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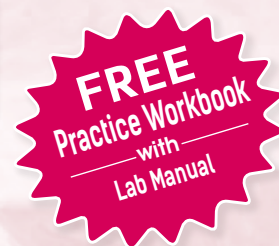


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(SHORT VERSION AND LONG VERSION)

**12<sup>th</sup> Standard**

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## UNIT VI : Reproduction in Plants

### Chapter

### 1

# ASEXUAL AND SEXUAL REPRODUCTION IN PLANTS

### *Chapter Snapshot*

- 1.1 Asexual Reproduction
- 1.2 Vegetative Reproduction
  - 1.2.1 Natural methods
  - 1.2.2 Artificial Methods
- 1.3 Sexual Reproduction
- 1.4 Pre-fertilization Structure and Events
  - 1.4.1 Male Reproductive part - Androecium
  - 1.4.2 Female reproductive part - Gynoecium
  - 1.4.3 Pollination
- 1.5 Fertilization
  - 1.5.1 Double fertilization and triple fusion
- 1.6 Post Fertilization Structure and Events
- 1.7 Apomixis
- 1.8 Polyembryony
- 1.9 Parthenocarpy



## EVALUATION

1. Choose the correct statements from the following.

- (a) Gametes are involved in asexual reproduction.
- (b) Bacteria reproduce asexually by budding.
- (c) Conidia formation is a method of sexual reproduction.
- (d) Yeast reproduce by budding.

[Ans. (d) Yeast reproduce by budding]

2. An eminent Indian embryologist is

- (a) S. R. Kasyap
- (b) P. Maheshwari
- (c) M. S. Swaminathan
- (d) K. C. Mehta

[Ans. (b) P. Maheshwari]

3. Identify the correctly matched pair

- (a) Tuber – *Allium Cepa*
- (b) Sucker – *Pistia*
- (c) Rhizome – *Musa*
- (d) Stolon – *Zingiber*

[Ans. (c) Rhizome - Musa]

4. Pollen tube was discovered by

- (a) J. G. Kolreuter
- (b) G. B. Amici
- (c) E. Strasburger
- (d) E. Hanning

[Ans. (b) G. B. Amici]

5. Size of pollen grains in *Myosotis*

[Govt.MQP-2019]

- (a) 10 micrometer
- (b) 20 micrometer
- (c) 200 micrometer
- (d) 2000 micrometer

[Ans. (a) 10 micrometer]

6. First cell of male gametophyte in angiosperm is

- (a) Microspore
- (b) Megaspore
- (c) Nucleus
- (d) Primary Endosperm Nucleus

[Ans. (a) Microspore]

7. Match the following

- I. External Fertilization – (i) Pollen grain
- II. Androecium – (ii) anther wall
- III. Male gametophyte – (iii) algae
- IV. Primary parietal layer – (iv) Stamens
- (a) I – iv II – i III – ii IV – iii
- (b) I – iii II – iv III – i IV – ii
- (c) I – iii II – iv III – ii IV – i
- (d) I – iii II – i III – iv IV – ii

[Ans. (b) I – iii, II – iv, III – i, IV – ii]

8. Arrange the layers of anther wall from locus to periphery

- (a) Epidermis, middle layers, tapetum, endothecium.
- (b) Tapetum, middle layers, epidermis, endothecium.
- (c) Endothecium, epidermis, middle layers, tapetum.
- (d) Tapetum, middle layers endothecium, epidermis.

[Ans. (d) Tapetum, middle layer, endothecium, epidermis]

9. Identify the incorrect pair.

- (a) Sporopollenin – Exine of pollen grain
- (b) Tapetum – Nutritive tissue for developing microspores.
- (c) Nucellus – Nutritive tissue for developing embryo.
- (d) Obturator – directs the pollen tube into micropyle

[Ans. (c) Nucellus – Nutritive tissue for developing embryo]

10. Assertion : Sporopollenin preserves pollen in fossil deposits.

Reason : Sporopollenin is resistant to physical and biological decomposition.

- (a) assertion is true; reason is false
- (b) assertion is false; reason is true
- (c) Both assertion and reason are not true
- (d) Both assertion and reason are true

[Ans. (d) Both assertion and reason are true]



## Unit Test

[Time : 1 hr]

[Marks: 25]

### I. CHOOSE THE CORRECT ANSWER. $10 \times 1 = 10$

#### 1. Choose the correct statements from the following.

- (a) Gametes are involved in asexual reproduction.
- (b) Bacteria reproduce asexually by budding.
- (c) Conidia formation is a method of sexual reproduction.
- (d) Yeast reproduce by budding.

#### 2. Identify the incorrect pair.

- (a) Sporopollenun – Exine of pollen grain
- (b) Tapetum – Nutritive tissue for developing microspores.
- (c) Nucellus – Nutritive tissue for developing embryo.
- (d) Obturator – Directs the pollen tube into micropyle

#### 3. Choose the correct statement(s)

- (I) An example for root cutting is *Hibiscus*.
- (II) *Scilla* is bulbous plant and grows in rocky soils.
- (III) *Solanum tuberosum* is an example of corm
- (IV) Adventitious roots store food in *Ipomea batatus*.
- (a) I, II correct II, IV wrong
- (b) I, II wrong III, IV correct
- (c) I, II, III correct IV wrong
- (d) IV only

#### 4. Assertion (A) : Ruminant endosperm has irregular surface.

Reason (R) : The best example of this is *Areca Catechu*.

- (a) Both Assertion and Reason are true and Reason is correct explanation of Assertion.
- (b) Both Assertion and Reason are true but reason is not correct explanation of Assertion.
- (c) Assertion is true; Reason is false.
- (d) Both Assertion and Reason are false.

#### 5. Which of the following represents megagametophyte?

- (a) Ovule
- (b) Embryo sac
- (c) Nucellus
- (d) Endosperm

#### 6. Identify the correctly matched pair

- (a) Tuber – *Allium Cepa*
- (b) Sucker – *Pistia*
- (c) Rhizome – *Musa*
- (d) Stolon – *Zingiber*

#### 7. Sexual reproduction of higher plants include \_\_\_\_\_ stages.

- (a) 2
- (b) 4
- (c) 3
- (d) 5

#### 8. Match the following.

A	Tristyly	(i)	<i>Primula</i>
B	Distyly	(ii)	<i>Vallisneria</i>
C	Anemophily	(iii)	<i>Lythrum</i>
D	Hydrophily	(iv)	<i>Eichhornia bamboo</i>

- |     |     |     |     |     |
|-----|-----|-----|-----|-----|
|     | A   | B   | C   | D   |
| (a) | iv  | i   | ii  | iii |
| (b) | ii  | i   | iii | iv  |
| (c) | iii | i   | iv  | ii  |
| (d) | i   | iii | ii  | iv  |

#### 9. An eminent Indian embryologist \_\_\_\_\_.

- (a) S. R. Kasyap
- (b) P. Maheshwari
- (c) M. S. Swaminathan
- (d) K. C. Mehta

#### 10. Find the odd man out and given reason.

- (a) Integuments
- (b) Funiculus
- (c) Hilum
- (d) Exine

## UNIT VII : Genetics

### Chapter

### 2

# CLASSICAL GENETICS

## Chapter Snapshot

- |  |   |
|--|---|
| <p><b>2.1</b> Heredity and Variation</p> <p><b>2.2</b> Mendelism</p> <p><b>2.2.1</b> Father of Genetics – Gregor Johann Mendel (1822 – 1884)</p> <p><b>2.2.2</b> Mendel's Experiments on Pea Plant</p> <p><b>2.2.3</b> Terminology Related to Mendelism</p> <p><b>2.2.4</b> Mendelian Inheritance – Mendel's Laws of Heredity</p> <p><b>2.3</b> Laws of Mendelian Inheritance</p> <p><b>2.3.1</b> Mendel's Analytical and Empirical Approach</p> <p><b>2.3.2</b> Test Cross</p> <p><b>2.3.3</b> Back Cross</p> <p><b>2.3.4</b> Dihybrid Cross</p> <p><b>2.3.5</b> The Dihybrid Test Cross</p> <p><b>2.3.6</b> Trihybrid Cross</p> <p><b>2.3.7</b> Extensions of Mendelian Genetics</p> | <p><b>2.4</b> Monohybrid, Dihybrid, Trihybrid cross, Backcross and Testcross.</p> <p><b>2.4.1.</b> Incomplete Dominance – No Blending of Genes</p> <p><b>2.4.2.</b> Codominance (1 : 2 : 1)</p> <p><b>2.4.3.</b> Lethal genes</p> <p><b>2.4.4.</b> Pleiotropy – A single gene Affects Multiple Traits</p> <p><b>2.5</b> Interaction of Genes -Intragenic and Intergenic Incomplete Dominance, Lethal Genes, Epistasis</p> <p><b>2.6</b> Polygenic inheritance in Wheat Kernel Colour, Pleiotropy – <i>Pisum Sativum</i></p> <p><b>2.7</b> Extra Chromosomal Inheritance- Cytoplasmic Inheritance in Mitochondria and Chloroplast.</p> |
|--|---|

