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**CBSE Class 12 Biology**  
**NCERT Exemplar Solutions**  
**CHAPTER 9**  
**STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION**

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**Multiple Choice Questions (MCQs)**

**1. The chances of contacting bird flu from a properly cooked (above 100°C) chicken and egg are:**

- (a) very high**
- (b) high**
- (c) moderate**
- (d) none**

**Ans. (d) none**

**Explanation:** When chicken is properly cooked, it helps in destroying the virus of bird flu.

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**2. A group of animals which are related by descent and share many similarities are referred to as:**

- (a) breed**
- (b) race**
- (c) variety**
- (d) species**

**Ans. (a) breed**

**Explanation:** Race is a social group and has no biological meaning. Variety is used in case of plant. Species is a proper taxonomic group. Breed can be termed as pseudo-taxonomic group within a species.

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**3. Inbreeding is carried out in animal husbandry because it:**

- (a) increases vigour**
- (b) improves the breed**
- (c) increases heterozygosity**
- (d) increases homozygosity**

**Ans.** (d) increases homozygosity

**Explanation:** Increased homozygosity is helpful in obtaining a pure line of breed.

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**4. Sonalika and Kalyan Sona are varieties of:**

- (a) wheat**
- (b) rice**
- (c) millet**
- (d) tobacco**

**Ans.** (a) wheat

**Explanation:** (a) wheat

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**5. Which one of the following is not a fungal disease?**

- (a) Rust of wheat**
- (b) Smut of Bajra**
- (c) Black rot of crucifers**
- (d) Red rot of sugarcane**

**Ans.** (c) Black rot of crucifers

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**Explanation:** Black rot of crucifers is a bacterial disease.

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**6. In virus-infected plants the meristematic tissues in both apical and axillary buds are free of virus because:**

- (a) the dividing cells are virus resistant**
- (b) meristems have anti-viral compounds**
- (c) the cell division of meristems are faster than the rate of viral multiplication**
- (d) Viruses cannot multiply within meristem cell (s).**

**Ans.** (c) the cell division of meristems are faster than the rate of viral multiplication

**Explanation:** Because of faster rate of multiplication; meristematic cells are not affected by virus.

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**7. Several South Indian states raise 2-3 crops of rice annually. The agronomic feature that makes this possible is because of**

- (a) shorter rice plant**
- (b) better irrigation facilities**
- (c) early yielding rice variety**
- (d) disease resistant rice variety.**

**Ans.** (c) early yielding rice variety

**Explanation:** (c) early yielding rice variety

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**8. Which one of the following combination would a sugarcane farmer look for in the sugarcane crop?**

- (a) Thick stem, long internodes, high sugar content and disease resistant**
  - (b) Thick stem, high sugar content and profuse flowering**
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**(c) Thick stem, short internodes, high sugar content, disease resistant**

**(d) Thick stem, low sugar, content, disease resistant**

**Ans.** (a) Thick stem, long internodes, high sugar content and disease resistant

**Explanation:** (a) Thick stem, long internodes, high sugar content and disease resistant

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**9. Fungicides and antibiotics are chemicals that:**

**(a) enhance yield and disease resistance**

**(b) kill pathogenic fungi and bacteria, respectively**

**(c) kill all pathogenic microbes**

**(d) kill pathogenic bacteria and fungi respectively.**

**Ans.** (b) kill pathogenic fungi and bacteria, respectively

**Explanation:** (b) kill pathogenic fungi and bacteria, respectively

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**10. Use of certain chemicals and radiation to change the base sequences of genes of crop plants is termed:**

**(a) recombinant DNA technology**

**(b) transgenic mechanism**

**(c) mutation breeding**

**(d) gene therapy.**

**Ans.** (c) mutation breeding

**Explanation:** Changing the base sequence of genes results in mutation.

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**11. The scientific process by which crop plants are enriched with certain desirable nutrients is called:**

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- (a) crop protection**
  - (b) breeding**
  - (c) bio-fortification**
  - (d) bio-remediation.**

**Ans.** (c) bio-fortification

**Explanation:** The term 'fortification' means augmentation of something.

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**12. The term 'totipotency' refers to the capacity of a:**

- (a) cell to generate whole plant**
- (b) bud to generate whole plant**
- (c) seed to germinate**
- (d) cell to enlarge in size.**

**Ans.** (a) cell to generate whole plant

**Explanation:** (a) cell to generate whole plant

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**13. Given below are a few statements regarding somatic hybridization. Choose the correct statements.**

