CHAPTER – 9

STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

With the increase in population, enhancement of food production is a major necessity.

Several techniques are being used to enhance the food production.

Animal Husbandry: is the farming activity of breeding and rearing cattle. Animal husbandry is the care and raising of animals such as buffaloes, cows, pigs, horses, cattle, sheep, camel goats, and so on. It encompasses poultry farming and fishing.

Fisheries involve the breeding, capturing, and selling of fish, molluscs (shellfish), and crustaceans, among other things (prawns, crabs, etc.)

India and China account for more than 70% of the cattle population.

Management of Farm and Farm animals: A professional approach to farm management has multiplied food output many times over. The following are some of the management techniques used in diverse livestock:
Dairy farm management: Dairying is the management of animals for the production of milk and products for human use. We work with procedures and systems that enhance milk output and improve milk quality in dairy farm management.

It is critical to select good breeds with great producing potential as well as disease resistance.

Cattle must be housed properly, have access to clean water, and be kept disease-free.

Cattle feeding should be done in a scientific manner (quality and quantity of fodder).

Strict sanitation and hygiene are required for milking, storage, and transportation of milk and its products.

Poultry Farm management: **Poultry is a class of domesticated bird that is raised for food or for its eggs. It mostly consists of chicken and ducks, as well as turkey and geese.** The following are important aspects of poultry farm management:

- breeding disease-free animals
- proper farm maintenance and safety
- adequate feed and water and hygiene
- medical care.

Animal Breeding: It aims to increase animal production while also improving the product's desired features. **A breed is a collection of animals that are related by ancestry and share many characteristics such as overall look, features, size, configuration, and so on.** Breeding may be classified into two types.

(i) Inbreeding refers to the mating of more closely related individuals within the same breed for 4- 6 generations. Inbreeding increases homozygosity. Inbreeding exposes harmful recessive genes that are eliminated by selection. It also helps in accumulation of superior genes and elimination of less desirable genes. However, continued inbreeding, especially close inbreeding, usually reduces fertility and even productivity. This is called **inbreeding depression**.

It can be overcome by mating selected animals of the breeding population with unrelated superior animals of the same breed. The breeding strategy is as follows:

- Superior males and superior females of the same breed are identified and mated in pairs.
- The progeny obtained from such matings are evaluated and superior males and females among them are identified for further mating.
- A superior female, in the case of cattle, is the cow or buffalo that produces more milk per lactation.
- On the other hand, a superior male is the bull, which gives rise to superior progeny as compared to those of other males.

(ii) **Out-breeding** is the breeding of the unrelated animals, which may be between individuals of the same breed but having no common ancestors for 4-6 generations (out-crossing) or between different breeds **(cross-breeding)** or different species **(inter-specific hybridisation).**

Out-crossing: This is the practice of mating animals of the same breed with uncommon ancestors on either side of their lineage during the first 4-6 generations. **The offspring of such a mating is called as outcross.**
Cross-breeding: Superior males of one breed are coupled with superior females of another breed. The technique allows the merging of good traits of two different breeds.
Inter-specific hybridisation: Male and female animals of opposing species mate. The progeny may inherit favourable characteristics from both parents. **E.g. mule**

- **Artificial insemination is used in controlled breeding experiments.**
- The breeder collects the sperm from the male chosen as a parent and injects it into the reproductive tract of the chosen female.
- **MOET (Multiple Ovulation Embryo Transfer Technology)** is a technique used to improve the success rate of artificial insemination.
- In this approach**, a cow is given hormones (FSH)** to stimulate follicular maturation and super ovulation, resulting in 6-8 eggs instead of one.
- The fertilised eggs are collected non-surgically and delivered to surrogate mothers at the 8-32 cell stage.
- The genetic mother is available for another round of super ovulation.

Brush Up Your Understanding

Q1. Poultry includes which of the following?
(a) Chicken (b) Ducks
(c) Turkey (d) All of the above

S1. (d)

Q2. In MOET, the cow is administered with which of the following hormone to induce follicular maturation and superior ovulation?
(a) LH (b) hCG
(c) FSH (d) All of the above

S2. (c)

Bee-keeping: Beekeeping, also known as **apiculture**, is the care of honeybee colonies for the production of honey. Honey is a high-nutritional-value food that is also used in traditional medical systems. It also makes beeswax. ***Apis indica* is the most prevalent honey bee species**. The following factors are critical for effective beekeeping:

- Understanding the biology and behaviours of bees
- Choosing an appropriate place for the beehives
- Swarm capture and hiving
- Management of beehives during the seasons
- Honey and beeswax handling and gathering
- Keeping beehives in crop fields during flowering period increases pollination efficiency and improves the yield.

Fishries: Fishery is the capture, processing, and sale of fish, shellfish, and other aquatic creatures.

Catla, rohu, and common carp are among the most prevalent fresh water fishes. Hilsa, sardines, mackerel, and pomfrets are common marine fishes.

Pisciculture: It is the process of raising fish and selling or using the products for personal or business purposes. Fish may be raised in both marine and fresh water.

