

METHODS OF CROP VARIETY IMPROVEMENT

An improved variety of a crop is superior to the other existing varieties in respect to one or more characters. A crop variety must possess several desirable characters like, high yield, superior quality, early maturity, resistance to important diseases and insect pests, etc.

There are two major methods of obtaining an improved variety of a crop.

(i) HYBRIDIZATION

It is the most common method of incorporating desirable characters into crop varieties. “Hybridization” refers to a cross between genetically dissimilar plants. It involves:

1. Selection of parents, one used as female and other as male.
2. Before the flowers of the female parent open, their anthers are carefully removed, this is called emasculation. This prevents self-pollination in bisexual flowers.
3. Pollens from the flowers of the male parent are placed on the stigma of emasculated flowers.
4. Seeds produced by the flowers of the female parent are hybrid seeds.

(ii) **Genetic engineering**– it is the deliberate introduction of a gene that provides the desired characteristic and results in genetically modified crops (GM crops).

(iii) **Other methods of obtaining new**, genetically different variety are-

1. Mutation
2. Domestication
3. Plant introduction

SELECTION

A breeder selects from a population, those plants that have desirable characteristics. Seeds from only the selected plants are harvested and used to raise the next generation. Rests of the plants are rejected. This process is called selection and is the step that brings about improvement in the crop. Therefore, the extent of improvement in a character depends mainly on the effectiveness of selection.

FACTORS FOR WHICH IMPROVEMENT IN VARIETY IS DONE

1. HIGHER YIELD

It refers to the increase in production of the crop per acre. For new varieties to be accepted, it is necessary that the variety produce high yield under different conditions in different areas. The farmers need to be provided with good quality seeds, of a particular variety, which should germinate under the same conditions.

2. IMPROVED QUALITY

Quality considerations of crop products vary from crop to crop. The quality of a crop-produce includes all those characters that determine whether it is suitable for various uses. For examples, fruit size, colour, shape, flavor, taste, etc. are important quality characters in tomato, apple and other fruits. Similarly, baking quality is important in wheat; protein quality in pulses; oil quality in oilseeds.

3. BIOTIC AND ABIOTIC RESISTANCE

It aims to provide resistance against certain biotic (diseases, insects and nematodes) and abiotic (drought, salinity, water logging, heat, cold and frost) stresses.

4. CHANGE IN MATURITY DURATION

The high-yielding varieties of crops take less time for maturing than the traditional varieties of crops. This has the following benefits:

- (i) Allow farmers to grow multiple rounds of crops in a year.
- (ii) Short duration reduces the cost of crop production,
- (iii) Uniform maturity makes the harvesting process easy and reduces loss during harvesting.

5. WIDER ADAPTIBILITY

The improved variety should be able to grow in diverse climatic conditions. This helps in stabilizing the crop production under different environmental conditions.

6. DESIRABLE AGRONOMIC CHARACTERISTICS

Certain specific features of crops need to be improved. For example, fodder crops are more useful if they are tall and profusely branched, whereas, cereals are desired to be short (dwarf variety) so that fewer nutrients are consumed and the plants can withstand strong winds.

PLANT NUTRIENTS:-

Plants require certain mineral elements for their normal growth, development and flourishing. These are called as plant nutrients. There are about 30 to 40 elements found in plants but only 16 of these are essential for better growth and development of plants. The 16 elements found essential for growth and development of plants are (i) Carbon, (ii) Hydrogen, (iii) Oxygen, (iv) Nitrogen, (v) Phosphorus, (vi) Magnesium, (vii) Calcium, (viii) Sulphur, (ix) Potassium, (x) Manganese, (xi) Iron, (xii) Copper, (xiii) Zinc, (xiv) Boron, (xv) Molybdenum, and (xvi) Chlorine. Each of these elements fulfils the following requirements to be an essential element;

- (i) In the absence of the element, the plant cannot complete its life cycle,
- (ii) The shortage and deficiency of the element can be corrected only by supplying that element, and
- (iii) The element has the direct influence on the plant nutrition and metabolism.

All elements found in the plants are derived from atmosphere, water and soil.

