

CHAPTER – 17



Food – Higher yields

Since the advent of agriculture, man had been growing plants and rearing animals to meet his requirements. However, the original varieties of plants and animals that man cultivated or reared did not completely fulfill his requirements, either in quality or in quantity. This is when man started to learn how to influence the process of natural evolution of plants/animals so as to produce better varieties of plants and animals.

17.1 PLANT BREEDING

Gradually, the process of developing new varieties, particularly in plants, through selection and cultivation, acquired the form of a routine endeavor—what we today call '**plant breeding**'. In plant breeding, heredity, (transfer of characters from parents to progeny) plays an important role.

Various methods have evolved in plant breeding. One of the most important methods is that of **selection**.

The ability to choose gave birth to the idea of **selection**. This is the most primitive and by and large the most successful method of plant breeding. Selection as a part of plant breeding started with the domestication of plants by early man. **Domestication** refers to the process of bringing wild species under human management. Not all selection over the years have been human influenced—many of the important crop species have resulted from the **natural selection** process, which is an integral part of evolution. As human knowledge of agriculture grew, man started shuffling crop species from one geographical region to another, thus making new introductions.



Fig. 17.1: New fruit varieties

The first prerequisite of selection is the availability of **variability**, i.e. different types of forms. After a variable population is recognized, individuals that are the best performers for the desired feature, say fruit size in the case of tomatoes, are chosen and the rest of the population is discarded or rejected. The progeny of the selected individuals is grown further and again screened for the desired feature. This process is repeated until a uniform plant population is attained which has the best-desired characters. Eventually, a desired uniform crop variety is produced by this successive selection followed by multiplication of the selected individuals.

Selecting higher yielding plant varieties is not easy. Various techniques have been devised for effective plant selection. One such technique is application of mathematical

computations. This technique, known as **biometrics** is now an important branch of genetics. **Biometrics** is defined as the application of statistics in biology. There are three common methods by which plant selection is carried out, namely

1. Selection for uniform plants, known as pure line selection;
2. Selection from field-grown plants, known as bulk selection or mass selection, and
3. Selection from a well-documented list of parentage, commonly known as the **pedigree system**.

17.1.1 Hybridization

In traditional terms, hybridization refers to the union of the male gamete from a particular species with the female gamete belonging to another species to produce a zygote. In plant science, hybridization also refers to the crossing or mating of two different plants. The story of scientific hybridization of crop plants started with **J G Kolreuter**, who in 1761 published his work on the scientific bases of hybridization. Since then, hybridization followed by selection, has been the major tool of plant breeding.

Ways in which hybridization is used

Some of the ways in which hybridization has been exploited in breeding crop plants are given below.

17.1.2 Combination breeding

The main aim of combination breeding is to transfer one or more desired characters from many varieties into a single variety or plant type. The most commonly used method to achieve this goal is known as the **backcross method**. The plant type in which the character or the trait is being transferred is known as the **recipient parent** and the other as the **donor parent**. For this, the two plants are mated or crossed and the progeny is screened for the desired trait. The progeny plants possessing the desired trait are then selected and crossed back to the recipient parent. This process is repeated until the desired plant type having all the characteristics of the recipient in addition to the trait being transferred is finally obtained. This exercise is known as backcrossing. Backcrossing involves both hybridization and selection.



Hybrid tomato



Hybrid cabbage

Fig.17.2: Some hybrid varieties of vegetables

17.1.3 Hybrid varieties

Plant scientists exploit the characteristic feature of better yielding ‘hybrids’ in plants. Hybrid vigour, or **heterosis** as it is scientifically known, exploits the fact that some offspring from the progeny of a cross between two known parents would be better than the parents themselves. Many hybrid varieties of several crop species are being grown all over the world today. An example of this is the hybrid tomatoes that we eat commonly. The philosophy of hybridization has been extended from ‘within the same species or genera (the same type of plants)’ to ‘different species or genera (totally different plants)’. This is known as wide or **distant hybridization**. Wide hybridization has helped breeders to break what is known as the species or genera barrier for gene transfer, i.e. it has helped breeders to transfer beneficial characteristics from wild and weedy plants to the cultivated crop species.

17.2 CROP PRODUCTION MANAGEMENT

Food is one of the most important basic needs of all organisms. Food provides energy and materials required by the living body. Adequate amount of nutritious food is necessary for proper development and growth of all living organisms including human beings. Thus, procurement of food enough to sustain the individual has become a basic duty of one and all.

As food obtained from natural sources is never enough to feed everyone, production of food has to be done. Increasing the production of food crops requires scientific knowledge and systematic management. In this chapter, we shall study the different management practices for increasing food production.

17.2.1 Use of fertilizers

Fertilizers are naturally occurring or synthetic chemicals containing plant nutrients. Some commonly used fertilizers are **ammonium sulphate**, **potassium chloride**, **super phosphate** and **potassium sulphate**. They provide specific nutrients like nitrogen, phosphorus and potassium to deficient soil. The use of fertilizer has increased productivity but only when appropriate amounts are applied. Improper application of fertilizers may cause serious pollution problems. Excessive addition of fertilizer damages the soil by reducing natural composting ability. Chemical fertilizers leached from the agricultural fields pollute ground and surface waters and create many health problems. To avoid such problems, it is better to adopt natural measures like use of organic manures.

The soil nutrients can also be replenished by growing one crop alternately with another. This type of cultivation is called **crop rotation**. It helps in increasing nutrient content of the soil. When leguminous crops are cultivated in one year and cereals the in next year, nitrogen content of the soil become increased. Farmers are encouraged to adopt such type of cultivation.

Leaving the soil uncultivated for long time may replenish the soil with plant nutrients. The process of leaving the field uncultivated is called **fallowing**. When the field is abandoned, many plants invade the area. Organic materials derived from these

plants the enrich the soil with nutrients. It is a traditional method used in the hilly regions of Manipur for rejuvenating the soils in abandoned jhumlands.

17.2.2 Manuring

We have learnt that plants obtain nutrients from the soil. However, continuous cultivation of the same crop year after year in the same place depletes the soil nutrients. To replenish soil with the lost nutrients, farmers add manure or artificial fertilizer to the soil. Organic materials, derived from animal, human and plant residues that contain plant nutrients are called **manures**. The addition of these materials to the soil is called **manuring**.

17.2.3 Compost

Compost is an organic manure artificially prepared from plant residues and animal waste products. The process of making compost is known as **composting**. It is largely a biological process in which aerobic and anaerobic micro-organisms decompose organic matter and lower the carbon-nitrogen ratio of the refuse.

Compost is prepared from waste vegetables and other refuse mixed with cow-dung and urine and also from town waste and night-soil. The compost becomes ready in about three to four months without any further attention. Composts are of two types and they differ in nature and composition.

(i) Rural/Village Compost

This type of compost is prepared from farm waste products, e.g. straws, crop stubbles, crop residues such as sugarcane trash, groundnut husks and leaves, cotton stalks, etc. Weeds, waste fodder, urine soaked earth, litter from cowshed and hedge clippings may also be used. This type of compost contain 0.4-0.8 per cent Nitrogen (N), 0.3-0.6 per cent phosphorus (P_2O_5) and 0.7-1.0 per cent potash (K_2O).

(ii) Urban Compost or Town Compost

This type of compost is prepared from town waste and night soil. It contains 1.0-2.0 per cent nitrogen, 1.0 per cent phosphorus (P_2O_5) and 1.5 per cent potash (K_2O).