Aquaculture: It is the process of producing and selling aquatic creatures for commercial reasons. It entails feeding, harvesting, and a variety of other procedures.

E.g Shrimp, crab, fish, lobster, and a few more are the most common ones cultivated in controlled conditions.

Brush Up Your Understanding

Q1. *Apis indica* is a species of.
(a) Butterfly (b) Honey bee
(c) Silkworm (d) A plant

S1. (b)

Q2. Hilsa is a.
(a) Freshwater fish (b) Marine water fish
(c) Both (a) and (b) (d) None of the above

S2. (b)

Plant Breeding

It is the deliberate modification of plant species in order to develop desirable plants that are more suited for cultivation, yield higher yields, and are disease resistant.
Crossing or hybridization of pure lines is followed by artificial selection to generate plants with desirable features such as increased yield, nutrition, and disease resistance.

Main steps of plant breeding are:

(i) Collection of variability: **genetic variability is the root of any breeding programme.** The step refers to the gathering and preservation of all the many wild varieties, species, and relatives of farmed plants. **Germplasm collection refers to the whole collection that contains various alleles for all genes in a certain crop.**

(ii) Evaluation and selection of parents: Parent evaluation and selection is the identification of plants with desired combinations of characteristics. The selected plants are multiplied and employed in the hybridisation process.

(iii) Cross hybridisation among the selected parents: To get desired crop characteristics, cross hybridisation among the selected parents is required, for example, high protein quality from one parent may need to be paired with disease resistance from another parent. This is accomplished by crossing the two parents to generate hybrids that genetically combine the desired characteristics in a single plant.

(iv) Selection and testing of superior recombinants: The selection procedure is critical to the accomplishment of the breeding goal and necessitates meticulous scientific examination of the progeny. This phase produces plants that outperform both parents.

(v) Testing, release and commercialisation of new cultivars: the newly chosen lines are assessed for yield and other agronomic features like as quality, disease resistance, and so on.

Agriculture contributes for around 33% of India's GDP and employs over 62% of the workforce. One of the major issues that India faced after independence was providing enough food to feed its growing population.

In the mid-1960s, the introduction of multiple high yielding wheat and rice cultivars as a consequence of diverse plant breeding techniques resulted in a tremendous rise in food production in our country. This period is known as the **Green Revolution.**

Wheat and Rice: Wheat and rice production rose dramatically between 1960 and 2000 as a result of the introduction of semi-dwarf rice and wheat cultivars.

In 1963, numerous high producing and disease resistant wheat cultivars, such **as Sonalika and Kalyan Sona,** were introduced throughout India's wheat-growing fields.

Semi-dwarf rice cultivars originating from IR-8 were released in 1966, as was Taichung Native-1. In India, better-yielding semi-dwarf cultivars **Jaya and Ratna** were later created.

Nobel laureate Norman E. Borlaug, at International Centre for Wheat and Maize Improvement in Mexico, developed semi-dwarf wheat.

Sugarcane: *Saccharum barberi* (North India) and *Saccharum officinarum* (South India) were crossed to obtain the desirable characteristics of high yield, thick stems, high sugar, and capacity to thrive in north Indian sugar cane locations.

Millets: In India, hybrid maize, jowar, and bajra were produced. These varieties are high producing and drought resistant.

Plant Breeding for Disease Resistance: Several fungal, bacterial, and viral diseases have an impact on plant output and quality. Disease-resistant cultivars were developed to reduce this loss. Breeding is done either traditionally or through mutation breeding.

It is done in following way:

(i) Selection of genome with disease-resistant traits
(ii) Mating of the selected parents
(iii) Selection of superior hybrids
(iv) Testing of the hybrid for superior variety
(v) Release of the new variety

Some of the varieties bred by hybridisation and selection are as follows:

Crop	Variety	Resistance to diseases
Wheat	*Himgiri*	*Leaf and stripe rust, hill bunt*
Brassica	*Pusa swarnim (Karan rai)*	*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: Mutation is the process by which genetic variants are developed by changing the base sequence inside genes, resulting in the production of a new character or feature that was not present in the parental kinds. It is accomplished by the use of mutants such as chemicals or radiations. This is known as **mutant breeding**.

e.g Mutation resulted in mung bean resistance to yellow mosaic virus and powdery mildew.

Resistance to yellow mosaic virus was transmitted from a wild species to bhindi (*Abelmoschus esculentus*), resulting in a novel variety of known as ***Parbhani kranti.***

Brush Up Your Understanding

Q1. Himgiri is a variety of.

(a) Rice (b) Millet
(c) Wheat (d) None of the above

S (c)

Q2. IR-8 is a semi-dwarf variety of.

(a) Wheat (b) Spinach
(c) Bathua (d) Rice

S2. (d)

Plant Breeding for developing resistance to insect pests: Insects and pests destroy crop plants and crop products on a vast scale. To avoid this loss, new varieties are being developed that show resistance to insect pest.

