9. STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

Newer strategies (methods) are adopted to increase food production in order to fulfil demand of ever increasing population.

ANIMAL HUSBANDRY

- It is the scientific practice of breeding and raising animals.

1. *Dairy Farm Management*

- **It is the management of animals for increasing yield and quality of milk & its products (cheese, butter, curd etc.).**

For the yield potential-

- ✓ Select breeds having **high yield** potential & **disease resistance**.
- ✓ The cattle have to be **housed well**, should have adequate **water** and be **maintained disease free**.
- ✓ Feed scientifically – with good **quality and quantity of fodder**
- ✓ Strict **cleanliness and hygiene** (of the cattle & the handlers) while milking, storage and transport of the milk. It can be achieved by mechanising these processes
- ✓ Regular **visits by a veterinary doctor**.

2. *Poultry Farm Management*

- **Poultry is the domestication of chicken, ducks, turkey, geese, quails etc. for meat or eggs.**

Components of poultry farm management:

- ✓ Selection of disease free and suitable breeds
- ✓ Proper and safe farm conditions
- ✓ Proper feed and water
- ✓ Hygiene and health care

3. *Bee-keeping / Apiculture*

- **It is the maintenance of hives of honeybees for the production of honey and beeswax.**
- Most common species that can be reared is ***Apis indica*.**

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 of beeswax.

- *Economical importance:-*
  - **Honey:** A food of high nutritive and medicinal value.
  - **Beeswax:** It is used in cosmetics, polishes etc.
  - **Pollinating agent:** Keeping beehives in crop fields increase pollination and there by improves crop yield.

4. *Fisheries*

- **Fishery refers to catching, processing and selling of fish or other aquatic animals (prawn, crab, lobster, oyster etc).**

Some edible fishes-
Freshwater fishes: *Catla, Rohu,* common carp etc.
Marine fishes: *Hilsa,* Sardines, Mackerel, Pomfrets etc.

Animal Breeding

- A **breed** is a group of animals related by descent and similar in appearance, features, size etc.
- **Breeding** is the modification of genotype of an organism to make that organism more useful to humans.

Steps:-

o Superior males and superior females of the same breed are identified and mated in pairs.
o The progeny obtained are evaluated and superior males and females among them are identified for further mating.

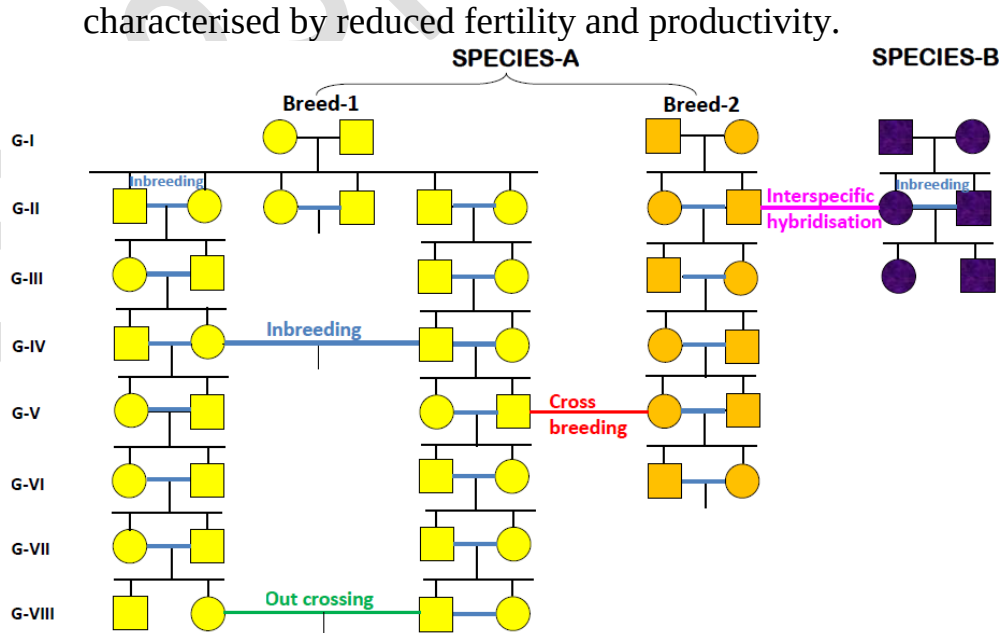
Breeding is 2 types: Inbreeding and out-breeding.

