CHAPTER- 09
STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

To fulfil the demand of food items due to increasing population, biological principles are applied in animal husbandry and plant breeding.

Animal husbandry- is the agricultural practice of breeding and raising livestock. Animal husbandry deals with the care and breeding of livestock like buffaloes, cows, pigs, horses, cattle, sheep, camel goat etc. it also includes poultry farming and fisheries. More than 70% of livestock population of the livestock live in India and China.

Management of Farm and Farm Animals
A professional approach of farm management have increased the food production many folds. Some of the management procedures applied in various livestock are as follows-

- Dairy farm management
  Dairying is the management of animals for its milk and its product for human consumption. Milk production mainly depends upon the quality of breeds in the farm. Selection of good breeds having high yielding potential combined with resistance to disease is very important. For yield potential to be realised the cattle have to be well looked after-
  - They have to be housed well
  - Should have adequate water
  - To be maintained disease free
  - Feeding of cattle to be scientific
  - Stringent cleanliness and hygiene.
  - Regular visit by veterinary doctor.

- Poultry Farm Management- poultry is the class of domesticated birds used for food or for their eggs. It mainly includes chicken and ducks and with turkey and geese. Important components of poultry farm management includes-
  - Selection of disease free and suitable breeds.
  - Proper and safe farm condition.
  - Proper feed and water
  - Hygiene and health care

Animal Breeding – aims at increasing yields of animals and improving the desirable qualities of the produce. A breed is a group of animals related by descent and similar in most of characters like general appearance, features, size, configuration etc. there are two kinds of breeding

- Inbreeding – breeding between animals of same breeds.
- Outbreeding- crosses between different breeds.

- Mating of more closely related individuals within the same breed for 4-6 generation is done in inbreeding. It includes-
  - Identification and mating of superior males and females of same breeds.
  - Evaluation of progeny and identification of superior male and female form them.

- Inbreeding increases homozygosity. Close inbreeding usually reduce fertility and even productivity. This is called breeding depression.

- Out-breeding is the breeding of unrelated animals, which may be between individuals of same breed but, having no common ancestors or between different breeds (cross breeding) or different species (interspecific hybridisation).
Out-crossing - this is the practice of mating of animals within the same breed but having no common ancestors on either side of their pedigree up to 4-6 generation. The offspring are called out-cross.

Cross breeding - superior male of one breed are mated with superior female of another females of another breed. Cross breeding allows the desirable qualities of two breeds to be combined.

Interspecific hybridisation - male and female animals of two different species are mated. The progeny may combine desirable features of both and parents. Ex- mule.

Controlled breeding experiments are carried out using artificial insemination. The semen is collected from the male that is chosen as a parent and injected into the reproductive tract of the selected female by the breeder.

Multiple Ovulation Embryo Transfer Technology (MOET) is used to increase the success rate of artificial insemination. In this method, a cow is administrated hormones (FSH) to induce follicular maturation and super ovulation, instead of one egg; they produce 6-8 eggs. The fertilised eggs 8-32 cells stages, are recovered non-surgically and transferred to surrogate mothers.

Bee-keeping
Bee-keeping or apiculture is the maintenance of hives of honeybees for the production of honey. Honey is a food of high nutritive value and also finds use in the indigenous systems of medicine. It also produces beeswax.

- The most common species of honey bee is *Apis indica*. The following points are important for successful bee-keeping-
  - Knowledge of the nature and habits of bees
  - Selection of suitable location for keeping the beehives
  - Catching and hiving of swarms
  - Management of beehives during different seasons
  - Handling and collection of honey and of beeswax.

Fisheries
Fishery is an industry devoted to catching, processing or selling of fish, shellfish or other aquatic animals.

- Fresh water fishes which are very common include catla, rohu and common carp. Common marine fishes are Hilsa, sardines, mackerel and pomfrets.
- Different techniques have been applied to increase production like aquaculture and pisciculture. Blue Revolution is implemented to increase fish production.

Plant Breeding is the purposeful manipulation of plant species in order to create desired plant species in order to create desired plant types that are better suited for cultivation, give better yields and are disease resistant.

- Classical plant breeding involves crossing or hybridisation of pure lines, followed by artificial selection to produce plants with desirable traits of higher yield, nutrition and resistance to disease.
- The characters breeder try to incorporate in new crops includes
Increased crop yield and improved quality
- Increased tolerance to environmental stress
- Resistance to pathogens
- Increased tolerance to insect pests.