- (i) protoplasts of different cells of the same plant are fused**
  - (ii) protoplasts from cells of different species can be fused**
  - (iii) treatment of cells with cellulase and pectinase is mandatory**
  - (iv) the hybrid protoplast contains characters of only one parental protoplast.**
- (a) (i) and (iii)**
  - (b) (i) and (ii)**
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**(c) (i) and (iv)**

**(d) (ii) and (iii)**

**Ans.** (d) (ii) and (iii)

**Explanation:** (d) (ii) and (iii)

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**14. An explant is:**

**(a) dead plant**

**(b) part of the plant**

**(c) part of the plant used in tissue culture**

**(d) part of the plant that expresses a specific gene.**

**Ans.** (c) part of the plant used in tissue culture

**Explanation:** Explant is used for growing a whole new plant

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**15. The biggest constraint of plant breeding is:**

**(a) availability of desirable gene in the crop and its wild relatives**

**(b) infrastructure**

**(c) trained manpower**

**(d) transfer of genes from unrelated sources.**

**Ans.** (a) availability of desirable gene in the crop and its wild relatives

**Explanation:** Enough infrastructure is available for the purpose and there is not dearth of trained manpower because of over thousands of years of experience in farming.

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**16. Lysine and tryptophan are:**

**(a) proteins**

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**(b) non-essential amino acids**

**(c) essential amino acids**

**(d) aromatic amino acids.**

**Ans.** (c) essential amino acids

**Explanation:** (c) essential amino acids

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**17. Micro-propagation is:**

**(a) propagation of microbes in vitro**

**(b) propagation of plants in vitro**

**(c) propagation of cells in vitro**

**(d) growing plants on smaller scale.**

**Ans.** (b) propagation of plants in vitro

**Explanation:** Smaller scale can mean a small flower pot, so option 'd' is incorrect. Microbes and cells are small enough to be easily growth in vitro and hence options a and c are incorrect.

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**18. Protoplast is:**

**(a) another name for protoplasm**

**(b) an animal cell**

**(c) a plant cell without a cell wall**

**(d) a plant cell.**

**Ans.** (c) a plant cell without a cell wall

**Explanation:** (c) a plant cell without a cell wall

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**19. To isolate protoplast, one needs:**

- (a) pectinase**
- (b) cellulase**
- (c) both pectinase and cellulase**
- (d) chitinase.**

**Ans.** (c) both pectinase and cellulase

**Explanation:** These are needed to dissolve the cell wall.

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**20. Which one of the following is a marine fish:**

- (a) Rohu**
- (b) Hilsa**
- (c) Catla**
- (d) Common Carp.**

**Ans.** (b) Hilsa

**Explanation:** Rohu, Catla and Common carp are freshwater fish.

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**21. Which one of the following products of apiculture is used in cosmetics and polishes:**

- (a) honey**
- (b) oil**
- (c) wax**
- (d) Royal jelly**

**Ans.** (c) wax

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**Explanation:** (c) wax

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**22. More than 70 per cent of livestock population is in:**

- (a) Denmark**
- (b) India**
- (c) China**
- (d) India and China.**

**Ans.** (d) India and China.

**Explanation:** (d) India and China.

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**23. The agriculture sector of India employs:**

- (a) 50 per cent of the population**
- (b) 70 per cent of the population**
- (c) 30 per cent of the population**
- (d) 60 per cent of the population.**

**Ans.** (d) 60 per cent of the population.

**Explanation:** (d) 60 per cent of the population.

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**24. 33 percent of India's (Gross Domestic Product) comes from**

- (a) Industry**
  - (b) Agriculture**
  - (c) Export**
  - (d) Small-scale cottage industries.**
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**Ans.** (b) Agriculture

**Explanation:** (b) Agriculture

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**25. A collection of all the alleles of all the genes of a crop plant is called:**

**(a) germplasm collection**

**(b) protoplasm collection**

**(c) herbarium**

**(d) somaclonal collection**

**Ans.** (a) germplasm collection

**Explanation:** (a) germplasm collection

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**Very Short Answer Types Questions**

**1. Millions of chickens were killed in West Bengal, Assam, Odisha and Maharashtra recently. What was the reason?**

**Ans.** This was done because of bird flu scare.

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**2. Can gamma rays used for crop improvement programmes prove to be harmful for health? Discuss.**

**Ans.** This method has been used for producing moong variety which is resistant to yellow mosaic virus and powdery mildew. This is a good evidence that use of Gamma rays for crop improvement is not harmful for health.