17.2.4 Farm Yard Manure (FYM)

Farm yard manure is a mixture of the solid and liquid excreta of farm animals along with litter (i.e., the materials used for bedding purposes of cattle) and left over material from roughages or fodder fed to the cattle. The chemical composition of FYM is nitrogen—0.5%, phosphate – 0.2 %, potassium – 0.5 % and water 76 %.

17.2.5 Oil Cakes

Oil cakes are the by-products of oil seeds. Oil cakes are the important and quick acting organic nitrogenous manure. It also contain small amounts of phosphorus and potassium.

(i) Edible Oil Cakes

This type of oil cake is used for feeding cattle in the form of concentrates, e.g. mustard oil cakes, groundnut cake, sesame or til cake, linseed cake, coconut cake, etc.

(ii) Non-edible oil cakes

This type of oil cake is not suitable for feeding to cattle and mainly used for manuring crops, e.g., castor cake, neem cake, etc. The non-edible oil cakes contain a harmful toxic substance, which make them unsuitable for feeding to cattle. But these are a good sources of nitrogenous manure. The amount of nitrogen varies with the type of oil cake. It ranges from 2.5 per cent in mahua cake to 7.9 per cent in decorticate safflower cake. In addition to nitrogen, all oil cakes contain small quantities of phosphoric acid (0.8 to 2.9 per cent) and potash (1.1 to 2.2 per cent). Oil cakes are insoluble in water. But their nitrogen becomes quickly available in about a week or ten days after application to crops.

17.2.6 Green Manure

The practice of ploughing or turning into soil under-composed green plant tissue for the purpose of improving physical condition as well as fertility of the soil is referred to as **green manuring** and the manure obtained by this method is known as **green manure**.

The green manure crops should

- have profuse leaves and rapid growth early in its life cycle.
- have abundant and succulent tops
- be capable of making a good stand on poor and exhausted soils.
- have a deep root system.
- be a legume with good nodular growth habit.

Use of leguminous green manure crop is more useful in comparison to non-legumes, as more nitrogen is added by legumes. This will be advantageous for the soils and crops grown after green manuring.

17.2.7 Vermicomposting

Vermicompost (also called **worm compost** or worm manure) is the end-product of the breakdown of organic matter by some species of earthworm. Vermicompost is a nutrient-rich, natural fertilizer and soil conditioner. The process of producing vermicompost is called **vermicomposting**.

The earthworm species or **composting worms** most often used are **Red Wigglers** (*Eisenia foetida*) or Red Earthworms (*Lumbricus rubellus*). These species are commonly found in organic rich soils and especially prefer the conditions in rotting vegetation, compost and manure piles. Small-scale vermicomposting is well suited to turn kitchen waste into high-quality soil, where space is limited.

Together with bacteria, earthworms are the major catalyst for decomposition in a healthy vermicomposting system although other soil (such as insects, mold), etc. also play a contributing role.

Vermicomposting bins: Vermicomposting bins vary depending on the desired size of the system. Garden-scale containers can be made out of bricks arranged in the shape of a box. Bins for an apartment or similar dwelling can be anything from reused plastic buckets to purpose-built commercial containers.



Garden bin



Circular bin

Fig. 17.3: Different models of vermicomposting

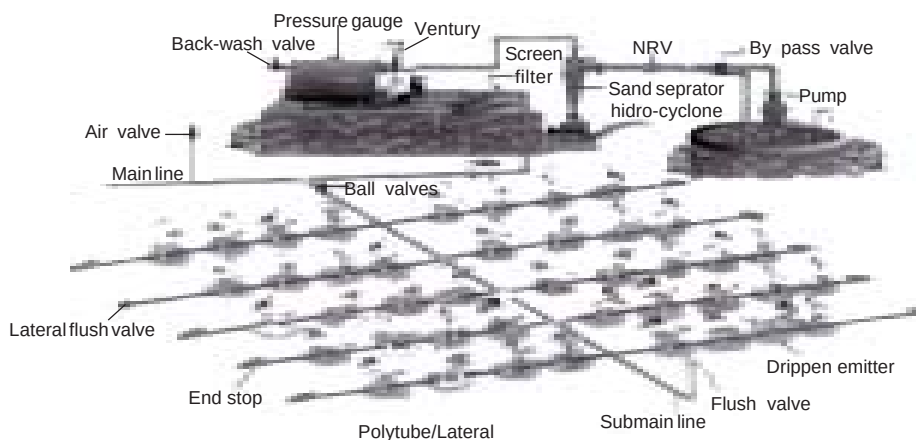
Vermicompost benefits soil by

- improving its physical structure;
- enriching soil micro-organisms, adding plant hormones such as auxins and gibberellic acid, and adding enzymes such as phosphates and cellulase;
- attracting deep-burrowing earthworms already present in the soil;
- improving water holding capacity;
- enhancing germination, plant growth, and crop yield; and
- improving root growth and structure.

Vermicompost can be used to make **compost tea** (worm tea), by mixing some vermicompost in water and steeping for a number of hours or days. The resulting liquid is used as a fertilizer. Vermicompost fed to poultry stimulates their immune system

17.2.8 Irrigation

The artificial application of water for the purpose of supplying moisture essential to plant growth is called **irrigation**. The most ancient and common type of irrigation is **surface irrigation**. It is the introduction of a stream of water at the field and allowing the water to flow throughout the field over the soil surface. In many advanced countries, **sprinkler** or **overhead irrigation** is used where water is supplied in the form of spray created by expelled water under pressure from an orifice. In areas where water is scarce, **trickle** or **drip irrigation** is practiced. Water is directly applied to individual plants in the form of discrete, continuous drops through mechanical devices called **emitters** located at selected points.

*Fig.17.4: Drip irrigation*

Whenever there is proper irrigation facility, the farmers are benefited in the following manners:

- (a) Improvement in crop quality
- (b) Significant increase in crop yields, particularly on soils having low moisture content
- (c) Increased opportunity for double cropping

Though water is essential for plant growth, excessive presence of water in the soil is also harmful. **Water logging** is the condition where water is present in excess amount in the soil. It reduces air in the soil restricting respiration by underground parts of the plant. At the same time, many nutrients are lost through leaching. Crop plants could not grow properly in such condition. To prevent harmful effects of water logging, excess water should be drained out from the field.

17.3 Cropping pattern

Cropping activities go on all the year-round in India, provided water is available for crops. In northern India, there are two distinct seasons, **kharif** (July to October), and **rabi** (October to March). Crops grown between March and June are known as **zaid**. In some parts of the country, there are no such distinct seasons, but there they have their own classification of seasons. The village revenue officials keep plot-wise record of crops grown in each season. These are annually compiled district-wise, state-wise and on all-India basis. From these records one could calculate the relative abundance of a crop or a group of crops in a region. These crops are grown alone or mixed (mixed-cropping). **Mixed cropping** is a system of sowing two or three crops together on the same



Fig. 17.5: Mixed cropping

land, one being the main crop and the others the subsidiaries. When cropping is done in a definite sequence, it is called **rotational cropping**. The land may be occupied by one crop during one season, i. e. **mono-cropping**, or by two crops which may be grown in a year in sequence i. e. **double-cropping**. Of late, the trend is even more than two crops (**multiple-cropping**) in a year. These intensive croppings may be done either in sequence or even there may be relay-cropping (one crop sown under a standing crop). With wide-rowed slow growing cropping patterns, companion crops may be grown. There are various ways of utilizing the land intensively.

