UNIT 11 SOILS, CROPS AND AGRICULTURAL PRACTICES

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11.1 INTRODUCTION

Soil refers to the loose material composed of weathered rock and other minerals, and also partly decayed organic matter, that covers large part of the land surface. Soil formation is a long process. It usually takes about 100 years for the formation of a centimeter of soil.

Crops refer to the agricultural plants in the fields and are the sources of food, fibres and various other human requirements. They are grown throughout the year under irrigated as well as in rain-fed conditions. A farmer cultivates the soil and sows the seeds as per his requirement either in rainy days (Kharif), winter (Rabi) and summer (Zaid) seasons. Selection of the seeds depends on his choice and the market's demand.

The quality of seeds, proper sowing and intercultural operations, irrigation at the critical stages, balanced fertilization, top dressing of nutrients in standing crop and safety from wild animals, rodents and pests are the important factors that govern the crop yield.

A crop is harvested when it attains physiological maturity. Afterwards it is subjected to operations like threshing and winnowing. And the seeds need to be dried before storage. This unit will give you an overview of these processes.

11.2 OBJECTIVES

After going through this unit, you will be able to:

- discuss the functions of soil;
- describe the types of soil;
- analyse the properties of soil and the factors affecting soil structure;
- discuss the common agricultural practices and the variety of crops in India appreciate the need of quality seeds for better yields;
- explain with the main plant protection measures;
- recognise the stages at which crops are ready for harvesting, along with the threshing and winnowing operations; and
- suggest some simple measures of protecting food grains in the house.

11.3 SOIL

The outer layer of the earth, in and on which, organic life exists, is the soil and is the source of all living existence. Soils are thus intermediate between the deal world (lithosphere) and the living world (biosphere), being the prime source and carrier of all life.

11.3.1 Soil Formation

Soil is a vital natural resource. They are formed as a result of weathering of rocks and minerals. Weathering is the disintegration and decomposition of rocks and minerals by various physical and chemical processes. As stated earlier, it takes about 100 years to form a centimeter of soil.

The soil consists of four main components namely, mineral matter, organic matter, water and air. These components do not exist as separate entities but exist in close contact and are intimately mixed. A typical fertile soil of optimum moisture content has the following approximate contitution:

A. Solids, 50 per cent by volume [(i) Inorganic (95%), (ii) Organic (5%)]
B. Liquid, 25 per cent by volume
C. Gases, 25 per cent by volume

11.3.2 Soil Function

The natural and the most visible function of soil is that it supports plant life, providing the requisite mechanical, nutritional and biological support. In addtion, it also provides moisture and air and acts as a natural store house of the nutrients necessary for the proper growth of plants. Besides being the source of all life, it is also the ultimate place for all the organisms that have died. The micro-organisms present in the soil digest the complex remains of the dead plants and animals and release the elements locked up in their tissues, for the use of the next generation of plants.

11.3.3 Classification of Soil

The soil can be divided into two strata: (1) the top soil and (2) the sub-soil. The top soil is rich in organic matter that is at various stages of disintegration. The plants are anchored to the soil in this vary layer. The top soil is further distinguished into surface and sub-surface top soils. On the other hand, the sub-soil lies underneath the top soil and extends to the parent rock. On moving from top to the parent rock, the amount of oraganic matter diminishes.

The various types of soil are listed in Table 1.

Table 11.1 : Types of Soil

1. Alluvial soil	2. Alluvial soil impregnated with varying amount of salt	3. Coastal sandy alluvium
4. Old alluvium soil	5. Saline and deltaic soil	6. Calcareous soil
7. Deep black soil	8. Medium black soil	9. Shallow black soil
10. Mixed red and black soil	11. Red sandy soil	12. Mixed red loam and red sandy soil
13. Lateritic soil	14. Forest and hill soil	15. Gravelly soil
16. Submontane soil	17. Tarai soil	18. Marshy land
19. Peat soil	20. Desert soil	21. Red loan soil

Soil Profile: For a study of the soil in its undisturbed condition at a given place, a vertical section up to unweathered rock (or up to a depth of about 2 meter in case of alluvial soil) is usually examined. This vertical section is called 'soil profile' and it is made up of a succession of horizontal layers (termed 'horizons') which are of varying thickness but can be reasonably differentiated on the basis of features such as colour, texture and structure. Some times they contain distinct accumulation of compounds at the distinct horizons. This is shown as A, B and C in the Figure 11.1. A horizon forms the surface soil of the plough layer. B horizon is the layer next below, in which part of the products leached out from A horizon have been deposited. It is termed as sub-soil. Immediately under it is the C horizon, which consists of weathered parent materials in the upper part and unweathered rock below. The A and B horizons form the true soil or the solum. (Figure 11.1).

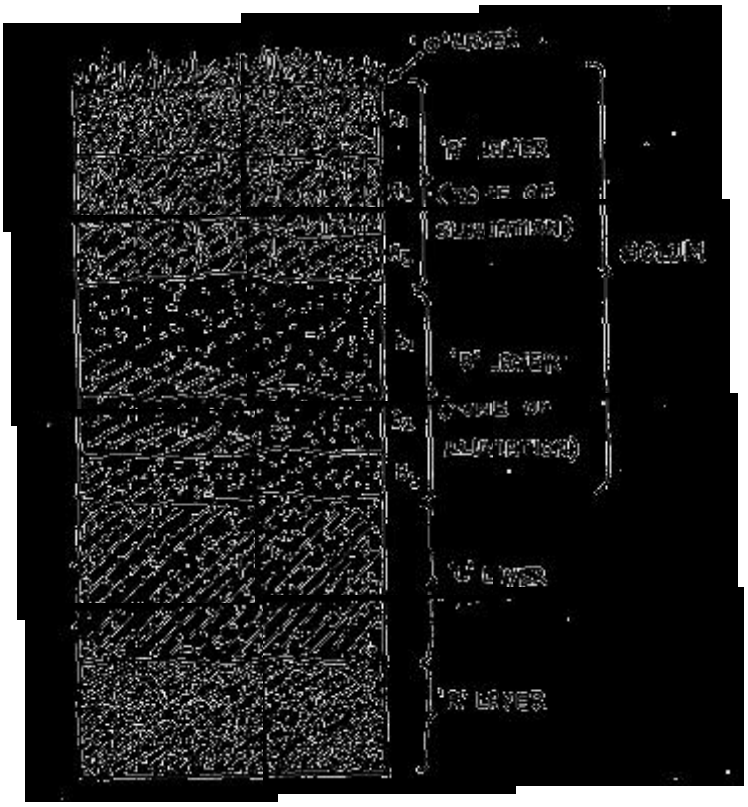

Fig. 11.1 : A Theoretical Mineral Soil Profile

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of this unit.

1. Write two lines on how the formation of soil takes place.

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2. State the various functions of soil.