**MUST KNOW DEFINITIONS**

<b>Alleles</b>	: Alternative forms of a gene.
<b>Back Cross</b>	: Crosses between $F_1$ off-springs with either of the two parents (hybrid) are known as back cross.
<b><math>F_1</math> / First Filial Generation</b>	: The second stage of Mendel's experiment is called $F_1$ generation.
<b>Gene</b>	: The determinant of a characteristic of an organism (Mendelian factor).
<b>Genetic Code</b>	: The set of 64 triplets of bases (codons) corresponding to the twenty amino acids in proteins and the signals for initiation and termination of polypeptide synthesis.
<b>Genotype</b>	: The types of alleles in a single individual is called genotype.
<b>Genome</b>	: The total complement of genes contained in a cell.
<b>Heterozygous</b>	: Diploid organisms that have two different alleles at a specific gene locus are said to be heterozygous.
<b>Homozygous</b>	: A diploid organism in which both alleles are the same at a given gene locus is said to be homozygous.
<b>Hybrid Vigour or Heterosis</b>	: The superiority of hybrid over either of its parents in one or more traits.
<b>Locus</b>	: The site or position of a particular gene on a chromosome.
<b>Phenotype</b>	: The physical expression of an individuals gene. The physical observable characteristics of an organism.
<b>Punnett Square / Checkerboard</b>	: A sort of cross-multiplication matrix used in the prediction of the outcome of a genetic cross, in which male and female gametes and their frequencies are arranged along the edges.
<b>Lethal genes</b>	: An allele which has the potential to cause the death of an organism.
<b>Extra nuclear inheritance</b>	: Traits are governed either by the chloroplast or mitochondrial genes.
<b>Pleiotropy</b>	: A single gene affecting multiple traits and thus alters the phenotype of an organism.
<b>Codominance</b>	: A type of intragenic interaction in which simultaneous expression of both alleles occurs in the heterozygote.
<b>Incomplete dominance</b>	: One allele is not completely dominant over another alleles and the phenotype is a blend of expression of both alleles. Also called blending inheritance.
<b>Gene interaction</b>	: A single phenotype is controlled by more than one set of genes, each of which has two or more alleles. This phenomenon is called gene interaction.





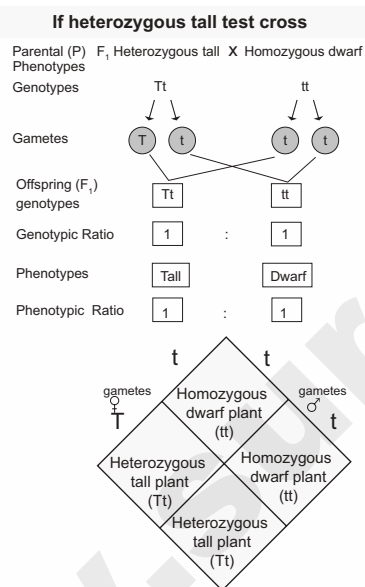
(ii) Peas with purple flowers, brown seeds and dark spot on the axils of the leaves were crossed with a variety of peas having white flowers, light coloured seeds and no spot on the axils of the leaves, the three traits for flower colour, seed colour and a leaf axil spot all were inherited together as a single unit.

(iii) This is due to the pattern of inheritance where the three traits were controlled by a single gene with dominant and recessive alleles. Example: sickle cell anemia.

4. Draw the flow chart for heterozygous tall x homozygous dwarf *Pisum sativum* plants.

[PTA-3]

Ans.



5. Codominance is an example of intragenic gene interaction. How?

[PTA-6]

Ans. (i) Interactions take place between the alleles of the same gene i.e., alleles at the same locus is called intragenic or intralocus gene interaction.

(ii) Red and white flowers of Camellia, inheritance of sickle cell haemoglobin, ABO blood group system in humanbeings.

(iii) In humanbeings,  $I^A$  and  $I^B$  alleles of I gene are codominant which follows Mendel's law of segregation.

(iv) The codominance was demonstrated in plants with the help of electrophoresis or chromatography for protein or flavonoid substance.

## GOVERNMENT EXAM QUESTIONS

### Bio-Botany (Short version)

#### VERY SHORT ANSWERS

2 MARKS

1. What do you know about pleiotropy? [QY-2019]

Ans. (i) The single gene affects multiple traits and alter the phenotype of an organism.

(ii) The pleiotropic gene influences number of characters simultaneously and such genes are called pleiotropic gene. Eg: sickle cell anaemia.

2. Define Atavism.

[HY-2019]

Ans. It is a modification of biological structure where by an ancestral trait reappears after having been lost though evolutionary changes in the previous generation. Eg: Reemergence of sexual reproduction in the flowering plant *Hieracium pilosella*.

#### SHORT ANSWERS

3 MARKS

1. Why Mendel has chosen *Pisum sativum* for his experiment?

[HY-2019]

Ans. He chose pea plant because,

(i) It is an annual plant and has clear contrasting characters that are controlled by a single gene separately.

(ii) Self-fertilization occurred under normal conditions in garden pea plants. Mendel used both self-fertilization and cross-fertilization.

(iii) The flowers are large hence emasculation and pollination are very easy for hybridization.

## UNIT VII : Genetics

### Chapter

### 3

# CHROMOSOMAL BASIS OF INHERITANCE

## Chapter Snapshot

- |   |   |
|---|---|
| <p><b>3.1 Chromosomal Theory of Inheritance</b></p> <p><b>3.1.1</b> Historical Development of Chromosome Theory</p> <p><b>3.1.2</b> Salient Features of the Chromosomal Theory of Inheritance</p> <p><b>3.1.3</b> Support for Chromosomal Theory of Heredity</p> <p><b>3.1.4</b> Comparison between Gene and Chromosome Behaviour</p> <p><b>3.2 Linkage - Eye Colour in <i>Drosophila</i> and Seed colour in Maize</b></p> <p><b>3.2.1</b> Coupling and Repulsion Theory</p> <p><b>3.2.2</b> Kinds of Linkage</p> <p><b>3.2.3</b> Linkage Groups</p> <p><b>3.3 Crossing over, Recombination and Gene mapping</b></p> <p><b>3.3.1</b> Mechanism of Crossing Over</p> <p><b>3.3.2</b> Types of Crossing Over</p> <p><b>3.3.3</b> Importance of Crossing Over</p> <p><b>3.3.4</b> Recombination</p> <p><b>3.3.5</b> Genetic Mapping</p> <p><b>3.4 Multiple Alleles</b></p> <p><b>3.4.1</b> Characteristics of Multiple Alleles</p> <p><b>3.4.2</b> Self-sterility in Nicotiana</p> | <p><b>3.5 Sex determination in Plants</b></p> <p><b>3.5.1</b> Sex determination in Papaya</p> <p><b>3.5.2</b> Sex Determination in <i>Sphaerocarpos</i></p> <p><b>3.5.3</b> Sex Determination in Maize</p> <p><b>3.6 Mutation-types, Mutagenic Agents and Their Significance.</b></p> <p><b>3.6.1</b> Types of Mutation</p> <p><b>3.6.2</b> Mutagenic Agents</p> <p><b>3.6.3</b> Chromosomal Mutations</p> <p><b>3.7 DNA Metabolism in Plants</b></p> <p><b>3.7.1</b> Eukaryotic DNA Replication</p> <p><b>3.7.2</b> Experimental Evidence of DNA replication: Taylors Experiment</p> <p><b>3.8 Protein synthesis in Plants</b></p> <p><b>3.8.1</b> Transcription</p> <p><b>3.8.2</b> RNA Splicing in Plants</p> <p><b>3.8.3</b> Translation</p> <p><b>3.8.4</b> Alternative Splicing in Plants</p> <p><b>3.8.5</b> RNA Editing – Post Transcriptional RNA Processing in Plants</p> <p><b>3.8.6</b> Jumping Genes</p> |
|---|---|

**BOTANY LONG VERSION QUESTIONS (FOR PURE SCIENCE GROUP)****LONG VERSION EVALUATION**

Q.No. 1 to 12 Refer Evaluation.

- 13.** Which one of the following pairs of codons is correctly matched with their function or the signal for the particular amino acid?

(a) UUA, UCA - Leucine  
 (b) GUU, GCU - Alanine  
 (c) UAG, UGA - Stop  
 (d) AUG, ACG - Start / Methionine

**[Ans. (c) UAG, UGA - Stop]**

- 14.** Removal of introns and joining of exons in a defined order during transcription is called

(a) Splicing (b) Looping  
 (c) Inducing (d) Slicing

**[Ans. (a) Splicing]**

- 15.** If one strand of DNA has the nitrogenous base sequence as ATCTS, what would be the complementary RNA strand sequence?

