9. STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

I. ANIMAL HUSBANDRY

Management of Farms & Farm Animals

Dairy Farm Management (Dairying)

- It is the management of animals for increasing yield and quality of milk and its products.
- Milk yield depends on the quality of breeds in the farm.
- It is important to select good breeds having high yielding potential and resistance to diseases.
- **Ways for the yield potential:**
  - Look after the cattle (housing well, give adequate water and maintain disease free).
  - Feeding of cattle in a scientific manner – emphasis on the quality and quantity of fodder.
  - Stringent cleanliness and hygiene of cattle & handlers while milking, storage and transport of the milk.
- To ensure these stringent measures there should be
  - Regular inspections to identify and rectify problems.
  - Regular visits by a veterinary doctor.

Bee-keeping (apiculture)

- It is the maintenance of hives of honeybees to produce honey and beeswax.
- Most common species that can be reared is ***Apis indica.***
- Honey is a food of high nutritive and medicinal value.
- Beeswax is used in preparation of cosmetics, polishes etc.
- Apiculture can be practiced in an area having **bee pastures** of some wild shrubs, fruit orchards and cultivated crops.
- **Important points for successful bee-keeping:**
  - (i) Knowledge of the nature and habits of bees.
  - (ii) Selection of suitable location for keeping beehives.
  - (iii) Catching and hiving of swarms (group of bees).
  - (iv) Management of beehives during different seasons.
  - (v) Handling and collection of honey and beeswax.
- Bees are the pollinators of crop species such as sunflower, *Brassica*, apple and pear.
- Keeping beehives in crop fields during flowering period increases pollination. It improves crop and honey yield.

II. PLANT BREEDING

Steps of Plant breeding

(i) Collection of genetic variability

- In wild relatives of many crops, pre-existing genetic variability is available.
- The entire collection of plants/seeds having all the alleles for all genes in a given crop is called **germplasm collection.**

(ii) Evaluation and selection of parents

- The germplasm is evaluated for identifying plants with desirable characters.

(iii) Cross hybridisation of the selected parents

- In this, desired characters are genetically combined from 2 different parents to produce hybrid plant.
- E.g. high protein quality of one parent is combined with disease resistance from another parent.

(iv) Selection & testing of superior recombinants

- It is crucial to the success of the breeding objective and requires careful scientific evaluation of the progeny.
- It yields plants that are superior to both parents.

(v) Testing, release & commercialization

- The newly selected lines are evaluated for their yield and other agronomic traits of quality, disease resistance, etc.

Plant Breeding for Improved Food Quality

- 3 billion people suffer from micronutrient, protein and vitamin deficiencies **('hidden hunger').**
- Breeding crops with higher levels of nutrients is called **Biofortification.** It helps to improve public health.

Objectives of breeding for improved nutritional quality:

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

Examples for hybrids with improved nutritional quality:

- **Maize hybrids** having twice the amount of amino acids, **lysine & tryptophan** compared to existing maize hybrids.
- **Wheat** variety, **Atlas 66**, having high protein content.
- **Iron-fortified rice variety** containing over five times as much iron as in common varieties.
- **Vitamins & mineral rich vegetable crops:** Released by Indian Agricultural Research Institute (IARI), New Delhi.
  - Vitamin A enriched carrots, spinach, pumpkin.
  - Vitamin C enriched bitter gourd, *bathua*, mustard, tomato.
  - Iron & calcium enriched spinach & *bathua*.
  - Protein enriched beans (broad, lablab, French & garden peas).

III. SINGLE CELL PROTEIN (SCP)

- It is the protein derived from single-celled organisms.
- It is an alternate source of proteins for animal and human nutrition. E.g. ***Spirulina*** (a blue green alga), ***Methylophilus methylotrophus*** (a bacterium).
- ***Spirulina*** is rich in protein, minerals, fats, carbohydrate & vitamins. It is grown on materials like waste water from potato processing plants, straw, molasses, animal manure & sewage. This also reduces environmental pollution.

IV. TISSUE CULTURE

- A technique of growing plant cells/tissues/organs in sterile culture medium under controlled aseptic conditions.
- The ability to generate a whole plant from any cell/explant is called **totipotency**. An **explant** is any part of a plant that is grown in a test tube under sterile nutrient media.
- The nutrient medium must provide a carbon source (such as sucrose), inorganic salts, vitamins, amino acids and growth regulators like auxins, cytokinins etc.
- The method of producing thousands of plants in very short time through tissue culture is called **micropropagation**.
- These plants will be genetically identical to original plant, i.e., they are **somaclones**.
- Tomato, banana, apple etc. are produced by this method.
- Tissue culture is also used to recover healthy plants from diseased plants. The **meristem** (it will be virus-free) from infected plant is removed and grown *in vitro* to obtain virus-free plants. Scientists have cultured meristems of banana, sugarcane, potato, etc.
- **Somatic hybridization:** It is the fusion of protoplasts from two different varieties of plants (with desirable characters) to get hybrid protoplasts. It can be grown to form a new plant called **somatic hybrids.** Protoplasts can be isolated after digesting the cell walls of plant cells.
  E.g. Protoplast of tomato + protoplast of potato → **pomato.** This hybrid plant has the characteristics of tomato & potato. But it has no all desired characteristics for its commercial utilization.