17.4 Crop Protection from pests and diseases

Many organisms damage the crop plants that we grow for consumption as food. These organisms are called **pests**. Plant pests include insects, annelids, nematods, fungi, bacteria and virus. They cause various diseases in plants and destroy them.

Using chemical pesticides had been the only way of eradicating the plant pests. However, people have realized the lasting harm caused by chemical pesticides which pollute the environment. Residues of these chemicals enter our body through the food chain and cause a number of ailments. Hence, methods and ways to replace their use for pest eradication have been developed. Presently, the best biological pest control method is the use of **biopesticides**.



Cabbage looper



Aphids and their predator fly

Fig.17.6: Some examples of pests

Biopesticides are a class of environment friendly pesticides that are used to control pests like (fungi, insects, weeds and diseases). Biopesticides include naturally occurring substances that control pests (biochemical pesticides), microorganisms that control pests (microbial pesticides), and pesticidal substances produced by plants containing added genetic material (plant-incorporated protectants).

17.4.1 Fungi to Control Insects

Many fungi are capable of infecting and killing insects. The application of fungal insecticides is usually done using fungal spores. However, fungal mycelia are also used as inoculant to control insect pathogens.

17.4.2 Fungi to Control Weeds

The use of fungi for the control of weeds termed as mycoherbicides is certainly an environment friendly control method. This is an important alternative to control many weeds in range lands, turfs, and golf greens. Fungal herbicides are mass-produced and then applied to the area needing control. Fungal spores are used in aerosol sprayers and applied to an area needing control.

17.4.3 Fungi to Control other Fungi

Several fungi are used to control the plant fungal pathogens. One example is the damping-off disease that affects seedlings. Other plant diseases form galls and rots in plants while others infect the leaves. There are fungal organisms that actually attack these different plant pathogens and have been used to control them.

17.5 MIXED FARMING

Mixed farming is the combining of two independent agricultural enterprises on the same farm. A typical case of mixed farming is the combination of crop enterprise with dairy farming or in more general terms, crop cultivation with livestock farming. Mixed farming may be treated as a special case of diversified farming. This particular combination of enterprises, support each other and add to the farmer's profitability.

Integrated fish farming is combined culture of fish together with compatible combination(s) with poultry, duckery, pig rearing and cattle. Under this system of farming small livestock and farm yard animals, viz. pigs, poultry, ducks, etc., are integrated with composite fish culture by constructing animal housing sheds on the pond embankments in such a way that the animal wastes and washings are diverted into fish ponds. The fish not only utilize spilled animal feed but also directly feed on fresh animal excreta which is partially digested and is rich in nutrients. Surplus excreta support the rich growth of planktonic fauna. Fertilizers and supplementary feed are not used, resulting in drastic cost reduction. The salient features of the various types of livestock/carp integrated culture systems are as follows:

17.6 Integrated fish - pig farming

Pigsties are constructed either on the pond embankment or near the pond to facilitate easy drainage of waste directly into the pond which acts as pond fertilizer and supports dense growth of natural fish food organisms. Besides, fish also feed directly on the pig excreta. No other feed or fertilizer is applied to the pond. A pond is prepared by following the usual pond preparation techniques and stocked with fingerlings of all the six species of carps, column, bottom feeders and grass carp in the ratio of 40:20:30:10. Marketable size fish are sold by partial harvesting while final harvesting is done only after 12 months of farming.

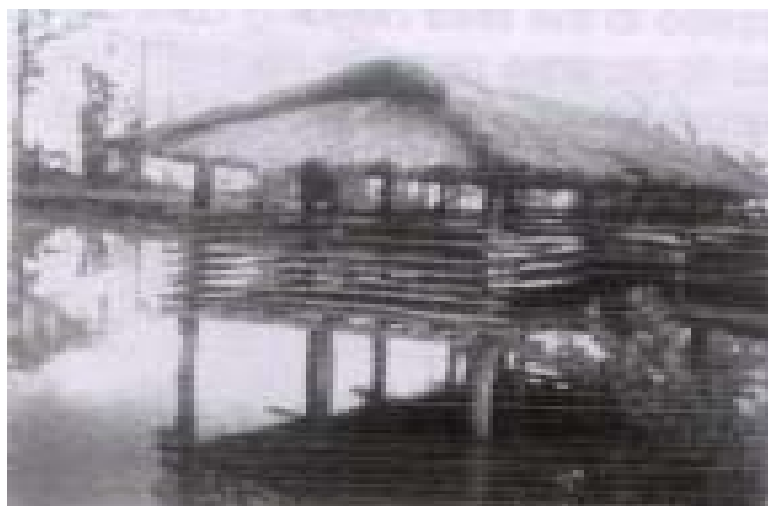


Fig.17.7: A fish-pig farming

About 2 months-old weaned piglets are fattened for six months when they attain slaughter size (60–70 kg) and similarly a second crop is raised within the next six months. About 30–40 pigs should be kept for proper fertilization of the pond. Pigs are fed on mash at an average rate of 1 kg/day. Green grasses or animal fodder is also provided. Grass with interlocked soil in root system is provided once a week to avoid mineral deficiency. Grass carp is fed with aquatic weeds or green animal fodder. Fish yields ranging from 6 000–7 000 kg/ha/yr are generally obtained.

17.7 Integrated fish - duck farming

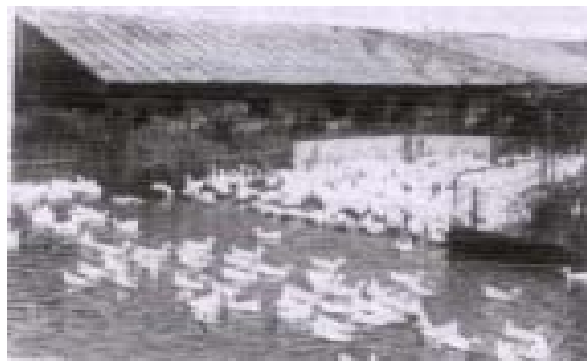


Fig.17.8: A fish-duck farming

This is also an efficient integrated system based on the principle of waste recycling. A duck house is normally constructed on the pond embankment or on the pond water on a floating platform. When given free range, ducks feed on aquatic organisms such as insect larvae, tadpoles, molluscs, weeds, etc. The duck droppings like pig excreta act as fertilizer. Ponds are prepared and stocked with fingerlings of all the six carp species at 600 ha with surface, column, bottom feeder and grass carp in the ratio of 40:20:30:10. Fingerlings of over 10 cm are preferred for stocking. About 200–400 ducks are sufficient to adequately fertilize a 1 ha pond. Normally 2–3 months old ducklings are preferred. Although ducks are able to feed upon natural food from the pond, they are also provided with duck feed at the rate of 100 g/bird/day. Ducks start laying after 5–6 months and continue for 2 years. Fish yields ranging from 3 000–5 000 kg/ha/yr are generally obtained.

17.8 Organic farming

Organic farming is a form of agriculture which avoids or largely excludes the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives. As far as possible, organic farmers rely on crop rotation, integrated pest management, crop residues, animal manures and mechanical cultivation to maintain soil productivity and tilth to supply plant nutrients, and to control weeds, insects and other pests.

Organic agricultural methods are internationally regulated and legally enforced by many nations, based in large part on the standards set by the International Federation

of Organic Agricultural Movements (IFOAM), an international umbrella organization for organic organizations.

Approximately 31 million hectares (75 million acres) worldwide are now grown organically.