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3. What is a soil profile?

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11.4 TYPES OF SOIL AND THEIR PROPERTIES

Since the soils are formed by the disintegration of rocks, they can be classified as per the type of their parent rock.

11.4.1 Types of Soil

i) **Soils formed by weathering of granite, basalt and their metamorphic** derivates (gneiss and schist). These soils are derived from loams to sandy loams because the weathered residue consists of a considerable proportion of quartz grains, mixed with fine particles, including clay.

ii) **Soils formed by weathering of shale and slate:** These are hardened sedimentary deposits of silt and clay and some sand, which give rise to fine-texture soils; such as loams, clay loams and clays. Very hard slate slowly gives rise to shallow, loose and infertile soils, Shales containing calcite, feldspar and ferro-magnesium minerals are likely to produced deep, heavy soils, fairly high in plant nutrients.

iii) **Soils formed by weathering of sandstone and quartz:** Sandy soils, which are the common product of sand stone, are usually low in both plant nutrients and water-holding capacity. With increasing amounts of clay and carbonates in the rock, more fertile soils of a loamy nature are formed. Quartzite is outstanding amongst rocks for its resistance to disintegration and decomposition. As a consequence, stony and infertile soils develop form quartzite.

iv) **Soil formed by weathering of lime-stone and marble:** Lime stones generally are desirable sources of soil material. The greater portion of lime-stone, (as much as 95 per cent) is composed of carbonates, which disappears entirely by going in solution and by the leaching process. Thus, only the impurities in the rock such a silt and clay are left to form fertile soils.

11.4.2 Soil Properties

Physical Properties

The soil contains mineral particles of varying size, and organic matter in the form

of humus. The soil mass not only reflects the individual properties of these components, but also due to the combined influence of these properties, the mass assumes many additive properties.

Chemical Properties

The rocks from which soils are formed differ very much in their mineralogical and chemical composition. Igneous rocks are divided into acidic, intermediate and basic groups, depending on their relative content of silica. Similarly, sand, stones and shales differ markedly in composition. The principal minerals occurring in the earth's crust are given in Table 11.2:

Table 11.2: Principal Minerals found in the Earch's crust

Mineral	Percentage	Mineral	Percentage
Felspar	48	Quartz	36
Mica	36	Lime-stone and magnesium lime-stone	2
Hornblende and Augite	1	Olivine and Serpentine	1
Clays	1	Other Minerals	1

In the course of weathering of rocks, the readily soluble products are carried away by drainage waters, whereas the comparatively insoluble products accumulate to form soil. This is particularly so in humid climates and in consequence, silica, aluminium and iron oxide, as such or in silicate combinations, form the major portions of soils in heavy rainfall areas. Silicon in silicate form also dissolves, leaving laterites which consist chiefly of aluminium iron oxides.

Inorganic Components

The total amount of elements contained in soils depends partly on the nature of the rocks from which they are formed and partly on their age and the extent to which soluble products have been leached away. The chemical composition of different horizons of a soil also shows a good deal of variation. Generally speaking, the A Horizon is richer in insoluble compounds as compared with the B Horizon. Usually the elements that are commonly leached out are the ones required in largest quantities by plants.

Organic Materials

Besides inorganic substances, soild contain organic matter in amounts ranging from less than 1 per cent in arid sandy soils to as much as 90 per cent in peaty soils. The presence of organic matter distinguishes soil from disintegrated rock material.

11.4.3 Factors Affecting the Properties of the Soil

Soil Structure: Soil structure refers to the arrangement of soil particles both primary and secondary. This is one of the most important properties of the soil mass, since it influences aeration, permeability, water capacity etc. In the field, the structure is described in terms of (i) type i.e. shape and arrangement, (ii) class i.e. size, and (iii) grade i.e. degree of aggregation.

Soil structure is affected by the (i) pressure exerted by (a) Welting (b) Freezing and thawing (under cold climate) (c) Plant roots and (ii) Cementing substances (a) colloidal material (clay mineral, colloidal oxides of Fe and Al and colloidal organic matter) and (b) soil mycetical growth, mechanical effect of fungi, mycelia-gum, wax etc. (secretion or organic compounds of fungi).

Factors Affecting Soil Structure

i) **Soil management:** The cutting action of ploughs or other tillage implements breaks up the soil mass and may have favourable or adverse effects on the structure, depending on whether the soil is worked under optimum moisture conditions or not.

ii) **Absorbed cations:** Sodium and potassium ions on the clay complex have a tendency to disperse the soil. Calcium, on the other hand, has favourable effects on its aggregation.

iii) **Micro-organisms:** The filamentous growth of soil fungi and the microbial decomposition products of organic matter have a binding effect on soil particles thus favouring aggregation.

iv) **Variations in soil moisture:** Variations of soil moisture due to drying and wetting influence the structure. The drying of soil, in general, forms cracks and big clods. Poorly drained soils, with excess moisture, usually have an unfavourable structure.

Soild Texture: Soil texture depends on the varying proportions of particles of different size groups in a soil. Some soil characteristics are described below:

i) **Density:** Soils having larger particles are usually heavier in weight per unit volume than those with smaller particles.

ii) **Pore Space:** Pore space of the soil is the portion occupied by air and water. Sands have low pore space of about 30 per cent whereas clays may have as much as 50-60 per cent pore space.

iii) **Plasticity and Cohesion:** Sandy soils may be considered to be non-plastic and clayey soils to be plastic. Plasticity is the property that enables a moist soil to change shape on the application of force and retain this shape even when the force is withdrawn.

iv) **Soil Air:** Depending on its texture, the soil may have pore space of 30-60 per cent. In coarser textured soils the individual pore spaces are of bigger type, though the percentage of pore space is less in such type of soil.

v) **Soil Water:** When aggregated, the fine soil separates like clay and silt provide not only minute pores and angles around each particle but also large pores between the aggregates. Thus finer the texture, the more will be the **capillary** capacity.

11.5 AGRICULTURAL PRACTICES

11.5.1 Preparation of Soil

Tillage is the manipulation of the soil with tools and implements for loosening the surface crust and bringing about conditions favourable for the germination of seeds and the growth of crops. The tillage operations done to fields from the time of crop harvesting to the sowing of next one go by the name of “preparatory cultivation” or “primary tillage”.

In a good seed-bed, the loosened layer is in contact with the compact soil below, which facilitates water movement and development of roots in the soil.

11.5.2 Pre-sowing Operations

The pre-sowing operations include ploughing, harrowing, cultivating, levelling, planking and basal application of organic manner. Ploughing the most essential operation in growing crop aims at stirring and disturbing the top layer of soil uniformly, without leaving and unploughed strips of land.

A modern plough opens and pulverizes the soil and covers plant residues which improves physical, chemical and biological properties of the soil.