Steps for breeding disease-resistant plants include the following:

(i) Genome selection for disease resistance characteristics
(ii) Mating of the chosen parents
(iii) Choosing outstanding hybrids
(iv) The hybrid is being tested for improved diversity.
(v) Release of the new variety

Some of the plants that have been developed are:

Crop	Variety	Insect Pests
Brassica (rapeseed mustard)	*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*

Bio-fortification: Crops with better amounts of vitamins and minerals, or more protein and healthier fats, are being bred. The goals of breeding for increased nutritional characteristics are as follows:

- Protein quantity and quality
- The quantity and quality of oil
- Vitamin content
- Mineral and micronutrient content

Atlas 66, a donor with high protein content, has been utilised to improve grown wheat.

IARI, New Delhi, has released many varieties of vitamin and mineral-rich vegetables crops, such as vitamin A-enriched carrot, spinach, and pumpkin, as well as vitamin, C-enriched bitter guard, bathua, mustard, iron and calcium-enriched spinach and bathua, and protein-enriched beans – broad, lablab, French, and garden peas.

Single Cell Protein: it is an alternative protein source for animal and human diets Microbes are produced on an industrial scale to provide excellent protein.

Microbes such as spirulina may be easily produced in huge quantities on materials such as wastewater from potato processing facilities with starch, molasses, animal dung, and even sewage, and can serve as food rich in protein, minerals, lipids, carbs, and vitamins.

***Methylophilus methylotrophus* has a high rate of biomass production and development, and 250 g of microbe may be predicted to create 25 tonnes of protein.**

Tissue Culture: The ability to grow complete plants from any cell/explant is referred to as **totipotency.** Thousands of plants can be generated from sprouts in a short period of time if appropriate nutritional medium, aseptic conditions, and phytohormones are used.

Micropropagation is a way of generating thousands of plants. Each of these plants will be genetically identical to the original plant from which it was developed, indicating that they are **somaclones.** There are several significant food plants, such as tomato, banana, and apple that have been produced by this method and have been commercialised.

Meristem culture: Meristem culture can be used to restore healthy plants from diseased plants. Despite the fact that the plant is afflicted with a virus, the meristem (apical and axillary) remains virus-free. As a result, the meristem may be removed and grown in vitro to produce virus-free plants.

Somatic Hybridisation: Somatic hybridisation is the process of isolating single cells from their plants and combining the cytoplasms of two different types after digesting their cell wall.

SUMMARY

Food is any substance that is provided in order to meet the body nutritional requirement. With the increase in population, enhancement of food production becomes a primary issue. Plant breeding and animal husbandry are major efforts to enhance the food production and to meet the requirements of increasing population. A significant aspect of animal husbandry deals with breeding of animals. It aims to increase the yield of the animals and introduction of desirable trait into the animal. Agriculture practice of breeding and raising the livestock is known as animal husbandry. It is a science of managing and caring of farm animals by human beings. Use of domesticated fowl (birds) for food and egg is known as poultry farm management. The management of animals for the milk and milk products includes the dairy farm management. It includes the management that can improve the quality and yield the milk. Apiculture or bee keeping is the maintenance of honey bees for honey and other products such as beeswax, propolis, pollen and royal jelly. Plant breeding is the practice of selecting and breeding specific desired plant species in order to obtain desirable traits such as more yield, pest resistance, herbicide resistance etc. The process by which the nutritional quality of food is enhanced through agronomic practices, conventional plant breeding and modern biotechnology is called biofortification. SCP is an alternative source of protein for both animals and humans. Tissue culture is defined as the capability to develop the whole plant from the part of the plant.

IMPORTANT POINTERS

Inbreeding increases homozygosity.

Hisardale is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Marino rams.

Controlled breeding experiments are carried out using artificial insemination.

Multiple Ovulation Embryo Transfer Technology (MOET) is a programme for herd improvement.

Catla, Rohu and common carp are freshwater fishes and Hilsa, Sardines, Mackerel and Pomfrets are marine fishes.

Even if the plant is infected with a virus, the meristem (apical and axillary) is free of virus.

MULTIPLE CHOICE QUESTIONS

Q1. Which of the following is an agricultural practice of breeding and raising livestock?
(a) Dairying
(b) Animal Husbandry
(c) Poultry
(d) Apiculture

Q2. What is poultry?
(a) It is the class of domesticated animals
(b) It is the class of domesticated bees
(c) It is the class of domesticated birds
(d) All of the above

Q3. Which of the following is/are important aspects of poultry farming?
(a) Selection of disease free breeds
(b) Safe farm conditions
(c) Proper feed and water
(d) All of the above

Q4. What is inbreeding?
(a) it refers to the mating of more closely related individuals within the same breed for 2 to 3 generation
(b) it refers to the mating of more closely related individuals within the same breed for 4 to 6 generation
(c) it refers to the mating of more closely related individuals within the same breed for 6 to 8 generation
(d) it refers to the mating of more closely related individuals within the same breed for 8 to 610 generation

Q5. Which of the following is correct about inbreeding?
(a) It increases heterozygosity
(b) It increases homozygosity
(c) It helps to evolve a pure-line in any animal
(d) Both (b) and (c)

