

STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

Animal Husbandry:

It 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, camels, goats, etc., that are useful to humans.

Management of Farms and Farm Animals:

1) Dairy Farm Management:

Dairying is the management of animals for milk and its products for human consumption. In dairy farm management, we deal with processes and systems that increase yield and improve quality of milk.

- Selection of good breeds having high yielding potential, combined with resistance to diseases is very important.
- Cattle have to be housed well, should have adequate water and be maintained disease free.
- The feeding of cattle should be carried out in a scientific manner (quality and quantity of fodder).
- Stringent cleanliness and hygiene are important while milking, storage and transport of the milk and its products.

2) Poultry Farm Management:

- Poultry is the class of domesticated fowl used for food or for their eggs.
- Selection of disease free and suitable breeds, proper and safe farm conditions, proper feed and water, and hygiene and health care are important components of poultry farm management.

Animal Breeding:

- Animal breeding aims at increasing the yield of animals and improving the desirable qualities of the produce.
- When breeding is between animals of the same breed it is called Inbreeding, while crosses between different breeds are called Outbreeding.

Inbreeding:

- It refers to the mating of more closely related individuals within the same breed for 4-6 generations. The breeding strategy is, superior males and superior females of the same breed are identified and mated in pairs.
- Inbreeding increases Homozygosity. However, continued inbreeding, especially close inbreeding, usually reduces fertility and even productivity. This is called Inbreeding Depression. Whenever this becomes a problem, selected animals of the breeding population should be mated with unrelated superior animals of the same breed. This usually helps restore fertility and yield.

Out-breeding:

It is the breeding of the unrelated animals, which may be between individuals of the same breed or between different breeds or different species.

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 generations. The offspring of such a mating is known as an out-cross. A single outcross often helps to overcome inbreeding depression.

Cross-breeding:

In this method, superior males of one breed are mated with superior females of another breed. Cross-breeding allows the desirable qualities of two different breeds to be combined. The progeny hybrid animals may themselves be used for commercial production. For example, Hisardale is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Marino rams.

Interspecific Hybridisation:

In this method, male and female animals of two different species are mated. In some cases, the progeny may combine desirable features of both the parents, and may be of considerable economic value. Eg. Mule.

Artificial Insemination:

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.

The success rate of crossing mature male and female animals is fairly low even though artificial insemination is carried out.

To improve chances of successful production of hybrids, other means are also used (MOET).

Multiple Ovulation Embryo Transfer Technology (MOET):

In this method, a cow is administered hormones, with FSH-like activity, to induce follicular maturation and super ovulation-instead of one egg, which they normally yield per cycle; they produce 6-8 eggs. The animal is either mated with an elite bull or artificially inseminated. The fertilized eggs at 8-32 cells stages, are recovered non-surgically and transferred to surrogate mothers. The genetic mother is available for another round of super ovulation.

3) Bee-keeping / Apiculture:

Bee-keeping or Apiculture is the maintenance of hives of honeybees for the production of honey. There are several species of honeybees which can be reared. Of these, the most common species is *Apis indica*.

Honey is a food of high nutritive value and also finds use in the indigenous systems of medicine. Honeybee also produces beeswax, which finds many uses in industry, such as in the preparation of cosmetics and polishes of various kinds.

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 (group of bees),
- Management of beehives during different seasons, and
- Handling and collection of honey and of beeswax.
- Keeping beehives in crop fields during flowering period increases pollination efficiency and improves the yield.

4) Fisheries:

- Fishery is an industry devoted to the catching, processing or selling of fish, shellfish or other aquatic animals. Freshwater fishes – Catla, Rohu and common crab; Marine fishes – Hilsa, Sardines, mackerel and Pomfrets.
- In order to meet the increasing demands on fisheries, different techniques have been employed to increase production.

- Through aquaculture and pisciculture we have been able to increase the production of aquatic plants and animals, both fresh-water and marine.

II Plant Breeding: Green revolution was dependent to a large extent on plant breeding techniques for development of high – yielding and disease resistant varieties in wheat, rice, maize, etc.

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

The main steps in breeding a new genetic variety of a crop are –

- Collection of variability* – Collection and preservation of all the different wild varieties, species and relatives of the cultivated species.
- Evaluation and selection of parents* – Evaluation is done to identify plants with desirable characters. The selected plants are multiplied and used in the process of hybridization.
- Cross hybridization among the selected parents* – By cross hybridizing the two parents to produce hybrids that genetically combine the desired characters in one plant.
- Selection and testing of superior recombinants* – The selection process is crucial to the success of the breeding objective and requires careful scientific evaluation of the progeny. These are self pollinated for several generations till they reach a state of uniformity, so that the characters will not segregate in the progeny.
- Testing, release and commercialization of new cultivars* – This evaluation is done by growing these plants in the research fields and recording their performance under ideal fertilizer application irrigation, and other crop management practices. It will be followed by testing the materials in farmers’ fields, for at least three growing at several locations in the country.

