CHAPTER 10

Relevance of Biology to Agriculture

Classification of plants

Plants can be classified based on of three criteria:

(i) Botanical classification;
(ii) Agricultural classification; and
(iii) Classification based on life cycle.

Botanical classification

As in Zoology, the system of classification uses the *binomial system* (see Chapter 1). However, there are some minor differences in nomenclature in botany and zoology. In Zoology, names of families are formed by adding *idae* to the stem of the name of the genus, e.g. Ranidae from *Rana*, (the frog); sub-family names are formed by adding *inae* to the stem, e.g. Fasciolinae from *Fasciola* (the liver fluke). In botany, family names usually end in *aceae*, though a few have *ae* e.g. Caesalpinaceae, from *Caesalpinia* (Pride of Barbados); others end in *ales* e.g. Rosales, the roses, divisions end in phyta Spermatophyta - the seed-bearing plants.

It is common to group the Kingdom Plantae into four divisions, namely: Thallophyta, Bryophyta, Pteridophyta and Spermatophyta. Some of the main distinguishing features of each division have been outlined in Chapter 1. *Table 10.1* illustrates a summary of the classifications of two plants using no subcategories.

Table 10.1 *Classification of some plants*

	Plant A	**Plant B**
Kingdom	Plantae	Plantae
Division	Spermatophya	Spermatophya
Class	Angiospermae	Angiospermae
Order	Leguminosae	Liliflorae
Family	Caesalpinia	Liliaceae
Genus	*Caesalpinia*	*Cana*
Species	*pulcherrima*	*indica*

The following older classifications are still often used for plant group names.

1. Cryptogams – Plants with microscopic reproductive organs that produce spores e.g.Thallophyta, Bryophyta and Pteridophyta.
2. Vascular crytogams – Crytogams with differentiated vascular tissues e.g. only the Pteridophyta.
3. Phanerogams – Plants bearing macroscopic reproductive structures, flowers, seed producers e.g. Spermatophyta.
4. Archegoniatae – Plants with an archegonium for producing female gametes, e.g. Bryophyta and Pteridophyta.

Fig 10.1 A banana plant, a monocotyledon

Table 10.2 *Main features of monocotyledons and dicotyledons*

	Monocotyledons	**Dicotyledons**
1.	Most are herbaceous, no true trees except palms and bamboos	Herbs, shrubs and trees
2.	Parallel-veined leaves	Net-veined leaves
3.	Vascular bundles arranged irregularly in the stem	Vascular bundles arranged in rings in the stem
4.	Rarely secondary growth	Secondary growth is usual
5.	Fibrous root system	Tap root system

	Monocotyledons	Dicotyledons
6.	Flowers in threes and multiples of threes.	Flowers in fours, fives or multiples of these
7.	Seed has one cotyledon	Seed has two cotyledons

Angiosperms are the largest single group of plants, numbering about 200,000 known species. The class Angiosperms is divided into two main subclasses, Monocotyledons and Dicotyledons. *Table 10.2* summarises their main distinguishing characteristics.

Fig 10.2 A hibiscus plant, a dicotyledon.

Agricultural classification

In agriculture, plants are classified based on their uses or products as follows:

1. *Legumes*

These are plants which are sources of protein for animals including humans. They are primarily grown for their seeds e.g. cow peas, lima beans, pigeon peas, soya beans, groundnuts and beans.

2. *Cereals*

These plants belong to the family Gramineae. They are grasses and are grown for their grains e.g. barley, maize, millet, oats, sorghum and wheat.

3. *Root tuber crops*

These are crops grown primarily for the food stored in their swollen roots e.g. cassava, carrots and sweet potatoes.

4. *Stem tuber crops*

These are underground stems which are swollen with food reserve e.g. cocoyam, Irish potato and yam.

5. *Vegetable crops*

These are plants grown chiefly as vegetables e.g. cabbage, carrot, egg plants, lettuce, okra, onion, pawpaw, spinach and tomatoes.

6. *Oil crops*

These are crops grown mainly for the oil that could be extracted from their fruits and seeds e.g. coconut, groundnut, oil palm, shea butter and sunflower.

7. *Spices*

These are used mainly to add special flavours to food e.g. green or red peppers (*Capsicum* spp), black pepper, *Pepper nigrum*, ginger, sugarcane and cinnamon.

8. *Forage crops*

These are grown mainly to feed animals. They consist mainly of legumes and grasses.

9. *Edible or cultivated fruits*

These are crops grown mainly for their fruits e.g. avocado pears, bananas; citrus fruits, *Dacryoides edulis* (local pear), guavas, mangoes, pawpaws, pineapples and plantains.

10. *Beverages and drug plants*

These are plants used as beverages and for making drugs e.g. cocoa, coffee, kolanut, tea, tobacco, nim *(Azadiracta indica)* and lemon grass.

11. *Rubber or latex crops*

The latex of these cultivated plants is collected and coagulated to form rubber e.g. Para rubber *(Hevea brasiliensis), Ficus elastica, Funtumia elastica* (Lagos rubber), and *Landolphia owerensis.*

12. *Fibre crops*

These are crops cultivated mainly for their fibres. Fibres from plants are used for clothing (e.g. cotton, pineapple), ropes (e.g. sisal hemp, sorrel plant, jute, guinea hemp and baobab), sack making (e.g. jute) and paper making fibres. Fibres are obtained from the plantsâ€™ stems (e.g. flax, jute or *Corchorus olitorius)*, seeds and fruits (e.g. cotton and silk cotton), and leaves (e.g. hemps and pineapples).

13. *Wood crops*

Some trees provide hardwood which is used mainly for making furniture or building materials, e.g. ebony, mahogany, and iroko *(Chlorophora excelsa)*. Some trees yield softwood used for wood pulp and paper, as well as for buildings.

Classification based on life cycle

On the bases of their life cycles, plants are grouped into annuals, biennials and perennials.

Annuals

These are crops which complete their life cycles in one season. That is, they germinate, their seedlings develop and mature, and finally produce seeds and die within a season, e.g. rice, maize, millet, sorghum and beans. Many annuals are herbs.

Plants which complete two life cycles within a growing season are called ephemerals, e.g. lettuce and okra.

Biennials

These are plants which complete their life cycles within two years. During the first year, they develop their vegetative parts and store food, while they reproduce and die during the second year e.g. carrots and onions.

Perennials

These are plants that live for several years. They produce fruits every season and sometimes twice in a season or once in several seasons.

The aerial parts of herbaceous perennials die down each season, while the underground part sends out new flowering shoot, e.g. yam with modified stem, onions and other bulbs with modified swollen leaf bases for food storage.

Some perennials are shrubs, e.g. *Hibiscus rosasinensis* (garden *Hibiscus)*, croton and *Allamanda*. They are bigger than herbs and have woody, aerial parts which do not die off at the end of each growing season. Their stems divide into several branches very close to the ground.

Trees are also perennials which are taller than shrubs. They are woody and have a main stem (trunk) which does not normally branch until it is many feet above the ground, e.g. mango, orange and flambouyant, *(Delonix regia).*

Effects of agricultural activities on ecological systems

To establish a dynamic balance between the plant and animal communities and their environments takes hundreds of years. This balance is easily destroyed either deliberately as in agriculture or unintentionally through excessive fishing and hunting. Discussed below are some of the ways humans have interrupted the natural cycles and disturbed the balance of the ecosystems they exploit for food.

(i) *Bush burning*

This is an aspect of the traditional method of agriculture used by African peasant farmers in the tropical rain forest and the savanna. In the tropical rain forest, before the planting season, the farmers cut down most of the trees, all the shrubs and herbs. When dry, they are

burnt. In the savanna, an area to be used for cropping is always set on fire before the cropping season. The ash produced gives the soil a slightly alkaline content in the place of the generally acidic content typical of most tropical African soils. Burning also exposes the soil surface to erosion by wind and rain and destroys soil micro-organisms. As a result, the balance in the ecosystem is upset.