CLASSIFICATION OF PLANT NUTRIENTS:-

On the basis of the plant requirements the plant nutrients are chiefly classified as:

- a) **Micro Nutrients:-** These include those nutrients, which are required by a plant in very small amounts for growth and development. These are also called as Minor nutrients and their deficiency in the soil lead to malnutrition of the crop plants. These nutrients act as activators for some important enzymes and are generally required in less than 1.0 mg per gram of dry weight of a plant. These nutrients may be required in small quantities but they are as essential for the growth and development of plant as the macro nutrients. The micro nutrients required by plants are iron, manganese, copper, molybdenum, zinc and chlorine.
- b) **Macro Nutrients:-** The mineral elements required by the plants in large amounts are called as Macro Nutrients. These are also called as Major Nutrients. These are the nutrients which are involved in the synthesis of organic molecules in the protoplasm of cells. Out of the 13 soil nutrients, only nitrogen, phosphorous, potassium, calcium, magnesium and sulphur are six major or macro nutrients.

Difference between Macro-nutrients and micro-nutrients

Macro-nutrients	Micro-nutrients
1. Found in plants in easily detectable (large) quantities.	Found in plants in very less quantities (traces)
2. Concentration is more than 1 mg/g/ dry matter of plant	Concentration is less than 1 mg/g dry matter of plant
3. Used in building up of plant body and various protoplasm's constituents.	Used as activator for certain enzymes
4. Do not become toxic if present in excess quantity.	Becomes toxic if present in more than required quantity.
5. Examples- Carbon, Hydrogen, Oxygen, Nitrogen, Potassium, Chlorine, Copper, Molybdenum, Phosphorous, Calcium, Magnesium, Sulphur	Examples- Iron, Zinc, Manganese.

I) MANURING:-

It is a process in which depleted nutrients of the soil are replenished so as to maintain the fertility of the soil to ensure a healthy yield. Adding manures and fertilizers to the soil does it, which are good sources of plant nutrients.

- a) **Manures:-** A manure is a natural substance obtained by the decomposition of animal wastes like cowdung, human wastes and plant residues which supplies essential nutrients and humus to the soil there by making its fertility and ensures a good produce. Though, the manures are not very rich in nutrients like Nitrogen, Potassium and Phosphorous but these are rich in organic substances like humus which improves the physical and the chemical properties of the soil.
- b) **Fertilizers:-** A fertilizer is a salt or inorganic compounds containing essential plant nutrients like Nitrogen, Phosphorous and Potassium which adds to the fertility of the soil and ensures a good and productive crop.

TYPES OF FERTILIZERS:-

A chemical fertilizer can be of the following types:-

- a) **Nitrogenous Fertilizer:-** A chemical fertilizer containing Nitrogen as one of its nutrients is called as Nitrogenous fertilizers. For example Ammonium sulphate $[(NH_4)_2]$, Ammonium Nitrate $[NH_4 NO_3]$, Sodium Nitrate $(NaNO_3)$ and Urea $[CO (NH)_2]$
- b) **Phosphatic Fertilizer:-** A chemical fertilizer which contains phosphorous as one of its essential nutrients is called as a Phosphatic fertilizer. For example, Super Phosphate or Calcium-di-hydrogen phosphate $[Ca (H_2 PO_4)_2]$, Ammonium phosphate $[NH_4 PO_4]$, Ammophos or Ammonium hydrogen phosphate $[(NH_4) H_2PO_4]$.
- c) **Potassium Fertilizers:-** A chemical fertilizer containing potassium as one of its essential nutrient is called as a Potassium Fertilizer. For example, Potassium Chloride (KCl), Potassium Sulphate $(K_2 SO_4)$ and Potassium Nitrate (KNO_3) etc.

Difference between Manures and Fertilizers

Manure	Fertilizer
1. It is natural substance obtained by the decomposition of animal wastes and plant residues.	It is a salt or an organic compound. It is nutrient specific and it can provide specific nutrient to the soil.
2. It is not nutrient specific and removes the general deficiency of soil.	It is easily soluble in water and is readily absorbed by plants.
3. It is not easily soluble in water.	It does not provide humus to the soil.
4. It provides humus to the soil.	It is prepared in the factories.
5. It is prepared in the fields or rural homes.	It is compact and concentrated, so it is easy to store and transport.
6. It is voluminous and bulky, so it is not convenient to store or transport.	

ADVANTAGES OF FERTILIZERS:-

Chemical fertilizers have many advantages over manures. Some of these are:

- (i) Chemical fertilizers are less bulky. They are easy to store, transport and apply.
- (ii) Chemical fertilizers are nutrient specific; they fulfill the requirement of a particular nutrient.
- (iii) Chemical fertilizers are soluble in crop water and hence are easily absorbed by plants.

DISADVANTAGES OF USING CHEMICAL FERTILIZERS:-

Modern agriculture relies heavily on chemical fertilizers. High doses of these chemicals do increase crop yield but these chemicals have many hazards also. The important disadvantages of using chemical fertilizers are:

- (i) These chemicals get washed off through irrigation, rainfall as drainage and reach rivers, lakes and other water bodies and pollute them, disturbing the natural ecosystem.