(a) ATCGU (b) TTAGU  
 (c) UAGAC (d) AACTG

**[Ans. (a) UAGAC]**

- 16.** Removal of RNA polymerase III nucleoplasm will affect the synthesis of

(a) rRNA (b) tRNA  
 (c) hnRNA (d) mRNA

**[Ans. (b) tRNA]**

- 17.** DNA dependent RNA polymerase catalyzes transcription on one strand of the DNA which is called the

(a) Alpha strand (b) Anti strand  
 (c) Template strand (d) Coding strand

**[Ans. (c) Template strand]**

- 18.** Which of the following correctly represents the flow of genetic information?

a) DNA → RNA → Protein  
 b) RNA → DNA → Protein  
 c) RNA → Protein → DNA  
 d) Protein → RNA → DNA

**[Ans. (a) DNA → RNA → Protein]**

- 19.** Initiation codon is

(a) UUU (b) UGA  
 (c) AUG (d) UAG

**[Ans. (c) AUG]**

- 20.** A eukaryotic gene contains two kinds of base sequences which of these plays an important role in protein synthesis?

(a) Introns (b) Exons  
 (c) Both a and b (d) None of the above

**[Ans. (b) Exons]**

- 21.** Codon – anticodon interactions occur by

(a) Covalent bond  
 (b) Electrostatic interactions  
 (c) Hydrogen bonds  
 (d) Hydrophobic interaction

**[Ans. (c) Hydrogen bonds]**

- 22.** Which of the following RNA polymerases is responsible for the transcription of protein coding genes in eukaryotes?

(a) RNA Pol I (b) RNA Poly II  
 (c) RNA Pol III (d) RNA Pol IV

**[Ans. (b) RNA Poly II]**

- 23.** How are RNA molecules transported out of the nucleus

(a) Passive diffusion through the membrane  
 (b) Through membrane pores in an energy independent process  
 (c) Through membrane pores in an energy dependent process  
 (d) Through a channel in the membrane that leads to the endoplasmic reticulum

**[Ans. (c) Through membrane pores in an energy dependent process]**

- 24.** During translation the codon in mRNA is actually “read” by

(a) The A site in the ribosomes  
 (b) The P site in the ribosomes  
 (c) The anticodon in at RNA  
 (d) The anticodon is an amino acid

**[Ans. (c) The anticodon in at RNA]**



## ADDITIONAL QUESTIONS AND ANSWERS

### CHOOSE THE CORRECT ANSWERS

1 MARK

#### I. CHOOSE THE CORRECT ANSWER

1. \_\_\_\_\_ was the first to suggest occurrence of distinct pairs of chromosomes.  
(a) Sutton (b) Boveri  
(c) Montgomery (d) Morgan  
[Ans. (c) Montgomery]
2. The number of chromosomes in a diploid cell of *Drosophila* is \_\_\_\_\_.  
(a) 6 (b) 8  
(c) 10 (d) 12 [Ans. (b) 8]
3. The number of chromosomes in a diploid cell of *ophioglossum* is \_\_\_\_\_.  
(a) 8 (b) 34 (c) 1262 (d) 48  
[Ans. (c) 1262]
4. \_\_\_\_\_ discovered that crossing over is completely absent in some species of male *drosophila*.  
(a) Morgan (b) Bridges  
(c) Bateson (d) Reginald  
[Ans. (b) Bridges]
5. Incomplete linkage was reported in \_\_\_\_\_.  
(a) *Drosophila* (b) *Neurospora*  
(c) Maize (d) Paddy  
[Ans. (c) Maize]
6. The term crossing over was coined by  
(a) Flemming (b) Morgan  
(c) Reginald (d) De Vries  
[Ans. (b) Morgan]
7. The number of chromosomes in a diploid cell of papaya is \_\_\_\_\_.  
(a) 26 (b) 36  
(c) 40 (d) 38 [Ans. (b) 36]
8. Chemical mutagenesis was first reported by \_\_\_\_\_.  
(a) H. J. Muller (b) C. Auerbach  
(c) Stadler (d) Morgan  
[Ans. (b) C. Auerbach]
9. Trisomy was first reported by \_\_\_\_\_.  
(a) Morgan (b) Blackeslee  
(c) Stadler (d) De Vries  
[Ans. (b) Blackeslee]
10. *Cynodon Dactylon* (doob grass) is a natural \_\_\_\_\_.  
(a) Allopolyploid (b) Autotetraploid  
(c) Autotriploid (d) Hexaploid  
[Ans. (c) Autotriploid]
11. *Sharbati Sonora* is a mutant wheat variety got by using \_\_\_\_\_.  
(a) Nitrous acid (b) X-ray  
(c) gamma ray (d) MMS  
[Ans. (c) gamma ray]
12. *Castor Aruna* is a mutant variety of castor developed for \_\_\_\_\_.  
(a) Pest resistance (b) high yield  
(c) Disease resistance (d) early maturity  
[Ans. (d) early maturity]
13. AUG codon is for the amino acid \_\_\_\_\_.  
(a) Cysteine (b) Methionine  
(c) Valine (d) Leucine  
[Ans. (b) Methionine]
14. The enzyme \_\_\_\_\_ breaks the covalent bonds in DNA and removes positive supercoiling during replication.  
(a) Ligase  
(b) Topoisomerase  
(c) Polymerase  
(d) Restriction endonuclease  
[Ans. (b) Topoisomerase]
15. \_\_\_\_\_ is required for transcription  
(a) TATA box  
(b) DNA Polymerase  
(c) Okazaki fragments  
(d) All the above  
[Ans. (a) TATA box]
16. Jumping genes was reported in \_\_\_\_\_.  
(a) *Neurospora* (b) *Drosophila*  
(c) Polymerase (d) Maize  
[Ans. (d) Maize]
17. \_\_\_\_\_ has been used in space research.  
(a) Maize (b) *Arabidopsis*  
(c) *Drosophila* (d) Pea  
[Ans. (b) *Arabidopsis*]



## UNIT VIII : Biotechnology

### Chapter

# 4

# PRINCIPLES AND PROCESSES OF BIOTECHNOLOGY

## Chapter Snapshot

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>4.1 Development of Biotechnology</li> <li>4.2 Historical Perspective</li> <li>4.3 Traditional Biotechnology                         <ul style="list-style-type: none"> <li>4.3.1 Fermentation</li> <li>4.3.2 Single Cell Protein (SCP)</li> </ul> </li> <li>4.4 Advancements in Modern Biotechnology                         <ul style="list-style-type: none"> <li>4.4.1 Genetic Engineering</li> <li>4.4.2 Steps involved in Recombinant DNA Technology</li> </ul> </li> <li>4.5 Tools for Genetic Engineering                         <ul style="list-style-type: none"> <li>4.5.1 Restriction Enzymes</li> <li>4.5.2 DNA Ligase</li> <li>4.5.3 Alkaline Phosphatase</li> <li>4.5.4 Vectors</li> <li>4.5.5 Competent Host (For Transformation with Recombinant DNA)</li> </ul> </li> <li>4.6 Methods of Gene transfer                         <ul style="list-style-type: none"> <li>4.6.1 Direct or Vectorless Gene Transfer</li> <li>4.6.2 Indirect or Vector-Mediated Gene Transfer</li> </ul> </li> <li>4.7 Screening for Recombinants                         <ul style="list-style-type: none"> <li>4.7.1 Insertional Inactivation - Blue-White Colony Selection Method</li> <li>4.7.2 Antibiotic Resistant Markers</li> <li>4.7.3. Replica Plating Technique</li> <li>4.7.4 Molecular Techniques - Isolation of Genetic Material and Gel Electrophoresis</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>4.7.5 Nucleic Acid Hybridization - Blotting Techniques</li> <li>4.7.6 Bioassay for Target Gene Effect</li> <li>4.7.7 Genome Sequencing and Plant Genome Projects</li> <li>4.7.8 Evolutionary Pattern Assessed using DNA.</li> <li>4.7.9 Genome editing and CRISPR - Cas9</li> <li>4.7.10 RNA Interference (RNAi)</li> <li>4.8 Transgenic Plants / Genetically Modified Crops                         <ul style="list-style-type: none"> <li>4.8.1 Herbicide Tolerant – Glyphosate</li> <li>4.8.2 Herbicide Tolerant - Basta</li> <li>4.8.3 Insect resistance - Bt Crops</li> <li>4.8.4 Virus Resistance</li> <li>4.8.5 FlavrSavr Tomato</li> <li>4.8.6 Golden Rice - Biofortification</li> <li>4.8.7 Polyhydroxybutyrate (PHB)</li> <li>4.8.8 Polylactic Acid (PLA)</li> <li>4.8.9 Green Fluorescent Protein (GFP)</li> <li>4.8.10 Biopharming</li> <li>4.8.11 Bioremediation</li> <li>4.8.12 Biofuel: Algal Biofuel</li> <li>4.8.13 Bioprospecting</li> </ul> </li> <li>4.9 Applications of Biotechnology.</li> </ul> |
|--|---|





## SHORT ANSWERS

3 MARKS

## 1. What are vectors?

**Ans.** A vector is a small DNA molecule capable of self-replication and is used as a carrier and transporter of DNA fragment which is inserted into it for cloning experiments. Vector is also called cloning vehicle or cloning DNA.

## 2. Write a short note on conventional biotechnology.

**Ans. (i)** This is the kitchen technology developed by our ancestors, it is as old as human civilization.

**(ii)** This technology uses bacteria and other microbes in the daily usage for preparation of dairy products like curd, ghee, cheese and in preparation of foods like idli, dosa, nan, bread and pizza.