Organic farming can be defined as an approach to agriculture where the aim is to create integrated, humane, environmentally sustainable agricultural production systems. Maximum reliance is placed on self-regulating agro-ecosystems, locally or farm-derived renewable resources and the management of ecological and biological processes and interactions. Dependence on external inputs, whether chemical or organic, is reduced as far as possible.

The main advantages of organic farming are:

- the market price for such products are higher,
- the way in which they are produced involves less intensive use of land,
- the attainment of a better balance between supply of, and demand for, agriculture products,
- better protection of the environment.

Another advantage is that organic farms are in general, more labour intensive than conventional farms, and therefore, should contribute to rural employment and help keep in business small farms which would otherwise not be able to cope with intensification and global competition.



Fig. 17.9: Organic farm vegetables

17.9 Animal husbandry

Animal husbandry, also called animal science, is the agricultural practice of breeding and raising livestock. Livestock production is an integral part of crop farming and contributes substantially to household nutritional security and poverty alleviation through increased household income. The returns from livestock, especially dairying and mixed farming represent a sustainable income for the farmers. The progress in this sector results in more balanced development of the rural economy, and improvement in economic status of poor people associated with livestock.

India has nearly 57 per cent of the world's buffalo population and 16 per cent of the cattle population. India has now become the largest producer of milk in the world. Piggery, cattle farming, Poultry farming, etc. are common animal husbandry practices.

The economic value of livestock includes:

1. Livestock provides us meat which is a useful form of dietary protein and energy.
2. Mammalian livestock is a good source of milk, which can in turn easily be processed into other dairy products such as yoghurt, cheese, butter, ice

cream, etc. Using livestock for this purpose can often yield several times the food energy of slaughtering the animal for meat.

3. Livestock produce a range of fiber/textiles. For example, sheep and goats produce wool and mohair; cows, deer, and sheep skin can be made into leather; and bones, hooves and horns of livestock can be used.
4. Cowdung can be spread on fields to increase crop yields. This is an important reason why historically, plant and animal domestication have been intimately linked. Cowdung is also used to make plaster for walls and floors and can be used as a fuel for fires. The blood and bone of animals are also used as fertilizer.
5. Animals such as horses, cows, buffaloes, donkey and yaks can be used for mechanical energy. They are still used for this purpose in many places of the world, including ploughing fields, transporting goods, and military functions.
6. The grazing of livestock is sometimes used as a way to control weeds and undergrowth in western countries. For example, in areas prone to wild fires, goats and sheep are set to graze on dry scrub which removes combustible material and reduces the risk of fires.

17.9.1 Piggery

Among the various livestock species, piggery is the most potential source of meat production and more efficient feed converters after the broiler. Apart from providing meat, it is also a source of bristles and manure. Pig farming will provide employment opportunities to seasonally employed rural farmers and supplementary income to improve their living standards. The advantages of the pig farming are:

1. The pig has the highest feed conversion efficiency i.e. they produce more live weight gain from a given weight of feed than any other class of meat producing animals except broilers.
2. The pig can utilize wide variety of feed stuffs viz. grains, forages, damaged feeds and garbage and convert them into valuable nutritious meat. However, feeding of damaged grains, garbage and other unbalanced rations may result in lower feed efficiency.
3. They are prolific with shorter generation interval. A sow can be bred as early as 8-9 months of age and can farrow twice in a year. They produce 6-12 piglets in each farrowing.
4. Pig farming requires small investment on buildings and equipments
5. Pigs are known for their meat yield, which in terms of dressing percentage ranges from 65 - 80 in comparison to other livestock species whose dressing yields may not exceed 65%.
6. Pork is nutritious with high fat and low water content and has got better energy value than that of other meats. It is rich in vitamins like thiamine, Niacin and riboflavin.
7. Pigs manure is widely used as fertilizer for agriculture farms and fish ponds.
8. Pigs store fat rapidly for which there is an increasing demand from poultry feed, soap, paints and other chemical industries.

9. Pig farming provides quick returns since the marketable weight of fatteners can be achieved with in a period of 6-8 months.
10. There is good demand from domestic as well as export market for pig products such as pork, bacon, ham, sausages, lard etc.

Construction of a pigsty

A **pigsty** should be constructed on dry and properly raised ground. Water-logged, marshy and heavy rainfall areas are to be avoided. The side walls of the sheds should be 4-5 ft. high and remaining height should be fitted with bamboo, wooden poles or GI pipes. The walls may be preferably plastered to make them damp proof. The roof of the shed should be at least 8-10 ft. high. The pigsties should be well ventilated. The floor should be hard, even, non-slippery, impervious, well sloped and properly drained to remain dry and clean. A cemented floor is preferable.

Feeding may be done using wooden feed troughs with spaces of 6-12 inches per pig. The corners of feed troughs, drains and walls should be rounded for easy cleaning. Adequate open space should be provided for each animal. Proper shade and cool drinking water must be provided in hot summer months. Excreta (dung and urine) should promptly and properly cleared. Individual pens for boars and lactating sows should be constructed, but the dry sows and fatteners can be housed in group pens.

Selection of breeding stock



Hampshire boar



Tamworth

Fig.17.10: High breed variety of pigs

For commercial pig farming upgraded or cross bred or exotic pigs in good health should be selected. While selecting a sow, a female that will produce large survivable litter and which can attain marketable weight at an age of six months or less should be considered. Exotic breeds of pigs like Large white Yorkshire, Hampshire, Berkshire, and Saddleback, etc. are recommended for pig farming in Manipur.

If possible animals which are ready to be bred should be obtained. The newly purchased animals are to be vaccinated against diseases. As precautionary measure, the newly procured animal must be kept under observation for a period of about two weeks before mixing them with the other animals. If any of the animals are found in bad health and grow slowly culling and replacement of animals must be done.

Feeding management

The animals are to be given the best feeds and the ration should contain adequate concentrates. Adequate vitamins and minerals should be provided. The animals should be given clean drinking water. Special care should be taken while feeding the

piglets as high quality and more fortified diets are needed for feeding them. Adequate feeding of the sows during pregnancy is also of utmost importance for obtaining increased litter size.

Commercial pig farming should aim at the exploitation of non-conventional feed resources viz., waste from Kitchen/hotel/ cold storage/warehouses, in replacing the balanced rations to minimise the cost of production.

Protection against Diseases

Disease is the worst enemy for farm animals. A farmer must be on the alert for signs of illness such as reduced feed intake, fever, abnormal discharge or unusual behaviour. If any abnormality is detected a veterinary centre must be consulted.

Care should be taken to protect the animals against common diseases. In case of outbreak of contagious diseases, the sick and the healthy animals must be immediately segregated. The sick animals are to be treated immediately. The faeces of the adult animals must be regularly examined to detect eggs of internal parasites and treat the animals with suitable drugs. The animals must be washed from time to time to promote sanitation.

Breeding care

Pigs are highly prolific in nature and two farrowings in a year should be planned by adopting optimal management conditions. Breeders may be kept in the ratio of one boar for every 10 sows for maximum fertility. The animals are to be allowed to breed when it is in peak heat period (i.e. 12 to 24 hours of heat).

Care during Pregnancy

Give special attention to pregnant sows one week before farrowing by providing adequate space, feed, water etc. The sows as well as farrowing pens should be disinfected 3-4 days before the expected date of farrowing and the sows should be placed in the farrowing pen after bedding it properly.

