CHAPTER 1

OBJECTIVES

At this end of this chapter, students should be able to:

â—† list plant nutrient elements under the major classes.

â—† recognise the deficiency symptoms of different elements in crops.

â—† state the factors affecting availability of soil nutrients.

â—† describe the different methods of replenishing lost soil nutrients.

â—† illustrate the nutrient cycles and their importance.

Plants and animals require food in the form of nutrients for their growth, proper body functioning, maintenance and survival. There are several chemical elements found in the soil that are known to be very important for plant growth, development and survival. The most basic nutrient elements are carbon, hydrogen and oxygen. These are usually obtained from the air or water medium in which the plants grow. All the other elements can be distinguished into two groups as macro- and microelement nutrients.

TABLE 1.1 Nutrient sources, functions and deficiency symptoms

Element/ Nutrient	Sources	Nutrient Function	Deficiency Symptoms
Nitrogen	• Enter the soil by the decay of organic substances • Added directly to soil as components of fertilizer • Fixation through thunderstorm • Nitrogen-fixing microorganisms	• Forms an essential constituent of all plant proteins and is required for plant growth • Promotes vegetative growth and makes vegetables to look more succulent • Helps to increase grain size in cereals as well as promotes carbohydrate synthesis • Promotes the uptake of other nutrients such as potassium and phosphorus • Improves the plant shoot system especially in vegetable crops causing them to be deep green and appealing • Helps in chlorophyll formation making leaves to appear deep green • Is needed in the formation of plant hormones • Excessive nitrogen may, however, + delay plant's maturation and fruiting and + make plant stems to become weak and bend over (to lodge) easily	• Reduced plant growth • Stunted growth • Leaves turn yellowish in colour (described as chlorosis) • Leaves drop prematurely • Poor formation of flowers and fruits
Phosphorus	• Enter the soil by the decay of organic substances • Added directly to soil as components of fertilizer	• Required for all plant biochemical reactions • Promotes cell division • Helps plants to build and breakdown carbohydrate • Aids good seed germination, root development, flowering, fruit and seed formation • Encourages and quickens ripening of fruits	• Stunted growth • Lodging is increased • Poor root development • Delayed and retarded flowering, fruit and seed formation • Purple colouration may occur especially in maize

Element/ Nutrient	Sources	Nutrient Function	Deficiency Symptoms
		• Balances the adverse effects of excess nitrogen • Encourages and strengthens fibre production especially in cereal crops, reducing the plant tendency to lodge • Helps plants to become more resistant to pest and disease attack • Aids fruit formation and maturity • Improves the palatability of forages and vegetables	
Potassium	• Enter the soil by the decay of organic substances • Added directly to soil as components of fertilizer • Ash is obtained after burning	• Is a major constituent of plant tissues • Aids the development and formation of strong root system in plants • Helps to increase the resistance of plant to bacterial and fungal pathogen attack • Is required for the formation of chlorophyll and the synthesis of carbohydrates • Helps in activating essential enzyme reactions in plants • Aids translocation of sugars from one part of plant to areas where they are needed • Helps in the formation of grains in cereals and tubers in tuberous crops such as yam. • Promotes healthy development of seedlings and young plants • Helps to neutralise organic acids especially in young plants • Promotes nitrate uptake from soil • Is associated with stomata movements and promoting water circulation and regulation in plants	• Weak slender stems • Leaf edges look dry, scotched and rough • Irregular chlorosis • Brown colour at edges of leaves • Premature leaf drop • Delayed growth

Element/ Nutrient	Sources	Nutrient Function	Deficiency Symptoms
Calcium	• Added directly into soil in the form of lime • Obtained from the weathering of primary minerals in the soil	• Helps to reduce soil acidity • Is needed for the growth of plants especially the plant meristems (the meristem is the region of actively dividing cells usually at root or shoot tips) • Strengthens the cell wall through addition of calcium pectate which helps to thicken the cell wall • Controls the field toxicity of aluminium, manganese and sodium ions • Aids in the translocation and deposition of carbohydrates and proteins in seeds and tubers • Is needed for normal growth of root tips • Helps in improving soil aeration, water infiltration and retention • Improves the soil pH to ease nitrogen fixation	• Causes the meristems to stop growing • Stunted growth • Poor root development • Pale yellowing of leaves • Weak slender plants • Stunting of the root system
Magnesium	• Added directly into soil in the form of lime such as dolomite (calcium, magnesium carbonate) • Obtained from the weathering of primary minerals such as hornblende and serpentine in the soil	• Works with Calcium to reduce soil acidity • Is needed in the synthesis of carbohydrate because it is a major constituent of chlorophyll • Helps in the transportation of phosphate ions that is needed for the developing fruits and seeds • Promotes healthy plant growth • Is required for normal cell division • Is required for production of oils in plants	• Interveinal chlorosis