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**3. In animal husbandry, if two closely related animals are mated for a few generations, it results in loss of fertility and vigour. Why is this so?**

**Ans.** In breeding for many generations leads to inbreeding depression which causes loss of fertility and vigour.

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**4. In the area of plant breeding, it is important not only to preserve the seeds of the variety being cultivated, but also to preserve all its wild relatives. Explain with a suitable example.**

**Ans.** Preservation of the seeds of the cultivated variety and its wild varieties helps in making a good germplasm collection. Many high yielding and disease-resistant varieties of wheat, rice and maize have been produced by selective breeding of plants. This could be possible because of a better germplasm collection.

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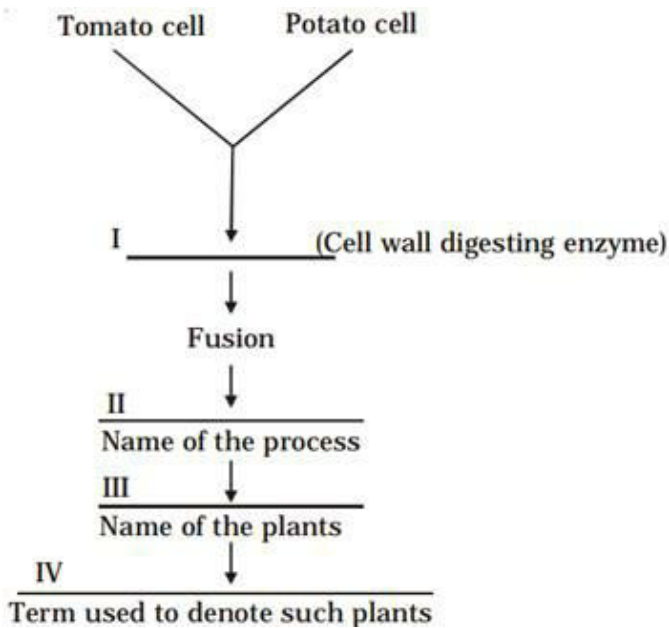
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5. Name a man-made cereal? Trace how it was developed and where is it used?

**Ans.** Triticale is the first man-made cereal. It is a hybrid of wheat and rye. It was first bred in laboratory in the late nineteenth century in Scotland and Sweden. It combines the yield potential and grain quality of wheat and resistance qualities of rye. It is mainly used as fodder.

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6. Fill in the blanks



**Ans.** I: Cellulase, II: Somatic hybridization, III: Tomato and potato, IV: Somatic hybrid

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7. A few statements are given below followed by a set of terms in a box. Pick the correct term and write it against the appropriate statement

(a) Mating of closely related individuals within the same breed

(b) Mating of animals of same breed but having no common ancestors on either side for 4-6 generations

(c) Mating of animals of two different species

(d) Breeding of animals belonging to different breeds

(i) Cross breeding

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(ii) Inter-specific hybridization

(iii) Out breeding

(iv) Out crossing

(v) Inbreeding

**Ans.** (a) → (v)

(b) → (iv)

(c) → (ii)

(d) → (i)

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**8. What is meant by 'hidden hunger'?**

**Ans.** Many people are able to get food which contains only carbohydrates. These people do not get other nutrients; like protein, vitamins and minerals. This condition is called 'hidden hunger'.

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**9. Why are plants obtained by protoplast culture called somatic hybrids?**

**Ans.** Protoplast culture involves fusion of two protoplasts from different plants. This is then allowed to produce a plant which has desirable characters from both plants. Since somatic cells are used for the purpose hence such plants are called somatic hybrids.

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**10. What is protoplast fusion?**

**Ans.** When protoplast from two plants is fused; this is called protoplast fusion. It is made possible by first dissolving the cellulose by a suitable enzyme.

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**11. Why is it easier to culture meristems compared to permanent tissues?**

**Ans.** Cells of meristem have the capability of cell division while cells of permanent tissues do not have this capacity. Hence, it is easier to culture meristems compared to permanent

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tissues.

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**12. Why are proteins synthesised from Spirulina called single cell proteins?**

**Ans.** Spirulina is an unicellular organism. Hence, protein synthesized by it is called single cell protein.

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**13. A person who is allergic to pulses was advised to take a capsule of Spirulina daily. Give the reasons for the advice.**

**Ans.** Spirulina is a good source of protein which contains all essential amino acids. Protein content of Spirulina is much higher than pulses. Hence, it can be a better source of protein; especially for those who are allergic to pulses.

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**14. What is aquaculture? Give example of an animal that can be multiplied by aquaculture.**

**Ans.** Rearing of aquatic animals and plants is called aquaculture. Pisciculture is a part of aquaculture. Prawn can be multiplied by aquaculture.