**(iii)** It also used for the preparation of alcoholic beverages like beer, wine, etc.

## 3. Define biopiracy. Give its examples.

**Ans.** Biopiracy can be defined as the manipulation of intellectual property rights laws by corporations to gain exclusive control over national genetic resources, without giving adequate recognition or remuneration to the original possessors of those resources.

**Eg:** Recent patents granted by the U.S. Patent and Trademarks Office to American companies on turmeric, 'neem' and, most notably, 'basmati' rice. All three products are indigenous to the Indo-Pak subcontinent.

## 4. Define Biopharming. Give its uses.

**Ans. (i)** Biopharming also known as molecular pharming.

**(ii)** It is the production and use of transgenic plants genetically engineered to produce pharmaceutical substances for use of human beings. This is also called "molecular farming or pharming".

**Uses:** These plants are different from medicinal plants which are naturally available.

Many pharmaceutical substances can be produced using transgenic plants.

**Example:** Golden rice.

## 5. Write a note on bioprospecting.

**Ans. (i)** Bioprospecting is the process of discovery and commercialization of new products obtained from biological resources.

**(ii)** Bioprospecting may involve biopiracy, in which indigenous knowledge of nature, originating with indigenous people, is used by others for profit, without authorization or compensation to the indigenous people themselves.

## 6. How can biotechnology used in plants for virus resistance?

**Ans. (i)** Biotechnological intervention is used to introduce viral resistant genes into the host plant so that they can resist the attack by virus.

**(ii)** This is by introducing genes that produce resistant enzymes which can deactivate viral DNA.

## 7. How will you transfer the genes into the plant cell with the help of electricity?

**Ans.** Electroporation is a method of direct gene transfer. A pulse of high voltage is applied to protoplasts, cell or tissues which makes transient pores in the plasma membrane through which uptake of foreign DNA occurs.

## 8. Write notes on FlavrSavr tomato.

**Ans. (i)** *Agrobacterium* mediated genetic engineering technique was followed to produce **FlavrSavr tomato**, i.e., retaining the natural colour and flavor of tomato.

**(ii)** The tomato was made more resistant to rotting by *Agrobacterium* mediated gene transfer mechanism of introducing an antisense gene which interferes with the production of the enzyme polygalacturonase, which help in delaying the ripening process of tomato during long storage and transportation.

## 9. Give an account of limitations of Bioremediation.

**Ans. (i)** Only biodegradable contaminants can be transformed using bioremediation process.

**(ii)** Bioremediation processes must be specifically made in accordance to the conditions at the contaminated site.

**(iii)** Small scale test on a pilot scale must be performed before carrying out the procedure at the contaminated site.

## UNIT VIII : Biotechnology

### Chapter

### 5

# PLANT TISSUE CULTURE

### Chapter Snapshot

- |  |   |
|--|---|
| <b>5.1</b> Milestones in Plant Tissue Culture        | <b>5.5</b> Applications of Plant Tissue Culture                           |
| <b>5.2</b> Basic Concepts in Plant Tissue Culture    | <b>5.5.1</b> Micropropagation of Banana                                   |
| <b>5.3</b> Plant Tissue Culture Techniques and Types | <b>5.5.2</b> Artificial Seed  |
| <b>5.3.1</b> Laboratory Facilities for PTC           | <b>5.5.3</b> Virus-free Plants  |
| <b>5.3.2</b> Technique Involved in PTC               | <b>5.6</b> Conservation of Plant Genetic Resources                        |
| <b>5.3.3</b> Types of Plant Tissue Cultures          | <b>5.6.1</b> Germplasm Conservation                                       |
| <b>5.4</b> Plant Regeneration Pathway                | <b>5.7</b> Intellectual Rights of Property (IPR), Biosafety and Bioethics |
| <b>5.4.1</b> Somatic Embryogenesis                   | <b>5.7.1</b> Patents  |
| <b>5.4.2</b> Organogenesis                           | <b>5.7.2</b> Biosafety and Bioethics                                      |
|  | <b>5.8</b> Future Biotechnology   |

**MUST KNOW DEFINITIONS**

- Aseptic condition** : Preparation of materials free from microbes *in vitro* cultures.
- Cell Culture** : Growing of cells *in vitro*, including the culture of single cells or small aggregates of cells in a liquid medium.
- Chemically defined medium** : A nutritive medium used for culturing cells or tissue; each chemical of this medium is known and defined.
- Cybrid** : Cytoplasmic hybrid obtained by the fusion of cytoplasm of cells of different parental sources; a term applied to the fusion of cytoplasm of two different protoplasts.
- Organogenesis** : The process of initiation and development of shoot or root through *in vitro* culture particularly from callus.
- Patents** : It is a special right to the discoverer/inventor that has been granted by the government through legislation for trading new articles.
- Claim** : Claim specifically defines the scope of the invention to be protected by the patent which the others may not practice.
- Embryogenesis** : Process of tissue culture in which the callus cells undergoes differentiation and produces somatic embryos, known as Embryoids.
- Cybrid** : The fusion product of protoplasts without nucleus of different cells is called a cybrid.
- Artificial seeds** : Somatic embryos are coated with inert materials like agarose and sodium alginate to obtain artificial seeds.
- Totipotency** : The property of live plant cells to give rise to complete individual plant.

**ABBREVIATIONS AND EXPANSION**

<b>GEAC</b>	: Genetic Engineering Appraisal committee
<b>GMO</b>	: Genetically Modified Organisms
<b>ELSI</b>	: Ethical, Legal and Social Implications
<b>HGP</b>	: Human Genome Project
<b>BRL</b>	: Biosafety Research Level
<b>RCGM</b>	: The Review committee on Genetic manipulation
<b>IBSC</b>	: The Institutional Bio-Safety Committee

<b>IPR</b>	: Intellectual Property Rights
<b>PEG</b>	: Poly Ethylene glycol
<b>MS medium</b>	: Murashige and skoog medium
<b>LAFC</b>	: Laminar Air Flow Chamber
<b>HEPA</b>	: High Efficiency Particulate Air
<b>KNOPS</b>	: Solution – Nutrient used in plant tissue culture.



## Unit Test

[Time : 1 hr]

[Marks: 25]

**I. CHOOSE THE CORRECT ANSWER.  $10 \times 1 = 10$** **1. Micro propagation involves**

- (a) vegetative multiplication of plants by using micro-organisms.
- (b) vegetative multiplication of plants by using small explants.
- (c) vegetative multiplication of plants by using microspores.
- (d) Non-vegetative multiplication of plants by using microspores and megaspores.

**2. Match the following :****Column A****Column B**

- |                       |     |   |
|-----------------------|-----|---|
| (1) Totipotency       | (A) | Reversion of mature cells into meristem                 |
| (2) Dedifferentiation | (B) | Biochemical and structural changes of cells             |
| (3) Explant           | (C) | Properties of living cells to develop into entire plant |
| (4) Differentiation   | (D) | Selected plant tissue transferred to culture medium     |

- |     |   |   |   |   |
|-----|---|---|---|---|
|     | 1 | 2 | 3 | 4 |
| (a) | C | A | D | B |
| (b) | A | C | B | D |
| (c) | B | A | D | C |
| (d) | D | B | C | A |

**3. Select the incorrect statement from given statement**

- (a) A tonic used for cardiac arrest is obtained from *Digitalis purpurea*.
- (b) Medicine used to treat Rheumatic pain is extracted from *Capsicum annum*.
- (c) An anti malarial drug is isolated from *Cinchona officinalis*.
- (d) Anti-carcinogenic property is not seen in *Catharanthus roseus*.

**4. Cryopreservation means it is a process to preserve plant cells, tissues or organs**

- (a) at very low temperature by using ether.
- (b) at very high temperature by using liquid nitrogen.
- (c) at very low temperature of  $-196$  by using liquid nitrogen.
- (d) at very low temperature by using liquid nitrogen.

**5. Dimethyl sulphoxide is added during cryopreservation because it**

- (a) reduces the temperature.
- (b) helps in enzymatic activities.
- (c) protects tissues from stress of freezing.
- (d) maintains tissues in dormant condition.

**6. Name the phenomenon of the reversion of mature cells to the meristematic state.**

- (a) Redifferentiation
- (b) Dedifferentiation
- (c) Totipotency
- (d) Differentiation

**7. Explant of \_\_\_\_\_ sterile segment selected from leaf for tissue culture.**

- (a) 1 - 3 cm
- (b) 1 - 2 cm
- (c) 1 - 1.5 cm
- (d) 1 - 4 cm

**8. Choose the incorrect pair.**

- (a) Roots - Rhizogenesis
- (b) Shoots - Caulogenesis
- (c) Artificial seed - Strawberry
- (d) Micropropagation - Banana

**9. Answer in a one word**

Growing of plant tissue in artificial media \_\_\_\_\_

**10. A complex mucilaginous polysaccharide is obtained from \_\_\_\_\_.**

- (a) sea weeds
- (b) bacteria
- (c) *bacillus*
- (d) *micrococcus*

**II. VERY SHORT ANSWER** **$2 \times 2 = 4$** 

- 1. What is hardening?
- 2. What are artificial seeds?