Element/ Nutrient	Sources	Nutrient Function	Deficiency Symptoms
Sulphur	• Added into soil during decay of organic substances • Washed by rain to soil in industrial centres • Added directly to soil as components of some fertilizers	• Helps to build proteins as it forms parts of some amino acids such as cystine and methionine in plants • Is a constituent of plant hormones such as biotin and thiamine • Helps in chlorophyll formation • Is required for carbohydrate metabolism and nitrogen fixation by leguminous plants	• Yellowing of leaves • Stunted growth • Poor rate of photosynthesis
Iron	• Rock minerals • Decayed organic matter	• Is important for chlorophyll formation • Facilitates many enzyme system reactions associated with the oxidation and reduction reactions in plants	• Chlorotic conditions called iron-induced chlorosis
Molybdenum	• Rock minerals • Decayed organic matter	• Necessary for nitrogen fixation as part of the enzyme system that catalyses nitrification	• Poor growth
Manganese	• Rock minerals • Decayed organic matter	• Is a constituent of enzyme responsible for protein synthesis • Is needed for certain nitrogen transformation in plants and microorganisms	• Pale greenish yellow discolouration between veins especially in young plants and seedlings
Copper	• Rock minerals	• Is needed for the chlorophyll formation • Is a constituent of certain enzymes • Is required for respiration in plants • Is important in the utilisation of iron	• Pale green discolouration of young leaves and seedlings • Deficiency pronounced in soil rich in organic matter and also alkaline soil • Tips of old leaves dry off and die back
Zinc	Rock minerals	• Is a constituent of certain enzymes	• Causes mottled and small leaves

Element/ Nutrient	Sources	Nutrient Function	Deficiency Symptoms
Boron	Rock minerals	• Is needed for protein synthesis • Facilitates good root development • Aids formation of fruits and seeds • Encourages cell division • Aids nodulation in legumes	• Death of shoot and root tips • Causes lodging and stem breaking • Flower buds failure to develop • General poor growth • Rate of water absorption and translocation of sugar decrease
Cobalt	Rock minerals	• Essential for leguminous crops • Required for symbiotic fixation of nitrogen	• Reduced nitrogen due to reduced symbiotic fixation of nitrogen

1.1.1 Macroelements

These are nutrient elements that are required by plants in relatively large quantities. Examples are nitrogen, phosphorus, potassium, calcium, magnesium and sulphur.

1.1.2 Microelements

These are nutrient elements that are required by plants in relatively small quantities. Examples of micronutrients are zinc, copper, boron, molybdenum, iron, chlorine and manganese.

1.2 Factors Affecting Availability of Soil Nutrients

The following are the factors that influence the availability of nutrients in the soil:

1.2.1 Soil pH

This describes the degree of acidity or alkalinity of the soil or any other medium in which a plant is grown. The level of such acidity or alkalinity affects the availability of nutrients in both the soil and the plants in the following ways:

1. At low pH (high acidity), several micronutrients such as iron, manganese and zinc are dissolved in high quantity. Such trace elements that are required in small quantities are released in excess, causing toxicity to plants.

2. Low pH (increased acidity) also hinders the activities and sometimes kills beneficial soil organisms that help in organic matter decomposition and nitrogen fixation.

3. High acidity also encourages the breakdown of clay minerals like calcium, iron and aluminium, causing them to leach away from the soil.

4. Low pH also reduces the availability of some nutrient elements like nitrogen, phosphorus and sulphur. Phosphorus is more available at a pH of 6–7.