Harrowing

Harrowing is done with the use of a blade harrow to make a loose, friable, and well-aerated seed-bed. This helps in increasing the activities of the micro-organisms in the soil. It serves many purposes, for example, it crushes clods, levels the seed-bed, destroys the germinating weeds, compacts the sub-soil and leaves the surface soil loose and pliable. Harrowing is a very important operation and for some crops the seed-bed can best by prepared only by harrowing with the blade harrow.

Cultivation

This is mainly to break the crust to encourage germination of the seeds and destroy the weeds. It refers to the operations done with hand tools, but if the areas is large, the use of some type of implement pulled with bullocks or a tractor may be desirable to save time and labour. A thorough cultivation should always be done before sowing a crop and continued until the spread of the crop prevents further cultivation. Cultivation before the crop comes up is called **blind tillage**. This type of cultivation is essential to break the surface crust if it rains immediately after sowing.

Levelling

Levelling of land is one of the occasional land development operations and not an operation that is necessary every year. When the level of the land is not as required, this operation is carried out after ploughing, with a bullock-drawn buckscraper and a plank to ensure an even distribution of rain and irrigation water, to avoid the death of plants due to stagnation of water in low-lying areas, and to stop soil erosion and the breaching of bunds. Farmers of the irrigated and paddy tracts must be particular about the level of the land.

Clod Crushing

Clod crushing is a big job when the crops are raised in off seasons. If irrigation water is plentiful, the cloddy land may be irrigated and the clods that are softened by the water can be broken by running a heavy plank or a blade harrow over the soil. Clod crushing is not always necessary. If the land is ploughed when the moisture conditions are optimum, very few clods are formed. When rain-fed crops are to be grown, the fields are ploughed and left undisturbed until a shower of rain is received. This does a good job of softening and breaking the clods.

Compacting

Sometimes the soil may be loosened too much by over working resulting in excessive aeration and a loss of soil moisture. It is necessary to compact such loose soils. Small seeded crops like mustard, sesamum, bajra and the millets require the firm seed-beds. This operation is essential for every cultivated field.

Basal Application of the Bulky Organic Manure

These include farm manure, farm compost, town compost, green manure and other bulky sources of organic matter. All these manures are bulky in nature and supply (i) plant nutrients in small quantities, and (ii) organic matter is large quantities. Farm-yard manure, compost and green manure are the most important and widely used in organic manure. Farm yard manure refere to the dung and urine of farm-animals along with litter (bedding material) and left over material from roughages or fodder fed to the cattle. Compost is prepared from refuse collected on the farm or in the town or village. Green manuring can be defined as a practice of ploughing or turning into the soil undecomposed green plant tissues for the purpose of improving the soil. Manures are applied to the soil before the crop is sown or planted or transplanted to improve the soils' physical properties, increase humus content in the soil, increase drainage of clay soil and provide for soil micro-organisms.

Check Your Progress

Notes: a) Write your answers in the space given below.
b) Compare your answers with those given at the end of this unit.

4. Explain the meaning of tillage.

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5. Name the activities for field preparation.

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11.5.3 Selection of Crops and Seeds

Crop plants are those plants, whose economic or commercial values are known and they are grown in community for the known or specific purpose. Crope could be classified in three major categories viz.

- Garden crops (orchard crops, kitchen garden vegetables and ornamental crops),
- Plantation crops (tea, coffee, coca, rubber, cardamom and so on), and
- Field crops (food grain crops, oilseeds and pulses).

A seed may be defined as a fertilized ovule, consisting of an embryo, stored food and seed-coat. It is viable and has the capacity to germinate, Sometimes it may also be called as "a unit of reproduction of flowering plants" and may be described as "a plant embryo in a dormant state, surrounded by a food supply and a protective outer skin or seed-coat".

The seeds, in their real meaning, must be:

1. true to their type;
2. uniform in its texture, structure and looks;
3. viable i.e. the germination capacity is up to the standard and it has been tested recently;
4. healthy, pure and free from all the contaminating material and the weed seeds;
5. truthfully labelled and produced under all due care and strict supervision so that they do not germinate quickly; and, of course,
6. free from any seed-borne disease.

Importance of Seeds

Seed is an important input in crop production. Without good seed the investment on fertilizer, water, pesticides and other inputs will not pay the required dividends. Seed is (i) a carrier of new technologies; (ii) a basic tool for secured food supply; and (iii) the principal means to secure yield, in less favourable conditions of production.

The use of seed of an appropriate class and from an approved source is necessary for raising a seed crop. Four classes of seeds namely, *breeder's, foundation, registered* and *certified*, are generally recognized in seed certification.

Breeder's Seed: Breeder's seed is the seed or the vegetative propagating material, which is directly controlled by the originating or in certain cases, the sponsoring breeder or the institution. It provides for the initial and recurring increase of the foundation seed.

Foundation Seed: This seed stock is maintained to preserve specific genetic identity and purity. Production must be carefully supervised or approved by representatives

of the agricultural experiment station. Foundation seed is the source of all other certified seed classes, either directly or through registered seed.

Registered Seed: Registered seed is the progeny of foundation or registered seed. This class of seed should be of a quality suitable for production of certified seed.

Certified Seed: Certified seed is the progeny of registered or certified seeds.

Classification of Crops

Classification of crops is undertaken with certain objectives. These are – (i) To get the user acquainted with cultural requirements and practices in order to arrange the required inputs for an improved and scientific crop management. (ii) To know about the yield potential of indigenous or native plant types and their quality aspects so that the necessary improvements may be done by crossing with exotic plant types or by acclimatizing/introducing the exotics as such. (iii) To formulate a need based crop planning. Keeping land capacity class in view.

The classification is based upon: (a) the place of origin; (b) the botanical classification; (c) the commercial classification; and (d) the seasonal classification.

a) The crops of Indian origin are rice, barley, black gram, green gram, mustard, sugarcane and cotton. These are also known as the native crops. Crops like tobacco, potato, maize and jute are of foreign origin.
b) Botanical classification helps in an easy understanding about the plant's characteristics, requirements and management practices needed for their production. The crop plants are grouped into different families viz., *Leguminosae* family consisting of leguminous plants like pulses, groundnut, soyabean, clovers beans and many other which are characterised with nodule bacteria and the symbiosis process.
c) Commercial classification is based on the trade and commerce of agricultural produce under which they are sold in the market viz., food crops (including rice, wheat, coarse grains, green gram, black gram and soyabean); industrial or commercial crops (including cotton, jute, sugarcane, sugarbeet and tobacco); food adjuncts which include spices and condiments.
d) Seasonal classification of crops is the grouping of the crops according to their climatic requirements viz., requirement of temperature, humidity and photoperiod, which includes Kharif (July to September), Rabi (October to March) and Zaid (April to June). Presently evolution of photo and theremo – non-sensitive strains of various crops like maize, sorghum and tomato, have made it possible to grow a crop in any season or throughout the year.