**III. SHORT ANSWER** **$2 \times 3 = 6$** 

- 1. What is patent?
- 2. Write the application of somatic embryo genesis?

**IV. LONG ANSWER** **$1 \times 5 = 5$** 

- 1. Write a note on Applications of plant tissue culture.





## UNIT IX : Plant Ecology

### Chapter

# 6

# PRINCIPLES OF ECOLOGY

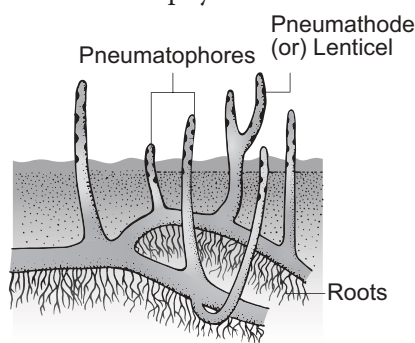
### Chapter Snapshot

- 6.1 Ecology
  - 6.1.2 Ecological Hierarchy
  - 6.1.3 Branches of Ecology
  - 6.1.4 Habitat and Niche
  - 6.1.5 Ecological Equivalents
- 6.2 Ecological Factors
  - 6.2.1 Climatic Factors
  - 6.2.2 Edaphic Factors
  - 6.2.3 Topographic Factors
  - 6.2.4 Biotic Factors
- 6.3 Ecological Adaptations
- 6.4 Dispersal of Fruits and Seeds
  - 6.4.1 Dispersal by Wind (Anemochory)
  - 6.4.2 Dispersal by Water (Hydrochory)
  - 6.4.3 Dispersal by Animals (Zoochory)
  - 6.4.3 Dispersal by Explosive Mechanism (Autochory)





- (v) Leaves are thick, entire, succulent and glossy. Some species are **aphyllous** (without leaves).
- (vi) Vivipary mode of seed germination is found in halophytes.



Pneumatophores of mangrove plant

**55. What are the advantages of seed dispersal?****Ans. Advantages of seed dispersal:**

- (i) Seeds escape from mortality near the parent plants due to predation by animals or getting diseases and also avoiding competition.
- (ii) Dispersal also gives a chance to occupy favourable sites for growth.
- (iii) It is an important process in the movement of plant genes. Particularly this is the only method available for self-fertilized flowers and maternally transmitted genes in out crossing plants.
- (iv) Seed dispersal by animals help in conservation of many species even in human altered ecosystems.
- (v) Understanding of fruits and seed dispersal acts as a key for proper functioning and establishment of many ecosystems from deserts to evergreen forests and also for the maintenance of biodiversity conservation and restoration of ecosystems.

**56. Describe dispersal of fruit and seeds by animals.****Ans.** Dispersal of fruits of fruits and seeds by animals is called zoochory.**They have the following devices:**

- (i) **Hooked fruit** : The surface of the fruit or seeds have hooks, (*Xanthium*), barbs (*Andropogon*), spines (*Aristida*) by means

of which they adhere to the body of animals or clothes of human beings and get dispersed.

**(ii) Sticky fruits and seeds :**

- (a) Some fruits have sticky glandular hairs by which they adhere to the fur of grazing animals.

**Example :** *Boerhaavia* and *Cleome*.

- (b) Fruits with viscid layer adhere to the beak of the bird which eat them and they rub them on to the branch of the tree, they disperse and germinate.

**Example :** *Cordia* and *Alangium***PTA Question & Answers****CHOOSE THE CORRECT ANSWERS****1 MARK****1. Match the following and find the correct answer. [PTA-3]**

(i)	Free floating hydrophyte	(A)	Utricularia
(ii)	Rooted floating hydrophyte	(B)	Pistia
(iii)	Submerged floating hydrophyte	(C)	Hydrilla
(iv)	Rooted -submerged hydrophyte	(D)	Nymphaea

- (a) (i) B (ii) D (iii) A (iv) C  
 (b) (i) B (ii) C (iii) D (iv) A  
 (c) (i) C (ii) D (iii) A (iv) B  
 (d) (i) D (ii) C (iii) B (iv) A

**[Ans. (c) (i) C (ii) D (iii) A (iv) B]****3. Assertion (A) : Hypolimnetic layer of water is always cold.****Reason (R) : The water holds the temperature of soil at the bottom of pond. [PTA-4]**

- (a) (A) correct; (R) wrong  
 (b) Both (A) and (R) are correct; but (R) is not the correct explanation of (A)  
 (c) Both (A) and (R) are correct; (R) is the correct explanation of (A)  
 (d) Both (A) and (R) are wrong

**[Ans. (a) (A) correct; (R) wrong]**

## UNIT IX : Plant Ecology

### Chapter

# 7

# ECOSYSTEM

### Chapter Snapshot

**7.1** Structure of Ecosystem

**7.2** Functions of Ecosystem

**7.2.1** Photosynthetically Active Radiation (PAR)

**7.2.2** Productivity of an Ecosystem

**7.2.3** Concept of Trophic Level in an Ecosystem

**7.2.4** Energy Flow

**7.2.5** Food Chain

**7.2.5** Food Chain

**7.2.7** Ecological Pyramids

**7.2.8** Decomposition

**7.2.9** Biogeochemical Cycle (Nutrient cycle)

**7.2.10** Types of Ecosystem

**7.2.11** Ecosystem Services ( Benefits)

**7.2.12** Ecosystem Management

**7.3** Plant Succession

**7.3.1** Causes of Succession

**7.3.2** Characteristics of Ecological succession

**7.3.3** Types of Succession

**7.3.4** Process of Succession

**7.3.5** Classification of Plant Succession

**7.3.6** Significance of Plant Succession

**7.4** Vegetation

**7.4.1** Vegetation Types of India and Tamil Nadu



## EVALUATION

**I Choose the most suitable answer from the given four alternatives and write the option code and the corresponding answer.**

**1. Which of the following is not a abiotic component of the ecosystem?**

- (a) Bacteria
- (b) Humus
- (c) Organic compounds
- (d) Inorganic compounds

[Ans. (a) Bacteria]

**2. Which of the following is / are not a natural ecosystem?**

- (a) Forest ecosystem
- (b) Rice field
- (c) Grassland ecosystem
- (d) Desert ecosystem

[Ans. (b) Rice field]

**3. Pond is a type of**

- (a) forest ecosystem
- (b) grassland ecosystem
- (c) marine ecosystem
- (d) fresh water ecosystem

[Ans. (d) fresh water ecosystem]

**4. Pond ecosystem is**

- (a) not self sufficient and self regulating
- (b) partially self sufficient and self regulating
- (c) self sufficient and not self regulating
- (d) self sufficient and self regulating

[Ans. (d) self sufficient and self regulating]

**5. Profundal zone is predominated by heterotrophs in a pond ecosystem, because of**

- (a) with effective light penetration
- (b) no effective light penetration
- (c) complete absence of light
- (d) a and b

[Ans. (b) no effective light penetration]

**6. Solar energy used by green plants for photosynthesis is only**

- (a) 2 – 8%
- (b) 2 – 10%
- (c) 3 – 10%
- (d) 2 – 9%

[Ans. (b) 2 – 10%]

**7. Which of the following ecosystem has the highest primary productivity?**

- (a) Pond ecosystem
- (b) Lake ecosystem
- (c) Grassland ecosystem
- (d) Forest ecosystem

[Ans. (d) Forest ecosystem]

**8. Ecosystem consists of**

- (a) decomposers
- (b) producers
- (c) consumers
- (d) all of the above

[Ans. (d) all of the above]

**9. Which one is in descending order of a food chain?**

- (a) Producers → Secondary consumers → Primary consumers → Tertiary consumers
- (b) Tertiary consumers → Primary consumers → Secondary consumers → Producers
- (c) Tertiary consumers → Secondary consumers → Primary consumers → Producers
- (d) Tertiary consumers → Producers → Primary consumers → Secondary consumers

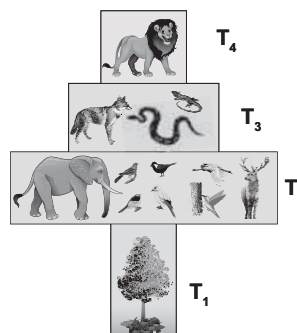
[Ans. (c) Tertiary consumers → Secondary consumer → Primary consumers → Producers]

**10. Significance of food web is / are**

- (a) it does not maintain stability in nature
- (b) it shows patterns of energy transfer
- (c) it explains species interaction
- (d) b and c

[Ans. (d) b and c]

**11. The following diagram represents**







### 1. Primary productivity :

The chemical energy or organic matter generated by autotrophs during the process of photosynthesis and chemosynthesis is called **primary productivity**. It is the source of energy for all organisms, from bacteria to human.

#### a. Gross Primary Productivity (GPP):

The total amount of food energy or organic matter or biomass produced in an ecosystem by autotrophs through the **process of photosynthesis** is called gross primary productivity.

#### b. Net Primary Productivity (NPP) :

The proportion of energy which **remains after respiration loss in the plant** is called net primary productivity. It is also called as apparent photosynthesis. Thus the difference between GPP and respiration is known as NPP.

$$\text{NPP} = \text{GPP} - \text{Respiration}$$

### 2. Secondary productivity :

The amount of energy stored in the tissues of **heterotrophs** or **consumers** is called secondary productivity.