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**15. What are the duties of a veterinary doctor in management of a poultry farm?**

**Ans.** A veterinary doctor has following duties in management of a poultry farm:

- (a) Regular inspection to ensure disease free environment.
  - (b) Ensure proper diet for the poultry.
  - (c) Ensure clean and hygienic enclosures.
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**16. Would it be wrong to call plants obtained through micro-propagation as 'clones'? Comment.**

**Ans.** It depends on the source of gene pool. If a plant is produced from a single plant through micro-propagation, then it will be a clone. If a plant is produced after combining genes from more than one plant, then it cannot be a clone.

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**17. How is a somatic hybrid different from a hybrid?**

**Ans.** A somatic hybrid is made from somatic cells, while a conventional hybrid is the result of fusion of gametes. Sexual reproduction is necessary to produce a conventional hybrid but is not necessary to produce somatic hybrid.

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**18. What is emasculation? Why and when is it done?**

**Ans.** Removal of anthers in a flower is called emasculation. This is done by cutting off the anthers by scissors or any other suitable tool.

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**19. Discuss the two main limitations of plant hybridization programme.**

**Ans.** Two main limitations of plant hybridization programme are as follows:

(a) **Collection of germplasm:** Cultivators and agricultural scientists need to have seeds of current cultivated varieties as well as from wild varieties. This can be a tedious process.

(b) **Selection and Testing:** A hybrid variety needs to be tested for all possible environmental factors; like climate, soil type, flood, draught, etc. before being released for real life production. This is also a time-consuming process.

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**20. Interspecific crosses are rare in nature and intergeneric crosses almost unknown. Why?**

**Ans.** Interbreeding is a major criterion for members of any species. If two individuals cannot breed, they cannot be termed to belong to the same species. Hence, interspecific crosses are rare in nature. Some logic applies for intergeneric crosses. The main reason lies in the difference in number of chromosomes in the cells of different organisms. Due to this, a viable zygote cannot be formed by two gametes having different numbers of chromosomes. But artificial hybridization is being frequently used to produce interspecific and intergeneric crosses; especially for producing better varieties of plants.

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**21. Differentiate between pisciculture and aquaculture.**

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**Ans.**

<b>Pisciculture</b>	<b>Aquaculture</b>
(i) Involves rearing and catching fish and other aquatic animals for food.	(i) Involves farming of all useful aquatic plants and animals.
(ii) Plants do not come under this.	(ii) Plants too come under this.

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**22. Give two important contributions of Dr. M. S. Swaminathan.**

**Ans.** Two important contributions of Dr. M. S. Swaminathan are as follows:

- (a) Was instrumental in initiating Green Revolution in India
- (b) Began the programme called “Lab to Land” to ensure food security in India.

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**23. The term ‘desirable trait’ can mean different things for different plants. Justify the statement with suitable examples.**

**Ans.** This can be illustrated with the help of following examples:

- (a) Thick and tall stem can be a desirable trait in sugarcane but dwarf stem is desirable in rice plant.
  - (b) More leaves are desirable in spinach but it may not be the case in mustard plant.
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**Short Answer Type Questions**

**1. You are planning to set up a Dairy Farm. Describe the various aspects you would consider before you start the venture.**

**Ans.** Following aspects need to be considered before starting the venture:

**(i) Selection of Good Breed:** The breed should be able to give high yield of milk. It should be resistance to various diseases.

**(ii) Construction of cattle shed:** Cattle shed should be properly ventilated and should get plenty of natural light. The slope of the floor should allow for quick drainage of water.

**(iii) Availability of fodder:** Fodder should contain bulk as well as necessary nutrients.

**(iv) Availability of veterinary doctor:** A veterinary doctor should be available nearby so that proper medical care for cattle can be ensured in time of need.

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**2. It is said, that diseases are spreading faster due to globalisation and increased movement of people. Justify the statement taking the example of H5N1 virus.**

**Ans.** H5N1 virus is a subtype of influenza virus. The influenza caused by this virus is called avian influenza or bird flu. This disease first erupted in South East Asia and then spread to other parts of the world. Spread of this disease to many other countries was mainly possible because of international trade of chickens. This shows that globalization and increased movement of people have facilitated in faster spread of diseases.

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**3. Explain the concept of the Blue Revolution.**

**Ans.** Blue Revolution is similar to Green Revolution but is related to aquaculture. Aquaculture has been practiced in many parts of the world since ages but traditional

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methods have failed to improve productivity to keep pace of growing demand. Use of scientific methods to improve variety of fish products, better management of aquaculture products, improved catch, etc. come under Blue revolution. Blue revolution has helped in improving fish production in many parts of India. It has also helped in improving the income of thousands of fishermen in our country.