Care of Piglets

The new born piglets should be protected with guard rails. The umbilical cord must be cut with a clean, sharp knife and disinfected. The piglets require their mothers milk for first 6-8 weeks along with creep feed. They should be protected against extreme weather conditions, particularly during the first two months after birth. Their needle teeth should be clipped shortly after birth. Vaccinate the piglets as per recommended vaccination schedule. Supplementation of Iron to prevent piglet anaemia is necessary. The piglets meant for sale as breeder stock must be reared properly. Male piglets not selected for breeding should be castrated preferably at the age of 3-4 weeks which will prevent the boar odour in the cooked meat. Additional feed requirements of lactating sow must be ensured for proper nursing of all the piglets born.

17.9.2 Cattle farming

Cattle (*Bos*) are valuable source of food (milk, cheese, butter, meat) and other items of commercial importance. These animals convert cheap, low-grade fodder into highly nutritious milk. In addition to milk, cow dung is an important organic fertilizer for

crop production. Dried cow dung is also used as household fuel in rural India. In modern India, cow dung forms an important raw material for biogas production. Cattle also provide us with mechanical energy for various, farm works like transport, ploughing, etc.

In most parts of India including Manipur, cattle farming are carried out mainly for production of milk. However, for certain sections of people, it represents a good source of meat. Notwithstanding the ultimate purpose, the basics of setting up and management of a cattle farm involves the following considerations.

Shelter

Cattle farms should be set up in a dry, airy area, where a suitably ventilated sheltering shed should be constructed. The walls of the sheds should be 1.5 to 2 metres high. The sheds should be with brick plastered walls, concrete floor and proper roofing. The floor should be hard, even, non-slippery, impervious, well sloped (3 cm per metre) and properly drained to remain dry and clean. The roof should be 3-4 metres high. A standing space of 2 x 1.05 metre for each animal is needed. A pucca drain, 0.25 metre wide must be provided at the rear of the standing space for collection of dung and urine.

Cattle sheds are to be provided with wooden or concrete feeding troughs preferably with rounded corners for easy cleaning. The sheds are to be regularly washed for maintaining cleanliness. Straw or grass may be used as dry bedding for the animals. The size of the shed depends on the number of animals to be kept. Any sharp projection is to be removed to avoid injury to animals.

Maintenance of sanitary condition around the shed is a necessity. External parasites (ticks, flies etc.) may be controlled by spraying the pens, sheds with Malathion or Copper sulphate solution. Newly purchased animals may be vaccinated against diseases. Drain urine into collection pits and then transfer it to the field through irrigation channels. Dispose of dung and urine properly. Convert the dung along with bedding material and other farm wastes into compost. Give adequate space for the animals.

Selection of breed

Selection of breed of cattle to be reared should be done with help from veterinary experts, because it is the most important step in setting up a dairy farm. The important breeds of Indian cows are Red Sindhi, Gir, Sahiwal, Kankrej, Hallikar, Ongole, Nelore, etc. all of which belong to the species *Bos indicus*. Exotic breeds such as Holstein, Friesian, Brown, Jersey, Swiss, Angus, etc. belong to the species, *Bos taurus*.



Holstein breed



Dutch friesian breed

Fig.17.11: Some foreign variety of cattle breed

High-milk yielding breeds hybrid cattle like Friesian-Sahiwal, Holstein-Friesian, etc. are also available. Important buffalo breeds are Bhadavari, Jaffarabadi, Mehsana, Murrah, Nili-Ravi, Surti, etc. belonging to the species *Bubalus bubalis*. Generally new breeds are also disease-resistant.

Feeding

Milk-giving animals are to be fed properly after adding adequate green fodder in the ration. The feed may be categorized into roughage and concentrates. Roughage includes grasses, dry fodder (paddy chaff), green fodder including soyabean hay and legumes like clover (*Trifolium repens*), cowpea (*Vigna sinense*), alfalfa (*Medicago sativa*), etc. Chaff the roughage before feeding. Concentrates include cereals, millets, corn, rice bran, oil cakes, etc. Oil cakes made from mustard and cottonseeds may be used to enrich the feed. Crush the grains and concentrates. The oil cakes should be flaky and crumbly. The concentrate mixture may be moistened before feeding. Urea may also be used as a protein substitute. Silage (stored fodder) prepared from succulent green fodder, if properly preserved, may be used throughout the year.

Adequate vitamins and minerals may also be added to the concentrate ration. Providing salt licks besides addition of mineral mixture to the concentrate ration enhances mineral nutrition of the animals. There should be provision for adequate, clean water.

The timing and frequency of feeding is also very important. Milch cattle are generally fed twice a day, once in the morning and once in the evening before milking are done. Water also is to be given twice a day. In rural areas, family cattle are sent out to the grazing fields in the morning and brought back in the evening.

Culling

Since milch cattle are reared for production of milk, old cattle that are not healthy and with low milk yield, are to be removed from the farm. This is known as culling. The old animals after 6-7 lactations should be culled.

Milking of Animals

The lactating animals can be milked two to three times a day. It is important to milk the animal at fixed times in a day. Milking must be done in a clean place. One milking session should not last more than eight minutes. The udder and teat are to be washed with antiseptic lotions or luke-warm water and dried before milking. As far as possible, milking should be done by the same person regularly. The milker should be free from any contagious diseases and also should wash his hands with antiseptic lotion before each milking.

Health care

Dairy animals may suffer from a number of diseases, parasitic infections and other ailments. Common diseases of cattle include foot and mouth disease, bloat, Anthrax, Mad cow disease, Foot rot, Bovine diarrhoea, etc. Foot-and-Mouth Disease is a severe, highly communicable viral disease characterized by blister-like lesions on the

tongue, nose and lips, in the mouth, on the teats and between the toes, which then burst, leaving painful ulcers. **Bloat** is a form of severe indigestion marked by a collection of gas in the rumen that the animal is unable to expel. It is due to excessive green fodder and lack of dry fodder in the feed. **Anthrax**, a highly infectious and fatal disease is caused by a spore-forming bacterium called *Bacillus anthracis*. **Mad cow disease** is a fatal disease that affects the central nervous system of cattle. **Bovine Virus Diarrhoea** infection can cause numerous problems, such as damage to the digestive and immune systems, pneumonia, abortions, calf deformities, etc.

Various external as well as internal parasites also cause lots of inconveniences to the animals. Flies, ticks, lice and mites are the major external parasites infesting beef cattle. Calves under one year of age are often infected by internal worm parasites. Breeding is the most important stage in rearing of cattle. The pregnant and nursing cows are to be maintained in good health all the time. They must be given nutritious feed regularly. Care should be taken to keep the newly born disease free. Precautions should be taken to prevent diseases rather than attempting to control them, as many diseases are usually difficult to control and are fatal.

Protection against Diseases

Farmers should be on the alert for signs of illness such as reduced feed intake, fever, abnormal discharge or unusual behaviour. The nearest veterinary aid centre should be consulted for help if illness is suspected. Immediate segregation of the sick animals from the healthy ones is necessary to prevent a disease from spreading. The animals may be washed from time to time to promote sanitation.

17.9.3 Poultry farming

Poultry meat and egg are good sources of important nutrients such as high quality proteins, minerals and vitamins to balance the human diet. Poultry farming, using specially developed fast growing varieties of egg layer chicken with high feed conversion efficiency, can be a main source of family income. It can provide additional income and gainful employment to farmers throughout the year. Poultry manure has high fertilizer value and can be used for increasing yield of crops.

Setting up a Poultry farm

Setting up a modern poultry farm requires the following considerations.