5. At high pH, calcium and magnesium ions accumulate in the soil and this affects plant growth negatively.

1.2.2 Concentration of other nutrient elements

Availability of different nutrients depends on the concentration of other elements in the soil. The nutrients therefore need to be balanced if anything good would be obtained from such soil. For example, excess amount of soluble iron and aluminium in acidic soils and calcium in alkaline soil reduces the availability of phosphorus. Thus, excess amount of some elements prevent proper absorption and utilization of other elements; for example, high concentration of nitrogen and phosphorus in soil results in non-availability of potassium. These conditions result in retarded growth, low yield and eventual death of the plant.

1.2.3 Leaching

This is the washing down of nutrients in soluble form from the plant root zone down the soil beyond the reach of plantsâ€™ roots. Nutrients such as calcium, magnesium and potassium are lost from the topsoil this way. Leaching causes the accumulation of aluminium and hydrogen ions which later becomes acidic and toxic to plants.

1.2.4 Burning

It destroys soil organic matter directly and exposes the soils to erosion and other factors of the environment that wash or sweep away soil organic matter. Organic matter contents are very rich in nitrogen, phosphorus and sulphur but these nutrients are lost in gaseous form during burning. Burning also destroys beneficial soil organisms that help in soil aeration and organic matter decomposition.

1.2.5 Crop removal

Plants utilise the nutrients taken from the soil to build up their body tissue and to effect growth, development and production. At harvesting, the whole plant is removed away from the field and consumed; thus the nutrients used up by the plants are taken away and not returned to the soil. The rapid removal of nutrients this way by continuous cropping completely depletes the soil of such nutrients.

1.2.6 Oxidation

It involves change in valency. Some nutrients like manganese and iron exist in reduced or oxidised forms. The oxidized form of manganese and iron (Fe_{3+}) is not soluble, thus reducing their availability to plants. Also some compounds such as that of ammonia are oxidised to gaseous ammonia. Nitrates are also reduced to molecular nitrogen or oxides of nitrogen by denitrifying bacteria. These products escape into the atmosphere and the soil is depleted of the nutrients.

1.2.7 Erosion

Rainfall causes water erosion by washing away the topsoil along with its nutrients. The top soil is also blown away by wind along with the nutrients contained in it.

1.3 Methods of Replenishing Lost Soil Nutrients

The following are common ways by which farmers replenish the soil or replace the nutrients that have been lost in the soil.

1.3.1 Crop rotation

This is the system of farming in which the farmer grows different crops on the same piece of land year after year in a definite order so as to maintain the soil fertility. The rotation is planned in such a way that nutrients taken from soil during crop removal are restored. An example of a four-course rotation is given in Table 1.2.

TABLE 1.2 Four-course rotation

Year	Plot 1	Plot 2	Plot 3	Plot 4
1	Cassava	Maize	Yam	Cowpea
2	Maize	Yam	Cowpea	Cassava
3	Yam	Cowpea	Cassava	Maize
4	Cowpea	Cassava	Maize	Yam

1.3.1.1 Principles underlying crop rotation

(a) Deep rooted crops like yam and cassava must not follow each other in the rotation because they will draw soil nutrients from the same depth in the soil.

(b) Shallow rooted crops like maize and rice should not follow each other.

(c) Crops that are likely or are known to be attacked by the same pest should not follow each other in the rotation.

(d) Crops from the same family should not follow each other.

(e) There should be at least a legume in the rotation.

(f) There should also be a fallow period during which the land is allowed to rest.

1.3.1.2 Advantages of crop rotation

â Crop rotation helps to check or control weeds through the use of leguminous cover crops.

â The inclusion of legumes in the rotation helps to enrich the soil nutrients with nitrates.

â It helps in erosion control and prevents nutrient loss from soil.

â It helps to maximise the use of soil.

â It makes continuous cropping possible for many years.

1.3.1.3 Conditions for practice of crop rotation

Crop rotation is practised where

â there is the need to plant different varieties of crops.

â there is need to maintain soil fertility.

â the land is scarce and in short supply.

â human population is high.

â the soil has been depleted of nutrients.