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**4. A farmer was facing the problem of low yield from his farm. He was advised to keep a beehive in the vicinity. Why? How would the beehive help in enhancing yield?**

**Ans.** It appears that low yield from the farm was because of absence of sufficient pollinators. We know pollination is important for seed production in many crops. Insects are important agents of pollination and bees pollinate many plant species. Keeping a beehive near the farm will help in proper pollination of the crop during flowering stage. This will eventually help in improving the farm yield. Moreover, it will also augment the farmer's income by selling honey and beeswax.

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**5. Life style diseases are increasing alarmingly in India. We are also dealing with large scale malnutrition in the population. Is there any method by which we can address both of these problems together?**

**Ans.** Lack of balanced diet is at the root of lifestyle diseases and malnutrition. A person who takes carbohydrate and fat rich diet and ignores protein, vitamins and minerals is more likely to suffer from lifestyle diseases. Malnutrition happens because of lack of most of the nutrients in the diet. Ensuring availability of all kinds of food (in terms of available nutrients) is one way of tackling these problems. Another method could be by using biofortification to improve availability of all the nutrients in food.

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**6. How can we improve the success rate of fertilisation during artificial insemination in animal husbandry programmes?**

**Ans.** To improve the success rate of fertilization during artificial insemination in animal husbandry, a good method to follow is MOET. MOET stands for Multiple Ovulation Embryo Transfer Technology. Under this programme, a cow is administered a hormone which has similar activity like FSH (Follicle Stimulating Hormone). This causes super ovulation in the

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cow and the cow produces six to eight eggs in an ovulation cycle instead of the normal count of one egg per ovulation cycle. After that, that animal is artificially inseminated. Zygotes are allowed to develop up to 8 to 32 cell stage. Then the embryo is transplanted to surrogate mother so that a healthy calf would be produced. This method ensures a higher success rate in artificial insemination.

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**7. What is meant by germplasm collection? What are its benefits?**

**Ans.** Preservation of the seeds of the cultivated variety and its wild varieties helps in making a good germplasm collection. Following are the benefits of germplasm collection.

- (a) This helps in preparing a large pool of desirable characters in a plant species.
  - (b) This helps in proper selection of suitable traits during a hybridization programme.
  - (c) This helps in combining the best of cultivated and wild varieties of plants.
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**8. Name the improved characteristics of wheat that helped India to achieve green revolution.**

**Ans.** Following were the improved characteristics of wheat that helped India to achieve green revolution:

- (a) **Semi-dwarf Plants:** Dwarf plants means that most of the resources are utilized in producing more number of grains in the plant.
  - (b) **High Yield:** The new varieties could give higher yield; in terms of per acre production of wheat.
  - (c) **Disease Resistance:** The new plants were resistant to many diseases which used to afflict the traditional wheat varieties.
  - (d) **Quick Yield:** The new varieties took short time duration for maturation of crops.
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**9. Suggest some of the features of plants that will prevent insect and pest infestation.**

**Ans.** Some of the features of plants that prevent insects and pest infestation are as follows:

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(a) Hairy leaves are supposed to resist pest attack, e.g. jassids do not attack cotton and leaf beetle does not attack wheat.

(b) Solid stem of wheat makes it resistant to stem sawfly.

(c) Nectar-less cotton varieties do not attract bollworms.

(d) High aspartic acid, low nitrogen and sugar content in maize leads to resistance to maize stem borers.

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**10. It is easier to culture plant cells in vitro as compared to animal cells. Why?**

**Ans.** It is easier to culture plant cells in vitro as compared to animal cells. Following are the reasons for this:

(a) Meristem is present in plant and cells of meristem always undergo cell division. In animals; most of the cells stop dividing after a certain age. The main purpose of cell division in an adult animal is repair.

(b) Plant tissues dedifferentiate in case of need but animal tissues do not show such property.

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**11. The culture medium (nutrient medium) can be referred to as a 'highly enriched laboratory soil. Justify the statement.**

**Ans.** Soil is the reservoir of water and plant nutrients. Similarly, culture medium is the reservoir of water and plant nutrients for plants being grown on culture medium. Soil may have a higher or lower nutrient content and many nutrients may be missing. But in culture medium, all the essential nutrients are supplied as per need. Hence, culture medium is richer in terms of nutrients for plants. Due to these reasons, culture medium can be called as a highly-enriched laboratory soil.

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**12. Is there any relationship between dedifferentiation and the higher degree of success achieved in plant tissue culture experiments?**

**Ans.** We know that cells of meristematic tissue undergo differentiation and lose their capability to divide in order to form a permanent tissue. But plants have this special ability

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to convert permanent tissue into meristematic tissue if the need arises. This phenomenon is called dedifferentiation. Because of their ability to undergo dedifferentiation many plant tissue can once again undergo cell division to produce new parts. So, higher degree of success is achieved in plant tissue experiments because of this ability of plant tissues.