(ii) *Tillage*

In subsistence agriculture practised by local farmers, land is prepared for cropping (tilled) manually with tools like cutlasses, axes and hoes. In tropical rain forest, manual tillage is easier, cheaper and more practicable than mechanical tillage. For modern mechanized farming, the plough is the most important tillage implement. The ploughing loosens the soil and exposes it to erosion by rainfall.

By using manual tillage, undergrowths of shrubs and saplings are slashed down to the ground level. Other trees are felled with axe or hand-operated saws from any convenient height above the ground. When the twigs are dry, they are burnt. The stumps of the trees are removed from the soil (stumping). Stumping is very expensive but it is necessary where the land is needed for permanent cultivation in modern mechanized farming which needs farm machinery. Stumping is also done by the Ministry of Agriculture.

(iii) *Fertilizers*

Experiments have shown that by using crop rotation and applying farmyard manure (natural fertilizer) to the soil, crop yields can be increased over a period of 50 years. Nonetheless, the long-term effects of using chemical or artificial fertilizers (especially the soluble salts of nitrogen) are not that satisfactory. Organic manure (natural fertilizer) increases the soil humus content, helps in maintaining its crumb structure and thus, its porosity and permeability to air. On the other hand, using only chemical fertilizers continuously results in a loss of organic humus, destroys the soil crumb structure and its permeability to air. The soluble salts of chemical fertilizers are washed off by rain from the soil and finally drained into rivers and lakes where they cause *eutrophication.*

Eutrophication is the over-growth of microscopic aquatic plants resulting from excess nitrogenous and sulphate fertilizers reaching rivers and lakes. In these places, such nitrates and sulphates provide abundant nutrients for microscopic green algae. These algae grow at a faster rate than they could be eaten by first order consumers. The algae eventually die and decompose. However, the numerous aerobic bacteria which decompose them use so much oxygen, that it supply is eventually exhausted. As a result of this, aquatic animals suffocate and die. The partly decomposed algal remains, form an oxygen-deficient mud.

Exclusive use of chemical fertilizers, especially on light soil, destroys its crumb structure. This makes it dry and powdery and therefore open to wind erosion. Valuable top soil is thus lost.

Intensive application of nitrates to crops as artificial fertilizers, has

resulted in an increase in free nitrates in food plants. This has got to a point that could endanger human health.

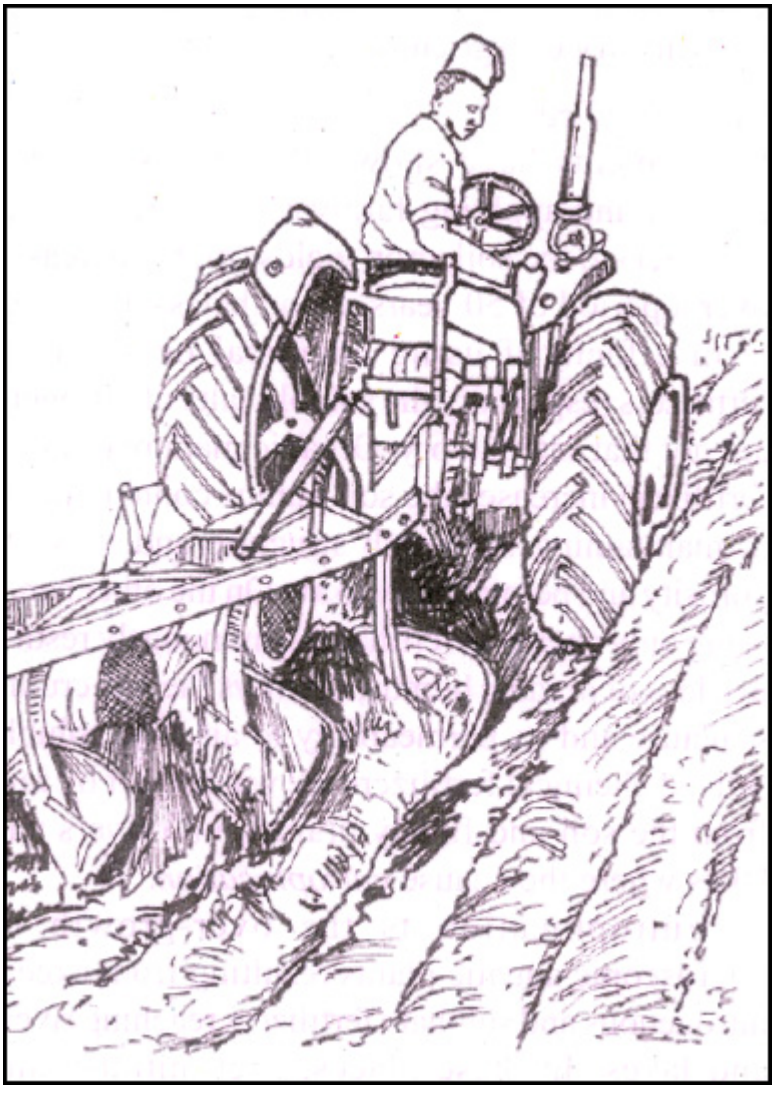

Fig 10.3 A ridger in operation on a farmland.

(iv) *Herbicides*

Herbicides are chemicals used in weed control. Herbicides are of two types: selective weed killers and non-selective weed killers. Selective weed killers will only kill some weeds and spare other plants including crop plants. These herbicides are thus commonly used by farmers. Non-selective weed killers kill both weeds and cultivated crops.

With the introduction of herbicides in recent years, it has been possible to control weeds much more effectively and cheaply than by cutting and hoeing. Some herbicides are ineffective against weeds, highly toxic to young seedlings and, again, less toxic to older plants.

(v) *Pesticides*

Insecticides such as DDT (chlorinated hydrocarbon) are often sprayed on crops to kill their insect pests. This prevents the loss of a lot of food crops and, hence, increases agricultural productivity. For example, the crop obtained from a high yielding variety of sorghum was increased

from 1,200kg per hectare to 5,400kg per hectare after using an insecticide.

The use of pesticides in some cases disturbs the dynamic balance of the ecosystem in some unexpected ways. For example, insecticides affect both beneficial and harmful insects.

Fig 10.4 A farm treated with herbicides

DDT seemed to be a perfect insecticide that kills all insects a few years after it was developed. It is used to kill body lice and mosquitoes. It therefore helped to save the lives of thousands of people suffering from typhus and malaria respectively. However, the widespread use of DDT is now known to have unpleasant consequences. Some of them are the following:

1. DDT is a very stable compound. Thus, instead of being excreted by animals, it is stored in their body fats. When the fat is oxidized during respiration in some animals, harmful quantities of DDT may be liberated into the blood. Humans are likely to ingest DDT when they eat materials sprayed with it. While there is no evidence that DDT is directly destructive to humans, there is ample evidence that excessive use has destroyed other vertebrates.
2. When applied to crops, DDT reaches all the soil and destroys the insects there. It finally reaches rivers, lakes and oceans where in large concentration, could poison the aquatic organisms. Indeed, DDT has been found even in the penguins of the Antarctic land mass.
3. Wind erosion also distributes DDT to other countries. Since many pests controlled by DDT cannot be so cheaply controlled by any other known measure, it is impractical to ban its use worldwide.
4. DDT tends to reach high concentration of the top carnivores of

other food chains including many birds of prey. There is evidence that the accumulation of DDT in the body has adverse effects on the breeding of these birds. Hence, the use of DDT has been limited or completely prohibited in many developed countries e.g. U.S.A., U.K. and Sweden.

