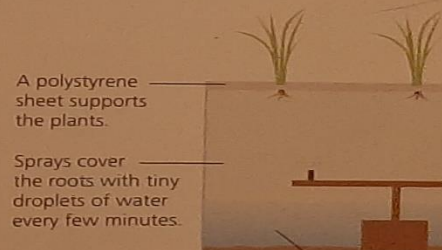
↑ The roots of these rice plants hang in air so they can absorb oxygen.

Roots take in minerals by **active transport**. The minerals can't simply diffuse into plant cells like oxygen does. They need to be moved from where they are very spread out (in soil) to where they are concentrated (in plant cells). So the roots need to use energy when they take in minerals.

To release the energy they need for active transport, roots must respire – so they need oxygen. When roots grow in soil they take oxygen from the air between soil particles. They can take some oxygen from water, but oxygen isn't very soluble.

Aeroponics lets roots get extra oxygen. The roots are left dangling in air. They are sprayed with water and dissolved minerals every few minutes. The roots stay moist and get as much oxygen as they can use.

Aeroponics makes plants grow faster and use less water.



↑ Plants obtain all their water and minerals from the sprays.

- 1 What is added to the water used in hydroponic systems?
- 2 List the four main elements plants obtain from minerals.
- 3 A plant has purple leaves and few roots. Which mineral is it short of?
- 4 List the symptoms that show a plant is short of potassium.
- 5 Plants grown in soil lacking nitrogen are usually very small. Explain why they can't grow properly without nitrogen.
- 6 Describe how you could collect evidence to show that rice plants need magnesium.

- Roots respire, so plants lose oxygen.
- Roots also need potassium, phosphorus, and magnesium.

Check your understanding :page 163

2. List the four main elements plants obtain from minerals .

Nitrogen , Magnesium , Potassium , Phosphorus

3. A plant has purple leaves and few roots . Which mineral is it short of?

Phosphorus

4. List the symptoms that show a plant is short in potassium .

A plant that is short of potassium has poor flower and fruit growth, and older leaves wilt and lose their colour.

5. Plants grown in soil lacking nitrogen are usually very small . Explain why they can't grow properly without nitrogen .

Nitrogen is used to make protein , protein is needed to build new cells.

6. Describe how you could collect evidence to show that rice plants need magnesium .

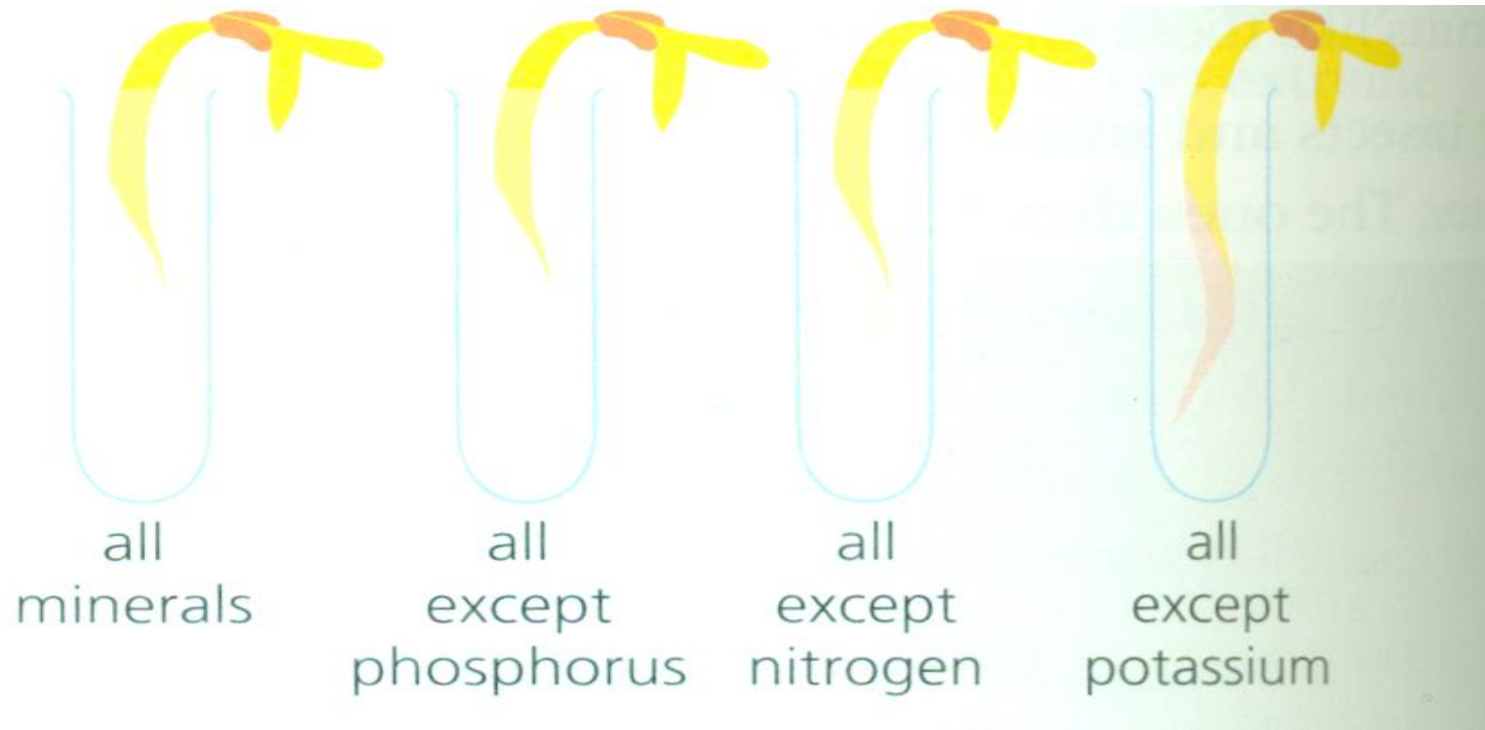
Plant one group of rice plants in normal soil and another group in soil that is short of magnesium. Make sure both groups receive the same conditions of other minerals, light, water, temperature, and carbon dioxide. Compare the appearance of the groups after 2 weeks (any suitable time).