Q6. What is inbreeding depression?
(a) Reduction in fertility and increase in productivity
(b) Reduction in fertility with intermediate fertility
(c) Increase in fertility and productivity
(d) Reduction in fertility and productivity

Q7. Which of the following is incorrect about out-crossing?
(a) it is the practice of mating of animals within the different breed having no common ancestors on either side of the pedigree up to 4 to 6 generation
(b) it is the practice of mating of animals within the same breed having no common ancestors on either side of the pedigree up to 4 to 6 generation
(c) it is the practice of mating of animals within the same breed having no common ancestors on either side of the pedigree up to 2 generations
(d) it is the practice of mating of animals within the same breed having common ancestors on either side of the pedigree up to 4 to 6 generation

Q8. Which of the following is the full form of MOET?
(a) Multiple Ovulation Embryo Transfer Technology
(b) Multiple Ovum Embryo Transfer Technology
(c) Multiple Ovulation Egg Transfer Technology
(d) Main Ovulation Embryo Transfer Technology

Q9. What is apiculture?
(a) Bird keeping
(b) Bee keeping
(c) Housefly keeping
(d) Cattle keeping

Q10. Which among the following are fresh water fishes?
(a) Hilsa (b) Sardines
(c) Catla (d) Mackerel

Q11. What is aquaculture?
(a) It is the rearing of fish
(b) It is the rearing of fish as well other aquatic organisms.
(c) It is the rearing of oysters
(d) It is the rearing of plants

Q12. What is Blue revolution?
(a) It focuses mainly on increasing fish production
(b) It also focuses on production of other aquaculture resources
(c) The production is both inland and marine
(d) All of the above

Q13. What amount of GDP is contributed by agriculture in India?
(a) 23% (b) 33%
(c) 43% (d) 53%

Q14. Which of the following phases is often referred to as Green revolution?
(a) Mid-1950's (b) Mid-1960's
(c) Mid-1970's (d) Mid-1980's

Q15. Where was the first semi dwarf wheat variety developed?
(a) International Centre for Wheat and Maize Improvement
(b) National Institute for Plant Genome and Research
(c) Indian Grassland and Forest Research Institute
(d) International Centre for Engineering and Biotechnology

Q16. Which of the following is/are wheat varieties?
(a) Sonalika
(b) Kalyan sona
(c) Saccharum barberi
(d) Both (a) and (b)

Q17. Which of the following is the root of plant breeding programme?
(a) Variation
(b) Natural selection
(c) Genetic variability
(d) None of the above

Q18. Which of the following is a fungal disease of plants?
(a) Black rot of crucifers
(b) Tobacco mosaic
(c) Brown rust of wheat
(d) All of the above

Q19. What are the steps of plant breeding for developing disease resistance in plants?
(a) Screening of germplasm
(b) Hybridisation of selected parents
(c) Selection and evaluation of the hybrids
(d) All of the above

Q20. Which of the following is correct about IR-8?
(a) Semi-dwarf wheat varieties were derived from it.
(b) Semi-dwarf rice varieties were derived from it.
(c) Semi-dwarf wheasugarcane varieties were derived from it.
(d) Semi-dwarf mustard varieties were derived from it.

Q21. In which of the following plants diseases was induced by mutations?
(a) Mung bean
(b) Sugarcane
(c) Mustard
(d) Wheat

Q22. How is transfer of resistance genes in plants achieved?
(a) Sexual hybridisation between target and the surce
(b) Selection
(c) Variation
(d) Both (a) and (b)

Q23. What are the after effects of a diet lacking essential micronutrients?
(a) Risk of disease
(b) Reduction in life span
(c) Reduction in mental ability
(d) All of the above

Q24. What is biofortification?
(a) It is the process of breeding crops with higher levels of vitamins.
(b) It is the process of breeding crops with higher levels of minerals.
(c) It is the process of breeding crops with higher levels of vitamins, minerals, protein and fats
(d) It is the process of breeding crops with higher levels fats

Q25. Which of the following is an alternate source of protein for animals and human nutrition?
(a) Wheat (b) Maize
(c) SCP (d) Sugarcane

Q26. Which of the following species a Bacteria is capable of producing 25 tons of protein?
(a) Spirulina
(b) Methylophilus methylotrophus
(c) *A.esculentus*
(d) All of the above

Q27. What is an explant?
(a) Any part of a plant taken out from the original and grown soil
(b) any part of a plant taken out from the original and grown in a test tube under sterile conditions in special nutrition media
(c) any part of a plant taken out from the original and grown on petri dish
(d) any part of a plant taken out from the original and grown on a plate

Q28. What is totipotency?
(a) Capacity to generate whole plant from only cell
(b) Capacity to generate from only explant
(c) Capacity to generate whole plant from any cell or explant
(d) None of the above

Q29. Which of the following growth regulator is important to be present in the nutrition medium for tissue culture technique?
(a) Sucrose (b) Auxin
(c) Cytokinin (d) Both (b) and (c)