1.3.2 Soil rotation

This is much like shifting cultivation. It is a method where the soil is left uncultivated for a relatively short period after cultivation for about 2 years before it is cultivated again. During the period, the soil is left to fallow. The vegetation that grows on it is later turned into the soil and ploughed over to supply nutrients. This is different from shifting cultivation because the period of fallow is shorter and the farmer may not relocate to another site.

1.3.3 Organic manuring

Manure is any material that increases the fertility of the soil when added to it. Organic manure relates to the materials that are derived from either plant or animal origin or a combination of both which have decomposed and would readily release the nutrients they contain. There are three major types:

(a) Farm-yard manure (b) Compost manure (c) Green manure.

(a) Farm-yard manure This is a collection of animal wastes such as animal dung, faeces or poultry droppings, urine, beddings which have been allowed to undergo series of decomposition before being used as a fertilizer.

(b) Compost manure This is the type of manure that is prepared by deliberate action of human beings such that organic materials are packed together in a definite order or series and allowed to decompose progressively under careful supervision. Compost manure can be prepared in two ways.

â The pit method: This type is suitable for savanna areas where there is low rainfall.

â The heap method: This is suitable for the forest areas where rainfall is high.

(c) Green manure This is formed from leguminous cover crops and other fresh growing plants which have been ploughed into the soil while they are still green and fresh in the field. These plants are ploughed under when they are still young before flowering so that the rate of decomposition is fast. Examples of leguminous plants for green manures are cowpea, *Centrosema, Calopogonium, Pueraria* and grasses.

1.3.3.1 Advantages of using organic manures

â Organic manure encourages and promotes the activities of beneficial soil organisms such as earthworms and microbes.

â It helps to improve the soil structure – building the particles to form coarse texture.

â It reduces rapid soil temperature fluctuations.

â Mineralisation of the organic content adds nutrients directly to soil.

â It prevents soil erosion.

â It balances acid–base conditions of the soil.

â It helps the soil to conserve moisture.
â It protects the soil surface and reduces evaporation from soil.
â It increases the water retention capacity of the soil.
â It increases the rate of water percolation into soil.
â It improves soil aeration, allowing air to circulate within the soil.

1.3.4 Synthetic fertilizer application

The term fertilizer refers to anything added to the soil to make it fertile. However, this term is often used for the chemically formulated salts that have been manufactured with the purpose of supplying major nutrients that may be deficient in the soil. The macronutrients or elements play major roles in the manufacture of fertilizers and so they are called fertilizer elements.

1.3.4.1 Types of fertilizer

Fertilizers are classified based on the nutrients they supply.

(a) Single or straight fertilizers: These supply only one major nutrient. Examples are single super phosphate: $CaHPO_4$, ammonium sulphate: $(NH_4)_2SO_4$, ammonium nitrate: NH_4NO_3.

(b) Compound or mixed fertilizers: These supply more than one major nutrient. Examples are the NPK fertilizers and ammonium phosphate.

1.3.4.2 Application methods of fertilizer

Fertilizers may be applied to soil using the following methods:

1. Row or side band application: This is done for crops planted in rows or straight lines. The fertilizer is applied in a row made a few centimetres away from the crop. Drilling machine is often used to apply fertilizers this way.

2. Top dressing: This is done by spreading the fertilizer on the soil surface where the crop is already growing. Soluble fertilizers like nitrate of potash and ammonium nitrate are applied this way.

3. Broadcasting: This is done by scattering the fertilizer material evenly on the soil surface usually before cultivation. The fertilizer is later worked into the soil with a hoe or plough. This is done before the crop is planted.

4. Band placement: This is done by applying the fertilizer in bands by the side of the planted crop. This is done for individual plants.

5. Ring method: This is done by applying the fertilizer in rings, usually about 15 cm, around the planted crop. This is done for individual plants.

6. Foliar spray: This is done by dissolving some trace elements in water and spraying directly on the crop. The leaves and the stem absorb the elements directly

1.3.5 Planting cover crops

This involves the planting of crops which spread and cover the soil surface apart from the planted crop. The most common cover crops are legumes such as *Centrosema sp., Pueraria sp., Stylosanthes sp.* and *Calopogonium sp*. These crops have the ability to fix nitrogen in the soil through the help of some soil organisms especially bacteria.