Review questions page 170

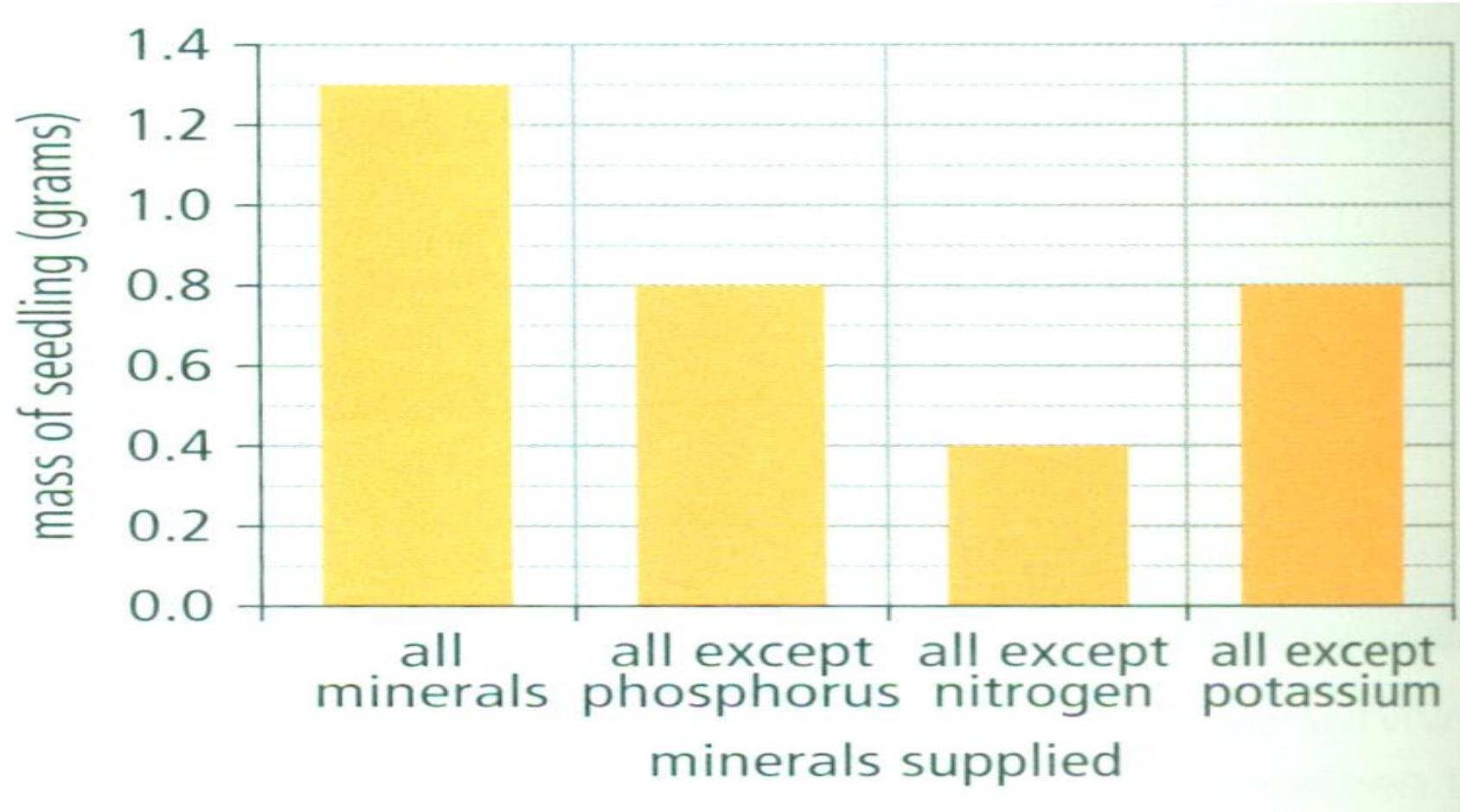
Q4. Mariam wants to know which mineral is important for plant growth .