Poultry Housing

For construction of poultry housing, a well raised land should be selected. Land with hard rock is more suitable. Water logging and flooding areas are to be avoided. Growing chickens and mature layers are to be housed in separate sheds. The farm should have adequate facility for water, electricity, approach road, supply of chicks, feed, veterinary aid and nearness to market for sale of culled birds and eggs. A prior training or experience in poultry farming is preferable before starting a farm.

The sheds must be constructed in such a way that the end walls face East-West direction and the side walls face North-South direction. Roofing materials of the shed should be strong and hard. Raising the plinth of the shed at least one foot above the outside ground level helps to keep the floor dry and ventilated. The roof must be made to overhang the floor by at least 3 to 4 feet.



Fig.17.12: Rhode Island Red

The shed should be provided adequate light and ventilation and comfortable housing conditions during all seasons (cool in summer and warm in winter). Sheds must be constructed in such a way that predators (cats/dogs/snakes) will not enter the shed. Avoid entry of rats by constructing rat proof structures. The shed must be kept clean and free from flies and mosquitoes. The walls and floors should be kept clean, white washed with lime and disinfected with 0.5% malathion or DDT insecticide spray. A 4" deep litter layer using dry and clean litter material (sawdust, paddy husk, etc.) is to be spread on the floor.

There must be proper lighting inside the shed. One 40 watt electric bulb is sufficient for 200 sq.ft. area.

The litter material should be always kept loose and dry. Stir the litter twice a week. Any wet litter/droppings etc. should be removed and replaced with fresh/clean dry litter.

Feeding

Use high quality balanced feeds. Starter feed (up to 8 weeks of age), grower feed (9 to 16 weeks of age) and layer feed (17 to 72 weeks of age) manufactured by reputed institutions/companies should be used. The feed may be stored in clean, dry, well ventilated room. A wet feed may bring fungus infection. Wastage of feed may be avoided by using properly designed feeders and by controlling the rats. Provide adequate feeding space per bird.

Keep proper records on feed consumption per bird for each batch. About 7 kg feed is required up to 20 weeks and 38 kg feed is required from 21 to 72 weeks of age. Excess consumption may be due to feed wastage, rats, low temperature of shed or poor feed quality (low energy feed). Too low feed consumption may be due to disease condition, low quality or unpalatability of feed, high temperature in poultry shed, etc.

Water for birds

Always give fresh and clean drinking water. Water should be always available for birds. Use properly designed watering equipment. Provide adequate drinking space per

bird. Always keep water-pots clean. Avoid birds entering inside pots. Provide cool water during summer. Store the water in tanks that are not exposed to hot sun in summer.

Disease Prevention and Control

Clean sanitary conditions of poultry sheds and equipment, balanced feed, fresh clean water, healthy chicks are essential to prevent diseases. Avoid entry of visitors to farm, especially inside the sheds. Use proper vaccination schedule. Keep vaccines in cool, dry conditions away from sunlight. Any left-over vaccine should be properly disposed off. Any dead bird should be immediately removed from the shed and sent to laboratory for post-mortem examination or buried/burnt suitably away from the poultry sheds. The waste of farm should be suitably disposed off. Any bird showing advanced signs of a disease, should be removed from the shed and culled. It can be sent to laboratory for diagnosis. Birds showing advanced signs of a disease should be shown to a qualified veterinarian and suitable medication/treatment be given. Poultry manure, if infected, can spread disease, from one batch to another. Keep the litter dry, remove it after flock is sold and dispose the manure properly and quickly.

Rats are important carriers of poultry disease. They may be controlled by using suitable rat poisons/rat traps. Many poultry medicines can be given in drinking water. When medication is to be given, remove the waterers in poultry sheds on the previous evening. Next morning give medicine in measured quantity of water, so that entire medicine will be quickly consumed and there will be no wastage of medicines. Mild infection of disease may not cause mortality but it will reduce growth.

17.9.4 Fish production

Fish is the cheapest and most easily digestible animal protein food. Man used to obtain it from natural sources from time immemorial. However, due to over exploitation and pollution, the availability of fish in natural waters has declined considerably. It has necessitated adoption of various methods to increase its production.

Fish farming in controlled or under artificial conditions has become the best way of increasing the fish production and its availability for consumption. Farmers can easily take up fish culture in village ponds, tanks or any new water body and can improve their financial position substantially. It also creates gainful employment for skilled and unskilled youths.

The type of fish culture in which more than one type of compatible fishes is cultured simultaneously is the most advanced and popular fish culture technology in the country. This technology is known as **Composite Fish Culture**. This technology enables to get maximum fish production from a pond or a tank through utilization of available fish food organisms in all the natural niches, supplemented by artificial feeding. Any perennial fresh water pond or tank retaining water depth of 2 metres can be used for fish culture purpose. However, the minimum level should not fall below one metre. Even seasonal ponds can also be utilized for short duration fish culture.

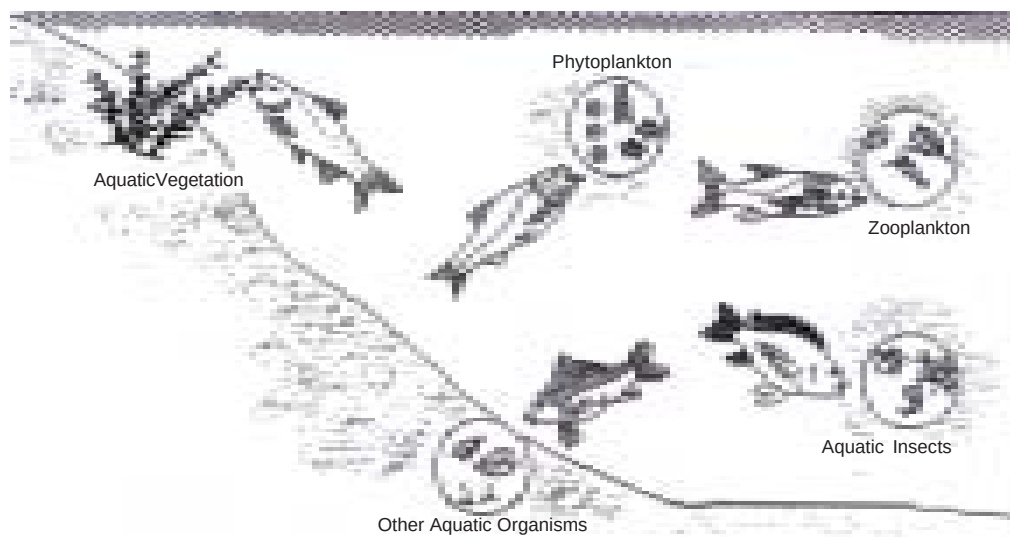


Fig.17.13: Different fishes having different feeding habits

Fish species used in composite fish culture

Depending on the compatibility and type of feeding habits of the fishes, the Indian as well as Exotic varieties of fishes shown in the following table have been identified and recommended for culture in the composite fish culture technology:

Table 17.1: Feeding habit and feeding zones of fishes

Name of fish species/variety	Feeding habit	Feeding zone
Indian Major Carps		
Catla	Zooplankton feeder	Surface feeder
Rohu	Omnivorous	Column feeder
Mrigal	Detritivorous	Bottom feeder
Exotic carps		
Silver carp	Phytoplankton feeder	Surface feeder
Grass carp	Herbivorous	Surface, column and marginal areas
Common carp	Detritivorous/Omnivorous	Bottom feeder

Table 17.2: List of commonly cultured fishes

Rohu <i>Labeo rohita</i>	
Mrigal <i>Cirrhinus mrigala</i>	
Catla <i>Catla catla</i>	
Calbasu <i>Labeo calbasu</i>	
Grass carp <i>Ctenopharyngodon idella</i>	
Common carp <i>Cyprinus carpio</i>	
Silver carp <i>Hypophthalmichthys molitrix</i>	

Technical requirements

Technical requirements that need to be fulfilled for a Composite Fish Culture farm are as follows:

1. Construction of Pond

The main criteria to be kept in mind while selecting the site for pond construction is that the soil should be water retentive (non-porous), adequate supply of water is assured and that the pond is not in a flood prone area. Derelict, semi derelict or swampy ponds can be renovated for fish culture by dewatering, desilting, repair of the embankments and provisions of inlet and outlet.