The roots of cover crops help to hold soil together. The leaves help to reduce the impact of splash during rain, allowing water to drop gently and percolate into the soil. This therefore prevents or reduces surface water run-off. It also helps in nutrients recycling and conserves soil water and living organisms.

1.3.6 Bush fallowing

This is the practice of allowing the soil that is used for farming to stay without cropping for some time after it has been used for growing crops. This makes the soil to build up its fertility from the organic matter deposits from the fallow vegetative cover after they decompose. The period of fallow could be up to 5 years but this generally varies depending on how readily available agricultural lands are and also on the human population pressure on the available agricultural soil. Fallow period tends to be longer where there is less pressure on land and where human population that wants to use it is relatively low. Leguminous fallow crops should be encouraged on fallow lands for a richer soil after the fallow period.

1.3.7 Liming

This is the act of adding chemical substances such as compounds of calcium and magnesium to the soil in order to reduce the acidity of that soil. Common examples of limes are calcium oxide, calcium magnesium carbonate and calcium carbonate. The limes also add calcium and magnesium to the soil in addition to reducing the soil acidity and this is why the two elements are called the lime elements.

1.4 The Nutrient Cycles and Their Importance

The nutrient cycle refers to the circulation of some nutrients in nature. Examples of this cycle are nitrogen, carbon and the water cycle.

1.4.1 The nitrogen cycle

This is the natural process by which nitrogen is added or removed from the soil. It consists of a series of naturally occurring reactions involving both plants and animals indicating how nitrogen is circulated within the soil and the atmosphere.

The nitrogen fixation process usually involves microorganisms and this adds a reasonable amount of nitrogen into the soil. Nitrogen enters the soil via the following processes:

(a) By electric discharge during lightening:

Nitrogen in the air combines with oxygen to form oxides of nitrogen such as nitric oxide, nitrous oxide and nitrogen peroxide. These undergo further oxidation to form nitrogen dioxide. When this dissolves in water during rain, nitrous acid and nitric acid are formed. These dissociate in soil to form nitrates.

(b) By ammonification and nitrification:

Ammonification is the process whereby ammonium compounds are formed from decomposing organic materials as well as from the waste products from plants and animals such as urine and faeces. The ammonium compounds so formed are broken down in series of reactions, first into nitrites by nitrifying bacteria called *Nitrosomonas,* and by oxidation

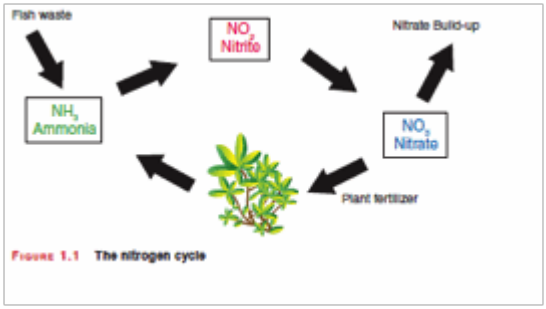

FIGURE 1.1 The nitrogen cycle

the nitrites are converted to nitrates by another bacterium, *Nitrobacter*. The nitrates formed are absorbed from the soil and used by plants.

(c) By symbiotic nitrogen fixation: Some symbiotic bacteria living in the root nodules of leguminous plants such as *Rhizobium leguminosarum* fix atmospheric nitrogen directly into the

plants. The bacteria obtain carbohydrates from the plant while the plant obtains combined nitrogen in the process.

(d) By non-symbiotic nitrogen fixation:

Some bacteria like *Azotobacter* and *Clostridium* which are free living in soil also fix atmospheric nitrogen into the soil aerobically and anaerobically.

(e) By addition of organic manure and nitrogen fertilizers: Direct application of organic and inorganic nitrogen fertilizers also adds to soil nitrogen.

1.4.1.1 Nitrogen loss from soil

Nitrogen is lost from the soil by denitrification, a process whereby nitrates in the soil are converted to nitrogen gas by certain bacteria. The nitrogen gas escapes through soil erosion, leaching, increased soil acidity, burning and by crop removal.