(vi) *Different types of farming methods*

There are different types of farming methods which affect the balance in the ecosystem. Some of these are:

(a) *Shifting cultivation*

A farmer cultivates a piece of land and plants crops on it for one to two years before moving to an uncultivated piece of land. This practice requires a large expanse of land to permit a long fallow period. Today, the increasing human population has caused the use of this method to decline. It used to be popular in Asia, South America and the equatorial forest.

(b) *Bush fallow*

In this method, a bush is cleared and planted with crops. Within a few years, the mineral salts in the soil are exhausted. As a result, the crop yields become poor. The farmer therefore leaves this land and allows it to revert to a bush while he cultivates another area. Within 8-10 years, the soil structure and fertility of the original land is restored adequately to make it suitable for cultivation again. This method is generally used in West Africa today.

(c) *Crop rotation*

This method of farming is commonly practised in temperate countries and some parts of Africa. In crop rotation, the same piece of land is cultivated continuously and different plants are grown on it at every growing season (*see Fig. 10.5*).

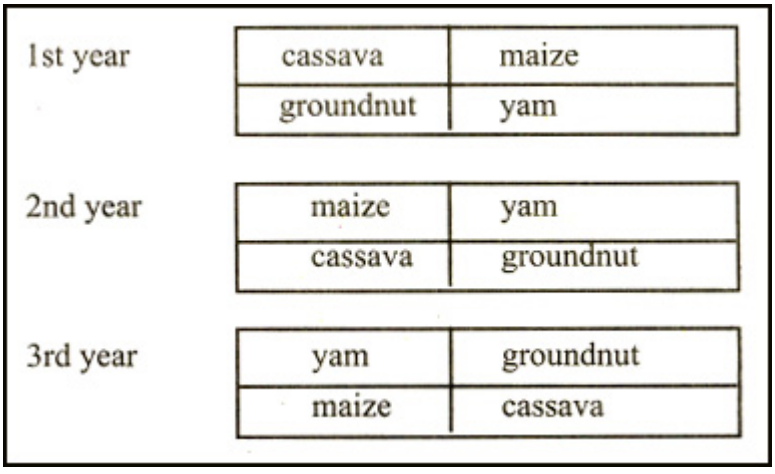

Fig 10.5: A three-plot crop rotation

For example, a surface feeder (e.g. maize) is planted where a deep feeder (e.g. cassava) was planted (*Fig. 10.5* i.e. second year). A surface feeder is a plant, the roots of which grow near the soil surfaee, while a deep feeder is a plant with roots growing deep into the soil.

Hence, crops with different demands on the soil follow one another in crop rotation.

Usually, legumes are included in a crop rotation to restore the nitrogen content of the soil because their root nodules containing nitrogen-fixing bacteria. Nitrogen-fixation is facilitated if some legumes are dug into the soil as green manure. To maintain soil fertility, some manure or fertilizers need to be added to the soil each season.

(d) *Monoculture*

This is the practice of planting only one type of crop on a piece of farmland or rearing one type of animal. This practice, which is widely used, makes the environment unsuitable for the majority of its original inhabitants.

Monocultureâ€™s major advantages are, greater efficiency, increased size of the growing field and allowance for repeated growth of the same crop on the same land. A major disadvantage of mono-culture is that it increases the spread and population of parasites to which it makes plenty of food available.

(e) *Mixed cropping*

To exploit different aspects of the soil, two species of plants can be grown together. For example, a mixture of surface feeder and deep feeder are planted to extract the maximum quantity of water and mineral salts from the soil. The planting of cocoa and bananas; yam and maize on the same land, are examples of mixed cropping. One advantage of this method is that insect pests and fungal diseases are not easily spread.

Pests and diseases of agricultural importance

There are many pests and diseases which attack different plants and animals, reducing their yields or killing them.

Plant pests

Pests attack most crops. The most devastating pests of crops are insects e.g. grasshoppers, locusts and caterpillars. Other plant pests include nematodes, rodents and birds. Insects and rodents always destroy stored crops like cocoa, coffee, groundnuts and yam. Pests cause plant diseases. Let us examine some specific plant pests.

(a) Caspid bugs of cocoa

The caspid bugs are the most serious pests of cocoa. They feed on the leaves, stems and pods. The lesions created by them may cause secondary infection by a fungus e.g *Calonectra*. The commonest symptom of infection is **die-back** of the young branches.

The pest is more prevalent in the dry season. Capsids are controlled by spraying with Aldrex 40, BHC, Dieldrin and Gammalin 20.

(b) Cotton stainer (*Drysdercus* spp.)

Cotton stainer bugs are pests which are common in all cotton growing areas. They are tiny, red-coloured insects which pierce the young

bolls, and seeds in the open bolls, and suck the sap. These insects transmit viral, fungal and bacterial diseases from one plant to another. The fungus causes the boll to rot internally, and stains the lint. (see Fig. 10.6)

Other pests of cotton include the boll weevil, pink bollworm, angular leaf spot, and cotton anthracnose.

(c) Yam beetles

Two species of the yam beetle have been identified: those which occur north of the coastal belt in the derived savanna, and those that occur along the coastal areas in the southern forest zones of Nigeria. Within a year, these beetles can destroy a whole yam crop plantation. The pests are controlled in Nigeria by treating yam setts and seeds with Aldrin just before planting.

Other pests of yam include eelworm which feeds on the tuber, rodents and wild animals which destroy the tubers.

(d) Pests of cassava

The cassava plants are attacked by mainly grasshoppers the commonest of which are the *Zonoceros variegatus*. In serious attacks, they might ruin the whole crop plantation by eating up all the leaves and young shoots. Some rodents feed on cassava tubers, others feed on its stem. Untethered goats and sheep can eat up all the leaves and stems of cassava plants on a farm.

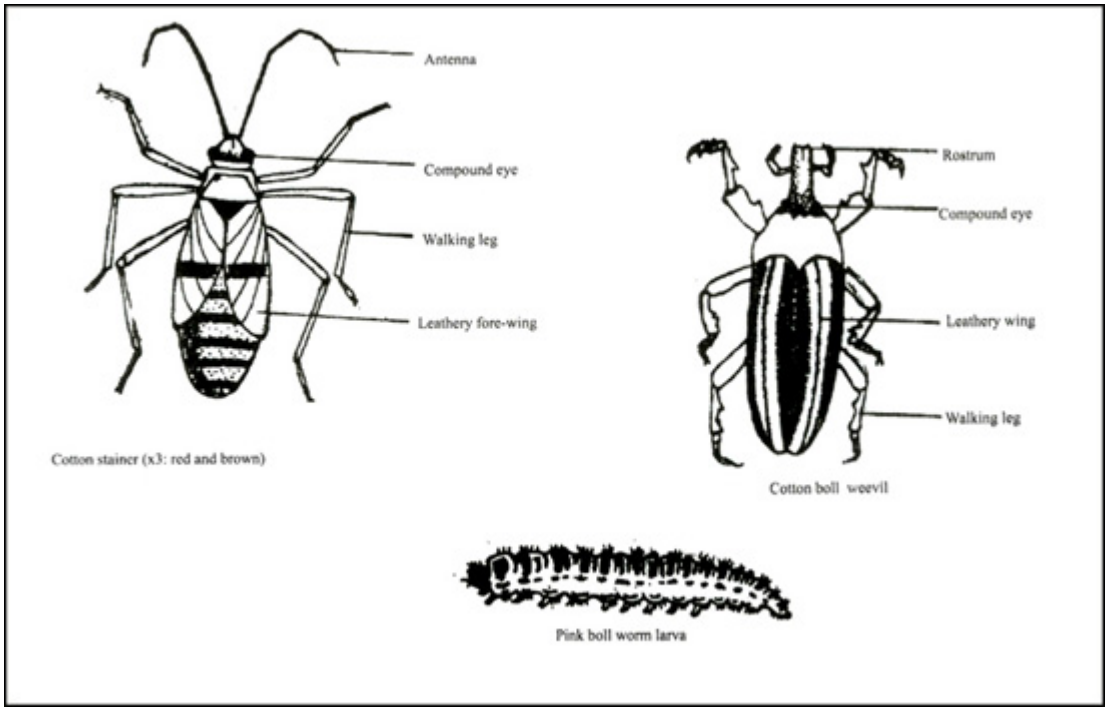

Fig 10.6 Some pests of the cotton plant.