- (ii) The continued use of chemical fertilizers can cause drastic alterations in the soil chemistry and affect the crop yield.
- (iii) The excessive use of nitrogenous fertilizers makes the water rich in nitrates, which makes the water unfit for drinking.
- (iv) The chemical fertilizers, especially nitrogenous can increase biological oxygen demand (BOD) of water leading to the destruction of aquatic animals like fishes and aquatic plants. This phenomenon is known as eutrophication.

II) IRRIGATION OF CROPS:-

The process of supplying water to a crop growing in a field by means of canals, reservoirs, wells and tube wells etc is known as Irrigation. It helps in the development of a crop plant by dissolving the essential nutrients of the soil, which are then absorbed by a plant through its root hairs. It is also supplies two essential nutrients-hydrogen and oxygen to a crop plant needed for its proper growth and development.

IMPORTANCE OF IRRIGATION

- (i) Supply of essential elements, i.e., hydrogen and oxygen.
- (ii) Germination of seeds – water is an essential condition for germination of seeds. It mobilizes the reserve food in the seed and makes it available for growth of embryo.
- (iii) Essential for growth and elongation of roots.
- (iv) Essential for absorption of nutrient elements by crop plants.
- (v) Maintains turgidity of the cells.

SOURCES OF IRRIGATION

The various source of irrigation used in our country are rivers, canals, reservoir, ponds, wells and tube well etc. In addition to these, a major portion of the cultivated land in our country is dependent on rains for its irrigation.

1. **TANKS:-** These are small storage reservoirs, which store the run-off from smaller catchment areas. The water stored is rarely sufficient for use all year round but it lengthens the growing period.
2. **CANAL SYSTEM:-** It is an extensive network of canals, which receive water from a reservoir or river. They are divided into branch canals, which are further divided into distributaries. These distributaries irrigate the field.
3. **ROTATION SYSTEM:-** This provides adequate irrigation to all the fields when the water supply is short. Each field is given water by rotation.
4. **RIVER LIFT SYSTEM:-** This involves drawing water directly from rivers to irrigate areas close to the river. This is done when the canal flow is insufficient or irregular.
5. **WELLS:-** wells are made to exploit ground water. These are of 2 types
 - (1) Dug Wells – water here is collected from water bearing strata.
 - (2) Tube wells – they tap water from the deeper strata of earth. Water is drawn by pumps, hence continuous water supply can be ensured by this system.
6. **RAINWATER HARVESTING:-** It is a technique to recharge groundwater by capturing and storing rainwater by constructing special water harvesting structures. In areas of high rainfall . rain water from roof tops is collected into water storage tanks from where water is diverted to some abandoned well and lifted by using a hand pump.
7. **WATERSHED MANAGEMENT:-** This involves building small check-dams which stores run-off or rainwater.
 - (i) It increases the ground water level by slow percolation.
 - (ii) Reduces the soil erosion.
 - (iii) Water can be treated and reused.

CROPPING PATTERNS:-

There are different ways of growing crops to give higher yield.

- (a) Mixed cropping. (b) Inter cropping (c) crop rotation

(a) **Mixed Cropping:-** The process of growing two or more different crops together in the same field is called mixed or multiple cropping. It is also a means for restoring soil fertility as the products and waste material from one crop, help the growth of other crop plants and vice versa.

In mixed cropping different crops are not grown in different fields, but many such crops are grown together in one and same field. For example, cotton and groundnut, maize and urd and soyabean are generally grown together in multiple cropping. One crop in the mixture is to be regarded as major crop and one or more others as subordinate.

ADVANTAGES OF MIXED CROPPING

1. Saving of time and labour. Multiple cropping saves time and labour of the farmers.
2. Optimum utilization. It helps in optimum utilization of the soil.
3. Avoids depletion in soil nutrients. It avoids depletion of soil nutrients due to different nutrient requirements of different crops in the same field.
4. The waste materials and products released by one crop may be beneficial to other crop in mixed or multiple cropping.
5. No risk of crop failure. When two crops different nature are grown simultaneously, risk of total crop failure is minimized due to uncertainty in monsoon.
6. Variety of produce. It is available in the form of cereals, vegetables etc. for human beings and fodder for animals.
7. Increase in yield. Growing of a legume crop along with cereal will increase the yield of cereal due to coverage of nitrogen deficiency in soil.
8. Minimizing pest damage. In mixed cropping when different crops are grown together chances of pest infestation is highly reduced. Because a particular type of plant is infected by a particular type of pest.