a. Inbreeding

- **It is the mating of closely related individuals within the same breed for 4-6 generations.**

Significance:
→ It increases **homozygosity** to evolve a pure line animal.
→ It helps in **accumulation of superior genes** and elimination of less desirable genes.

Drawbacks:
→ It exposes **harmful recessive genes that are eliminated** by selection.
→ Continued inbreeding leads to **inbreeding depression** characterised by reduced fertility and productivity.



b. Out-breeding

- **It is the breeding of unrelated animals.**

Out-breeding is of following types-

i) Out-crossing:

- This is mating of animals within the same breed, which having no common ancestors on either side of their pedigree up to 4-6 generations.
- The offspring of such a mating is known as **out-cross.**

Advantages of Outcrossing:

- It is the best method for animals having low productivity in milk production, growth rate in beef cattle, etc.
- It overcome the problems of **inbreeding depression**.

ii) Cross-breeding:

- Involves breeding of superior males of one breed with superior females of another breed.
- The desirable qualities of 2 different breeds are combined.

E.g. **Bikaneri ewes** x **Marino rams**
↓
Hisardale (sheep) -developed in Punjab

iii) Interspecific hybridization:

- It is the mating of male and female of two different species.

E.g. **Donkey** (male) x **Horse** (female)
↓
Mule

Controlled breeding experiments

A. Artificial insemination.

The semen collected from superior male parent is injected into the reproductive tract of selected female.

Advantages:-

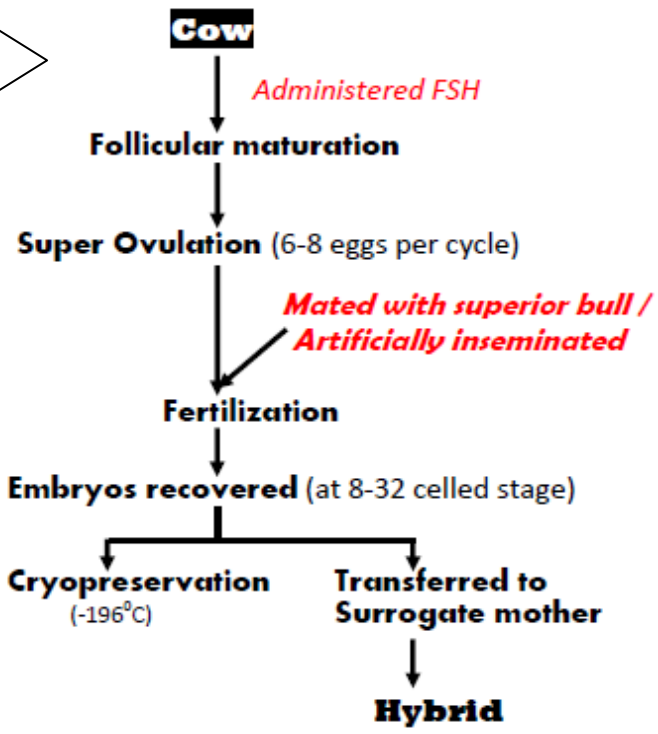
→ Collected semen may be used immediately or can be frozen and **used later**.

→ Frozen semen **can be transported** to where the female is housed.

B. Multiple Ovulation Embryo Transfer Technology (MOET)

- It is a programme for cattle (herd) improvement and increase the chance of successful hybrid production.