#### a. Gross secondary productivity :

It is equivalent to the total amount of plant material is ingested by the herbivores minus the materials lost as faeces.

#### b. Net secondary productivity :

Storage of energy or biomass by consumers per unit area per unit time, **after respiratory loss** is called net secondary productivity.

### 3. Community productivity :

The rate of net synthesis of organic matter (biomass) by a group of plants per unit area per unit time is known as **community productivity**.

## GOVERNMENT EXAM QUESTIONS

### Bio-Botany (Short version)

#### CHOOSE THE CORRECT ANSWERS

1 MARK

1. Photosynthetically active radiation wave length between the range of [Govt.MQP-2019]  
 (a) 200-700nm (b) 300-700nm  
 (c) 400-700nm (d) 500-700nm  
**[Ans. (c) 400-700nm]**
2. Water purification belongs to which of the following Ecosystem Services? [HY-2019]  
 (a) Regulating services  
 (b) Supporting services  
 (c) Cultural services  
 (d) Provisioning services  
**[Ans. (a) Regulating services]**

#### SHORT ANSWERS

3 MARKS

1. Draw a pyramid from following details and explain. The quantities of organisms are given: Hawks 25 and plants - 500 rabbit and mouse- 125 + 125 snake and lizard - 50 + 25 respectively. [Govt.MQP-2019]  
**Ans.** This is a pyramid of number and is based on grassland ecosystem.
  - (i) The number of producers is maximum. (500)
  - (ii) This is followed by primary consumers. (250)
  - (iii) This is followed by secondary consumers. (75)
  - (iv) The tertiary consumers are lesser than secondary consumers. (25)

## UNIT IX : Plant Ecology

### Chapter

### 8

# ENVIRONMENTAL ISSUES

### Chapter Snapshot

- |  |  |
|--|--|
| <b>8.1</b> Green House Effect, Ozone Depletion               | <b>8.7</b> Carbon Capture and Storage (CCS)                        |
| <b>8.1.1.</b> Effects of Global Warming                      | <b>8.7.1</b> International Union for Conservation of Nature (IUCN) |
| <b>8.1.2.</b> Sources of Green House Gases Emission          | <b>8.7.2</b> Endemic Centres and Endemic Plants                    |
| <b>8.1.3</b> Strategies to Deal with Global Warming          | <b>8.8</b> Rain Water Harvesting                                   |
| <b>8.1.4.</b> Ozone depletion                                | <b>8.9</b> Environmental Impact Assessment (EIA)                   |
| <b>8.1.5</b> Effects of Ozone Depletion                      | <b>8.9.1</b> Environmental Benefits of Rain Water Harvesting       |
| <b>8.2</b> Forestry  | <b>8.9.2</b> Importance of Lakes                                   |
| <b>8.2.1</b> Agro Forestry                                   | <b>8.10</b> Geographic Information System                          |
| <b>8.2.2</b> Social Forestry                                 | <b>8.11</b> Environmental Impact Assessment (EIA)                  |
| <b>8.2.3.</b> Major Activities of Forestry Extension Centres | <b>8.11.1</b> Biodiversity Impact Assessment (BIA)                 |
| <b>8.3</b> Deforestation                                     | <b>8.12.</b> Geographic Information System                         |
| <b>8.4</b> Afforestation                                     |  |
| <b>8.5</b> Alien Invasive Species                            |  |
| <b>8.6</b> Conservation                                      |  |



**Methane :**

Methane is 20 times as effective as CO<sub>2</sub> at trapping heat in the atmosphere. Its sources are attributed paddy cultivation, cattle rearing, bacteria in water bodies, fossil fuel production, ocean, non-wetland soils and forest / wild fires.

**N<sub>2</sub>O (Nitrous oxide):**

It is naturally produced in Oceans from biological sources of soil and water due to microbial actions and rainforests. Man-made sources include nylon and nitric acid production, use of fertilizers in agriculture, manures cars with catalytic converter and burning of organic matter.

**GOVERNMENT EXAM QUESTIONS****Bio-Botany (Short version)****CHOOSE THE CORRECT ANSWERS****1 MARK**

1. Loss of biodiversity in worldwide is caused by the plant: [HY-2019]

- (a) *Prosopis juliflora*  
(b) *Elchhornia crassipes*  
(c) *Gliricidia sepium*  
(d) *Sesbania grandiflora*

**[Ans. (b) *Elchhornia crassipes*]****VERY SHORT ANSWERS****2 MARKS**

1. Mention the year of Launching and application of Satellite CARTOSAT-2. [HY-2019]

**Ans.**

Name of the Satellites	Year of Launch	Application
CARTOSAT – 2	Jan. 2018	Earth observation
CARTOSAT – 2 (100th Satellite)	Jan. 2018	To watch border surveillance

**ADDITIONAL QUESTIONS AND ANSWERS****CHOOSE THE CORRECT ANSWERS****1 MARK****I. CHOOSE THE CORRECT ANSWERS:**

1. The gases that capture heat are called green house gases which include.

- (a) only CO<sub>2</sub> (b) Methane  
(c) N<sub>2</sub>O and CFC (d) All of these

**[Ans. (d) All of these]**

2. The International treaty called the Montreal protocol was held in \_\_\_\_\_.

- (a) America (b) Italy  
(c) Canada (d) England

**[Ans. (c) Canada]**

3. Aforestation means \_\_\_\_\_.

- (a) Planting of trees  
(b) Removal of Trees and Plants  
(c) Conversion of forest area into non forest area  
(d) Supplying of seedlings

**[Ans. (a) Planting of trees]**

4. Environmental impact assessment is an \_\_\_\_.

- (a) Environment management tool  
(b) Trees and plants management tool  
(c) Rain harvesting management tool  
(d) Supporting tool for biodiversity

**[Ans. (a) Environment management tool]**

## UNIT X : Economic Botany

### Chapter

### 9

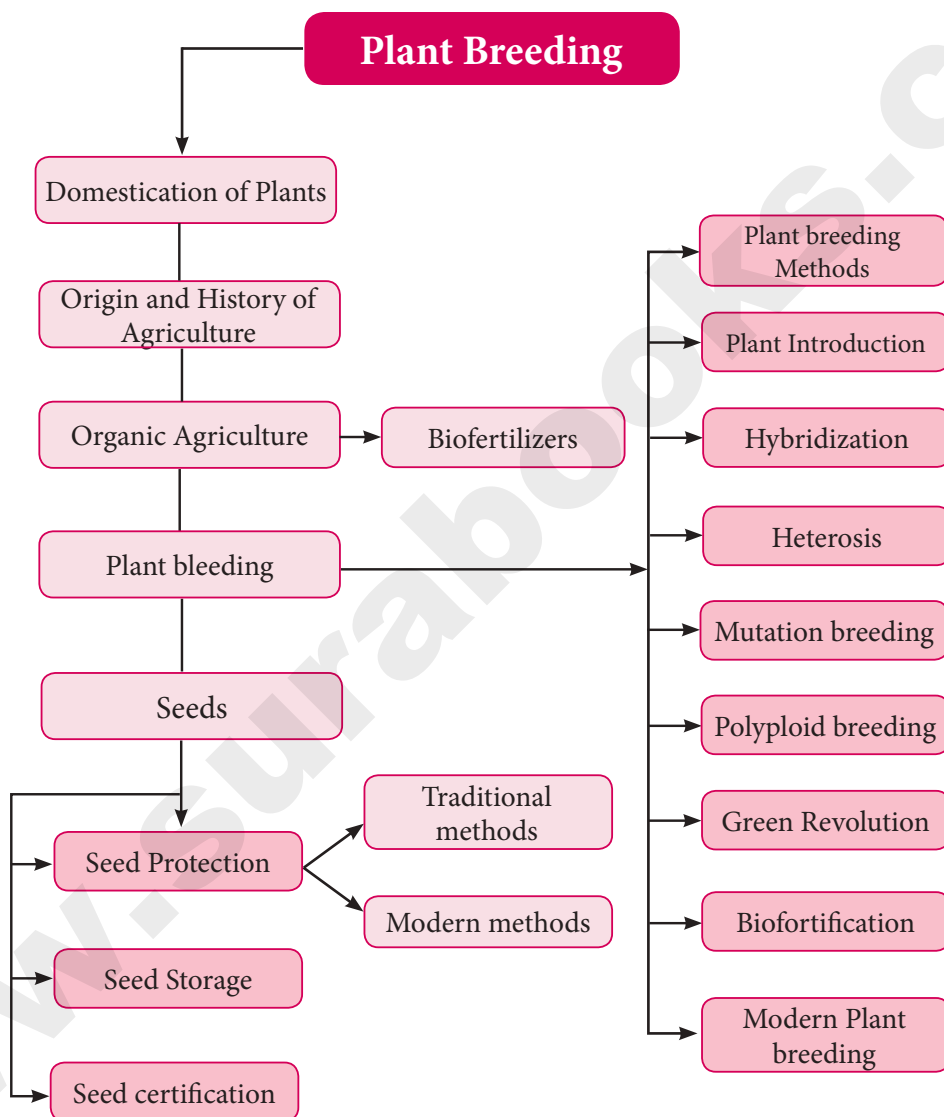
# PLANT BREEDING

### Chapter Snapshot

- 9.1 Relationship between Human and Plants
- 9.2 Domestication of Plants
- 9.3 Origin of Agriculture
- 9.4 History of Agriculture
- 9.6 Organic Agriculture
  - 9.6.1. Objectives of Plant Breeding
  - 9.6.2. Steps in Plant Breeding
- 9.7 Plant breeding
  - 9.7.1. Plant Introduction
  - 9.7.2. Selection
  - 9.7.3. Hybridization
  - 9.7.4. Heterosis
  - 9.7.5. Mutation Breeding
  - 9.7.6. Polyploid Breeding
  - 9.7.7. Green Revolution
- 9.8 Modern Plant Breeding Techniques
- 9.9 Seed Protection
  - 9.9.1. Traditional Methods of Seed Protection
  - 9.9.2. Modern Methods of Seed Protection
- 9.10 Seed Storage
  - 9.10.1. Classification of Seeds Based on Storage
  - 9.10.2. Methods of Seed Storage