Importance of Crops

Cereals: Amongst cereals, wheat, rice, barley and maize are the important crops grown throughout the country. Millets (sorghum, pearl millet) are warm weather cereals with small grains and are grown for fodder and grains.

Pulses: Their well known examples are: black gram, bengal gram, cowpea, green gram, pigeonpea, lentil and peas, They are an important part of Indian dietary. Being leguminous crops, possessing root nodules, they fix and utilize atmospheric nitrogen, and thereby enhance soil fertility.

Oilseeds: Their common examples are: groundnut, rapeseed and mustard, sesamum, linseed, castor, safflower, soyabean and sunflower. They are the backbone of the agricultural economy of our country from times immemorial. Farmers grow oilseeds on marginally fertile and unirrigated lands in which grain crops cannot grow.

Vegetables: These crops occupy only about 1.2 per cent of the total cultivated area of the country. They constitute an important item of human diet. The vegetables are dealt under thirteen groups, namely potato, solanaceous fruits (tomato, brinjal), cole

crops (cauliflower, knol khol, chillies and cabbage), root crops (radish, turnip, carrot), bulb crops (onion and garlic), peas, beans, cucurbits (cucumber, muskmelon, water melon, bottle-gourd, bitter-gourd, sponge-gourd, ridge-gourd, summer squash, winter squash and tinda).

Fodder Crops: There are several cereals and legume crops besides grasses, which are used as green fodder in India. In these days, while milk and butter are becoming scarce in the market and their prices are soaring because of the increase in the price of the feeds, production of green fodder is very essential not only to bring down the prices of concentrates but for the rearing of healthy animals.

Region	Fodder crops for different conditions	
	Rain-fed	Irrigated
Arid	Pearlmillet, sorghum	Sorghum, oats
Semi-arid	Sorghum, pearlmillet, cowpea	Sorghum, maize, cowpea, hybrid, napier, oats, sudan grass, setaria grass
Mountains	Oats, clover root crops and temperate grasses	

Root Crops: They are fleshy edible roots which are eaten raw, as salad or cooked or made into pickles and sweet meats. They are the source of vitamins (A, B and C) and minerals. Some examples of root crops are radish, turnip and carrot.

Fibre Crops: The fibres obtained are used for variety of purposes such as in making cloths, sack, carpets, mats, tarapulin, ropes, mats, paper, brushes, and other fancy articles. Jute, Ramie, Sisal are some examples of fibre crops.

Sugar Crops: Sugarcane and beetroot are the two main crops of this category. They are the major source of sugar. Their byproducts are valued as cattle feed.

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of this unit.

6. Define a seed.

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7. List the objectives of classifying the crops.

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8. Name the various categories of seeds.

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11.5.4 Methods of Sowing and Intercultural Practices

Establishment of a good stand is the essential pre-requisite for attaining high yields. It depends on time, depth and the method of sowing and the seed treatment.

Depth of Sowing: The depth at which seeds are sown is dependent on the size of the seed and the amount of moisture present in the soil at the time of sowing. Small seeds can produce short plummers only and are sown near the surface, to maintain the supply of moisture required for the germination of these small sized seeds: the large sized seeds are sown deep in the soil.

Methods of Sowing

Crops are sown in various ways. Broadcasting is very common method. In this the seeds are scattered by hand over the field. Dibbling seeds in plough furrows, planting seeds on ridges and drill sowing are some other methods of sowing.

Drilling

Drilling is the common method adopted for sowing. The seed drills need a lot of skill in operation. The seeds are sown in parallel lines which facilitate their inner cultivation with bullock hoes. Quite a large number of improved seed drills, both automatic and hand operated have been designed. It is necessary, particularly in respect of automatic seed drills, to calibrate them before sowing, so as to know the exact rate at which seed will drop. The seed-drills are to be calibrated for each type of crop separately because of the differences in the shape, size and weight of the seeds of different crops.

Intercultural Practices

Most of the interculture in India is done with a hand tool, which consist of a sharp-edged triangular or sickle-shaped blade or with a hand wheel hoe (Figure 11.2). Most of these tools have small handles and the user has to sit on his heels or bend his back while weeding.

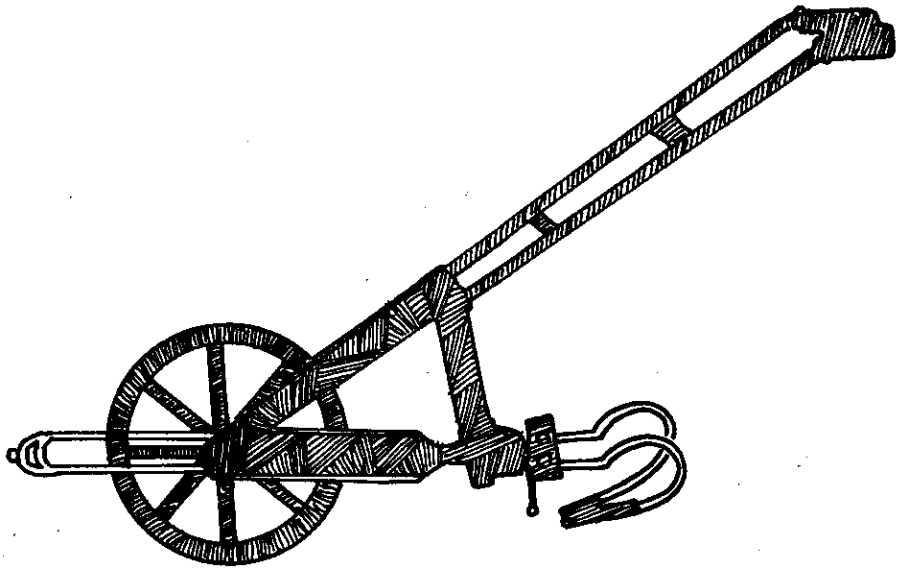

Fig. 11.2 : Hand Wheel Hoe

The single operation of weeding can increase the crop yield without much additional investment, because efficient weeding will save moisture crop nutrients and to some extent air and light required for cultivated crops. Hand pulling of individual weeds is a practical and efficient method of eliminating weed growth.

In the case of rain-fed crops, hoeing by using bullocks is done at the most three times, after which the plants grow tall and bushy and also the soil becomes hard. To cope with this condition, stronger and sharp hoes have been designed.

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of this unit.

9. How are seeds sown?

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10. What is the importance of inter-cultural practices?

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11. Does manual weeding help in crop production?

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11.5.5 Irrigation

The artificial application of water to the soil for the purpose of supplying moisture essential for plant growth is termed as irrigation. It provides an insurance against the short droughts. It helps to maintain soil-water balance. Irrigation reduces the risk of relying on rain water for scheduling any field operation such as land preparation, sowing and planting, inter-culture and fertilizer applications. Assured and potential irrigation helps to select a variety of high value crops suitable for the agro-ecological situation and market outlets.