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**13. “Give me a living cell of any plant and I will give you a thousand plants of the same type” Is this only a slogan or is it scientifically possible? Write your comments and justify them.**

**Ans.** We know that tissue culture has made it possible to produce a new plant from any part of a plant. A small part of a plant which is utilized for growing a plant through tissue culture is called explants. So, theoretically; a single cell from a plant can be utilized to produce a thousand plants of the same species.

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**14. What is the difference between a breed and a species? Give an example for each category.**

**Ans.** A breed is a specific group of domestic animals which are homogenous in appearance.

<b>Breed</b>	<b>Species</b>
(i) Animals of breed look similar.	(i) Animals of a species may not look similar.
(ii) A species can include more than one breed.	(ii) A species is a higher level compared to breed.
(iii) <b>Example:</b> Jersey and Sahiwal are breeds of cow.	<b>Example:</b> Bos indicus is species of cow.

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**15. Plants raised through tissue cultures are clones of the ‘parent’ plant. Discuss the utility of these plants.**

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**Ans.** Plants raised through tissue culture have following benefits:

- (a) A large number of clones can be produced in shorter time span.
- (b) Desirable characters can be easily selected through tissue culture.
- (c) Somatic hybrids can be prepared using this method.
- (d) High yield varieties can be produced from through tissue culture.
- (e) A healthy plant can be recovered from a diseased plant.

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**16. Discuss the importance of testing of new plant varieties in a geographically vast country like India.**

**Ans.** India is a vast country. It has different soil types and climatic conditions in different parts. A crop variety to be successful all over India should be able to show good results in each and every part of the country. Due to this, testing of new plant varieties is done in simulated conditions which mimic the diverse climatic conditions and soil types in the country. If a crop variety passes this test, then only it is considered suitable for introduction in the market.

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**17. Define the term 'stress' for plants. Discuss briefly the two types of stress encountered by plants.**

**Ans.** A plant has to constantly interact with various biotic and abiotic factors. These factors may put stress on a plant. Two types of stress which a plant often encounters are as follows:

(a) **Environmental Stress:** Environmental stress is produced by unfavourable conditions; like salinity, drought, extreme temperatures, etc. Many crop plants are unable to survive the extreme saline conditions or drought or extreme temperatures.

(b) **Biotic Stress:** Biotic stresses come in the form of insects and pests. Weeds also represent biotic stress for plants. While pests and insects do direct harm to the plants, weeds do so by competing for available resources; like sunlight, nutrients and water.

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**18. Discuss natural selection and artificial selection. What are the implications of the**

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**latter on the process of evolution?**

**Ans. Natural Selection:** As the name implies, nature selects organisms with suitable traits. Organisms which are better equipped to survive in the changed environmental conditions are able to produce more progenies and continue their lineage.

**Artificial Selection:** Artificial selection is brought about by humans. Human beings have been doing selective breeding of various plants and animals to obtain benefits from them. Artificial selection too has important role to play in the process of evolution. Many plant varieties or animal breeds have come into origin because of artificial selection. Let us take example of wild cabbage which has been subjected to artificial selection since a long time. Cauliflower, broccoli, cabbage, etc. are results of selective breeding in wild cabbage.

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**19. Discuss briefly how pure lines are created in animal husbandry.**

**Ans.** Pure lines are created using in-breeding. When breeding is done with closely related individuals it is called in-breeding. A superior male and a superior female are selected for this purpose and they are mated. From the next generation, superior male and female are selected to continue the process. This is continued for 4 to 5 generations to achieve pure line. In-breeding increases homozygosity and thus enables to obtain pure lines. However, inbreeding depression is a major problem with this method.

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**20. What are the physical barriers of a cell in the protoplast fusion experiment? How are the barriers overcome?**

**Ans.** Cell wall is the physical barrier which can prevent protoplast fusion. Cell wall; which is made up of cellulose is dissolve with help of enzyme cellulase. Fusion of protoplast is then carried out by electrical and chemical processes.

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**21. Give few examples of biofortified crops. What benefits do they offer to the society?**

**Ans. Examples of biofortified crops:** Golden rice (fortified with vitamin A, iron and zinc, sweet potato (fortified with beta carotene), vitamin A enriched carrot, iron enriched bitter gourd, etc.

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**Benefits of Biofortified Crops:** Biofortified crops promise many benefits for the society. These are especially useful for people who may be suffering from 'hidden hunger'. Many poor people get just enough food to beat the hunger. But they don't get most of the nutrients in their food. As a result, these people often suffer from malnourishment and related diseases. Cases of anemia, night-blindness, rickets, etc. are quite common among the poor people. These problems can be overcome by providing biofortified food to these people.