## Concept Map





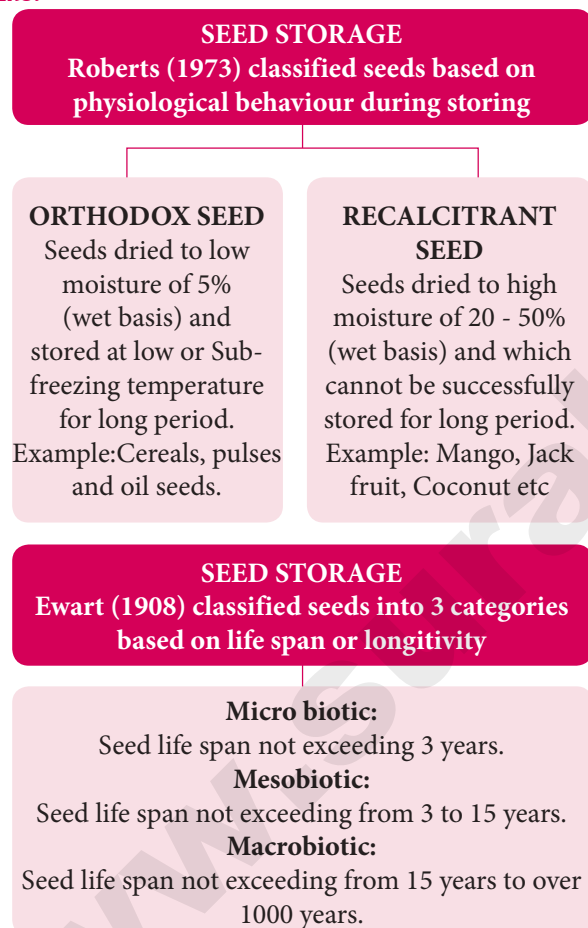
## BOTANY LONG VERSION QUESTIONS (FOR PURE SCIENCE GROUP)

### LONG VERSION EVALUATION

Q.No. 1 to 18 Refer Evaluation.

19. List the ways by which seeds can be stored for longer duration.

Ans.



Also there are other methods of seed storage. They are:

- (i) Conventional Methods of Seed Storage.
- (ii) Modern Methods of Seed Storage.
  - (a) Seed storage in cryopreservation .
  - (b) Seed storage in gene bank.
  - (c) Svalbard seed bank.

20. Refer Evaluation Q.No. 19

21. Refer Evaluation Q.No. 20

22. Discuss the importance of neem in seed storage.

Ans. Seeds are coated with Neem leaf powder and stored for short duration as a traditional way of seed protection.

23. Refer Evaluation Q.No. 21

21. Refer Evaluation Q.No. 22

25. Refer Evaluation Q.No. 23

26. Refer Evaluation Q.No. 24

### PTA Question & Answers

CHOOSE THE CORRECT ANSWERS

1 MARK

1. Assertion (A) : A variety formed by pure line selection method shows more homozygosity with respect to all genes.

Reason (R) : The pure line plants are produced by asexual method or Vegetative propagation method. [PTA-1]

- (a) (A) is correct; (R) is wrong
- (b) (A) is wrong; (R) is correct
- (c) (A) is correct; (R) does not explain (A)
- (d) (A) is correct; (R) explain (A)

[Ans. (a) (A) is correct; (R) is wrong]



## UNIT X : Economic Botany

### Chapter 10

# ECONOMICALLY USEFUL PLANTS AND ENTREPRENEURIAL BOTANY

### Chapter Snapshot

- |                                   |  |
|-----------------------------------|--|
| <b>10.1</b> Food Plants           | <b>10.6</b> Pulp wood  |
| <b>10.1.1</b> Cereals             | <b>10.7</b> Dye  |
| <b>10.1.2</b> Millets             | <b>10.8</b> Cosmetics  |
| <b>10.1.3</b> Minor Millets       | <b>10.8.1</b> Perfumes   |
| <b>10.1.4</b> Pulses              | <b>10.9</b> Traditional System of Medicines                    |
| <b>10.1.5</b> Vegetables          | <b>10.10</b> Medicinal Plants                                  |
| <b>10.1.6</b> Fruits              | <b>10.11</b> Entrepreneurial Botany                            |
| <b>10.1.7</b> Nuts                | <b>10.11.1</b> Mushroom cultivation                            |
| <b>10.1.8</b> Sugars              | <b>10.11.2</b> Single Cell Protein (SCP)<br>Production         |
| <b>10.1.9</b> Oil Seeds           | <b>10.11.3</b> Seaweed Liquid Fertilizer                       |
| <b>10.1.10</b> Beverages          | <b>10.11.4</b> Organic farming                                 |
| <b>10.2</b> Spices and Condiments | <b>10.11.5</b> Terrarium                                       |
| <b>10.3</b> Fibre                 | <b>10.11.6</b> Cultivation of Medicinal<br>and Aromatic Plants |
| <b>10.4</b> Timber                |  |
| <b>10.5</b> Latex                 |  |



## ABBREVIATION

IRRI	: International Rice Research Institute
SFA	: Saturated Fatty Acid
UFA	: Unsaturated Fatty Acid
MUFA	: Mono Unsaturated Fatty Acid
PUFA	: Poly Unsaturated Fatty Acid
TSM	: Traditional Systems of Medicine
USPTO	: United States Patent and Trade mark Office
TK	: Traditional Knowledge
THC	: trans-tetrahydrocannabinol
SCP	: Single Cell Protein
NCB	: Narcotics Control Bureau
NMPB	: National Medicinal Plants Board
CIMAP	: Central Institute of Medicinal and Aromatic Plants
HDL	: High Density Lipids
GI	: Geographical Indication

## EVALUATION

1. Consider the following statements and choose the right option.

- Cereals are members of grass family.
- Most of the food grains come from monocotyledon.

- (i) is correct and (ii) is wrong
- Both (i) and (ii) are correct
- (i) is wrong and (ii) is correct
- Both (i) and (ii) are wrong

[Ans. (b) Both (i) and (ii) are correct]

2. **Assertion :** Vegetables are important part of healthy eating.

**Reason :** Vegetables are succulent structures of plants with pleasant aroma and flavours.

- Assertion is correct, Reason is wrong
- Assertion is wrong, Reason is correct
- Both are correct and reason is the correct explanation for assertion.
- Both are correct and reason is not the correct explanation for assertion.

[Ans. (a) Assertion is correct, Reason is wrong]

3. Groundnut is native of \_\_\_\_\_

- Philippines
- India
- North America
- Brazil

[Ans. (d) Brazil]



2. Write the medicinal uses of Holy basil. [PTA-3]

**Ans. Medicinal Uses for Holy basil:**

- (i) The leaves are stimulant, antiseptic, anti-hypertensive and anti-bacterial and expectorant used in bronchitis.
- (ii) Decoction of roots is given as a diaphoretic in malarial fever.

3. Write any two uses of THC. [PTA-5]

- Ans. (i)** THC is used in treating Glaucoma a condition in which pressure develops in the eyes.
- (ii)** THC is also used in reducing nausea of cancer patients undergoing radiation and chemotherapy.
- (iii)** THC provides relief to bronchial disorders, especially asthma as it dilates bronchial vessels.

#### SHORT ANSWERS

3 MARKS

1. TN Govt suggest Nilavembu as a medicine for Dengue. Write its medicinal importance.

[PTA-1]

- Ans. (i)** Medicinal importance : *Andrographis* is a potent hepatoprotective and is widely used to treat liver disorders.
- (ii)** Concoction of *Andrographis paniculata* and eight other herbs (Nilavembu Kudineer) is effectively used to treat malaria and dengue.