Available Water Resources and Irrigation Potential

Rain water and snow are the main sources of fresh water in the country. The annual rainfall of the country averages to 112 cms over the entire geographical area, which amounts to 370 million hectare-metres of water. Twenty million hectare-metres water comes from the catchments located outside the country. Precipitation exhibits wide variations both in time and space. It varies from less than 30 cm in western Rajasthan to about 1000 cm in Chirrapunji in Meghalaya.

The country has given priority to the development of irrigation potential and irrigated area has increased considerably during the last three decades.

Systems and Methods of Irrigation

The design, the equipment and the technique of replenishing the soil water deficit by applying irrigation water is referred to as “irrigation systems”. The system adopted for irrigation must ensure a uniform distribution of water in the root zone of a crop and a high efficiency of water application. The method used should be inexpensive and economically justifiable.

Several systems of irrigation are in vogue to suit different crops, topography, soil types, water resources, climatic conditions and costs. These systems are: surface

irrigation system, sprinkler irrigation system, sub-irrigation system and deep irrigation system.

Surface Irrigation System

It is a system in which water is directly applied to the surface of the soil and is spread by gravity flow incidental to the slope of the land. There are several methods in this system, the commonest being flooding from a ditch, check basin, ring and basin, border strip and furrow (Figure 11.3). For irrigation with the surface system, fields are laid out every time before the crops are sown, since these layouts are destroyed during preparatory tillage. In order to achieve a higher water application efficiency in the surface system of irrigation, the fields must be levelled well.

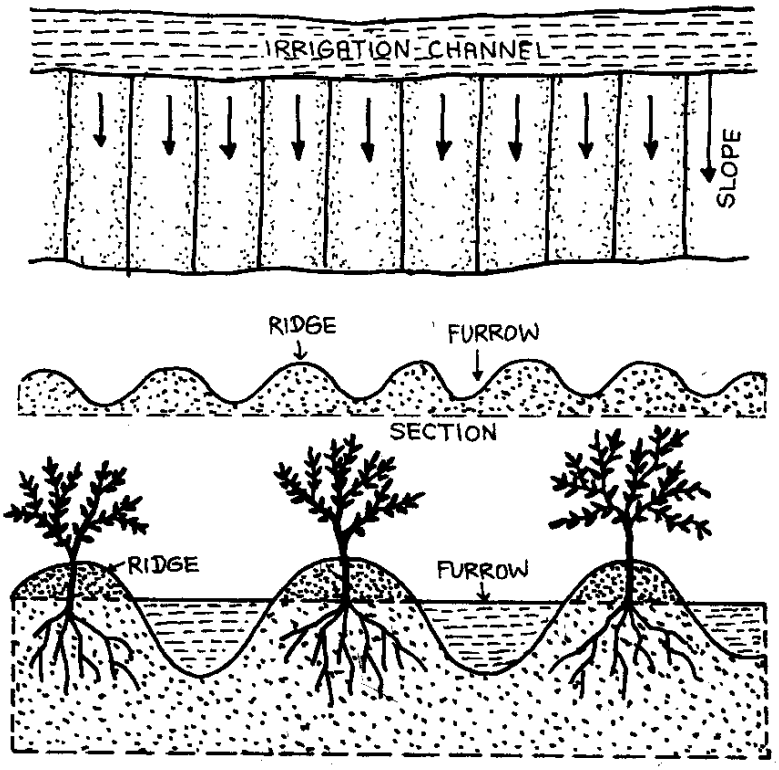

Fig. 11.3 : Surface–Irrigation System

Sprinkler Irrigation System: It is a system in which water pressure is applied to the surface of any crop or soil in the form of a thin spray from above. This method is advantageous, as water can be applied at any controlled rate with a uniform distribution and high efficiency. The sprinkler system is especially suited to shallow sandy soils of uneven topography, where levelling is not practicable, and in areas, where water and labour are scarce.

Sub-soil Irrigation System: In this system, water is applied into crevices of field ditches deep down to the impervious layer. It then moves laterally and then vertically through capillaries and saturates the root-zone. In artificial sub-irrigation, which is also known as sub-surface irrigation, perforated or porous pipes are laid underground in the vicinity of the root-zone and the water under pressure is distributed through these pipes. This system is adaptable on soils having an impervious layer at a suitable depth in the substratum. This system is practiced on sandy-loam soils for growing case crops.

Drip-irrigation System: Also termed “trickle irrigation”, it involves the slow application of water drop by drop, as the name signifies, to the root-zone of a crop. The method was initiated in Israel and is now being tried in other countries. In this method, water is used very economically, since losses due to deep percolation and

surface evaporation are reduced to the minimum. The system can also be used for aplying fertilizer solution. It may also workout to be cheaper than the sprinkler system, especially for orchard and other widely spaced crops.

Check Your Progress

Notes: a) Write your answers in the space given below.
b) Compare your answers with those given at the end of this unit.

12. Discuss the importance of irrigation.

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13. List the systems and methods of irrigation.

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11.5.6 Maintenance of Soil Fertility

Soil fertility refers to the capacity of the soil to supply plant nutrients in available forms to the crop plants. A fertile soil may or not be productive depending upon crop marketing conditions and several other factors but very productive soil has to be fertile. Therefore, it is essential for a farmer to manage soil fertility in such a way that he gets maximum production from his land. For better fertility management, one should always consider what elements are needed for a particular crop and in what quantity, and of the total requirements, how much is present in the soil. The first step, therefore, is to find out the soil fertility status, i.e., what is the capacity of the soil to supply elements required by the plants so that the application of elements may be balanced and timely to avoid the ill effects of unbalanced use of fertilizers. Thus, it is necessary for an agriculturist to know the fertility status of the soil which is to be used for crop production. However, for maintaining soil fertility management practices should be followed for all crops that are to be grown on a piece of land. Systems approach is applied to agriculture for efficient utilization of all resources, maintaining stability in production and obtaining higher net returns.

Cropping System

Cropping system is an important component of a farming system. It represents cropping patterns used on a farm and their interaction with farm resources, other farm enterprises and available technology, which determine their make up. Cropping pattern means the proportion of area under various crops at a point of time in a unit area. It indicates the yearly sequence and the spatial arrangement of crops and follow in an area.

Crop rotation refers to the recurrent succession of crops on the same piece of land either in a year or over a longer period of time. Component crops are so chosen so that soil fertility (soil health) is not impaired.

The soil normally cannot provide the primary plant nutrients in large quantities needed for healthy plant growth. These are, therefore, applied to the soil in the form of **chemical fertilizers**, which are the carriers of these essential plant nutrients. The secondary plant nutrients are required by plants in fairly substantial quantities and adequate amounts are present in most of the areas but are lacking in some. The

micro-nutrients are so called because they are required by the plants in very small quantities. Although these elements are supposed to be available in sufficient quantities in certain soils deficiency many occur due to intensive micro-nutrients. This also has to be corrected through the application of micro-nutrient carriers.