(b) **Inter Cropping:-** Is growing two or more crops simultaneously on the same field in a definite pattern. A few rows of one crop alternate with a few rows of a second crop, for example, soyabean + maize, or finger millet (bajra) + cowpea (lobia). The crops are selected such that their nutrient requirements are different. This ensures maximum utilization of the nutrients supplied, and also prevents pests and diseases from spreading to all the plants belonging to one crop in a field. This way, both crops can give better returns.

ADVANTAGES OF INTER CROPPING

1. Insurance against crop failure under rain fed conditions.
2. Higher productivity per unit area.
3. Intercropping system utilizes resources efficiently.
4. Prevents pests and disease from spreading to all the plants belonging to one crop in a field.
5. Both crops can give better returns.

(c) **Crop Rotation:-** This is a process of growing different crops alternately or in a pre-planned succession in the same field. In crop rotation, the leguminous crops like pulses, beans, groundnut, clover, etc. are sown in between the seasons of cereal crops like maize, wheat, rice, mustard, pearl millet, etc.

ADVANTAGES OF CROP ROTATION

1. Crop rotation improves the fertility of the soil.
2. It saves nitrogenous fertilizers.
3. It helps in pest and weed control.
4. It regulates the used of plant nutrients from the soil.
5. Two or three crops can be grown in a year, which means a good harvest.
6. The chemical nature of the soil does not change.

SELECTION OF CROP FOR ROTATION

Crops should be selected on the basis of.

1. **Availability of moisture.** The moisture condition, length of rainy season and type of soil decides the choice of crop rotation. In rain-fed areas.
 - Either the crop is grown in summer season and field remains vacant during winters.
 - Or field is kept vacant for conserving moisture in summer and rabi crops are grown during winters.
2. **Availability of Inputs.** Depending on the availability of inputs like irrigation facilities, fertilizers, pesticides, implements and manpower the farmers can harvest two or four crops in a year. Rice, wheat, mung, mustard, sugarcane, and berseem are some of the major components of crop rotation in these areas.

In case of limited inputs, farmers harvest on or two crops in a year.

3. **Condition of soil.** Some crops like sugarcane, maize, potato, rice and wheat require high amount of nutrients in the soil. While leguminous crops can also grow on less nutrient-rich soil. So, depending upon the nutrient status of the soil, the crop is selected for rotation.
4. **Duration of crop maturity.** The two or more selected crops should be such that their maturing cycle does not clash. One of them should have a long cycle while the other should mature faster.
5. **Marketing and processing facility.** The crops should be selected according to its demand in the market, presence of storage and processing facilities.

WEED CONTROL

- Weeds are unwanted plants, which grow of their own along with maincrop plants.
- Examples of common weeds are.
 - *Amaranthus*,
 - *Chenopodium*,
 - *Parthenium* (carrot or congress grass),
 - *Wild oats* (*avena*),
 - *Grasses* etc.
 - *Xanthium* (*gokhroo*)
 - *Cyperinus rotundus* (*motha*)
- A weed may be a crop plant or plant of another variety of the same crop. If barley or mustard plants appear in wheat field, they are called weeds, because they have appeared out of place.
- The growth of weeds in the field is harmful because:-
 - (i) They compete with main crop plant for nutrients, light, water, carbon dioxide, space and fertilizers.
As a result, crop yields are reduced considerably.
 - (ii) Weeds excrete certain chemicals into the soil which inhibit germination and growth of other plants in their vicinity.
 - (iii) Weeds harbor pests and diseases, which may attack the crops.

- (iv) Loss of quality-contamination of food grain with weed seeds of Datura, Argemone, Brassica etc., is harmful to human health also, they give an odd odour to flour.
- (v) Menaces to human health – weeds harbor organisms like mosquitoes that cause of transmit diseases. Some weeds are poisonous and others produce pollen, which causes allergies.

WEEDING:-

The wild or unwanted plants which grow along with a cultivated crop in a field are called as weeds and the process of removal of these unwanted plants or weeds is referred to as weeding. The growth of weeds is harmful to a crop plant because they consume a lot of fertilizers, water, sunlight, nutrients and space meant for the crop plants and reduces the quality as well as yield of a crop. These also spread the crop pests and diseases by acting as alternate host to insects and micro-organisms. Some of the common weeds found in the rice and wheat fields are Wild oat, Grass, Amaranthus, Chenopodium and Convolvulus etc. Parthenium, Solanum, Mut grass.