Procedure of MOET



PLANT BREEDING

- **It is the purposeful manipulation of plant species in order to create desired plant types.**

***Objectives of plant breeding*:-**

o Higher crop yield.
o Improve nutritional quality.
o Increase tolerance to environmental stresses (salinity, extreme temperatures & drought)
o Disease, Insect and pest Resistance.

- **Methods of breeding** include **conventional breeding & mutation breeding.**

Steps of Conventional Breeding

(i) Collection of Germplasm

- **Germplasm** refers to the sum total of the available genes of a particular crop in the form of *plant*, *seed* and other *propagules* (root, tuber, bulb, rhizome etc.).

(ii) Selection of parents

- The germplasm is evaluated to identify plants with desirable characters.

(iii) Hybridisation

- Selected parents are crossed.

(iv) Selection & evaluation of superior recombinants

- The hybrids having desired characters are selected from the progeny and then **self-pollinated for several generations** to make them homozygous (so that the characters will not segregate in the progeny).

(v) Testing & release for commercial purpose

- The selected lines are evaluated for agronomic traits by growing them in the research fields under ideal fertiliser application, irrigation, growing at several locations (representing all the agro climatic zones).
- The approved variety is released in the form of seed and commercially available to farmers.

Examples of High Yielding varieties:

- Wheat: ***Sonalika, Kalyan Sona***
- Rice: **IR-8, Taichung Native-1, *Jaya, Ratna***
- **Sugar cane**:

Saccharum barberi — Grown in north India, poor sugar content and yield

x

Saccharum officinarum — Grown in south India, higher sugar content

↓

High yield, thick stems, high sugar and grow in north India.

- **Millets**: Maize, Jowar & Bajra.

Examples for Disease Resistant varieties:

Crop	Variety	Resistance to
Wheat	Himgiri	Leaf & stripe rust, hill bunt
Brassica	*Pusa swarnim*	White rust
Cauliflower	*Pusa Shubhra*, *Pusa Snowball* K-1	Black rot, Curl Blight black rot
Cowpea	*Pusa Komal*	Bacterial blight
Chilli	*Pusa Sadabahar*	Chilly mosaic virus, Tobacco mosaic virus, Leaf curl.
Bhindi	***Parbhani kranti***	Yellow mosaic virus

Examples for Insect Resistant varieties:

Crop	Variety	Insect pests
Brassica (rapeseed mustard)	*Pusa Gaurav*	Aphids
Flat bean	*Pusa Sem 2*, *Pusa Sem 3*	Jassids, aphids & fruit borer.
Okra (Bhindi)	*Pusa Sawani*, *Pusa A-4*	Shoot and Fruit borer

Insect resistance in host crop plants may be due to morphological, biochemical or physiological characteristics.

Crop	Character	Insect not attracted-
Cotton	**Hairy leaves**	Jassids
Wheat		Cereal leaf beetle
	Solid stems	Stem sawfly
Cotton	**Smooth leaved, Nectar-less**	Bollworms
Maize	**High aspartic acid, low nitrogen-sugar content**	Stem borers

Examples for hybrids with Improved Nutritional Quality:

Crop	Improved nutrient
Maize	Amino acids (lysine & tryptophan)
Wheat (**Atlas 66**)	Protein
Rice	Iron

Vegetables released by Indian Agricultural Research Institute

Carrots, Spinach, Pumpkin	Vitamin A
Bitter gourd, *Bathua*, Mustard, Tomato	Vitamin C
Spinach, *Bathua*	Iron, calcium
Beans (broad, lablab, French & garden peas)	Protein

- **Biofortification** (breeding crops with higher levels of nutrients) helps to improve public health.

Objectives of Biofortification:

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

Steps of Mutation Breeding

(i) Selection of plant

- The crop variety chosen for breeding should be having most desirable agronomic features. Only one or two features of such variety can be altered trough mutation.

(ii) Inducing mutation

- The plant is mutated by using chemicals or gamma radiations.

(iii) Selecting source plants with desired mutation.