1.4.2 The carbon cycle

This is the natural process by which carbon is circulated in nature. Carbon dioxide constitutes about 0.03% of the atmospheric air.

1.4.2.1 Importance of carbon cycle

â Carbon is an essential body component of all living organisms. It is taken into plants in the form of carbon dioxide.

â Carbon dioxide is used by plants along with water, sunlight and chlorophyll for photosynthesis to take place. This is important for production of carbohydrates which plants and animals require for energy.

â Carbon helps to purify and maintain atmospheric level of carbon (IV) oxide.

1.4.2.2 Generation of carbon dioxide

Carbon (IV)oxide is produced during

â decomposition of organic matter

â burning of carbon-containing compounds like fuel and wood

â respiration of plants and animals

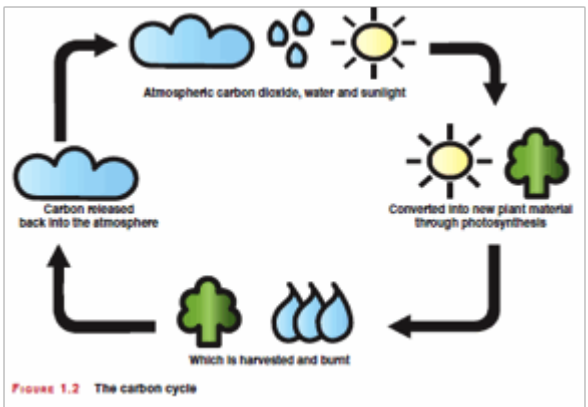

Figure 1.2 The carbon cycle

â death, decay and decomposition of plants and animals

â carbon (IV)oxide also dissolve and diffuse into rain water and lakes, rivers and oceans.

1.4.3 Water cycle

This refers to the movement and circulation of water molecules in nature. This process includes the evaporation of water from the exposed part of the earth surfaces such as the seas and the oceans, rivers and lakes and the soil followed by condensation to form cloud, and then followed by

precipitation to the ground as rain.
Water enters the atmosphere in the following ways:
â evaporation of water from the seas, oceans, rivers, lakes and the soil
â transpiration from plants
â breathing by plants and animals

Water enters the soil in the following ways:
â precipitation or rainfall
â percolation and infiltration into the soil

1.4.3.1 Importance of water

â It facilitates the translocation of nutrients to different parts of the plant where they are utilised.
â It provides the medium of absorption of minerals by plant roots.
â It is an essential raw material for photosynthesis.
â It facilitates enzymatic activities occurring in plants.
â It has cooling effect on crops.
â It is a major constituent of plant protoplasm.
â It facilitates opening and closing of stomata.
â It encourages seed germination.
â It maintains plant turgidity.

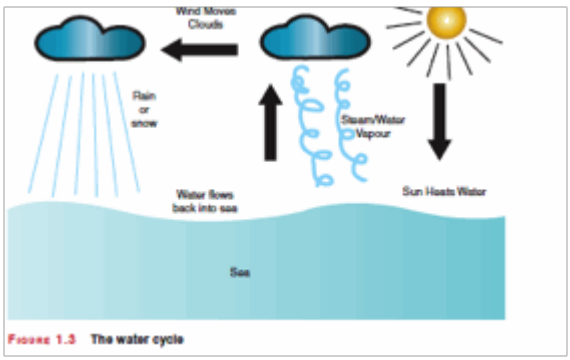

Figure 1.3 The water cycle

1.4.3.2 Occurrence of water in soil

Water occurs in the following forms in the soil:
â Capillary water
â Hygroscopic water
â Gravitational water

1.4.3.3 How to conserve soil water

â Addition of organic matter to soil
â Prevention of surface water run-off
â Weed control
â Mulching
â Cover cropping
â Contour ridging
â Strip cropping
â Adequate tillage

Activity Preparation of Compost

Pit size: About 180 Ã— 120 Ã— 60

Materials: Three pits labeled appropriately, grasses and legumes, ash or urine, animal dung and a little quantity of water.
Method: Pit A: Lay the grass and legume at the bottom layer, then add a layer of animal dung, then a layer of ash, sprinkle some water on top to keep it moist; then repeat the layers as before until the pit is filled. Place a stick (tester) that goes down into the layers. If the tester is hot, the procedure is successful. Turn the materials after 2 weeks and pack the materials into pit B, to allow air into the compost. This will keep the bacteria active in the compost. After another 2 weeks, pit B is turned into C and A is turned into B. This process continues until the last pit.