Table 11.3 : Nutrient Elements for Plants

Primary	Secondary	Micro-nutrient
Nitrogen	Calcium	Boron
Phosphorus	Magnesium	Copper, Zine, Iron
Potassium	Sulphur	Molybdenum, Chlorine

Manure and Fertilizers

The **Organic Manures** are derived from biological sources like the plant, animal and human residues. These organic manures contain low amounts of plant nutrients, but the organic matter is present in large quantities, hence these are known as the bulky organic manures. Among various bulky organic manures, farm yard manure, compost, green manure, concentrated manure and oil cakes are the most widely used. These are fairly quick acting manures which are applied well before the crop is sown.

Fertilizers are industrially manufactured chemicals containing plant nutrients. Nutrient content is higher in fertilizers than in organic manures and nutrients are realised immediately. Fertilizers are grouped based on the nutrient present in the fertilizers, namely, nitrogenous fertilizer, phosphatic fertilizer and potassic fertilizers.

Nitrogenous Fertilizers contain 'nitrogen' in a form absorbable by the plants. Ammonium sulphate, calcium nitrate, ammonium sulphate, nitrate urea are some important nitrogenous fertilizers:

Phosphatic Fetilizers contain phosphorus in forms aborbable by the plants for e.g.

i) The single super phosphate;

ii) The triple super phosphate

All commercial **potassic fertilizers** are water soluble and so are readily available to plants. Potassium chloride and potassium sulphate are important potassic fertilizers.

Methods of Fertilizer Application

a) **Broadcasting:** It refers to the uniform distribution of fertilizer over the entire field and mixing it with soil.

b) **Placement:** This refers to placing fertilizers at a specific place in the soil with or without reference to the position of seed. It is commonly practiced for applying phosphatic and potassic fertilizers. The most common methods of placement are as follows:

   i) **Plough Sole Placement**

   It is the placement of fertilizers in a continuous band at the bottom of the furrow at beginning of the process.

   ii) **Localized Placement**

   It refers to the application of fertilizers into the soil close to the seed or plant in order to supply the nutrients in adequate amounts to the roots of growing plants. (Figure, 11.4, 5, 6 and 7.)

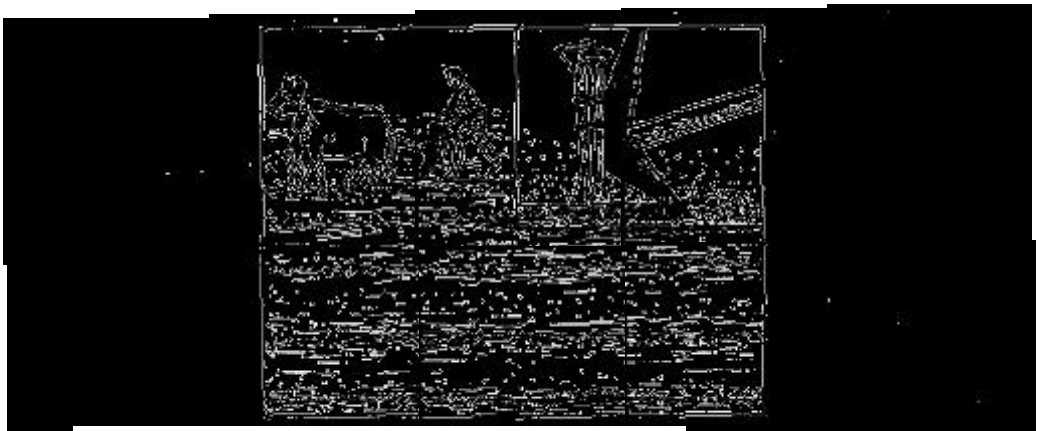

Fig. 11.4 : Drill Application

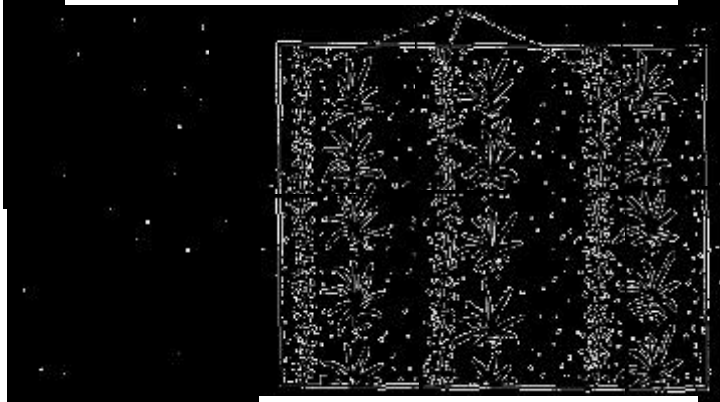

Fig. 11.5 : Single Band Placement

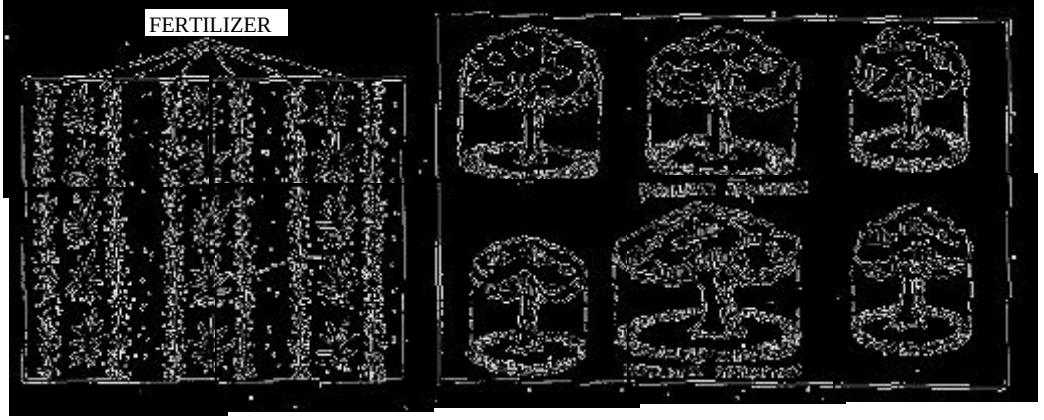

Fig. 11.6 : Double Band Application

Fig. 11.7 : Ring Placement

The common methods of placing fertilizers close to the seed or plant are:

i) **Contact Placement:** Drill placement or combined drilling, which enables the drilling of the seed and fertilizers together while sowing the crops.

ii) **Single Band Placement:** It is the placement of fertilizer in bands. It includes the following:

Hill Placement: It is practised for the application of fertilizers in orchards.