Control of plant pests

Insect pests of plants can be controlled by the application of insecticides, planting resistant varieties, using parasitic insects, fumigation (particularly for stored crops) and legislation.

The general control measures for plant pests include:

(i) destroying all diseased plant materials on the farm;
(ii) planting healthy plants;
(iii) growing resistant variety of plants; and
(iv) legislating against the movement of crops between countries.

Animal pests

Animals or livestock pests are often parasitic on their victims. Livestock pests are of two types: ectoparasites (external parasites) and endoparasites (internal parasites).

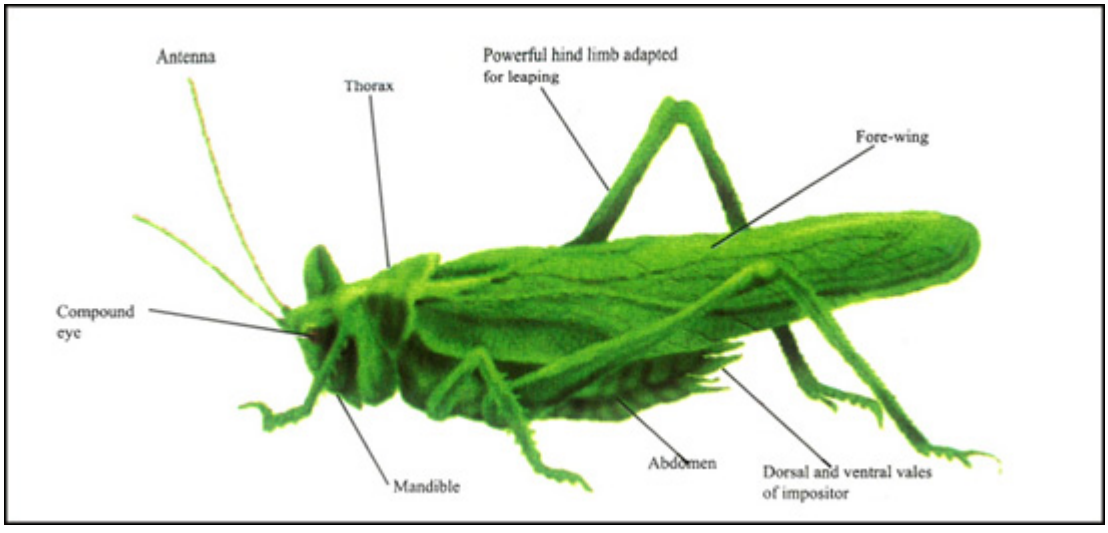

Fig 10.7 A grasshopper.

(a) *Ectoparasites*

Ectoparasites are those found on the body or skin of animals. They are mainly insects and their attack may be specific to one host. Some of them, like ticks, are vectors of diseases. For example, ticks, which are vectors of cattle, cause tick fever, and heartwater disease of cattle, sheep and goats. Other ectoparasites of livestock are, lice, mites, fleas and flies.

Life cycle of ticks

Several species of ticks affect livestock. They affect cattle, dogs, horses, mules, sheep etc. Ticks live all their lives attached to the animal, sucking its blood except during moulting and reproduction.

The life cycle of most ticks consist of four stages: the egg, the larval, the nymph and adult stages. Each of the stages needs a different host.

When the female is filled with blood, it detaches itself from the host and falls to the ground. She lays her eggs at the bottom of grasses in the pasture and dies. Each egg hatches into a larva having six legs. The larva crawls up the grass from where it fixes itself to the body of an animal that passes by it. The larva feeds on the host and falls on the ground again.

On the ground, the larva changes into a nymph with eight legs. The nymph crawls up the grass, gets fixed to a second host animal, feeds

and drops again on the ground, where it moults into an adult tick.

The adult tick crawls up the grass and gets attached to the third host animal. If the adult is a female, it pierces the skin of the host and starts to suck its blood. If the adult is a male, it does not fix itself on to the animal immediately, but crawls about, looking for a female. After copulation with the female, it dies. When the female is filled with blood, it drops on the ground to lay its egg and the entire life cycle is repeated.

Again, ticks live on the blood of their hosts. When infestation is heavy, there is considerable loss of blood by the animal each day. This affects its health. In young animals, growth is retarded. The animal becomes weak and unproductive. Their attack also lowers the value of the hides. Ticks cause irritation and itching of the body. This causes restlessness resulting in weight loss.

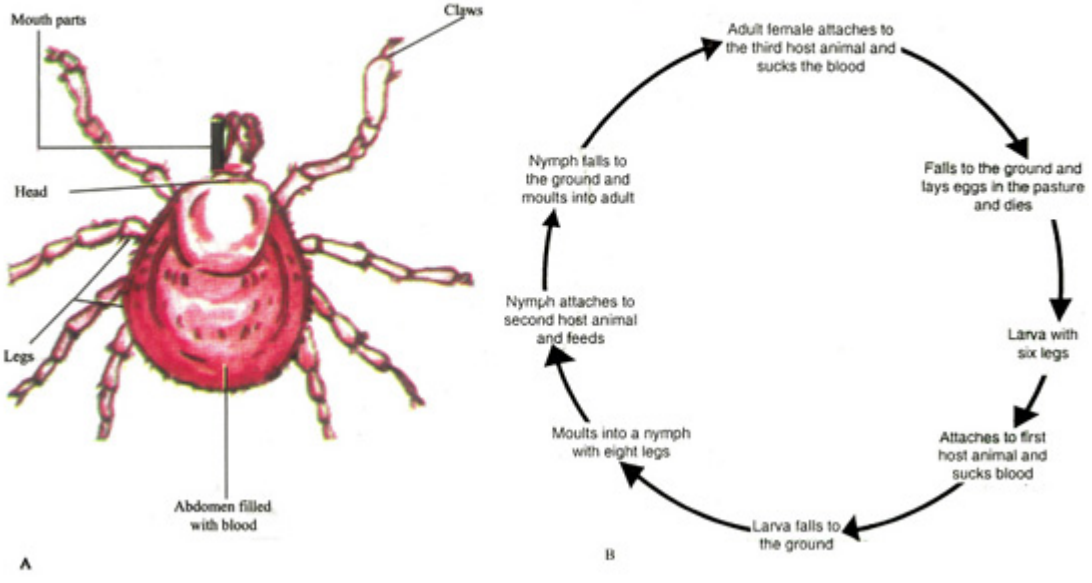

Fig 10.8 A. The female tick B. Life cycle of the tick.

Control of ticks

Ticks can be controlled either by killing them on the animal or in the pasture.

(i) Ticks on the animal can be killed by constantly dipping the animals in arsenic solution to kill the females before they are sexually mature. Dipping should be done at regular intervals, depending on the degree of infestation.

(ii) Ticks can be killed in the pasture by keeping animals off infested areas until the larvae or nymphs are starved to death. This involves rotating the pasture and livestock.