SUMMARY

Plants and animals require food in the form of nutrients for their growth, proper body functioning and maintenance and survival. There are several chemical elements and these can be distinguished into two groups as Macro- and Microelements nutrients.
â—† Macroelements are nutrient elements that are required by plants in relatively large quantities. Examples of these elements are nitrogen, phosphorus, potassium, calcium, magnesium and sulphur.
â—† Microelements are nutrient elements that are required by plants in relatively small quantities. Examples of these elements are zinc, copper, boron, molybdenum, iron, chlorine and manganese.
â—† The factors that influence the availability of nutrients in the soil are the soil pH, the concentration of other nutrient elements, leaching, burning, crop removal, oxidation and erosion.
â—† The common ways by which farmers replenish the soil or replace the nutrients that have been lost in the soil are crop rotation, soil rotation, organic manuring, synthetic fertilizer application, planting cover crops, bush fallowing and liming.
â—† The nutrient cycles such as the nitrogen, carbon and the water cycle refer to the circulation of some essential nutrients in nature.

Revision Questions

Essay Questions

1. (a) Mention six macronutrients.
(b) What are the sources of each nutrient in plants?
2. (a) Mention five micronutrients in the soil.
(b) What are the sources and functions of five named micronutrients in plants?
3. State the factors influencing the availability of nutrient in the soil.
4. (a) Describe a four-year course crop rotation practice.
(b) State the principles underlying crop rotation practice.
(c) What are the advantages of crop rotation?
5. (a) Describe briefly the carbon cycle.
(b) State the ways by which carbon (IV)oxide is generated.

Objective Questions

1. The washing down of nutrients in soluble form from the plant root zone down the soil beyond the root of plants is described as
(a) erosion.
(b) clearing.
(c) leaching.

(d) washing.

2. Burning is a bad practice because it creates all the following problems except it

(a) destroys soil organic matter directly.

(b) exposes the soils to erosion and other factors of environment that wash away soil organic matter.

(c) kills soil organisms.

(d) improves soil structure and increases organic matter content

3. Plants utilise the nutrients taken from the soil to achieve the following except

(a) building up their body tissue.

(b) effecting evaporation.

(c) development.

(d) production.

4. The soil pH affects the availability of nutrients in the following ways except

(a) trace elements that are required in small quantities are dissolved in high quantity and released in excess, causing toxicity to plants.

(b) low pH (increased acidity) hinders the activities and sometimes kills beneficial soil organisms.

(c) makes all nutrients to be available to plants.

(d) low pH reduces the availability of some nutrient elements like nitrogen, phosphorus and sulphur

5. The following are ways by which soil nutrients may be replenished except

(a) crop rotation.

(b) organic manuring.

(c) soil rotation.

(d) crop removal.

6. The system of farming in which the farmer grows different crops on the same piece of land year after year in a definite order so as to maintain the soil fertility is described as

(a) commercial farming.

(b) intercropping.

(c) interplanting.

(d) crop rotation.

7. All the following are the principles underlying crop rotation except

(a) crops that are similar may follow each other in the rotation.

(b) shallow rooted crops like maize and rice should not follow each other.

(c) crops that are known to be attacked by the same pest should not follow each other in the rotation.

(d) crop from the same family should not follow each other.

8. All the following are advantages of crop rotation except that

(a) it helps to check or control weeds through the use of leguminous cover crops.

(b) it helps to reduce the use of soil and disrupts farming programme.

(c) the inclusion of legumes in the rotation helps to enrich the soil nutrients with nitrates.

(d) it helps in erosion control and prevents nutrient loss from soil.

9. Crop rotation is practised where

(a) there is the need to plant different varieties of crops.

(b) there is need to maintain soil fertility.

(c) there is abundant land and human population is low.

(d) the land is scarce and in short supply.

Answers

1. c 2. d 3. b 4. c 5. d 6. d 7. a 8. b 9. b