# UNIT –20
# BREEDING AND BIOTECHNOLOGY

## I. Choose the correct answer

1. Which method of crop improvement can be practiced by a farmer if he is inexperienced?
   a) clonal selection **b) mass selection** c) pureline selection d) hybridisation
2. Pusa Komal is a disease resistant variety of_____. **[SEP – 2021]**
   a) sugarcane b) rice **c) cowpea** d) maize
3. Himgiri developed by hybridisation and selection for disease resistance against rust pathogens is a variety of _____. **[MAY - 2022]**
   a) chilli b) maize c) sugarcane **d) wheat**
4. The miracle rice which saved millions of lives and celebrated its 50th birthday is_____.
   **a) IR 8** b) IR 24 c) atomita 2 d) ponni
5. Which of the following is used to produce products useful to humans by biotechnology techniques?
   a) enzyme from organism b) live organism c) Vitamins **d) both (a) and (b)**
6. We can cut the DNA with the help of **[SEP – 2020, PTA – 2]**
   a) scissors **b) restriction endonucleases** c) knife d) RNAase
7. rDNA is a a) vector DNA b) circular DNA
   **c) recombinant of vector DNA and desired DNA** d) satellite DNA
8. DNA fingerprinting is based on the principle of identifying _____sequences of DNA. **[PTA – 5]**
   a) single stranded b) mutated c) polymorphic **d) repetitive**
9. Organisms with modified endogenous gene or a foreign gene are also known as
   a) transgenic organisms b) genetically modified c) mutated **d) both a and b**
10. In a hexaploid wheat (2n = 6x = 42) the haploid (n) and the basic (x) number of chromosomes respectively are
    a) n = 7 and x = 21 b) n = 21 and x = 21 c) n = 7 and x = 7 **d) n = 21 and x = 7**

## II. Fill in the blanks

1. Economically important crop plants with superior quality are raised by **plant breeding**.
2. A protein rich wheat variety is **atlas 66**.
3. **Colchicine** is the chemical used for doubling the chromosomes.
4. The scientific process which, produces crop plants enriched with desirable nutrients is called **biofortification**.
5. Rice normally grows well in alluvial soil, but **atomita 2** is a rice variety produced by mutation breeding that grows well in saline soil. **[SEP – 2021]**
6. **Genetic engineering/rDNA** technique made it possible to genetically engineer living organism.
7. Restriction endonucleases cut the DNA molecule at specific positions known as **restriction sites.**
8. Similar DNA fingerprinting is obtained for **identical twins**.
9. **Stem** cells are undifferentiated mass of cells.
10. In gene cloning the DNA of interest is integrated in a **suitable vector (Plasmid)**.

## III. True or False: (if false give the correct statement)

1. Raphano brassica is a man-made tetraploid produced by colchicine treatment. **[True]**
2. The process of producing an organism with more than two sets of chromosome is called mutation. **[False]**

   **Process of producing an organism with more than two sets of chromosome is called **polyploidy breeding.***
3. A group of plants produced from a single plant through vegetative or asexual reproduction are called a pureline. **[False]**

   **Group of plants from single plant through vegetative/asexual reproduction are called **clones.***
4. Iron fortified rice variety determines the protein quality of the cultivated plant. **[False]**

   **Iron fortified rice variety determines the **iron** quality of the cultivated plant.*
5. Golden rice is a hybrid. **[False]**

   **Golden rice is a **genetically modified rice.***
6. Bt gene from bacteria can kill insects. **[True]**
7. *In vitro fertilisation* means the fertilisation done inside the body. **[False]**

   **In vitro fertilisation means the fertilisation done **outside** the body.*
8. DNA fingerprinting technique was developed by Alec Jeffrey. **[True]**
9. Molecular scissors refers to DNA ligases. **[False]**

   **Molecular scissors refers to **restriction enzymes.***

## IV. Match the following

| Column A | Column B | Answer |
|---|---|---|
| 1. Sonalika | Phaseolus mungo | **1. Semi - dwarf wheat** |
| 2. IR 8 | Sugarcane | **2. Semi - dwarf Rice** |
| 3. Saccharum | Semi - dwarf wheat | **3. Sugarcane** |
| 4. Mung No. 1 | Ground nut | **4. Phaseolus mungo** |
| 5. TMV - 2 | Semi - dwarf Rice | **5. Ground nut** |
| 6. Insulin | Bacillus thuringienesis | **6. First hormone produced using rDNA technique** |
| 7. Bt toxin | Beta carotene | **7. Bacillus thuringienesis** |
| 8. Golden rice | First hormone produced using rDNA technique | **8. Beta carotene** |

## V. Assertion and Reason

a) Assertion is correct and reason is wrong. b) Reason is correct and the assertion is wrong.
c) Both assertion and reason is correct. d) Both assertion and reason is wrong.