(b) *Endoparasites*

Endoparasites are either flatworms (e.g. tapeworm and liver fluke)

or round-worms (e.g. *Ascaris*, hookworms) or protozoa e.g. *Trypanosome* and coccidia which cause coccidiosis. Endoparasites injure the tissues or organs in which they live. They cause wasting, stunting and death of livestock when they occur in large numbers.

Life cycle of a pig roundworm

Roundworms are generally parasites that harm all domestic animals. They invade virtually all the organs and tissues of the body either in the larval or adult stage.

The particular roundworm which affects the intestine of pigs is *Ascaris lumbricoides* variety. It differs from the *lumbricoides* found in humans. The pig roundworm is usually pinkish or reddish in appearance, about the thickness of a typical pencil and about 30cm long.

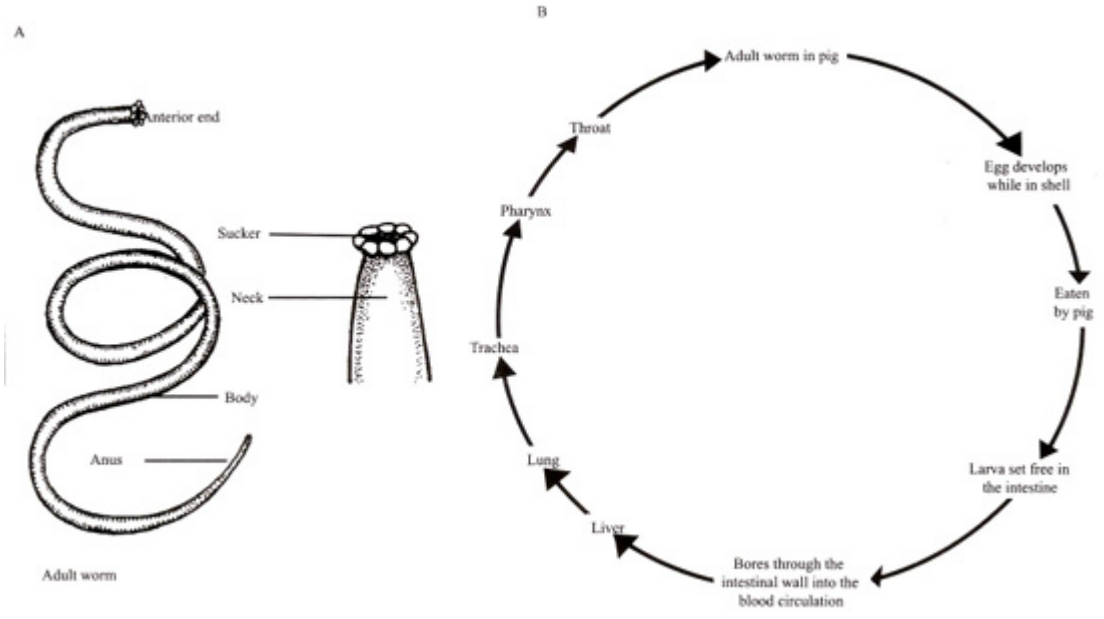

Fig 10.9 A. Adult roundworm of a pig. B. Life cycle of roundworm of a pig

After fertilization of the eggs in the female *Ascaris*, the larvae develop inside the egg shells. The eggs are deposited into the pigâ€™s intestine from where they are sent out with the faeces to the soil. The eggs can remain dormant in the soil for over five years but die very fast if exposed to intense sunlight.

When the eggs are ingested and swallowed by pigs, the egg shells are dissolved by the digestive enzymes. The larvae are thus liberated. They bore through the intestinal walls and enter the general blood circulation, first to the liver, then to the heart and the lungs. In the lungs, they pass into the bronchioles and up to the throat of the pig. From here, the larvae are swallowed back into the stomach through the gullet. On reaching the small intestine, the larvae develop to mature adult worms, and the life cycle is repeated.

Great infestation by the larvae might block the lung blood capillaries or damage the lungs to an extent that breathing is made difficult. Large infestation of the adult worms in the intestine may block the

digestive tract and cause digestive disturbances. The worms may also consume all the food of the animal resulting in retardation of growth.

Control of endoparasites

Two main effective ways of controlling endoparasites are as follows:

1. The use of appropriate drugs as directed by the veterinary department.
2. Proper management, to ensure that domestic livestock does not come in contact with the parasitic eggs or larvae. This could be done by:
   (i) maintaining good sanitation, by cleaning all feeding equipment, scrubbing and disinfecting the pens and livestock houses;
   (ii) providing drinkable water for the animals;
   (iii) rotating the pastures and livestock;
   (iv) eliminating the secondary hosts, such as snails in respect of the liver fluke and the reduction of the number of vectors, as in the case of tsetse fly, the disease vector of trypanosome;
   (v) avoiding the application of farmyard manure to pastures grazed by domestic animals.

Some plant diseases

Table 10.3 summarizes the causative organisms, major symptoms and control measures of selected plant diseases.

Table 10.3 *Selected plant diseases*

Disease	Causative organism	Host	Major symptoms	Control measues
Anthrac-nose	Fungi	Cocoa, coffee, cotton, oil palm	Brown, water-soaked patches on leaves and pods.	Use of fungicides.
Blackpod	Fungi	Cocoa	Dark brown, or black rot on pod, damage to fruit and seed walls	Spraying with fungicides, farm sanitation.
Brown spot	Fungi	Maize	Purplish-brown spots on leaves. Entire plant may break up	Avoid planting on infected spots
Bacterial wilt	Bacteria	Banana, plantain, cassava, tobacco and groundnut.	Leaf wilt and defoliation. Wilt of entire plant.	Use of clean planting materials – good sanitation.
Mosaic	Virus	Cassava tobacco	Leaf-mottling with dark green and greenish yellow patterns	Use of resistant varieties

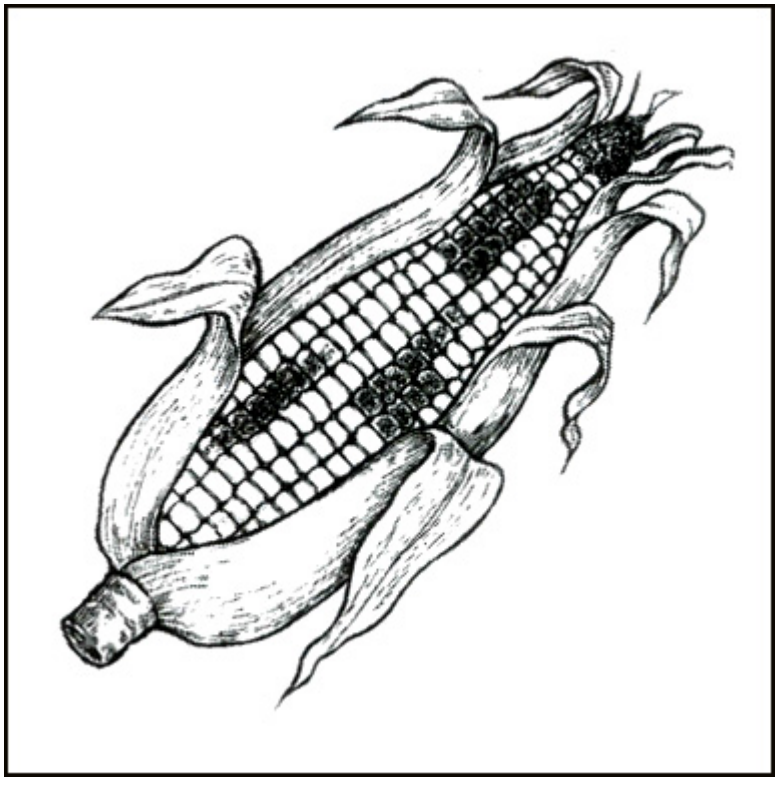

Fig 10.10 A blighted maize cob.