Wheat and Rice:

- In 1963, several varieties such as *Sonalika* and *Kalyan Sona*, which were high yielding and disease resistant, were introduced all over the wheat-growing belt of India.
- Semi-dwarf rice varieties were derived from *IR-8*, and *Taichung Native-1* were introduced in 1966. Later better-yielding semi-dwarf varieties *Jaya* and *Ratna* were developed in India.

Sugar cane:

- *Saccharum barberi* and *Saccharum officinarum* were crossed to get the desirable qualities of high yield, thick stems, high sugar and ability to grow in the sugar cane areas of north India.

Millets:

- Hybrid maize, jowar and bajra have been developed in India, which are high yielding and resistant to water stress.

a) Plant Breeding for Disease Resistance:

Methods of Breeding for disease resistance: The various sequential steps are; Screening germplasm for resistance, hybridization of selected parents, selection and evaluation of the hybrids and testing and release of new varieties.

CROP	VARIETY	RESISTANCE TO DISEASES
Wheat	Himgiri	Leaf and stripe rust, hill bunt
Brassica	Pusa swarnim	White
rust	Cauliflower	Pusa Shubhra, Pusa Snowball K –
1 Black rot and Curl blight	black rot	
Cowpea	Pusa Komal	Bacterial blight
Chilli	Pusa Sadabahar	Chilly mosaic virus, Tobacco mosaic
virus and Leaf curl		

Mutation Breeding:

- It 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 type.
- It is possible to induce mutations artificially through use of chemicals or radiations, and selecting and using the plants that have the desirable character as a source in breeding.
- For example, in mung bean, resistance to yellow mosaic virus and powdery mildew were induced by mutations.
- Resistance to yellow mosaic virus in bhindi (*Abelmoschus esculentus*) was transferred from a wild species and resulted in a new variety of *A. esculentus* called Parbhani kranti.

b) Plant Breeding for Developing Resistance to Insect Pests:

- Insect resistance in host crop plants may be due to morphological, biochemical or physiological characteristics.
- Hairy leaves in several plants are associated with resistance to insect pests, e.g., resistance to jassids in cotton and cereal leaf beetle in wheat.
- High aspartic acid, low nitrogen and sugar content in maize leads to resistance to maize stem borers.
- Smooth leaved and nectar-less cotton varieties do not attract bollworms.

CROP	VARIETY	INSECT PESTS
Brassica	Pusa Gaurav	Aphids
Flat bean	Pusa Sem 2, Pusa Sem 3	Jassids, aphids and fruit borer
Okra (bhindi)	Pusa Sawani, Pusa A – 4	Shoot and Fruit borer

c) Plant Breeding for Improved Food Quality:

- Diets lacking essential micronutrients – particularly iron, vitamin A, iodine and zinc – increase the risk for disease, reduce lifespan and reduce mental abilities.

Biofortification:- It is the process of breeding crops with higher levels of vitamins and minerals, or higher protein and healthier fats.

Breeding for improved nutritional quality is undertaken with the objectives of improving;

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

Examples;- Vitamin A enriched carrots, spinach, pumpkin; Vitamin C enriched bitter gourd, mustard, tomato; Iron and Calcium enriched spinach and Protein enriched Beans.

d) Single Cell Protein (SCP):

- Single cell proteins can be produced from algae, fungi, yeasts and bacteria.
- Some low-cost substrates are used to produce microbial biomass to produce single cell proteins.
- SCP is rich in high quality protein and is low in fat content, hence it is a desirable human food.
- SCP should also reduce the pressure on agricultural production systems for the supply of proteins and it can reduce environmental pollution.
- For example, microbes like *Spirulina* can be grown easily on materials like waste water from potato processing plants, straw, molasses, animal manure and even sewage, to produce large quantities and can serve as food rich in protein, minerals, fats, carbohydrate and vitamins.

d) Tissue Culture: Plant tissue culture refers to the maintenance and growth of plant cells, tissues and organs on a suitable synthetic medium in vitro and the whole plants could be regenerated from explants.

Explant: An explant is the plant part excised from a specific location in a plant, to be used for initiating a culture.

In this tissue culture process, explant, i.e., any part of a plant is taken out and grown in a test tube, under sterile conditions in special nutrient media. This capacity to generate a whole plant from any cell / explant is called Totipotency. This method of producing thousands of plants through tissue culture is called Micropropagation. Each of these plants will be genetically identical to the original plant from which they were grown i.e., they are somaclones.

Somatic Hybridisation / Somatic Hybrids: The first step in somatic hybridization is to remove the cell wall by digesting it with enzymes like pectinase and cellulase.

Isolated protoplasts from two different varieties of plants – each having a desirable character – can be fused to get hybrid protoplasts, which can be further grown to form a new plant. These hybrids are called somatic hybrids while the process is called somatic hybridization. For example, a protoplast of tomato is fused with that of potato to form new hybrid plants combining tomato and potato characteristics.