2. Pond Management

Pond Management plays a very important role in fish farming before and after the stocking of fish seed. Various measures that are required to be undertaken in pre and post stocking practices are described below:

A. Prestocking: In case of new ponds, prestocking operations include liming and filling of the pond with water. However, the first step for existing ponds requiring development include clearing the pond of unwanted weeds and fishes either by manual, mechanical or chemical means. Different methods are employed for this.

- a) Removal of weeds by Manual/Mechanical or through Chemical means.
- b) Removal of unwanted and predatory fishes and other animals by repeated netting or using mahua oil cake @ 2500 kg/ha metre or by sun drying the pond bed.

i) Liming: The tanks which are acidic in nature are less productive than alkaline ponds. Lime is used to bring the pH to the desired level. In addition lime also has the following effects:

- a) Increases the pH.
- b) Acts as buffer and avoids fluctuations of pH.
- c) It increases the resistance of soil to parasites.
- d) Its toxic effect kills the parasites; and
- e) It hastens organic decomposition.

The normal doses of the lime required ranges from 200 to 250 Kg/ha. However, the actual dose has to be calculated based on pH of the soil and water.

The pond is required to be filled with rain water or water from other sources after liming in case it is a new pond.

ii) Pond Fertilization: Fertilization of the pond is an important means of intensifying fish culture by increasing the natural productivity of the pond. The fertilization schedule has to be prepared after studying the quality of the pond soil. A combination of both Organic and Inorganic fertilizers may be used for best results. The fertilizer programme has to be suitably modified depending on the growth of the fish, available food reserve in the pond, physico-chemical properties of the pond and climatic conditions.

B. Stocking

The pond will be ready for stocking after 15 days of application of fertilizers. Fingerlings of 10 cm size (approx) should be used for stocking @ 5000 fish per hectare. However, if fingerlings of smaller size are used, suitable increase may be made accounting for mortality. Depending on availability of seed and market condition, stocking can be of 3, 4 or 6 species combination in the following ratio.

Table 17.2: List of commonly cultured fishes

Species combination (ratio)

Species	3-species	4-species	6-species
Catla	4.0	3.0	1.5
Rohu	3.0	3.0	2.0
Mrigal	3.0	2.0	1.5
Silver Carp	-	-	1.5
Grass Carp	-	-	1.5
Common Carp	-	2.0	2.0

c) Post stocking

iii) Supplementary feeding: Fishes need much more food than what is available naturally in the pond. Fishes can be fed with a mixture of bran and oilcake in equal quantities daily. The feed should be placed on a bamboo tray and lowered to the pond bottom or it can be sprayed at the corners. After some time the fishes will get used to this type of feeding and aggregate at the same place at the particular time. The recommended feeding rate is given in the table no 17.4 .

Table 17.4: Recommended feeding rate of fishes during culture period

Culture period	Quantity of feed per day in kgs.
1st 3 months	1.5 to 3
2nd 3 months	3 to 6
3rd 3 months	6 to 9
4 th 3 months	9 to 12
Total (for the year)	1,655 to 2,700

iv) Manuring: Organic manuring may be done in monthly instalments @ 1000 kg/ha. Inorganic fertilization may be done at monthly intervals alternating with organic manuring. However, the monthly rate of fertilization will depend on pond productivity and the growth of the fishes. It should be ensured that excess fertilisation does not take place which may result in **eutrophication**.

D) Harvesting:

Harvesting is generally done at the end of 1st year, when the fishes attain average weight of 750 g to 1.25 kg. A production of 4 to 5 tons/ha can be obtained in a year. Harvesting is done by partial dewatering and repeated netting. In some cases complete dewatering of ponds may be done.

17.9.5 Bee keeping

Beekeeping, or **apiculture**, is the culture of honey bees for obtaining honey, wax, etc. Honey bees live in large colonies of up to 100,000 individuals. In Europe and America the species universally reared by beekeepers is the Western honey bee *Apis mellifera*. In India, beekeeping is done using the Indian honey bee (*Apis indica*), though other wild species such as *Apis dorsata* (Rock bee), *Apis florea* (Little bee), etc. are also available.

Essential bee-keeping activities

While starting bee keeping activities, the following essential steps should be considered:

1. A beginner should learn the details about the habit and behaviour of the bees.
2. The hive and other necessary tools are to be procured.
3. The hive should be placed in a locality rich in vegetation, especially flowering plants.

4. When several hives are kept in a plot, the distance between two adjacent hives should be about at least 6 feet.
5. The hive should face east. It should receive sunlight in the morning and evening, and some shade during mid-day.
6. Water should be available nearby and an open space in front of hive entrance is necessary.
7. Spring is the best season to start bee keeping as during which bees can be easily procured to be hived.

Bee hive

In each honey bee hive, there are thousands of **worker bees** (sterile females), hundreds of **drones** (male), but only a single **queen**, who is mother to them all. The queen is somewhat larger than drones and workers, especially her abdomen, in which the ovaries are full of eggs. The ovary of the worker bee is shrunk and normally cannot produce eggs. The sting queen's is smooth and she can use it repeatedly. She uses it only to kill rival queens just after she emerges out as an adult. The worker's stinger is barbed-if used against an enemy with soft skin, such as a human, it may remain in the victim's flesh. The worker bee pulls out its own entrails in trying to escape and soon dies. Drones exist solely to mate with queens other than their own.

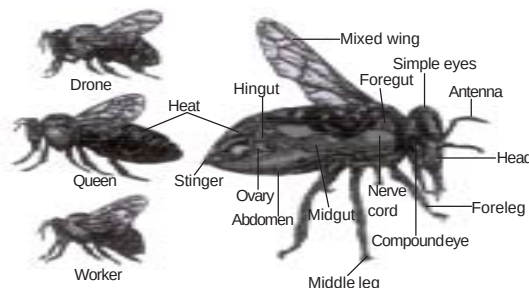


Fig. Three casts of honey bee



Fig. An artificial bee hive

Artificial bee hive: The modern bee hive is categorised as a '**Movable frame hive**'. The hive is made up of a wooden box with certain special features. The box may be single or double-walled. Single-walled hive is light and cheap, whereas the double-walled hive is heavy and costly. However, the double-walled hive is more durable and provides better protection to the bees. The double-walled hive with sufficient insulation keeps the hive warm in winter and cool in summer.

A modern bee hive, also known as the **Longstroth hive**, has a basal plate or bottom board on which is placed a wooden box called "**brood chamber**". A bottom pore in the brood chamber act as entrance for bees. Inside the hive the brood chamber has several frames hanging vertically from the top. These frames can be removed independently, hence the name movable frame hive. The distance between two frames is known as "**bee space**". This space serves as a passage for movement of the bees. This space should neither too narrow nor too wide.