Some animal diseases

Asides ectoparasites and endoparasites, which cause diseases in animals, the common diseases which affect domestic animals could be grouped as follows:

1. Bacterial diseases, e.g. black quarter, anthrax, foot rot, fowl pox, tuberculosis and contagious abortion.
2. Fungal diseases, e.g. ringworm.
3. Nutritional diseases, e.g. rickets, milk fever, ketosis, bloat and osteoporosis.
4. Protozoan diseases, e.g. coccidiosis, tick fever and trypanosomiasis (sleeping sickness).
5. Viral diseases, e.g. foot-and-mouth diseases, fowl cholera, Newcastle disease, pleuropneumonia, rinderpest and typhoid fever.

Table 10.4 summarizes the causative organisms, host, major symptoms and control measures of selected animal diseases.

Table 10.4 *Selected domestic animal diseases*

Disease	Causative organism	Host	Major symptoms	Control measures
Coccidiosis	Protozoans	cattle, fowl, sheep, goat	Bloody diarrhoea, weakness, emaciation, death	Good sanitation Avoid overcrowding. Disinfect house. Give sulphamethazine.
Anthrax	Bacteria	Cattle, goat, pig, sheep	Premature birth, stillbirth, retention of after birth, sterility	Vaccination of young animals before age of breeding. Good sanitation.
Newcastle	Virus	Poultry	Yellowish droppings. Comb turns purple. Coughing, gasping. Death	No effective cure. Kill off infected birds. Disinfect pens. Consult a a Veterinary Officer.
Ringworm	Fungus	Cattle, horses	Lesions at the base of hairs. Hairs fall off. Itching.	Use fungicides to wash lesions. Use fungicides in premises. Use antibiotics as oral treatment.
Rabies	Virus	Cats, cattle, dogs, horses, sheeps, pigs.	Excitement, tendency to attack, paralysis, incoordination, and death.	No effective, treatment. Control by vaccination and avoiding exposure to infection.

Food production and storage

The environmental factors which affect the production of crops include climate (rainfall, temperature, light and humidity), the nature of the soil, incidents of pests and diseases, topography and economic considerations.

Rainfall

Each crop needs a definite quantity of rain to grow properly. If a crop fails to obtain the optimum rainfall during the growing season, it will not thrive. For perennials to do well, they may need rainfall fairly evenly distributed throughout the year.

In general, the quantity and distribution of rain determines the soil water content. Hence, the abundance or scarcity of rain determines the kind of vegetation or distribution of crops.

Temperature

The greater the heat from the sun, the higher the temperature of the air and that of the soil. Hence, the temperature will be high where sunshine is intense, as in the tropics, and lower where the sunshine is less intense, as in temperate regions.

Within a certain range, an increase in temperature results in an increase in the biological activities of any organism until the optimum temperature is reached. Below or above the optimum temperature, the biological activities slow down. Thus, each crop needs a definite range of temperature within which it could grow well. As a result, temperature affects crop production and distribution.

Humidity

The relative humidity is the percentage of moisture the air contains compared with that of complete saturation at a given temperature. When the air is holding its maximum quantity of moisture, it is said to be saturated. When the temperature is high or the relative humidity is low, more water evaporates into the air. Hence, the quantity of rainfall also affects the relative humidity of the atmosphere.

High temperature and low relative humidity result in a high rate of transpiration from crops. Only crops which can balance the rate of transpiration with their water requirements during the growing season can thrive. Therefore, the relative humidity also determines the kind of vegetation in an area.

Light

To photosynthesize, green plants need light. Some plants need a high light intensity to do well. While some plants may need a short duration of light, others may need a long duration to grow well. The duration and light intensity determine the type of crops that will grow in an area.

Biotic factors

Plant diseases, animals and insect pests determine the success or

failure in the growing of crops in any particular area. For example, at a time in West Africa, the swollen shoot disease of cocoa threatened the production of the crop in Ghana and some parts of the former Western State of Nigeria. Blackpod disease reduces the yields of cocoa. Cotton stainers and cotton boll weevils adversely affect cotton production.

Soil

For crops to grow well, the soil on which they grow must have good structure and texture, good aeration, good temperature, sufficient moisture content and a high degree of fertility. The soil may be clayey, loamy or sandy. It may also be acidic or alkaline. All these factors determine the kind of crop which could grow on the soil and, hence, the distribution of crops.

Topography

Topography refers to features like hills, mountains and valleys. The quantity of rainfall, type of soil and vegetation are affected by the topography of an area.

Some crops may thrive better on a gentle slope than on a flat valley. Windward areas of a hill or mountain may be better for crop production than the leeward areas. The topography may also affect the type of cultivation and depth of soil and, thus, the kind of crops that can be cultivated.

Economic factors

Whenever there is a greater demand for a particular crop, farmers tend to concentrate on the production of that crop. Some crops may be grown in places where they cannot thrive properly because of their economic value. Farmers may also grow crops that are cheaper to produce.

Ways of improving crop yields

The various ways of improving the yields of crops include

1. breeding high yielding crops that are resistant to pests and diseases;
2. using fertilizers or manure extensively to maintain soil fertility and ensure high crop yields;
3. using effective methods of farming;
4. combating weeds by using herbicides instead of cutlasses or hoes.

Causes of wastage

A lot of crops are wasted annually on farms for many reasons including the following:

1. Late harvesting and bad harvesting techniques.
2. Delay in transporting harvested crops which make some crops to rot.

3. Infection of farm produce by fungi, insects and vermin due to inefficient storage methods.
4. The decay of some stored crops caused by moisture, especially when they are not stored properly e.g. groundnut, maize and rice.
5. Lack of good roads and good means of transportation for carrying farm products from farms to the markets or urban centres.
6. Lack of good storage facilities.

Methods of preserving and storing food

The methods commonly used in the preservation oand storage of foods include the following:

1. Salting e.g. meat and pepper. This prevents the growth of bacteria which could cause decay.
2. Drying e.g. vegetables and meat. This helps to remove the moisture present in the food. Microbes cannot grow or multiply if water is inadequate.
3. Smoking e.g. meat. Microbes on the outside of the material are killed by poisonous substances such as phenols in the smoke. The food material would stay good as long as the outer surface is not damaged afterwards.

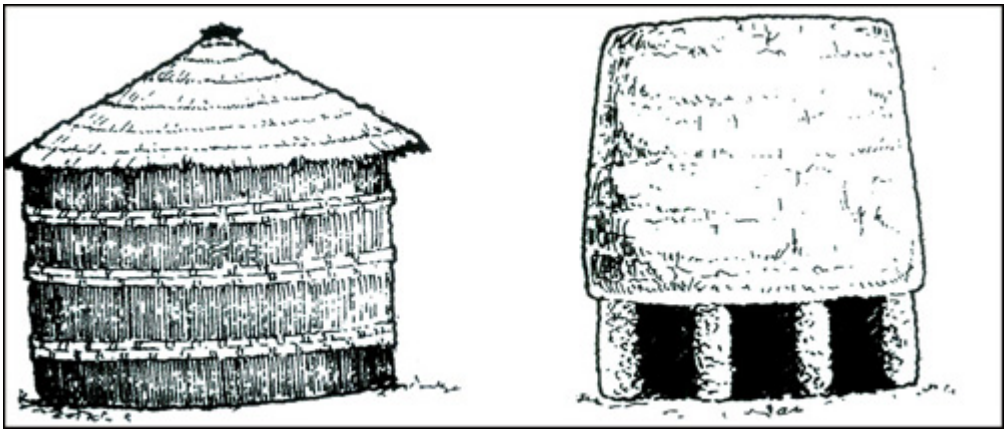

Fig 10.11 Two types of traditional silos for storing farm products.