She takes four samples of pure water and adds different minerals to each of them .

Then she puts a seedling in each sample of water .



After 2 weeks she compares the masses of the seedlings.



a. Suggest one thing Mariam kept the same for every material solution she tested .

The volume of water / The temperature.

b. Suggest one other thing she could have measured apart from the total mass of the seedlings .

The length of the seedling.

c. Which mineral appears to be most important for growth ? *Nitrogen*

d. What is this mineral used for ?

To make proteins.

e. The green substance in chlorophyll contains magnesium . Suggest how the color of leaves would change in plants grown without magnesium .

Older leaves turn yellow between the veins.

Review questions page 170/Q.1

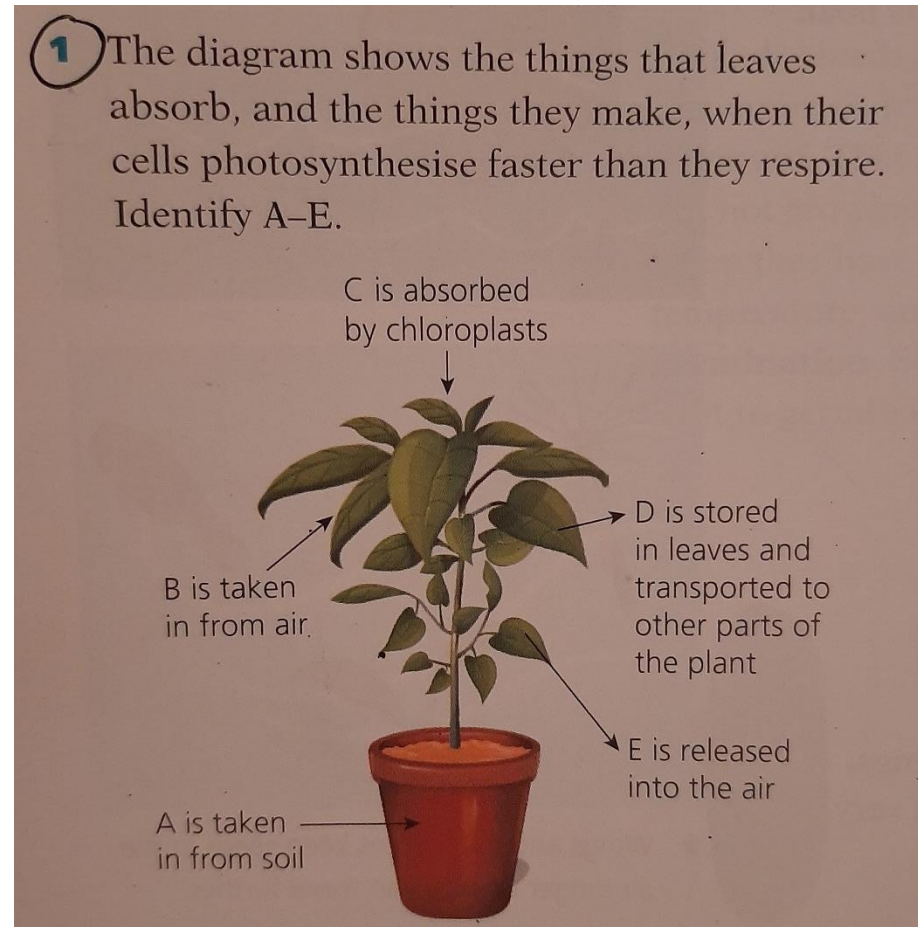
A : water

B: carbon dioxide

C: light

D : starch

E : oxygen



Review questions page 170/Q.2

The correct statements are :

A,C

- 2 Choose the correct statements about photosynthesis:
- a Photosynthesis takes place in chloroplasts.
 - b Photosynthesis is carried out by consumers.
 - c Photosynthesis makes glucose.
 - d Photosynthesis releases energy.
 - e In plants, photosynthesis is always faster than respiration.