Fig. Langstroth hive

There is another similar chamber above the brood chamber, which is known as “Super”. The “**Super**” is a chamber meant for storage of honey only. The queen is never allowed to enter this chamber. To prevent the queen from entering the super, a grill, known as “**queen excluder**” is used between super and brood chambers. On top of the super there is an inner covering and then a roof.

The hive is generally painted with two coats of white, green or yellow coloured paint, which not only protects the hive from different weather conditions but also help the bees to easily recognise their hive.

Different types of hives are used in different countries of the world. In India, three types of hive are generally in use, namely Langstroth, Newton and Jeolikote.

Comb foundation: It is a sheet of bee wax on both sides of which exact shapes of different cells of the natural comb is made in advance. The sheet is cut to the size of the hanging frames and are fitted in it. It can be used for several years.

Bee glove: These are leather gloves used by bee keepers to protect their hands from the sting of the bees.

Bee veil: The bee veil is made of fine net, usually silken through which bees cannot pass. A bee veil is used to protect the bee keeper’s face from the sting of the bees.

Smoker: It is a device used to subdue the bees if irritated during hive inspection. Smoke can be produced using anything like rotten wood chips, waste papers, etc. Carbolic acid is also sometimes used as bee quieter in place of smokers. It is a powerful antiseptic, a good repellent and can be used in dilute form.

Hive tool: It is a flat, narrow and long piece of iron used in scraping the dirty materials deposited by the bees including bee wax and superfluous pieces of comb on the inner walls of the hive.

Uncapping knife: It is a long, broad iron piece used in removing the cap of the hive during regular inspections.

Bee brush: It is used to brush off bees from honey combs particularly at the time of honey extraction.



Fig. Smoker

Queen introducing cage: It is a pipe made of wire nets through which the queen cannot pass. This tool is used in keeping the newly introduced queen arrested in the hive for about 24 hrs during which she becomes acquainted with the hive as well as the worker bees. The both ends of the pipe with the queen inside are plugged with “queen candy” made by kneading powdered sugar with some honey. In about 24 hrs a hole is eaten by both the queen and worker, thus releasing the queen. If the bees fail to eat the candy in 48 hrs, the queen is to be released directly.

Honey extractor: This is used in extracting honey from the comb. It is a metal drum having several pocket around a rotating wheel. The frames with honey are hanged from these pockets and rotated around a central axis. Centrifugal force separates honey from the combs. Honey is collected through a hole at the bottom. After extraction of honey, the combs can be used again.

Points to remember

- * Plant breeding is the process of developing new varieties, particularly in plants, through selection and cultivation.
- * Domestication refers to the process of bringing wild species under human management.
- * Selection is the most primitive and the most successful method of plant breeding.
- * The first prerequisite of selection is the availability of different types of forms i.e. variability.
- * Biometrics is defined as the application of statistics in biology.
- * There are three common methods by which plant selection is carried out
- * Hybridization traditionally refers to the union of the male from a particular species with the female gamete belonging to another species to produce a zygote.
- * The main aim of combination breeding is to transfer one or more desired characters from many varieties into a single variety or plant type.
- * The selection of progeny plants possessing a desired trait and crossing it back to the recipient parent is known as backcrossing.
- * Hybrid vigour, or heterosis, exploits the fact that some offsprings from the progeny of a cross between two known parents would be better than the parents themselves.
- * Hybridization between totally different plants belonging to different species or genera is known as wide or distant hybridization.
- * Fertilizers are naturally occurring or synthetic chemicals containing plant nutrients.
- * Chemical fertilizers leached from the agricultural field pollute ground and surface waters and created many health problems.
- * The soil nutrients can also be replenished by growing one crop alternately with another. This type of cultivation is called crop rotation.
- * Leaving the soil uncultivated for long time may replenish the soil with plant nutrients. The process of leaving the field uncultivated is called fallowing

- * Organic materials, derived from animal, human and plant residues that contain plant nutrients are called manures. The addition of these materials to the soil is called manuring.
- * Compost is a kind of organic manure artificially prepared from plant residues and animal waste products. The process of making compost is known as composting.
- * Farm yard manure is a mixture of the solid and liquid excreta of farm animals along with litter and left-over material from roughages or fodder fed to the cattle.
- * The practice of mixing under-composed green plant materials into soil for the purpose of improving physical condition and fertility of the soil is referred to as green manuring and the manure so obtained is known as green manure.
- * Vermicompost is the end-product of the breakdown of organic matter by some species of earthworms. The process of producing vermicompost is called vermicomposting.
- * The artificial application of water for the purpose of supplying moisture essential to plant growth is called irrigation.
- * In drip irrigation, water is directly applied to individual plants in the form of discrete, continuous drops through mechanical devices called emitters located at selected points.
- * Mixed cropping is a system of sowing two or three crops together on the same land, one being the main crop and the others the subsidiaries.
- * Growing two crops in a year in sequence is known as double-cropping. Growing more than two crops in a year is known as multiple-cropping.
- * Organisms which damage the crop plants that we grow are called crop pests.
- * Biopesticides are a class of environment-friendly, naturally occurring substances or organisms that are used as pesticides to control pests.
- * Mixed farming is the combining of two independent agricultural enterprises on the same farm.
- * Integrated fish farming is combined culture of fish together with compatible combinations with poultry, duckery, pig rearing and cattle.
- * Organic farming is a form of agriculture which avoids or largely excludes the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives.
- * Animal husbandry is the agricultural practice of breeding and raising livestock.
- * In most parts of India including Manipur cattle farming is carried out mainly for production of milk. However, for certain sections of people, it represents a good source of meat.
- * The type of fish culture in which more than one type of compatible fishes is cultured simultaneously is known as Composite Fish Culture.
- * In each honey bee hive, there are thousands of worker bees, hundreds of drones, but only a single queen.

EXERCISES

1. Define plant breeding.
2. Name the different methods of plant breeding.
3. What is biometrics?
4. What are the common methods of plant selection?
5. Define hybridization.
6. What is the main aim of combination breeding?
7. What is most common method for carrying out combination breeding?
8. Define hybrid vigour or heterosis.
9. Name some commonly used chemical fertilizers.
10. What are the nutrients that plants get from fertilizers?
11. Give two harmful effects of chemical fertilizers on the soil?
12. How can we replenish soil nutrients through crop rotation?
13. Define fallowing.
14. What do you mean by manures and manuring?
15. Define compost. How is it prepared?
16. Write three differences between rural compost and urban compost.
17. What is farmyard manure? What is its NPK composition?
18. Give two differences between the edible and non-edible oil cakes.
19. What is meant by green manuring?
20. What do you mean by vermicomposting?
21. Enumerate the benefits of using vermicompost to soil.
22. What is compost tea? What are its uses?
23. Name the different irrigation methods used in agriculture.
24. Enumerate the benefits of proper irrigation facilities.
25. Define mixed cropping.
26. Define crop pests with examples.
27. Write a short note on Biopesticides.
28. Write on the use of fungi as a biopesticide.
29. What do you mean by organic farming? What are the advantages of organic farming?
30. What do you mean by animal husbandry? How can animal husbandry improve rural economy?
31. Write down five economic values of livestock.
32. Define piggery. What are advantages of pig farming in Manipur?
33. Write what you know about Composite Fish Culture.
34. Name the Indian and exotic carps which can be cultured together.