METHODS OF WEEDING:-

Weeding is either done by hand i.e. by pulling the weeds out or by using the various agricultural implements like trowel or harrow. In addition, these can also be destroyed by the following two methods.

a) Chemical Method:- This method involves destruction of weeds by spraying special chemicals called weedicides which kill and check the growth of weeds. For example, 2,4,D [2,4,Dichloro Phenoxy Acetic Acid], MCPA[2 Methyl, 4 Chloro Phenoxy Acetic Acid] and Butachlor etc. Trizines, 2,4,S-T[2,4,5 Tri Chloro Phenoxy acidic acid, Borais, Chlorates.

b) Biological Method :- In this method, some appropriate insects or organisms are deliberately introduced into the crop field having weeds. These insects or organisms cause selective destruction of the weed plants without harming the main crop. For examples Cochineal insects are used to eradicate the opuntia weeds.

c) Safe storage of Food materials:- Safe storage of food materials like food grains, fruits and vegetables is very essential for a number of reasons like: -

- 1) It ensures availability of a food material throughout the year.
- 2) It ensures and facilitates smooth distribution of the food materials for the far and distant areas of the country.
- 3) It protects the stored food materials from pests, insects rodents and diseases.
- 4) It also reduces the spoilage and damage of the stored food material.
- 5) It maintains the nutritive value of the food materials.

FACTORS EFFECTING DAMAGE OF FOOD MATERIALS:-

The stored food grains and other food materials can be damaged either by living (biotic) or by non living (abiotic) factors: -

1) Non-Living or Abiotic Factors:- The various abiotic factors, which cause damage to the stored food materials are:

a) Temperature: - The maximum growth rate of the insects, which damage the stored food materials, varies between 30°C to 32°C and micro-organisms are active between 30°C to 40°C. Thus, the damage to the stored food materials can be minimised by storing it at a lower temperature than feasible to insects, micro-organisms and enzymes

b) Moisture: - For the safe storage of the food materials, the moisture content should be 14% by weight. Any increase in the moisture content accelerates the rate of decay of food materials caused by micro-organisms. However, any decrease in the moisture content reduces the identity as well as the nutritive value of a food material.

c) Humidity: - Higher humidity and higher temperature produces growth of moulds and fungi on the stored food grains which increases the moisture content of the grains and the grains become wet or damp.

d) Material of the Container: - The container used for the storing different types of the food materials should be selected carefully. It should not be toxic or should not produce harmful substances in combination with the stored food material.

2) Living or Biotic Factors: - The various biotic factors which cause damage to the stored food grains include

a) Rats (Rodents), Birds and Animals:- The maximum damage to the stored food grains is caused by rodents or rats and on an average six rats consume as much as food grains as a man does. Birds also eat and contaminate the stored food grains with their dropping (excreta) and feathers, and makes it unfit and poisonous. However, birds also cause substantial damage to the standing crops of fruits, vegetables and food grains.

b) Insects and Micro-organisms:- Insects and micro-organisms cause infestation which not only lowers the quality of the stored food materials but also spoils it by producing certain poisonous chemicals called as toxins. These chemicals when consumed cause damage to liver. Micro-organisms also decompose fats into fatty acids, proteins into amino acids, ammonia and sulphur compounds. The strong smell of these products of decomposition of food coming from the stored food materials confirms their decay and spoilage

c) Enzymes:- Enzymes are proteins which speed up and regulate many chemical reactions taking place in the living organisms, vital for their normal growth and development. These enzymes change the chemical composition of the various food materials, leading to their spoilage by producing undesirable chemicals unfit for human consumption.

CHARACTERISTICS OF A GOOD STORAGE STRUCTURE:-

A good structured storage not only stores the food grains but also reduces its loss. The essential features of a good storage structure are:-

- 1) It should not allow the rats, insects, birds and other animals to enter into it.
- 2) It should be made in such a way so that spraying of pesticides or fumigation for controlling insects and pests is efficiently possible.
- 3) It should be easy to clean and convenient for periodic inspections of the stored food materials.
- 4) It should be waterproof and should protect the stored food materials from temperature and humidity contrasts.
- 5) It should be situated away from the sources of infection, like garbage, dumps, chemical industries etc.
- 6) It should be maintained at a constant but low temperature.

ANIMAL HUSBANDRY:-

It is a branch of science which deals with the various aspects of maintenance and breeding of domestic animals. These aspects include feeding, breeding, heeding, and weeding etc.

- 1) **Feeding:-** The food eaten by animals is called as feed and the practice of providing food to animals as feeding. The feed given to cattle should contain food having sufficient quantity of carbohydrates, proteins, fats vitamins and minerals. In addition, a feed should also contain adequate amount of roughage and water.