Row Placement: In this method, the fertilizer is applied in continuous bands on one or both the sides of the row, particularly in crops like sugarcane that is sown in rows.

Pellet Application: It refers to the placement of nitrogenous fertilizer in the form of pellets, 2.5 to 3 cm deep between the rows of the paddy crop. The fertilizer is mixed with the soil in the ration of 1:10 and made into small pellets of convenient size to deposit in the mud of paddy fields.

Side Dressing: It refers to the spread of fertilizer in between the rows and around the plants.

Foliar Application: It refers to the spraying of fertilizer solution (2% urea) containing one or more nutrients on foliage of growing plants (Figure 11.8).

Fig. 11.8 : Foliar Application

Check Your Progress

Notes: a) Write your answers in the space given below.
b) Compare your answers with those given at the end of this unit.

14. Discuss the maintenance of soil fertility.

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15. Differentiate between manure and fertilizers.

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11.5.7 Protection of Crops

Need of Protection

The success of intensive and extensive agriculture with liberal use of fertilizers, irrigation, good seeds, multiple and relay cropping with high yielding varieties, will depend to a great extent on the adoption of timely and effective plant protection measures against major insect-pests and other diseases of crops. Plant protection has now been accepted as one of the major factors in increasing agricultural production as about 10-25 per cent of crops is eaten or rendered unfit to human consumption by insects alone.

Crops need protection from wild animals, rodents, insects and pests (the insects reach a pest status when they are responsible for 5% of the loss of the yield) and the use of insecticides and pesticides. The indiscriminate use of pesticides has resulted in several problems like pest resistance to pesticides, residues in food, water, air and soils, secondary pest outbreaks, resurgence of minor pests and human and animal health hazards. Therefore, safe plant protection measures are required that would not damage the human life, and the ecosystem on the whole.

The following insecticides are generally used for controlling crop pests:

BHC, Malathion, Parathion, Pyrethrum extract, Nicotine sulphate, methyl-demeton, phosphomidon and Dimethoate. Spraying equipment, viz., sprayer and dusting gun are commonly used as plant protection equipment (Figure 11.9 and Figure 11.10).

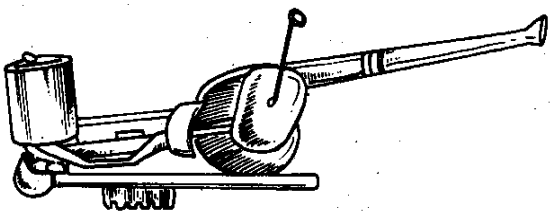

Fig. 11.9 : Dusting Gun

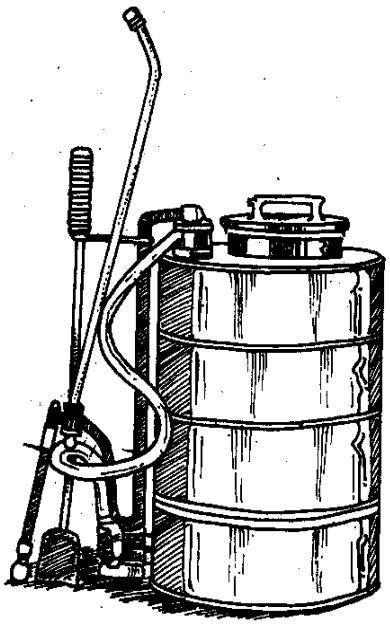

Fig. 11.10 : SIKAR-59 Knapsack Sprayer

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of this unit.

16. Discuss the importance of protecting the crops.

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17. Differentiate between an insect and a pest.

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11.5.8 Harvesting, Threshing and Winnowing

Harvesting

When the entire plants or their economically important parts after maturing are removed, it is called **harvesting**. The portion of the stem that is left on the field is known as stubble. The economic products may be grains, seeds, leaves, roots or the entire plants.

Time and Methods of Harvesting

Crops are harvested at their physiological maturity. Physiological maturity refers to a developmental stage after which no further increase in dry matter would add to the economic part whole plant. The harvest maturity generally occurs seven days after the physiological maturity.

Harvesting is done either manually or by mechanical means. In manual harvesting, a sickle is the most important tool. The sickle has to be sharp, curved and serrated for efficient harvesting. Nowadays serrated sickle is being used for harvesting the crops. The other tool used for harvesting is knife especially for harvesting of plants with woody parts.

Threshing

Threshing is a process, in which fruits or seeds are separated from plants. In cereals, straws and grain are separated and in pulses, seeds are separated from pods. Threshing of cereals, millets and few pulses is done mainly by beating against stones or any hard material or by beating with mallets or by treading under the feet of cattle or tractor tyres. Some threshers like olpad thresher, paddy thresher and roller are also used. Rollers made of stones are used to thresh grains from ears of sorghum, pearl millet, finger millet. Olpad thresher is used for threshing wheat, barley and oats.

Moisture content of grains at the time of harvesting of crops is about 18 to 20 per cent. Hence, the harvested crop is allowed to dry for a couple of days at the threshing floor and afterwards threshing may be done. The threshing floor must be well dried and drained. It should be located a bit higher than the ground level.

Winnowing

Winnowing is the process of separating grains from the mixture of threshed straw and grain in an artificial or natural stream of air. Winnowing basket is the oldest and common traditional method of winnowing in the country. A place higher than the general field is selected for this purpose. One man stands on a further high platform with basket full of threshed grain to be winnowed. He drops the material very slowly but continuously at the same rate by stretching his hand up and shaking the basket. The grain being heavy it falls under his leg, while broken straw and chaffs, being lighter than the grain, are taken by the wind to a far distance. Two men are required for this operation, one for winnowing and other for handing over a basket full of threshed material to the man on the platform. When the wind velocity is not adequate, winnowing fans, either manually or mechnically operated are mostly used to create a sufficient strong air blast.

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of this unit.

18. Define Harvesting.

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19. Explain Threshing in two lines.

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20. Describe the process of Winnowing.

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11.6 STORAGE

Harvesting of crops is seasonal, but consumption of the food grains is round the year. The market value of the produce is generally low at harvesting time. Therefore, there is a necessity to story the produce for different periods depending on the type of crop. Different categories of agricultural produce needing storage are foodgrains, oilseeds, seeds and fodder.

The faulty storage of food grains results is severe losses. The losses to stored material due to different pests or insects are about 2.55 per cent; due to rodents 2.50 per cent; by birds 0.85 per cent and by fungus and other micro-organisms is to the tune of 0.68%. Several pests like khapra, rice weevil, flour beetle, lesser grain borer, rice moth, grain moth and pulse beetles also attack grains in storage.