Q30. What is the method of producing thousands of plants to tissue culture called?
(a) SCP
(b) Micro propagation
(c) Bio-fortification
(d) Breeding

Q31. What are somaclones?
(a) They are plants that are genetically identical to each other
(b) They are plants that are genetically identical to other plants
(c) They are plants that are genetically identical to their parent
(d) They are plants that are genetically identical to none of them

Q32. Which of the following part of a plant remains disease free even it is infected with some pathogen?
(a) Leaf (b) Stem
(c) Meristem (d) Root

Q33. What is somatic hybridization?
(a) it is the fusion of isolated chloroplast from two different varieties to get a hybrid chloroplast that can be further grown into a new plant
(b) it is the fusion of isolated protoplast from two different varieties to get a hybrid protoplast that can be further grown into a new plant
(c) it is the fusion of isolated nucleoplasm from two different varieties to get a hybrid nucleoplasm that can be further grown into a new plant
(d) it is the fusion of isolated cytoplasm from two different varieties to get a hybrid cytoplasm that can be further grown into a new plant

Q34. In which of the following year semi dwarf rice varieties were introduced in India?
(a) 1946 (b) 1956
(c) 1966 (d) 1976

Q35. Where is more than 70% of the wold's livestock population present?
(a) America and China
(b) China and Africa
(c) India and America
(d) India and China

Q36. Which of the following is the pathogen for bird flu?
(a) H1N1 (b) H2N2
(c) H4N4 (d) H5N1

Q37. Which of the following is not included in aquaculture?
(a) Aquatic plants (b) Bees
(c) Fishes (d) Oyesters

Q38. Which of the following is correct about JAYA and Ratna?
(a) They semi-dwarf varieties of wheat
(b) They are semi-dwarf varieties of rice
(c) They are semi-dwarf varieties of mustard
(d) They are semi-dwarf varieties of maize

Q39. Which of the following is not a millet?
(a) Jowar (b) Bajra
(c) Wheat (d) Maize

Q40. Aphids affect which of the following crops?
(a) Bean (b) Mustard
(c) Rice (d) Wheat

Q41. Which sugarcane variety is grown in North India?
(a) Saccharum officinarum
(b) Saccharum barberi
(c) Both (a) and (b)
(d) None of the above

Q42. Which of the following activities is included in fisheries?
(a) Rearing (b) Catching
(c) Selling (d) All of the above

Q43. Which of the following males and females are used for inbreeding animals?
(a) Superior males and inferior females
(b) Inferior males and superior females
(c) Superior males and female
(d) Inferior males and females

Q44. Which of the following is correct about Late blight of potato?
(a) It is a fungal disease of plants
(b) It is a bacterial disease of plants
(c) It is protozoan disease of plants
(d) It is a viral disease of plants

Q45. During which period wheat production increased from 11 million tonnes to 75 million tonnes?
(a) 1940-1960 (b) 1940-1980
(c) 1960-2000 (d) 2000-2020

Q46. What is mutation?
(a) it is a 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
(b) it is a process by which genetic variations are created through changes in the nucleotide sequence within genes resulting in the creation of a new character or trait
(c) it is a process by which genetic variations are created through changes in the nucleoside sequence within genes resulting in the creation of a new character or trait
(d) it is a process by which genetic variations are created through changes in the bond sequence within genes resulting in the creation of a new character or trait

Q47. Which of the following can increase be grown on materials like waste water from potato processing plants, straw, molasses or animal manure?
(a) Anabena *(b) Nostoc*
(c) Blue green algae *(d) Azotobactor*

Q48. Which of the following growth regulator helps a plant to grow only in the upward direction?
(a) Cytokine (b) Gibberellin
(c) Auxin (d) Ethylene

Q49. Which of the following product of apiculture is used in beauty industry?
(a) Nectar (b) Honey
(c) Beeswax (d) All of the above

Q50. What is the advantage of keeping beehives in crop fields?
(a) Increases pollination
(b) Increases crop yield
(c) Increases honey yield
(d) All of the above

ASSERTION AND REASON

Direction: in the following questions, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct option among a, b, c and d.

Q1. **Assertion (A):** Poultry is the class of domesticated fowl (birds) used for food or for their eggs.
Reason (R): They typically include chicken and ducks, and sometimes turkey and geese.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q2. **Assertion (A):** When breeding is between animals of the same breed it is called inbreeding.
Reason (R): it is the mating of more closely related individuals of different breeds for 4- 6 generations.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q3. **Assertion (A):** Out-crossing is the 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.
Reason (R): It is the best breeding method for animals that are below average in productivity in milk production.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q4. **Assertion (A):** MOET stands for Main Ovulation Embryo Transfer Technology.
Reason (R): It is one such programme for herd improvement.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

TRUE AND FALSE

Q1. This capacity to generate a a part of a plant from any cell/explant is called totipotency.

Q2. Blue-green algae like Spirulina are good source of SCP.

Q3. The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called protoplasm collection.