COMPOSITION OF FEED:-

The cattle feed contains two main substances as explained under:-

a. Concentrates:- It is a mixture of substances rich in various nutrients essential for proper growth and development of the cattle. These are provided by cottonseeds, oilseeds, oil cakes, cereal and grains and rice polish etc. All these substances possess a high nutritive value and thus have a great influence on the productive yield of these animals. E.g. 50-60 gms- NaCl, Barssen, Lucerna, cowper, Alpha-Alpha.

b. Roughage:- It is a coarse and fibre substances having a low nutritive value. They neither provides energy nor builds the body of an animal, but for important for the normal functioning of the digestive system. These are provided by the substances like hay, fodder and silage etc.

2) Heeding:- Heeding means providing shelter to domestic animals. Domestic animals require a proper shelter, which protects them from heat, cold, rain prelatures and disease causing microorganisms. It also reduces discomforts of the animals and increases their productive yield.

CHARACTERISTICS OF A GOOD ANIMAL SHELTER:-

A good animal shelter should possess the following characteristics features:

1. It should be clean, dry airy and well ventilated.
2. It should receive an adequate amount of sunlight.
3. It should have enough space and ideal place.
4. It should have proper arrangement for the drinking water.
5. It should have proper arrangement for the disposal of animal excreta like dung and urine.
6. It should be strong so that it may provide protection to animals from the predators.
7. It should have hygienic surroundings so that it may safe guard the animals from various diseases.

3) Weeding:- Weeding means protection of animals. Domestic animals require an intimate care and protection from microorganisms and disease. When an organism is attacked by a disease, it not only affect its health but also reduces its productive yield.

SYMPTOMS OF A SICK OR AN ILL ANIMAL:-

The symptoms which can be used to detect a sick animal are as under:

1. It stops eating its food.
2. Its productive yield is reduced.
3. It becomes lazy or inactive, looks tired and remains isolated.
4. It either moves slowly or limps.
5. Its eyes turn red and body becomes hot but shivers.
6. It passes loose dung and colored urine.
7. It coughs wheezes, sneezes and shivers.
8. It pours water from mouth and nose.
9. Its ears drop down.
10. Its body becomes dull.

TYPES OF ANIMAL DISEASES:-

Depending upon the casual agent of a diseases are broadly classified into three main classes Viz.

- a. **Viral Disease:-** These diseases are caused in animals by viruses . For Example, Foot and Mouth disease of Cattle, Pox and Dermatitis of sheep and Goat etc
- b. **Bacterial Disease:-** These diseases are caused in animals by bacteria. For Example, Fowl Cholera, Diarrhoea of chick, Rinderpest and Anthrax etc.
- c. **Fungal Diseases:-** These diseases are caused in animals by Fungi. For Example, Aspergillosis of poultry.

PREVENTION OF ANIMAL DISEASES:-

Some of the elementary steps in animal management, which helps in preventing animal diseases and ensures a good health for animals, are:-

1. Animals should be fed regularly with a clean and nutritive feed.
2. Animals should be placed in spacious, airy, dry and clean shelter having hygienic surroundings.
3. Animals should be provided with clean drinking water.
4. Animals should be bathed and groomed frequently to protect them from skin infection.
5. Animals should be vaccinated at the proper age and unfit animals should be kept in isolation.
6. External parasites like Lice, Ticks, Mites and rodents should be controlled applying dilute pesticides.
7. Animals should be treated gently and not frightened at all.

IV) BREEDING:-

Breeding means animal production. It is practiced by two main methods.

- i. **Natural breeding:-** In this traditional method, an indigenous cow is cross bred with a high milk yielding foreign breed of bull by mating process.
- ii. **Artificial Breeding OR Artificial Insemination:-** In this method, semens are collected from a desired male and then injected into the genital tract of a female with the aid of suitable instrument and techniques, so as to obtain a better breed of the animal. The better breed or hybrid obtained contains only the desired character and is superior in every aspect like high milk yield, high disease resistance and longer life span etc.

PRECAUTIONS IN ARTIFICIAL INSEMINATION:-

The various precautions to ensure high fertility in artificial insemination method are as under:

1. The semens stored and used should be of the high quality male.
2. The female selected should be in proper health and age of reproduction.
3. The process should be done at the proper time of the productive cycle (Heat Period).
4. Injection of semen should be done by proper instruments with a suitable technique.

ADVANTAGES OF ARTIFICIAL INSEMINATION:-

The various advantage of the artificial insemination method are as under:-

1. It gives an opportunity for making selective breeding of the animals having desired characters.
2. It is a cheaper method as semens from a single bull can be used to impregnate about three (3) thousand cows at distant places.
3. It is better method of breeding than the natural method.
4. It is more reliable than the natural method of breeding.