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**Long Answer Type Questions**

**1. You are a Botanist working in the area of plant breeding. Describe the various steps that you will undertake to release a new variety.**

**Ans.** Following steps need to be taken to release a new variety of crop:

(a) **Collection of Variability:** Genetic variability is the most important for any breeding programme. For this, seeds of present cultivated varieties are collected along with seeds of wild varieties of plants. Currently cultivated varieties would give various desirable characters; from the perspective of better yield. Wild varieties will give desirable characters; from the perspective of resistance to various stresses.

(b) **Selection and Evaluation of Parents:** Germplasm is evaluated to make a list desirable characters. Varieties which fulfill most of the criteria are then selected to produce pure lines.

(c) **Cross Hybridization Among Selected Parents:** After the above step, cross hybridization of selected parents is carried out. The success rate of cross-hybridisation is quite low because very few individuals in the next generation may show all the desirable characters. Hence, this is a time-consuming process as well. Only one in a few hundreds or thousands of crosses show the desirable combination.

(d) **Selection and Testing of Superior Recombinants:** Crosses with desirable combination are selected and are self-pollinated for several generations to produce pure lines.

(e) **Testing and Release:** Agriculture involves various applications and is done in different kinds of climates and in different soil types. This is especially true for a vast country like India. Once pure line of plant with desirable characters is obtained, it is grown in various simulated conditions to assess the viability in real life. Once a variety passes this test, it is ready for release in the market.

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**2. (a) The shift from grain to meat diets creates more demands for cereals. Why?**

**(b) A 250-kg cow produces 200 g of protein per day but 250 g of Methylophilus**

**Methylotrophus can produce 25 tonnes of protein Name this emerging area of research. Explain its benefits.**

**Ans.** (a) We know that the 90% of the biomass consumed by an organism at a particular trophic level is utilized for its own need and just 10% is available for the organism at the next trophic level. So, to produce 1 kg of meat once needs to spend 3 to 10 kg of grains on the cattle. This shows that a shift from grain to meat diets creates more demand for cereals.

(b) This emerging area of research is called single cell proteins (SCP). Single cell protein is formed during decomposition of organic materials by bacteria, fungi and algae. Single cell protein provides very high protein content. Following are the benefits of this process:

- A higher protein yield per unit of biomass.
- Better utilization of solar energy per unit area.
- This is an environment-friendly process.
- Land requirement is low.
- Production is independent of seasonal or climatic variations.
- This may help in tackling the problem of food security.

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**3. What are the advantages of tissue culture methods over conventional method of plant breeding in crop improvement programmes?**

**Ans.** Tissue culture has following advantages over conventional method of plant breeding in crop improvement programmes:

- New plant can be produced by using any part of the parent plant.
  - A small tissue can be used to produce hundreds of plants.
  - Producing a new generation takes a short time span and hence this process is faster than conventional method.
  - Offspring are clones of parent plants so producing pure line is less time consuming. One need not wait for 4 to 5 generations to achieve this.
  - Land requirement is nil for this method. So, this method is less resource intensive
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than conventional method.

- Healthy plants can be recovered from diseased plants by utilizing this method. Thus, making disease resistance plants is quite easy with this method.
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**4. 'Modern methods of breeding animals and plants can alleviate the global food shortage'. Comment on the statement and give suitable examples.**

**Ans.** This is a correct statement that modern methods of breeding animals and plants can alleviate the global food shortage. If we compare the status of food security during World War days with the current situation; it can be said that food security situation is much better in modern times than it was earlier. This could have been possible because of better varieties of plants and cattle. Food processing and food preservation technologies have also been responsible for this but their role was at best at augmentation level. Following are some examples which illustrate this;

Before 1950s, India had to depend on wheat imports from the USA to meet its need. After Green Revolution, many better varieties of wheat have been introduced which helped in increasing the farm output. From 1960 to 2000, wheat production increased from 11 million tonnes to 75 million tonnes. In the same period, rice production increased from 35 million tonnes to 89 million tonnes. At present, India is not only a food sufficient nation but also exports a major chunk of its food grain production.

Introduction of hybrid breeds of cows made India a leading nation in terms of milk production.

Better practices in poultry farming has enabled majority of Indians to get access to chicken and eggs as part of regular diet.

Major developments have taken place in the field of pisciculture as well. This has helped in improving the income of fishermen and has also improved availability of fish throughout the country.