4. Refrigeration, e.g. meat, milk, butter, fish and vegetables. Refrigeration preserves food because microbes cannot multiply at low temperature, though it does not kill the microbes.
5. Canning, e.g. fruits, meat and fish. This kills bacteria of all types and most fungi. It removes oxygen which could quicken respiration.
6. Chemicals, e.g. fruits. These stop bacteria and fungi from growing on food thereby preventing decay. The food acidity may change.

Population growth and food supply

The worldâ€™s human population has been increasing at an alarming rate over the last 200 years. It doubled from 2,000 to 4,000 million from 1930 to 1980 – a period of 50 years. Yet, it took about 1,600

years, from the first century to the sixteenth century, to double from 250 to 5,000 million. It is estimated that the rapidly growing human population will reach about 6,000 million by the year 2,000 A.D. The marked improvement in human health due to great advances in medical science is responsible for this rapid increase in modern times.

At present, about 60 per cent of the world population is undernourished especially in protein. The tremendous efforts made by various governments to remedy the situation, have made very little impact on the problem. Even if all suitable agricultural lands are fully used, which would cost large sums of money, the present population will not be adequately nourished.

Factors affecting availability of food

Many factors affect the availability of food. They include the following:

1. *Subsistence farming*
   In many African countries, agriculture is mainly at the subsistence level. The main problem facing its development is how to improve the farming system in order to produce adequate high quality foods to feed the population and still have more for export.

2. *Communication, transport and marketing*
   Most of the existing lands suitable for agriculture in West Africa are located in inaccessible areas. Roads to such areas are usually bad or non-existent. There is often the lack of transport to export farm products. As a result, the farmer has to depend on the local market to sell his products. Farm products that could not be sold at the local market or cannot be exported are consequently left to waste due to lack of good storage facilities.
   Above all, the farmer often receives very poor prices for his commodities. Hence, there is a total lack of incentive for increased agricultural production.

3. *Land tenure system*
   Agricultural development could be hindered by the land tenure system. In many African countries, land is owned mostly by families, communities or chiefs who have control over the land within their localities. Land is rarely owned by individuals under freehold titles. The continuation of this practice leads to the fragmentation of the land which renders the individual farm lands uneconomically small. With the gradual development of plantation agriculture, the land tenure system in Nigeria has now moved towards the legal ownership of land by individuals and organizations with well-defined boundaries. In some cases, the government is positively supporting plantation agriculture and farm settlement projects. It is interesting to note that the Nigerian Agricultural Policy published in 1988 by the Federal Military Government stipulates that no individual should own more than 2,000 hectares of land for agricultural purposes.

4. Capital or Credit

As stated earlier, agriculture in most tropical countries is mainly of the subsistence type based on shifting cultivation or rotational bush fallowing.

With this peasant system, the farmer is mainly concerned with the provision for his family. It is only the surplus products that he sells for cash. Under this system, he needs only a small piece of land and uses simple tools. He does not need much capital or credit.

For a farmer to undertake large-scale agricultural projects, he needs finance and credit facilities. The peasant farmers who usually have no security needed for obtaining farm credit cannot obtain loan from the banks which provide such facilities. Hence, lack of facilities for obtaining farm credit is the greatest problem limiting agricultural development on a large scale.

5. *Government agricultural policy*

On their attainment of independence, many African countries embarked on gigantic agricultural development programmes. The programmes were hampered by undefined government policies, absence of planning, lack of skilled and experienced personnel and inadequate provision of funds by the government.

In Nigeria however, the huge finance invested in various government agricultural programmes (e.g. Operation Feed the Nation and the Green Revolution) was grossly mismanaged. In addition, there are reports of gross financial mismanagement by many of the River Basin Authorities established by the Federal Government to boost agricultural production.

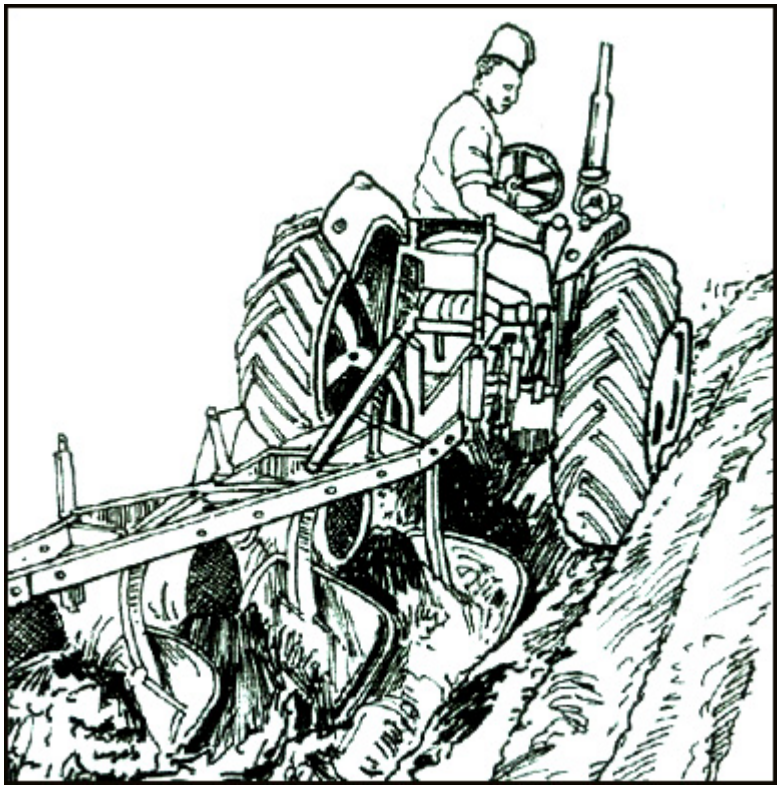

Fig 10.12 Tractor being used for mechanized farming.

Other factors that adversely affect the availability of food include: unfavourable climatic conditions (e.g. drought) lack of improved varieties of plants and livestock, inability of many farmers to use modern farming techniques due to lack of finance and technical know-how, and outbreaks of insect pests and diseases which could completely ruin a farmerâ€™s enterprise.

Relationship between food availability and human population

The quantity of food available to people has been demonstrated to determine the size of human population. An Englishman named Malthus, suggested that if human population grew faster than the rate of food production, then people would be distressed and might fight one another. The experiments with mice indicated that this is possible. Moreover, the experiments showed that if the mice did not have sufficient food to eat, their population would not increase. It is not known for sure whether this observation would be true of the human population.

Nonetheless, it is well-known that when people do not have the right type of food to eat in sufficient quantity, they suffer from malnutrition. When they have very little or no food to eat, they die of starvation. This is typical of areas where there is acute famine especially in the developing countries.

Experiment 10.1 To show the effect of food availability on mice population.

Method

1. Some mice or rodents are kept in two cages.
2. Those in one cage are provided with a lot of food and water (*Fig. 10.16a)* at the beginning of the experiment. Those in the second cage are supplied with enough food and water continuously.
3. The mice are left for some time.

Observation

It would be observed that the number of the mice would continue to increase in the cage with continuous supply of food. The population of mice in the cage with food supplied only once will increase for a while. When there is no food most of them will start to die.