1. **Assertion :** Hybrid is superior than either of its parents.
   **Reason :** Hybrid vigour is lost upon inbreeding.

   **Ans. (a)** ***Assertion is correct and reason is wrong.***

2. **Assertion :** Colchicine reduces the chromosome number. **[PTA – 3]**
   **Reason :** It promotes the movement of sister chromatids to the opposite poles.

   Ans. (d) ***Both assertion and reason is wrong.***

3. **Assertion :** rDNA is superior over hybridisation techniques. **[PTA – 4]**
   **Reason :** Desired genes are inserted without introducing the undesirable genes in target organisms.

   Ans. (c) ***Both assertion and reason is correct.***

## VI. Answer in a sentence

1. **Give the name of wheat variety having higher dietary fibre and protein.**
   Triticale.
2. **Semi - dwarf varieties were introduced in rice. This was made possible by the presence of dwarfing gene in rice. Name this dwarfing gene.**
   Dee-geo-woo-gene (DGWG)
3. **Define genetic engineering.**
   Genetic engineering is the manipulation and transfer of genes from one organism to another organism to create a new DNA called recombinant DNA (rDNA).
4. **Name the types of stem cells.** **[PTA – 2]**
   i) Embryonic stem cells ii) Adult / somatic stem cell
5. **What are transgenic organisms?** **[PTA – 6]**
   Plants/animals expressing modified endogenous gene / foreign gene is called transgenic organism.
6. **State the importance of biofertiliser.**
   - ❖ High yield, Cheaper and ecofriendly.
   - ❖ Reduce soil pollution.
   - ❖ Increase soil fertility.

## VII. Short answer questions

1. **Discuss the method of plant breeding for disease resistance.** **[PTA – 6]**
   Developing disease resistant crops, would increase yield and reduce fungicides & bactericides.

| Examples of disease resistant crop varieties | | |
|---|---|---|
| **Crop** | **Variety** | **Resistance to diseases** |
| Wheat | Himgiri | Leaf and stipe rust, hill bund |
| Cauliflower | Pusa Shubhra, Pusa snowball K-1 | Black rot |
| Cowpea | Pusa Komal | Bacterial blight |

   Selection and Hybridization are few methods of plant breeding to get disease resistant plants.

2. **Name three improved characteristics of wheat that helped India to achieve high productivity.** **[PTA – 4]**
   **i)** Sonalika, Kalyan Sona – **High-yielding, semi-dwarf**
   **ii)** Himgiri – **Diseases resistance**
   **iii)** Atlas – 66 – **Improved nutritional quality**

**3. Name two maize hybrids rich in amino acid lysine.** **[MAY - 2022, MDL – 19]**

Protina, Shakti, Rathna are maize hybrids rich in amino acid lysine.

**4. Distinguish between :**

**a) Somatic gene therapy and Germ line gene therapy.** **[SEP – 2021, PTA – 1]**

| Somatic gene therapy | Germ line gene therapy |
|---|---|
| 1. It replaces defective gene in somatic cells. | It replaces defective gene in germ cell. |
| 2. It cannot be carried to next generation. | It can be carried to next generation. |

**b) Undifferentiated cells and Differentiated cells.**

| Undifferentiated cells | Differentiated cells |
|---|---|
| 1. Unspecialised cells. | 1. Specialised cells. |
| 2. Have variable potency. | 2. Perform specific function. |
| 3. ***Ex :*** Stem cells. | 3. ***Ex :*** Nerve cell, etc. |

**5. State the applications of DNA fingerprinting technique.** **[SEP – 2020, PTA – 3]**

- ❖ It is used in forensic.
- ❖ It is used for paternity testing.
- ❖ It helps in the study of genetic diversity, evolution and speciation.

**6. How are stem cells useful in regenerative process?**

When tissues and organs are permanently damaged or lost due to genetic condition or disease or injury, stem cells are used to treat it.

**7. Differentiate between outbreeding and inbreeding.**

| Outbreeding | Inbreeding |
|---|---|
| 1. Breeding of unrelated animals. | Breeding of closely related animals within same breed. |
| 2. Hybrids are stronger and vigorous. | Accumulates superior genes. Eliminates undesired genes. |
| 4. ***Ex :*** Mule | ***Ex :*** Sheep Hissardale |

## VIII. Long answer questions

**1. What are the effects of hybrid vigour in animals?** **[PTA – 1, 5]**

***Hybrid vigour or heterosis:*** Superiority of hybrid obtained by cross breeding.

***Effects of hybrid vigour in animals:***

- ❖ Increased production of milk by cattle.
- ❖ Increased production of egg by poultry.
- ❖ High quality of meat is produced.
- ❖ Increased growth rate in domesticated animal.