It increases the productive yield by producing high milk yielding animals.

SIGNIFICANCE OF ANIMAL HUSBANDRY

In animal Husbandry, farming of cattle, goat, sheep, poultry and fish is undertaken. They help in.

1. Increasing milk production
2. Increasing egg production
3. Increasing meat production
4. Increasing fish production
5. Improving quality of products
6. Producing honey and bees-wax through bee keeping.

High milk yielding Breeds of Cow:- In India, there are about 32 indigenous breeds of cows and all of them do not yield a good quality of milk. The high milk yielding breeds of cows developed through cross breeding are Karan-Swiss, Friesian-Sahiwal, Karan-Fries, Jersey and Holstein-Friesian etc. Murrah(2000L) Bull/Lactation period.

BREEDS OF BUFFALO

There are ten breeds of buffaloes in India. The best-known breeds of Indian buffaloes are:

Nagpuri, Mehsana (Gujarat), Jaffrabadi, Surti, Murrah (Punjab and Haryana).

POULTRY

The word 'poultry' is used for birds, which can be raised in domestic conditions for economic purposes. It includes chicken, ducks, geese, turkeys, guinea fowls, pigeons and quails. It is undertaken to raise domestic fowl for egg production and chicken meat. Egg-laying birds are called layers, while meat-yielding birds are called broilers.

ADVANTAGES OF POULTRY

1. It provides eggs and meat, which are highly nutritious food. They are a rich source of animal protein, minerals and vitamins and contain a right kind of fat good for health.
2. Contributes to the economic upliftment of farmers.
3. Poultry droppings mixed with litter form rich manure.
4. It is also a means of recreation.

ADVANTAGES OF CROSS-BREED

- (1) These consume less feed to give same amount of meat as compared to desi breeds.
- (2) These consume less feed to produce same number of eggs as compared to indigenous breeds.
- (3) They are high egg laying birds.

The **focus of cross breeding programmes** is to develop new varieties because of the following desired traits:

- (4) Number and quality of chicks.
- (5) Dwarf broiler parent for commercial chick production.
- (6) Summer adaptation capacity or tolerance to high temperature
- (7) Low maintenance requirements.
- (8) Reduction in the size of the egg-laying bird with ability to utilize more fibrous cheaper diets formulated using agricultural by-products.

POULTRY CARE

It involves the following steps:

- (a) Maintenance of temperature and hygienic conditions in poultry housings.
- (b) Poultry feed.
- (c) Prevention and control of diseases and pests.

(a) **Maintenance of poultry housings.** These should be well ventilated (having fresh and cool air) and should extend in east-west direction (so that enough sunshine is available in winter). It must be rat and snake proof because rats not only eat the eggs but also spread diseases in the poultry house. As the photoperiod (of about 14-18 hours) regulates the growth of chicken and egg production, so poultry housed should be kept lit at night. It should be kept at about 55-75° F as the chicken show maximum growth at this temperature. The floor of poultry house should be covered by litter (e.g. paddy husk, saw dust, crushed maize cobs, etc.).

(b) **Feeding.** The chickens are fed on grains (wheat, rice, barley, jowar, bajra etc.), oil cakes, bone-meal, meat meal, green vegetables, etc. Growing chickens, called growers, need a balanced feed containing carbohydrates (as energy source), proteins (19%), fats (1%), minerals (calcium, phosphorus, sodium, etc.), vitamins (A, B and D), etc. a good feed makes the poultry healthier and they lay more eggs.

The daily food requirements (called ration) of broiler are different from those of layers e.g. the ration for the broilers should be protein and fat rich and with high amounts of vitamin A and K.

DISEASE CONTROL

- (i) **Vaccination.** It involves preventive inoculation which reduces the loss of poultry during an outbreak of disease.
- (ii) **Ectoparasites like lice,** mites and ticks can be controlled by spraying insecticides like malathion.
- (iii) **Endoparasites** like *Taenia* (tapeworm) and round worms can be controlled by wormicides.
- (iv) **Fungal diseases** like Mycosis and Thrush can be controlled by using Borda's mixture.
- (v) **Protozoan diseases** like coccidiosis can be treated with sulpha drugs.

(vi) **Bacterial diseases** can be treated by sulpha drugs and antibiotics.