Q4. Keeping beehives in crop fields during flowering period increases pollination efficiency and improves the yield, it is beneficial both from the point of view of crop yield and honey yield.

PRACTICE QUESTIONS (MCQ)

Q1. Hybrids are generally.
(a) Weak (b) Strong
(c) Like as parents (d) Mutants

Q2. Emasculation is achieved by.
(a) Removal of anther
(b) Removal of stigma
(c) Removal of entire organisms
(d) Removal of petals and sepals

Q3. *Saccharum barberry* had poor sugar content and yield. This variety of sugar cane mainly grown in which part of india?
(a) South India (b) East India
(c) North India (d) West India

Q4. The conventional method of breeding for disease resistance in plants is.
(a) Hybridisation (b) Selection
(c) Mutation (d) Both (a) and (b)

Q5. Production of thousands of plants through tissue culture method is called.
(a) Macropropagation
(b) Micropropagation
(c) Somatic embryo
(d) Totipotency

Q6. Plants produced by tissue culture method are called:
(a) Explant (b) Somaclones
(c) Micropropagation
(d) SCP (Single cell protein)

Q7. "Jaya" and "Ratna" are better yielding semi dwart varieties of rice. These varieties are doveloped in which country?
(a) Japan (b) India
(c) Phillipins (d) Mexico

Q8. Which of the following rice variety were developed in India?
(a) IR - 8
(b) IR - 36
(c) TN - 1
(d) Jaya

Q9. A protoplast is a cell.
(a) without cell wall
(b) without plasma membrane
(c) without nucleus
(d) undergoing division

Q10. Which of the following is not an objective of Biofortification in crops?
(a) Improve protein content
(b) Improve resistance to diseases
(c) Improve vitamin content
(d) Improve micronutrient and mineral content

Q11. In plant breeding programme, the entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called.
(a) germplasm collection
(b) selection of superior recombinants
(c) cross-hybridisation among the selected parents.
(d) evaluation and selection of parents

Q12. Somaclones are obtained by.
(a) Genetic engineering
(b) Tissue culture
(c) Plant breeding
(d) Irradiation

Q13. "Jaya" and "Ratna" developed for green revolution in India are the varieties of.
(a) Maize (b) Rice
(c) Wheat (d) Bajra

Q14. How many percent of the population of India get employees by agriculture?
(a) 82 (b) 62
(c) 17 (d) 92

Q15. As a plant breeder, which trait or character that you have firstly tried to incorporate into crop plants?
(a) Increase crop yield and improved quality
(b) Increase tolerance to environmental stresses
(c) Increase resistance to pathogens
(d) Increase tolerance to insect pests

Q16. Which one of the following is an example of somatic hybridisation?
(a) Bt cotton (b) Pomato
(c) Golden rice (d) All of these

Q17. Nobel laureate Norman E. Borlaug developed semi dwarf variety of.
(a) Wheat (b) Sugarcane
(c) Mustard (d) Chilli

Q18. Pomato is.
(a) Somatic hybrid (b) Allopolyploid
(c) Natural mutant (d) Both (a) and (b)

Q19. Animal husbandry deals with.
(a) Only caring of livestock
(b) Only breeding of livestock
(c) Both caring and breeding of livestock
(d) Slaughtering of livestock

Q20. An animal that is not included in the livestock is.
(a) Pig (b) Buffalo
(c) Goat (d) Rhinoceros

Q21. Rearing of bees is called.
(a) Horticulture
(b) Sericulture
(c) Apiculture
(d) Aquaculture

Q22. Aquaculture does not include production of.
(a) Useful aquatic plants
(b) Fish
(c) Prawns
(d) Silk

Q23. Fishery is an industry devoted.
(a) To catching of fishes
(b) To the catching and processing of fishes and shell fishes
(c) To catching, processing and selling of fishes, shell fishes, crabs and prawns.
(d) All of the above

Q24. High milk yielding varities of cows are obtained by.
(a) Use of surrogate mothers
(b) Super ovulation
(c) Artificial insemination
(d) All of the above

Q25. A process in which 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 is known as.
(a) Animal breeding
(b) Artificial insemination
(c) MOET
(d) Artificial spermatogenesis

Q26. MOET has been demonstrated for which of the following animals?
(a) Rabbit (b) Buffalo
(c) Mares (d) All of the above

Q27. The technique that helps us overcome several problems of normal mating is.
(a) Tissue culture (b) Artificial Insemination
(c) Both (a) and (b) (d) None of the above

Q28. *Hisardale* a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Merino rams is an example of.
(a) Outcrossing
(b) Cross-breeding
(c) Interspecific hybridisation
(d) Outbreeding

Q29. A group of animals related by descent and similar in most characters like general appearance, features, size, configuration, etc is called a.
(a) Population (b) Species
(c) Breed (d) None of the above

Q30. Bird Flu virus affected which of the following?
(a) Consumption of eggs
(b) Consumption of chicken
(c) Both (a) and (b)
(d) None of the above

ASSERTION AND REASON

Direction: in the following questions, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct option among a, b, c and d.