E.g. **Mung bean -**Resistant to **yellow mosaic virus** and **powdery mildew**

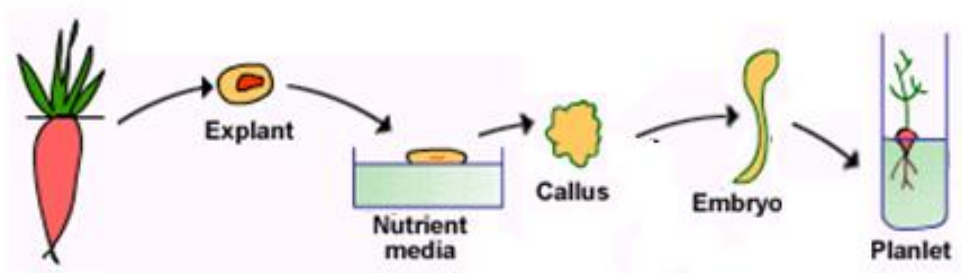
SINGLE CELL PROTEIN (SCP)

- **SCP is any microbial biomass produced by uni- and multicellular microbes and can be used for animal and human nutrition.**
- Microbes like *Spirulina*, *Methlophilus methlotrophus* can be grown in large scale as source of good protein.

  Advantages:-
  - **Reduces environmental pollution**: It is grown on materials like waste water from potato processing plants, straw, molasses, animal manure & sewage.
  - **Nutrient-rich:** Food rich in protein (45-80%), minerals, fats, carbohydrate & vitamins.
  - **High yield:** Due to high rate of biomass production and growth, large quantity is produced.

TISSUE CULTURE

- **Plant tissue culture is the technique of growing plant cells/tissues/organs in an artificial culture medium under sterile conditions.**



- The plant tissue culture is based on the principle of **cellular totipotency** i.e., capacity of a cell to generate a whole plant.
- An **explant** is any part of a plant that is used to raise a plant through tissue culture.

  Usually ***meristems*** are used as explant to obtain disease free healthy plants from a virus infected diseased plant. It is because meristems will be free of virus because virus cannot reach at there due to absence of vascular tissues

- The culture media contains **sucrose**, **inorganic salts,** certain **vitamins, amino acids** and **growth regulators** (auxins, cytokinins etc).
- This method of producing thousands of plants from explant in short duration is called **micropropagation**.

  These plants are genetically similar to parental plant so called **somaclones**.

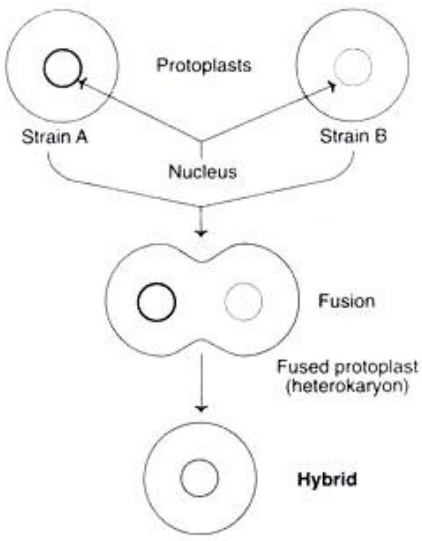
SOMATIC HYBRIDIZATION

One of the major advantages of tissue culture technique is protoplast fusion and somatic hybridisation. This technique is particularly used for hybridisation between two different species which cannot be made to cross by conventional method.

➔ It is the fusion of protoplasts of 2 somatic cells from different varieties of plants (with desirable characters) to develop hybrid protoplasts.

Procedure:-

Step 1. The cell wall of single cells of plants is digested.
Step 2. Isolate protoplasts
Step 3. Fusion of protoplasts (obtain hybrid protoplasts) in tissue culture media.
Step 4. They regenerate cell wall and later form a new plant.



E.g.:- Protoplast of tomato has been fused with that of potato, to form new hybrid plants with the characteristics of tomato and potato. But ***Pomato*** has no all desired characteristics for its commercial utilization.