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**5. Does apiculture offer multiple advantages to farmers? List its advantages if it is located near a place of commercial flower cultivation.**

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**Ans.** Apiculture indeed offers multiple advantages to farmers. Following are the advantages of having an apiary near a place of commercial flower cultivation:

- (a) Bees will get plenty of flowers as source of nectar. This will help them in preparing larger quantity of honey. Beeswax production will also increase significantly.
- (b) Bees are important pollinators. They will help in improving flower production. This will help the horticulturist to increase his income by selling flowers.
- (c) This will also help in improving availability of flowers for perfume industry.
- (d) Essential oil from many flowers is used in many medicinal products. So, a better flower cultivation will support this activity as well.

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**6. Answer the following:**

**(a) Mutations are beneficial for plant breeding. Taking an example, justify the statement.**

**(b) Discuss briefly the technology that made us self-sufficient in food production.**

**Ans.** (a) Changes which can be induced by changing the base sequence in gene are called mutation. Mutation can be induced in plants by using suitable technology; like Gamma radiation. Many disease resistance varieties of plants can be obtained through mutational breeding. For example; resistance to yellow mosaic virus and powdery mildew could be obtained in mung beans through mutational breeding.

(b) Plant breeding has made us self-sufficient in food production. Many techniques are employed for plant breeding; to produce high yielding and disease resistant varieties of various crops. In India, better varieties of rice, wheat, maize, etc. could be produced because of various methods of plant breeding.

Many technologies which were existent but not being used on large scale could be used by more farmers because of Green revolution. Irrigation, pesticides and synthetic fertilizers were among such technologies.

**Irrigation Projects:** Green Revolution could not be successful without proper

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implementation of large irrigation projects. Many multipurpose dams were built to feed irrigation canals. Punjab is a good example of state which benefited from a good network of canals.

**Pesticides:** Pesticides were used more vigorously during Green Revolution. This helped in improving farm yield significantly.

**Synthetic Fertilisers:** While manure is very good but it does not show as dramatic results as synthetic fertilizers. Government opened many fertilizer factories to meet the demand. Farmers were given subsidy on fertilizers so that farm production could be improved.

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### **7. Discuss how the property of plant cell totipotency has been utilised for plant propagation and improvement**

**Ans.** During 1950s, scientists could learn that a whole plant can be generated from an explant. Any part of a plant grown in a test tube under sterile conditions by using special nutrient medium is called explant. Ability of a cell to produce a whole organism is called totipotency. By using this property, it is possible to produce a large number of plants in a short duration. The nutrient medium for this purpose must contain a source of carbon; like sucrose. It should also contain inorganic salts, vitamins, amino acids and plant hormones.

Plants grown through this method are clones of parent plant. They are often called somaclones. Many desirable characters can be introduced in the progeny by using this method and a combination of genetic engineering. Healthy plants can be grown from a diseased plant by using this method. Virus free plants can be easily produced by using this method. This method has been employed to produce plants of banana, sugarcane, potato, etc.

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### **8. What are three options to increase food production? Discuss each giving the salient features, merits and demerits.**

**Ans.** Food production can be increased by following methods:

(a) **By introducing better crop varieties:** This can be done by selective breeding of plants to include desirable characteristics in a particular plant.

**Merits:** Many new varieties of wheat, rice, maize, etc. had been introduced. This helped in

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significantly improving wheat and rice production after implementation of Green Revolution in India. Per acre yield increased because of high yielding and disease resistant varieties of plants.

**Demerits:** Sometimes, selective breeding can produce some obnoxious weed which can be difficult to get rid of. Some mutations in plants can be highly harmful for the human population.

**(b) by improving irrigation facilities:** Water is very important for plants and crops need lot of water to grow properly. For example; rice plant needs so much water that it is kept submerged for most of the time of the cropping season.

**Merits:** Better irrigation facilities have helped in improving crop production in many states. Farmers of many states (like Punjab and Haryana) became rich because of better irrigation facilities.

**Demerits:** Intensive irrigation leads to overexploitation of water resources. At many places, water table has gone down drastically because of intensive irrigation. This is creating shortage of drinking water at many places. Constructing of dams also adversely affects the environment.

**(c) By using synthetic fertilizers:** Plants take up many minerals from soil. As a result, soil is sapped up of most of the nutrients after a couple of farming cycle. Some method needs to be applied so that soil can replenish lost nutrients. Adding synthetic fertilizers is the fastest way of achieving this.

**Merits:** Synthetic fertilizers help in quickly replenishing soil nutrients.

**Demerits:** Synthetic fertilizers leave many harmful chemicals in the soil. This leads to groundwater pollution. This also leads to accumulation of harmful substances in human body because of bio-accumulation.

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