Q1. **Assertion (A):** Biofortification is the breeding crops with higher levels of vitamins and minerals, or higher protein and healthier fats.
Reason (R): Certain bacterial species like *Methylophilus methylotrophus,* because of its high rate of biomass production and growth can be expected to produce 25 ton of protein.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q2. **Assertion (A):** Beehives are kept in crop field during flowering period.
Reason (R): Bees are pollinating agents.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q3. **Assertion (A):** Wild varieties of crop plants must be conserved.
Reason (R): Genome of wild plants serve as important resource for selection of desired genes like genes for pest resistance.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q4. **Assertion (A):** Honey is a food of high nutritive value and also finds use in the indigenous systems of medicine.
Reason (R): 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.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q5. **Assertion (A):** *Sonalika and Kalyan Sona*, which were high yielding and disease resistant wheat varieties.
Reason (R): *Jaya and Ratna* were developed in Philippines.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

SOLUTIONS MULTIPLE CHOICE

S1. **(b)** Animal husbandry is a vital skill for farmers and. It deals with the care and breeding of livestock like buffaloes, cows, pigs, and horses.

S2. **(c)** Poultry is the class of domesticated fowl that is used for food or for eggs. E.g chicken and duck and sometimes turkey.

S3. **(d)** Safe farm conditions, proper feed, water, and selection of disease-free breeds are very important components of poultry farm management.

S4. **(b)** Breeding of animals is an important aspect of animal husbandry, it helps in increasing the yield of animals and helps in improving the desirable qualities of the produce.

S5. **(d)** Inbreeding helps in the accumulation of superior genes and the elimination of less desirable genes

S6. (d) Continued inbreeding, especially close inbreeding leads to inbreeding depression.

S7. (b) Outcrossing is the best breeding method for animals that are below average in productivity in milk production etc.

S8. (a) Multiple ovulation embryo transfer technology is one such program for heard improvement, it also helps in improving the chances of successful production of hybrids.

S9. (b) Apiculture is the maintenance of hives of honey bees for the production of honey.

S10. (c) Fisheries is an industry devoted to the catching processing or selling of fish.

S11. (b) Aquaculture is controlled cultivation of aquatic organisms like crustaceans, molluscs, algae, aquatic plants and fishes.

S12. (d) Blue revolution mainly focuses on food and national security it also focuses on to generate employment and export earning along with production of fisheries with special focus on new technologies.

S13. (b) India is million agricultural country agriculture and accounts for about 33% of India's GDP and employs nearly 62 % of the population.

S14. (b) In mid-1960 'svarious high yielding varieties of wheat and rice for developed that resulted in dramatic increase in food production in the country, therefore this phase is referred to as Green revolution.

S15. (a) Semi dwarf variety of wheat was developed by Nobel Laureate Norman E Borlaug at International Centre for wheat and Maize improvement in Mexico.

S16. (d) *Sonalika* in *Kalyan Sona* are high yielding decisions and wheat varieties that were introduced in the 1963.

S17. (c) Genetic variability is the basis of plant breeding.

S18. (c) Plant breeding is very helpful in developing resistance to plants against these diseases

S19. (d) Breeding is carried out by the conventional breeding techniques or by mutation breeding

S20. (b) The semi dwarf rice varieties were derived from IR-8 and were developed at International rice Research Institute Philippines.

S21. (a) In Moong bean resistance to yellow mosaic virus and powdery mildew were induced by mutations.

S22. (d) Transfer of resistance genes in a plant is important to develop disease resistance in that plant for a particular disease.

S23. (d) Most of the world's population do not have adequate food and thus suffer from nutritional deficiency. Thus plant breeding becomes important.

S24. (c) Bio-fortification is the most practical means to improve public health, it focuses on breeding for improved nutritional quality.

S25. (c) Single cell protein or SC, in this microbes are being grown on industrial scale as a source of good protein. E.g Spirulina

S26. (b) *Methylophilus methylotrophus* can produce 25 tons of protein because of its high rate of biomass production and growth

S27. (b) Explants are capable of giving rise to whole new plants.

S28. (c) Totipotency is the basis of tissue culture it is a capacity to generate a whole new plant from any of the cell or an explant under sterilized lab conditions.

S29. (d) Growth regulator like auxin causes and cytokinin are very important for the growth of plant under sterile conditions

S30. (b) Micro-propagation is a method of reducing large number of plants in very short duration of time

S31. (a) Many important food plants like tomato, banana have been produced on commercial scale using the method of micro-propagation (soma clones).

S32. (c) The meristem of an infected plant can be removed and grown *in-vitro* to obtain disease free plants

S33. (b) the process of fusion of isolated protoplast to get a hybrid protoplast is called somatic hybridization

S34. (c) Many rice varieties were derived from IR-8 and were developed at International Rice Research Institute, Philippines. Later many semi dwarf varieties I joined also developed in India.