The main steps in plant breeding are-

a) **Collection of variability is the collection** and preservation of all the different wild varieties, species and relatives of the cultivated species. The entire collection having all the diverse alleles for all genes in a given crop is called **germplasm collection**.

b) **Evaluation and selection of parents** is the identification of plants with desirable combination of characters. The selected plants are multiplied and used in the process of hybridisation.

c) **Cross hybridisation among the selected parents** to obtain desired crop characters.

d) **Selection and testing of superior recombinants**

e) **Testing, releasing and commercialisation of new cultivars**

### Wheat and Rice

Production of wheat and rice increased tremendously between 1960-2000 due to introduction of semi-dwarf varieties of rice and wheat. Several varieties such as Sonalika and Kalyan Sona, which were high yielding and disease resistant were introduced all over the rice and wheat growing field of India. Semi-dwarf rice varieties were derived from IR-8 and Taichung Native. Two new varieties are, better yielding and semi-dwarf, Jaya and Ratana were developed in India.

### Sugar cane

Sugar cane (*Saccharum barberi*) was grown in north India and *Saccharum officinarum* in south India. Two species are successfully crossed to get sugar cane varieties combining the desirable qualities of high yield, thick stems, high sugar and ability to grow in sugar cane areas of north India.

### Millets

Hybrid maize, jowar and bajra are developed in India. These varieties are high yielding and resistant to water stress.

### Plant Breeding for Disease Resistance

Several fungal, bacterial and viral pathogens affect the yield and quality of plant products. To minimise this loss, disease resistant varieties were developed. Breeding is carried out by conventional method or by mutation breeding. Some crop varieties bred by hybridisation and selection for disease resistance to fungi, bacterial and viral disease are released.
• Mutation is the process by which genetic variations are created through changes in the base sequence within genes resulting in the creation of a new character or trait not found in the parental types. It is done by using mutants like chemicals or radiations. This process is called mutation breeding. Mung bean resistance to yellow mosaic virus and powdery mildew were induced by mutation.

**Plant breeding for Developing Resistance to Insect Pests**

Crop plant and crop products are destructed by insects and pests on large scale. To prevent this loss new varieties resistance to them are developed. Breeding is similar to other breeding programme and resistance gene is obtained from cultivated varieties, germplasm collection of crop or wild relatives.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Variety</th>
<th>Insect Pests</th>
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<tbody>
<tr>
<td><em>Brassica</em></td>
<td><em>Pusa Gaurav</em></td>
<td><em>Aphids</em></td>
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<tr>
<td>(rape seed mustard)</td>
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<tr>
<td><em>Pusa Sem 2,</em></td>
<td><em>Pusa Sem 3</em></td>
<td><em>Jassids, aphids and fruit borer</em></td>
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<tr>
<td><em>Okra</em> (Bhindi)</td>
<td><em>Pusa Sasanvi,</em></td>
<td><em>Shoot and Fruit borer</em></td>
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<td></td>
<td><em>Pusa A-0</em></td>
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**Bio-fortification** - Breeding crops with higher levels of vitamins and minerals, or higher protein and healthier fats. Breeding for improved nutritional qualities have following objectives of improving

- Protein content and quality.
- Oil content and quality
- Vitamin content
- Micronutrient and mineral content

IARI, New Delhi have released many varities of vegetables crops rich in vitamins and minerals like vitamin A enriched corrot, spinach and pumpkin and vitaminC enriched bitter guard, bathua, mustard etc.

**Single Cell Protien (SCP)**– alternate source of protien for animal and human nutrition. Microbes are grown on industrial scale as a source of good protien. Microbes like spirullina can be grown easily on materials like waste water from potato processing plants having strach, molasses, animal manure and even sewage to produce large quantities and can serve as food rich in protien, minerals, fats, carbohydrates and vitamins.

**Tissue Culture**

The capacity to generate whole plants form any cell/explant is called **totipotency**. Thousands of plants can be produced from expalnts in short interval of time using suitable nutrient medium, aseptic condition and use of phytohormones. This method of producing thousands of plant is called **micropropagation**.

**Somatic Hybridisation**

Isolation of single cells from their plants and after digesting their cell wall fusing the cytoplasms of two different varieties is called somatic hybridisation. The hybrid obtained is called somatic hybrid. Attempts were made to fuse protoplasm of tomato and potato to get a new hybrid plants but fails to grow.