Moiture Percentage in Seed and Storage Containers

Grains must be dried properly before storage. Moisture content for safe storage of grains of most crops in about 14 per cent. Moisture content of grains for safe storage for various crops is presented as under:

Crop	Moisture
Paddy, raw rice	14
Parboiled rice	15
Pulses	12
Coriander chillies	10
Groundnut pods, rape and mustard	06

Grains can be preserved in small quantities by using metal drums or bins. The bins made of steel, aluminium, R.C.C. are used for storage of grains out side the house. These bins are fire and moisture proof.

Check Your Progress

Notes: a) Write your answers in the space given below.
b) Compare your answers with those given at the end of this unit.

21. Discuss the importance of storing grains.

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22. List stored grain pests.

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23. What moisture percentage in grains is appropriate for their safe storage?

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11.7 LET US SUM UP

Soil is formed as a result of the combined action of climate and living organism on the parent rock over a long period of time. The soil supports the plant life both from the mechanical and nutritional stand point, by providing crops their all important requirements, viz. water and all other ingredients required for their growth and development.

Soil profile is given by the vertical section of a soil, and it includes succession of horizontal layers of varying thickness.

Ploughing, harrowing and levelling are the main activities of preparing the soil. Tillage is the first operation of preparing the soil before sowing seeds of any crop.

Clod crushing is done when the crops are raised in off seasons. If irrigation water is in plenty, the cloddy land may be irrigated and the clods that are softened by the water can be broken by running heavy plank or a blade harrow over the soil.

Crops can broadly be classified as (i) graden crops (ii) plantation crops and (iii) field crops.

Seed is a unit of reproduction of flowering plants and may be described as a plant embryo in a dormant stage surrounded by a food supply and outer cover and protection. Seeds must true to their type; uniform in its texture, structure and look; viable and with germination capacity; healthy, pure and free from any seed-borne disease.

The crops are classified as vegetables, cereals, millets, pulses, oil seeds, fodder crops, root crops, fibre crops and sugar crops.

The artificial application of water to the soil for the purpose of supplying moisture essential for plant growth is termed as ‘irrigation’. Various systems of irrigation include: (i) surface-irrigation systems; (ii) sprinkler irrigation system; (iii) sub-soil irrigation system, and (iv) drip irrigation system.

Manures and fertilizers are used as plant nutrients in the growth of crops. Organic manures are derived from biological sources like plant, animal and human residues. Fertilizers are industrially manufactured chemicals containing plant nutrients. Broadcasting and placement are methods of fertilizer application.

Bulky organic manure improves the physical properties of soils and provides food for soil micro-organisms. Farm yard manure, compost and green manuring are most widely used bulky organic manure.

Plant protection is accepted as one of the major factors in increasing agriculture production as about 10-25 per cent of crops is eaten or rendered unfit to human consumption by insects alone. Wild animals, rodents, insects and pests are the major threats to crops/plants. Various types of insecticides and pesticides are used for control of pests/insects. Herbicides are used in crop field or elsewhere to control the weeds.

Harvesting of a crop is the process in which the entire plants are removed physiological maturity. Threshing is separating the fruits or seeds from the plants. Winnowing is the process of separating grains from the mixture of threshold straw and grain is an artificially or naturally stream of air.

11.8 UNIT-END EXERCISES

1. Write about the classification of crops grown in the tract along with respective varieties. Collect the seeds of few crops and label them properly and attach them with the assignment file.
2. What are the different methods of sowing usually followed in the tract? Specify the need of adopting the methods of sowing crop-wise.
3. What are the common fertility problems of agricultural fields? Why are bulky manures preferred? How is proper fertilization done? Discuss the various methods of fertilizer application.
4. Why is irrigation essential for a good crop growth? What are the various methods of irrigation followed in cereal and orchard crops?

11.9 SUGGESTED READINGS

Singh, V., *Fundamental of Irrigation and Fertilizers.* Agricultural Research Information Centre, 45, Pritinagar, Hissar-125001.

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Sachedi, A.K.: *Fertilizers and Manures — Instructional–Cum–Practical Manual,* NCERT, New Delhi.

Crop Management, Instructional–Cum–Practical Manual, NCERT, New Delhi.

ANSWERS TO CHECK YOUR PROGRESS

1. The soil is formed as a result of the combined action of climate, living organisms on the parent rock over a long period of time.
2. There are various functions of a soil viz., physical, chemical and biological. The soil serves as the mechanical support for crops to stand and is the natural store house of the plant food.
3. The vertical section of a soil is called soil profile and it is made up of a succession of horizontal layers which are of varying thickness.
4. It is the first operation of preparing the soil before sowing seeds of any crop.
5. Ploughing, harrowing and levelling are the main activities of preparing the soil.
6. The seed is a fertilized ovule, consisting of an embryo, stored food and seed cost. It has the capacity to germinate.
7. To know about the yield, potential of native plant, type and the quality aspects.
8. The categories of seeds recognized by seed certification authorities are Breeders, Foundation Seed, Registered Seed and Certified Seed.

9. It is a process by which the seeds are put into the moist soil. There are various ways of sowing, such as broadcasting, dibbling seeds in plough furrows, planting seeds on ridges and drilling.
10. By intercultural operations the undesired plants are removed from the field and the soil moisture and nutrients are preserved for the crop growth.
11. Yes, this is a practical and efficient method of eliminating the weed growth; this ultimately enhances the crop yield.
12. It provides an insurance against short duration drought; and provides artificially moisture, needed for crop growth.
13. Applying irrigation water is refereed to as irrigation system and the way by which the water is applied to soil is know as the method of irrigation.
14. Soil fertility is maintained by implementing crop rotation methods along with use of organic manures and chemical fertilizers.
15. Generally, the term manure refers to the dung and urine of farm animal along with litter (bedding material) and left over material from roughages or fodder fed to the cattle. While when plant nutrients are supplied artificially to the soil, they are called fertilizers.
16. Most of the crops are damaged or rendered unfit to human consumption by insects alone. High yielding varieties have increased the possibility of inviting more insects – pests and diseases. Thus there is a need of plant protection measures to be adopted along with crop production practices.
17. An insect is a creature, whose body is clearly divided into three regions – head, thorax and abdomen; while insects reach a pest status, when they are responsible for 5% loss of the yield, and multiplies with a faster rate.
18. It is a process, in which the entire plants at maturity are removed. The crop is harvested at its physiological maturity.
19. When the fruits or seeds are separated from the plants, the process is called threshing.
20. Winnowing is the process of separating grains from the mixture of threshed straws and grains in an artificially or naturally stream of air. Winnowing basket is the oldst and the most common traditional method of winnowing in the country.
21. Storage of the produce for different period is essential for making it readily available to consumers at later stage the requisite quantity of grain.
22. Several insect pests like Khapra, rice weevil, flour beetle, lesser grain borer, rice moth, grain moth and pulse beetles attack grains in the storage conditions. So these insects are called as ‘store grain pests’.
23. Moisture content for safe storage of grains in case of most crops is about 14 per cent.