FISH AS FOOD:- Fish from an important constituent of human diet. Our country has a long coastline and many fresh water bodies. Thus, it has vast resources of marine as well as fresh water fish. Fish is a valuable source of food rich in proteins. Fish proteins are easily digestible. In addition, fish has the following uses for us:

- (i) **Medicinal use:-** Fish liver oil (cod liver oil) is an important source of vitamin A and D.
- (ii) **Industrial use:-** Body oils of some fishes like herrings and sardines are used for the manufacture of edible oil and margarine.
- (iii) **Agricultural use:-** They are used as an organic manure in the field.
- (iv) **Feed for farm animals:-** Dried fish are used to provide proteins to farm animals.
- (v) **Adhesive:-** Skin and bones of fish are used to make high quality glues and adhesives.

FISHERY :- Fishery is the business or occupation of catching fishes. There are two ways of obtaining fish:

- (a) **Capture fishing:-** It is the type of fishing in which fish is caught directly from their natural resources. The source can be either sea water or fresh water.
- (b) **Culture fishery:-** It is that type of fishery in which fish is cultivated in artificial water bodies called breeding ponds.

POLYCULTURE:- It is a novel method of fish farming in which many species of fish are cultured together in a pond or water body. It is also called poly culture.

ADVANTAGES OF POLYCULTURE:-

- Ensures full utilization of natural food in the body without competing with each other.
- Increases the yield from the pond.

BREEDS OF FISH:- The following breeds of fish are used in fish farming:

INDIGENOUS FRESH WATER MAJOR CARPS

- Catla catla (Katala).- Catla is the fastest growing carp.
- Labeo rohita (Rohu),
- L. calbasu (calbasu) and
- Cirrhina mrigala (mrigla)

EXOTIC FRESH WATER BREEDS

- Common carp, Mirror carp, Chinese carp, Silver carp, and Grass carp etc.

SALT WATER FISHES WHICH CAN LIVE IN SEAWATER

- Chanos, mullets.

MAIN OPERATIONS IN PISCICULTURE

Fish culture involves the following main operations:

1. Collection, transport and sowing of fish seeds.
2. Tending the hatchlings.
3. Nursing the fry.
4. Rearing the fingerlings.
5. Production of table sized fish.
6. Harvesting the fish grown to table size.

MARINE FISHRIES

India's marine fishery resources include 7500 km of coastline and the deep seas beyond it. Popular marine fish varieties include pomphret, mackerel, tuna, sardines, and Bombay duck. Marine fish are caught using many kinds of fishing nets from fishing boats. Yields are increased by locating large schools of fish in the open sea using satellites and echo-sounders.

INLAND FISHERIES

Fresh water resources include canals, ponds, reservoirs and rivers. Brackish water resources, where seawater and fresh water mix together, such as estuaries and lagoons are also important fish reservoirs. While capture fishing is also done in such inland water bodies, the yield is not high. Most fish production from these resources is through aquaculture.

APICULTURE :- Is the process of rearing of honeybees in artificial hives, called apiaries, for the production of honey on a commercial level. An artificial and movable beehive used for commercial production of honey is called apiary.

Honeybees belong to phylum arthropoda and class insecta. Some indigenous species of honeybees are:

APIS DORSATA :- It is commonly called rock bee or gaint bee (being largest sized). Though it produces maximum amount of honey, it is ferocious and a migratory bee, hence difficult to domesticate.

APIS CERANA INDICA :- It is commonly called Indian bee. It can be domesticated easily as it is very gentle in nature but a less honey producing species.

APIS FLORA :- It is commonly called little bee (being smallest sized). It is also very docile but yield is less.

Exotic species of honey bees that are introduced to increase the honey production are:

1. **Apis mellifera.** It is commonly called Italian bee. It is preferred over the indigenous species for the commercial production of honey because of its docile nature, high yield of honey, high egg production, and good defense mechanism.

IMPORTANCE OF APICULTURE

(a) Products of honey bees include honey, bees wax, bee venom and royal jelly.

(i) **Honey.** Honey has high food value, medicinal importance (used as laxative, antiseptic and sedative, so is used against disorder of digestion, dysentery, vomiting and stomach and liver problems), manufacturing of cakes, etc. Its iron and calcium promote the growth.

(ii) **Bees wax.** It is used in cosmetics, paints ointments, polishes, microtomy, etc.

(iii) **Bee venom.** It is used to cure certain diseases like gout and arthritis.

(iv) **Royal jelly.** It is used as tonic to heart patients and growing children.

(b) Honey bees are chief cross-pollinating agents.

(c) Apiculture provides additional income generating activity to the farmers.

PASTURAGE:- Pasturage includes all those plants which provide pollens and nectar to the honey bees like mango, neem, rose, maze, sunflower etc.