**2. Describe mutation breeding with an example.**

- **Mutation** is a sudden heritable change in nucleotide sequence of DNA.
- Utilization of mutation in crop improvement is called **mutation breeding**.
- Organism which undergo mutation is called **mutant**.
- Factors that induces mutation are called **mutagens**. It is of two types,
  - ***i) Physical mutagens :*** Radiations like X-rays, α, β and γ, UV rays, etc.
  - ***ii) Chemical mutagens :*** Chemical substances like nitrous acid.

**Example:** Sharbati Sonora wheat is produced from Sonora-64 by using gamma rays.

**3. Biofortification may help in removing hidden hunger. How?**

***Biofortification :*** Process of developing plants enriched with high levels of desirable nutrients.

***Hidden Hunger:*** It denotes the lack of micronutrients such as vitamin A, zinc and iron in diet.

***Removal of Hidden hunger :***

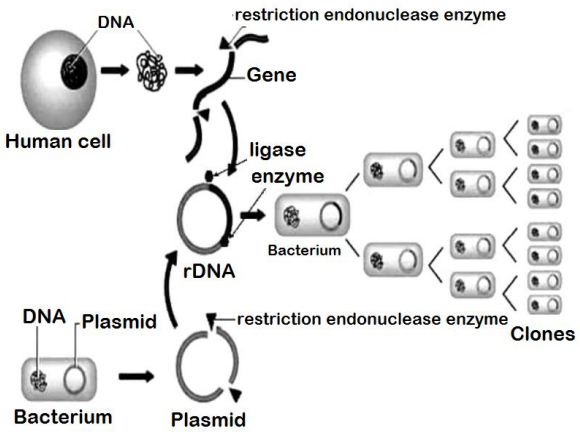
- Bio-fortified foods contribute body to store micronutrients throughout the life cycle.
- Thus, Bio-fortification is effective in removing hidden hunger.

***Ex:***

- Protina, Shakti and Rathna - Rich maize hybrids.
- Atlas 66 - Protein rich wheat.
- Iron rich fortified rice variety.
- Vitamin A enriched carrots, pumpkin and spinach.

**4. With a neat labelled diagram explain the techniques involved in gene cloning.**

***Gene cloning :*** Gene or a piece of DNA fragment is inserted into a bacterial cell where DNA will be copied as the cell divides. Clone is a genetically exact copy of an organism.




***Steps involved in gene cloning :***

- Isolation of desired DNA fragment by restriction enzymes.
- Insertion of the DNA fragment into vector (Plasmid) to make rDNA.
- Transfer of rDNA into bacterial host cell.
- Selection and multiplication of recombinant host cell to get a clone.
- Expression of cloned gene in host cell.

**5. Discuss the importance of biotechnology in the field of medicine.[MAY - 2022,SEP – 2021]**

Biotechnology helps to develop various medicinally valuable proteins or polypeptides that form the potential pharmaceutical products for treating various diseases.

***Medicines developed by rDNA technique :***

a) Insulin - Treat diabetes.
b) Human growth hormone - Treat children with growth defects.
c) Blood clotting factors - Treat haemophilia.
d) Tissue plasminogen activator - Dissolve blood clots and prevent heart attack.
e) Vaccines - For diseases like Hepatitis B and rabies.

## IX. Higher Order Thinking Skills (HOTS)

1. **A breeder wishes to incorporate desirable characters into the crop plants. Prepare a list of characters he will incorporate.**
   - ❖ Higher productivity and better quality
   - ❖ Disease resistance
   - ❖ Insects/pests resistance
   - ❖ Shorter duration
   - ❖ Nutritional Quality
   - ❖ Semi dwarf varieties

2. **Organic farming is better than Green Revolution. Give reasons.**

   ***Reasons for Organic farming is better than Green Revolution :***

   - ❖ Green revolution uses fertilizers and pesticides which are toxic and cause pollution. Whereas organic farming adds nutrients like nitrogen, phosphorus, potassium to soil.
   - ❖ In Organic farming,
     - ✓ Proper soil management is done.
     - ✓ It doesn't cause global warming.
     - ✓ There is no genetically altered gene (seeds). So it is very cheap.
     - ✓ Food chain is protected.

   Thus, organic farming is safer, healthier than green revolution.

3. **Polyploids are characterised by gigantism. Justify your answer.**
   - ❖ In polyploidy, genome becomes larger. So, nucleus and cells are also larger. Hence, they produce larger leaves, stems, flowers and fruits.
   - ❖ Thus, polyploids are characterised by gigantism.

4. **'P' is a gene required for the synthesis of vitamin A. It is integrated with genome of 'Q' to produce genetically modified plant 'R'.**

   **i) What is P, Q and R?**

   **P → Beta carotene  Q → Ordinary rice plant  R → Golden rice**

   **ii) State the importance of 'R' in India.**

   ***Important of Golden rice in India :***

   - ❖ It is used for fighting against cell damage
   - ❖ It is a healthy variety.
   - ❖ It prevents vitamin A deficiency.

   In India vitamin A deficiency in children & adults can be prevented by using golden Rice.