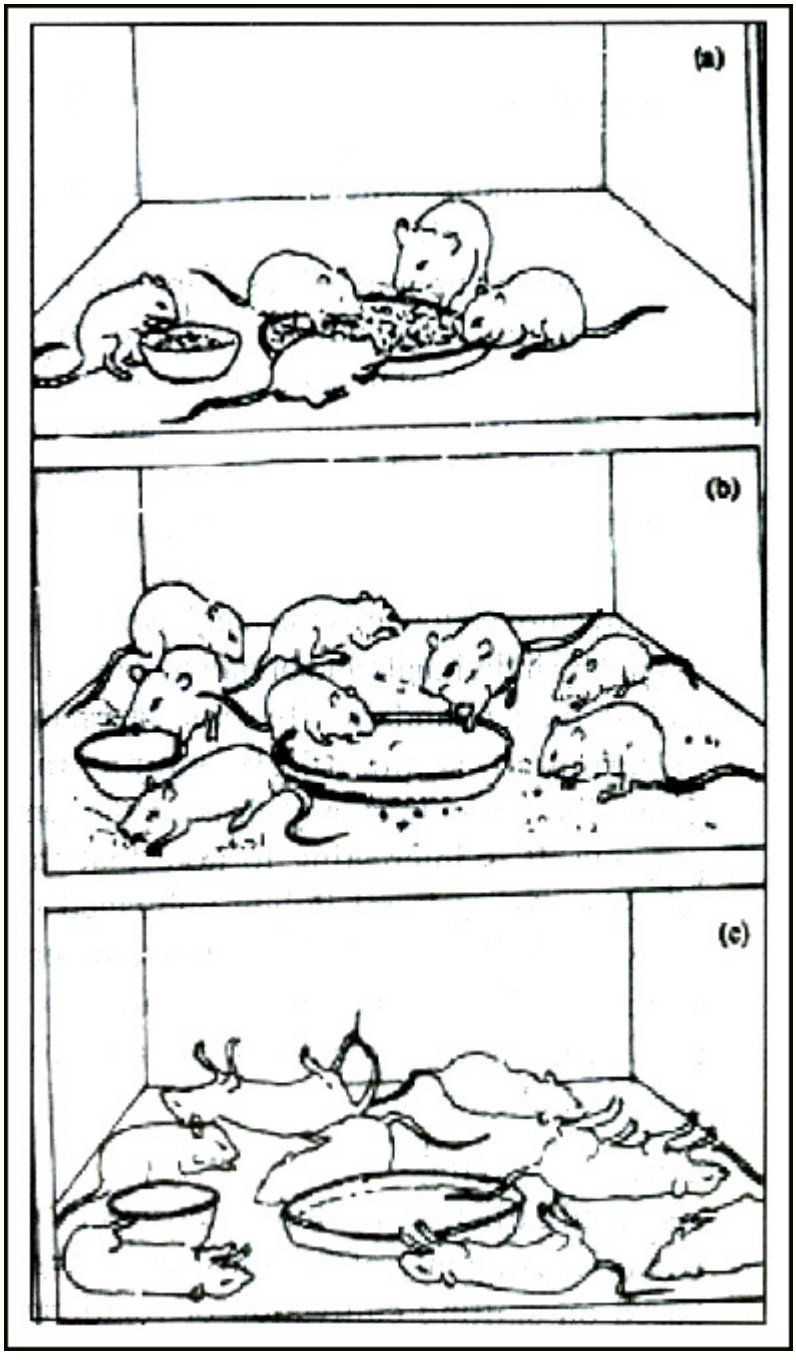

Fig 10.13 Diagrams showing the effect of limited food supply on caged mice.

Conclusion

It is concluded that the population of mice tends to increase when there is plenty of food, while their population tends to decrease when there is no food.

Suggested Practicals

1. Plant classification

(a) You will be provided with a variety of plants.

(b) Classify them using

(i) botanical classification

(ii) agricultural classification

(iii) classification based on life cycle.

2. *Study of insect pests*
   (a) Go to a farm near you
   (b) Write down the names of some insect pests you can find on named plants.
   (c) Write down the effects you can observe of such pests on the plants.

Summary

1. Plants can be classified on the bases of botanical classification, agricultural classification and life cycle.
2. The four main divisions of the plant kingdom are the thallophyta, bryophyta, pteridophyta and spermatophyta.
3. The older classifications still used for naming plant groups are cryptogams, vascular cryptogams, phanerogams and archegoniate.
4. Agricultural activities, which have many adverse and some beneficial effects on ecological systems include, bush burning, tillage, use of fertilizers, herbicides and pesticides.
5. The different farming methods which affect the balance in the ecosystem include, shifting cultivation, bush fallow, crop rotation, monoculture and mixed farming.
6. Many pests and diseases attack animals and plants thereby reducing their yields and killing them.
7. Insects, birds, rodents and nematodes are among the common plant pests. Caspid bugs of cocoa, cotton stainer and yam beetles are specific examples of plant pests.
8. Plant pests could be generally controlled by destroying all diseased plant materials on a farm, planting healthy plants, growing resistant varieties, legislating against the movement of crops between countries.
9. Pests of animals are usually parasites. The pests of livestock are usually ectoparasites (e.g. insects like ticks, lice, mites and flies), and endoparasites (e.g. flatworms like tapeworm, roundworms like *Ascaris*, and protozoans e.g. *Trypanosome).*
10. Plant diseases are caused by bacteria, fungi and viruses. Examples are anthracnose, blackpod of cocoa, brown spot of maize, bacterial wilt of banana and tobacco, and mosaic of cassava and tobacco.
11. Animal diseases are caused by bacteria, (e.g. anthrax and tuberculosis), fungi (e.g. ringworm), protozoan (e.g. trypanosomiasis), viruses (e.g. Newcastle disease, and rinderpest) and nutritional diseases (e.g. rickets, bloat and ketosis).
12. The production of food depends largely on such factors like rainfall, temperature, humidity, light, pests and diseases of plants and animals, soil structure, topography and economic factors.
13. Food can be preserved by salting, drying, smoking, refrigeration and canning.

14. Methods of farming, communication, transport and marketing, land tenure system, capital or credit, climatic conditions and government agricultural policy are the main factors that affect food production.

Objective Questions

1. In botanical classification, family names usually end in
   A. -idea
   B. -inae
   C. -aceae.
   D. -ales.
   E. -phyta.
2. A plant that shows secondary growth is likely to be
   A. a crytogam.
   B. an archegoniate
   C. a thallophyte.
   D. a monocotyledon.
   E. a dicotyledon.
3. Which one of the following agricultural practices does not have adverse effects on the ecosystem? The use of
   A. natural manure.
   B. pesticides.
   C. herbicides
   D. chemical fertilizers.
   E. tillage.
4. All the following are plant pests except
   A. birds.
   B. nematodes.
   C. bacteria.
   D. insects.
   E. rodents.
5. Which of the following is not an animal disease?
   A. Mosaic.
   B. Anthrax.
   C. Rabies.
   D. Ringworm
   E. Newcastle.

Essay Questions

1. (a) List the four main divisions of the plant kingdom.
   (b) Write an example of (i) a crytogam, (ii) a vascular crytogam, (iii) a phanerogam; and (iv) an archegoniate.
   (c) List ten groups of plants based on their agricultural classification and give two examples of each.

2. (a) In a tabular form, state five main differences between monocotyledons and dicotyledons.

(b) Discuss five agricultural practices each that have harmful and beneficial effects on ecological systems.

(c) Briefly explain five methods of farming commonly used in Nigeria.

3. (a) Mention four pests of named plants, state the effects they have on these plants and how the pests can be controlled.

(b) State four ways in which plant pests could be generally controlled.

(c) In a tabular form, name five plant diseases, their causative organisms, their hosts, major symptoms and control measures in each case.

4. (a) List five groups of animal diseases and give an example of each.

(b) (i) State five of the environmental factors that affect the production of crops.

(ii) State four ways of improving crop yields.

(iii) List five ways by which farm crops are wasted.

(c) (i) Mention five methods of preserving and storing food, giving an example in each case.

(ii) Briefly discuss five factors that affect the availability of food.