S35. (d) Though more than 70% of the world's livestock population is in India and China it is surprising to note that the contribution to the world's farm produced is only 25% from both these countries

S36. (d) Bird flu is also called as Avian influenza and is caused due to H5N1

S37. (b) Aquaculture is the rearing of aquatic plants, fishes, oysters and all aquatic animals, while rearing of bees is known as Apiculture.

S38. (b) Jaya and Ratna semi dwarf varieties of rice that were developed in India

S39. (c) Wheat is grain while jowar, bajra and maize are millets

S40. (b) The variety *Pusa Gauraw* of mustard is affected by aphids.

S41. (b) Hybrid variety of Saccharum was obtained by crossing *Saccharum officinarum* and *Saccharum barberi.* The obtained variety had high yield, had thick stems at high sugar content and had the ability to grow in sugarcane areas of North India as well.

S42. (d) Fishries includes rearing, catching and selling of fish, selfish, crustaceans like prawns and crabs.

S43. (c) In breeding superior males and superior females of the same bread are identified and mated in pairs and the progeny obtained from such mating are evaluated and superior males and females among them are identified for further mating.

S44. (b) Plant breeding is helpful in developing disease resistant varieties of crops

S45. (c) The increase in wheat production was due to development of semi dwarf varieties of wheat in that period.

S46. (a) some mutations are induced while some occur naturally, they may be useful as well as harmful

S47. (c) blue green algae can be easily grown on animal manure, straw and molasses to produce large quantity and can serve as food rich in protein, minerals, fats, carbohydrates and vitamins

S48. (c) Auxin is present in the apical part of the plant and help in growth of plant

S49. (b) honey is used in preparation of facial washes, moisturizers etc.

S50. (d) Keeping beehives in crop fields is beneficial to both bees as well as crops

ASSERTION AND REASON

S1. (a)

S2. (c) Inbreeding refers to the mating of more closely related individuals within the same breed for 4- 6 generations.

S3. (a)

S4. (d) MOET stands for Multiple Ovulation Embryo Transfer Technology.

TRUE AND FALSE

S1. (False) totipotency is the capacity to generate whole plant from any cell/explant.

S2. (True)

S3. (False) The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called germplasm collection.

S4. (True)

PRACTICE SOLUTIONS

S1. (b) A hybrid is created when plant breeders intentionally cross-pollinate (or use some other plant breeding techniques) two different varieties of a plant, aiming to produce an offspring or hybrid, that contains the best traits of each of the parents.

S2. (a) Emasculation involves the removal of stamens from bisexual flowers of the female parents in order to avoid self-pollination in these flowers.

S3. (c) *Saccharum barberi* is grown in North India but it has poor sugar content and yield.

S4. (d)

S5. (b) Micropropagation is the large scale production of plants in controlled environmental conditions by tissue culture.

S6. (b) The plants that are produced through micropropagation are genetically identical to the original plant from which they are grown and are called somaclones.

S7. (b) They were developed in India

S8. (d)

S9. (a) Protoplasts are cells with the plasma membrane, cytoplasm and nucleus, which have had their cell wall removed by the action of enzymes.

S10. (b) Improve resistance to diseases is not an objective of biofortification in crops.

S11. (a) Germplasm is the living genetic resources that fulfill the purpose of animal and plant breeding, preservation and other research use. Germplasm contains all the diverse alleles for all genes in a given organism.

S12. (b) somaclones are obtained by tissue culture method.

S13. (b) Jaya and Ratna are the varities of rice.

S14. (b) India is mainly an agricultural country. Agriculture accounts for approximately 33 per cent of India's GDP and employs nearly 62 per cent of the population

S15. (a) Increase crop yield and improved quality will incorporated in the crop on priority basis.

S16. (b) a protoplast of tomato is fused with that of potato, and then they are grown – to form new hybrid plants combining tomato and potato characteristics called pomato by the technique of somatic hybridisation.

S17. (a) Nobel laureate Norman E. Borlaug, at International Centre for Wheat and Maize Improvement in Mexico, developed semi-dwarf wheat.

S18. (a) pomato is a somatic hybrid.

S19. (c) Animal husbandry is a branch of agriculture concerned with the care and management of livestock

S20. (d)

S21. (c) Bee-keeping or apiculture is the maintenance of hives of honeybees for the production of honey.

S22. (d) Aquaculture is the **breeding, rearing**, and **harvesting** of fish, shellfish, algae, and other organisms in all types of water environments.

S23. (c) Fishery is an industry devoted to catching, processing or selling of fish, aquatic plants and aquatic animals.

S24. (d) All of the above methods are employed for obtaining high milk yielding varities of cow.

S25. (b)

S26. (d) This technology has been demonstrated for cattle, sheep, rabbits, buffaloes, mares, etc.

S27. (b)

S28. (b) *Hisardale* is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Marino rams is an example of crossbreeding.

S29. (c) Breeding of animals is an important aspect of animal husbandry. Animal breeding aims at increasing the yield of animals and improving the desirable qualities of the produce.

S30. (c)

ASSERTION AND REASON

S1. (b)

S2. (a)

S3. (a)

S4. (b)

S5. (c) *Jaya and Ratna* were developed in India.