#### GOVERNMENT EXAM QUESTIONS

#### Bio-Botany (Short version)

#### SHORT ANSWERS

3 MARKS

1. What aroma would you like to add to your tea? Write its uses. [HY-2019]

**Ans.** Cardomom aroma is one of my favourite aroma and that gives pleasing aroma and pungent taste to my tea.

**Uses of Cardamom:**

- (i) Seeds have a pleasing aroma and characteristic warm, slightly pungent taste.
- (ii) It is used for flavouring confectionaries, bakery products and beverages.
- (iii) The seeds are used in the preparation of curry powder, pickles and cakes.
- (iv) Medicinally, it is employed as a stimulant and carminative. It is also chewed as a mouth freshener.

## ADDITIONAL QUESTIONS AND ANSWERS

#### CHOOSE THE CORRECT ANSWER

1 MARK

#### I. CHOOSE THE CORRECT ANSWER:

1. All cereals are members of family \_\_\_\_\_.

- (a) Lamiaceae
- (b) Poaceae
- (c) Verbenaceae
- (d) Musaceae

**[Ans. (b) Poaceae]**

2. \_\_\_\_\_ is the only cereal which has originated and domesticated from the new world.

- (a) Paddy
- (b) Wheat
- (c) Millet
- (d) Maize

**[Ans. (d) Maize]**

3. \_\_\_\_\_ is used in manufacture of infant foods.

- (a) Rice bran oil
- (b) Corn syrup
- (c) Pearl millet
- (d) Quinoa

**[Ans. (b) Corn syrup]**

4. \_\_\_\_\_ is an example of a pseudocereal.

- (a) Cinchona
- (b) quinoa
- (c) Rauwolfia
- (d) Little Millet

**[Ans. (b) quinoa]**

5. Finger millet refers to \_\_\_\_\_.

- (a) Little Millet
- (b) Kodo Millet
- (c) Ragi
- (d) Foxtail Millet

**[Ans. (c) Ragi]**



## Unit Test

[Time : 1 hr]

[Marks: 25]

Chapter-10

### I. CHOOSE THE CORRECT ANSWER. $10 \times 1 = 10$

1. **Assertion** : Vegetables are important part of healthy eating.

**Reason** : Vegetables are succulent structures of plants with pleasant aroma and flavours.

- Assertion is correct, Reason is wrong
- Assertion is wrong, Reason is correct
- Both are correct and reason is the correct explanation for assertion.
- Both are correct and reason is not the correct explanation for assertion.

2. Find out the correctly matched pair.

- Rubber - *Shorea robusta*
- Dye - *Indigofera annecta*
- Timber - *Cyperus papyrus*
- Pulp - *Hevea brasiliensis*

3. Observe the following statements and pick out the right option from the following:

**Statement I** - Perfumes are manufactured from essential oils.

**Statement II** - Essential oils are formed at different parts of the plants.

- Statement I is correct
- Statement II is correct
- Both statements are correct
- Both statements are wrong

4. Groundnut is native of \_\_\_\_\_

- Philippines
- India
- North America
- Brazil

5. Match the following

A	Geraniol	(i)	Terrarium
B	Seaweed	(ii)	Fertilizer
C	Begonia	(iii)	Pesticide
D	Neem	(iv)	Lemon grass

- |         |     |     |     |
|---------|-----|-----|-----|
| A       | B   | C   | D   |
| (a) iv  | ii  | i   | iii |
| (b) iii | ii  | i   | iv  |
| (c) iv  | ii  | iii | i   |
| (d) i   | iii | ii  | iv  |

6. Answer in one word

A major constituent got from *Gloriosa superba* \_\_\_\_\_.

7. Choose the incorrect statement(s).

- Foxtail millet supports in strengthening of heart and improves eye sight.
- Thinai improves lactating mother.
- Kodo millet is originated from West Africa.
- Pulses are the edible seeds that are harvested from the fruits of malvaceae.

8. Choose the correct pair.

- |                 |   |               |
|-----------------|---|---------------|
| (a) Red gram    | - | Pigeon pea    |
| (b) Black gram  | - | Chick pea     |
| (c) Vigna mungo | - | Bengal gram   |
| (d) Green gram  | - | Cajanus cajan |

9. Find out the odd man out

- |            |           |
|------------|-----------|
| (a) Maize  | (b) Rice  |
| (c) Almond | (d) Wheat |

10. *Tectona grandis* belongs to the family

- |                      |               |
|----------------------|---------------|
| (a) Lamiaceae        | (b) Fabaceae  |
| (c) Dipterocarpaceae | (d) Ebenaceae |

### II. VERY SHORT ANSWER $2 \times 2 = 4$

1. Mention one difference between essential oil and vegetable oil.

2. What is a pseudo cereal? Give an example.

### III. SHORT ANSWER $2 \times 3 = 6$

1. What are millets? What are its types? Give example for each type.

2. Why do popcorn pops?

### IV. LONG ANSWER $1 \times 5 = 5$

1. Write a note on Turmeric and its uses.





## NEET BASED QUESTIONS

1. The plant of *Cycas*, which belongs to sporophytic generation, is differentiated into :  
 (A) Root, stem and leaves  
 (B) Male and female cones  
 (C) Leaves only  
 (D) Sometimes leaves and sometimes modified stems
2. Which of the following cell organelles produces lysosomes?  
 (A) ER  
 (B) Peroxisomes  
 (C) Golgi apparatus  
 (D) None of the above
3. Epidermis and Epiblema are produced from :  
 (A) Phellogen (B) Protoderm  
 (C) Procambium (D) Calyptragen
4. Which of the following is the characteristic of water storage tissue in xerophytes?  
 (A) Presence of large sized cells  
 (B) Presence of thin cell walls  
 (C) Presence of mucilage  
 (D) Presence of vacuole
5. What happens when lactose is present?  
 (A) The repressor becomes able to bind to the operator  
 (B) Transcription of *lac-y*, *lac-Z*, and *lac-a* genes occurs  
 (C) The repressor becomes unable to bind to the operator  
 (D) Both (B) and (C)
6. Which of the following organelles is usually absent in chloroplast of algae?  
 (A) Lamellae  
 (B) Grana  
 (C) Pigments  
 (D) Quantasomes
7. Abiogenesis theory states that :  
 (A) Life originated due to spontaneous generation  
 (B) Origin of life is due to preexisting organisms  
 (C) Origin of life occurred from blue-green algae like microorganisms  
 (D) Origin of life is due to organic evolution owing to chemical reactions in presence of light
8. Which of the process(es) is/are referred to as translation?  
 (A) Decoding of the triplet codons of mRNA by tRNA  
 (B) Decoding of amino acids to proteins  
 (C) Decoding of the triplet codons by tRNA to mRNA  
 (D) All of the above
9. Leafless stem of onion which is produced to bear flowers is called :  
 (A) Scape (B) Torus  
 (C) Thalamus (D) Pedicel
10. Feathery stigma and versatile anthers are found in :  
 (A) Compositae (B) Graminae  
 (C) Leguminosae (D) All of the above
11. Genotoxicity refers to the detection of agents that will damage :  
 (A) Vitamins (B) Enzymes  
 (C) DNAs (D) Proteins
12. Which one of the following families is commonly known as night-shade-family?  
 (A) Compositae (B) Malvaceae  
 (C) Both (A) and (B) (D) Solanaceae
13. The phospholipids are broken down to their residues by the action of enzymes called :  
 (A) Triose phosphate isomerase  
 (B) Cytochrome oxidase  
 (C) Peroxidase  
 (D) Malic dehydrogenase
14. *E. coli* have the full complement of enzymes for the glyoxylate and citric acid cycles in the :  
 (A) Mesosomes  
 (B) Mitochondria  
 (C) Cytosol  
 (D) Polysomes
15. At what phase of meiosis are there two cells, each with separated sister chromatids that have been moved to opposite spindle poles?  
 (A) Anaphase-I (B) Anaphase-II  
 (C) Metaphase-I (D) Metaphase-II
16. Plants that retain their evergreen foliage throughout the year are called :  
 (A) Draught escaping plants  
 (B) Evergreen plants  
 (C) Xerophytic plants  
 (D) All of the above
17. The term 'allelomorphic' means :  
 (A) Sex-linked characters  
 (B) Sex determining chromosomes  
 (C) A pair of contrasting characters  
 (D) Representatives of the same gene locus



## ANSWERS

1. (A)	2. (C)	3. (B)	4. (B)	5. (D)	6. (B)	7. (A)	8. (A)	9. (A)	10. (B)
11. (C)	12. (D)	13. (A)	14. (C)	15. (B)	16. (B)	17. (C)	18. (D)	19. (B)	20. (D)
21. (A)	22. (C)	23. (D)	24. (B)	25. (B)	26. (A)	27. (A)	28. (D)	29. (D)	30. (B)
31. (C)	32. (A)	33. (B)	34. (D)	35. (A)	36. (A)	37. (A)	38. (A)	39. (D)	40. (C)
41. (C)	42. (D)	43. (C)	44. (A)	45. (D)	46. (D)	47. (A)	48. (B)	49. (A)	50. (B)
51. (C)	52. (A)	53. (A)	54. (B)	55. (B)	56. (D)	57. (D)	58. (B)	59. (C)	60. (A)
61. (C)	62. (A)	63. (D)	64. (C)	65. (C)	66. (C)	67. (C)	68. (A)	69. (A)	70. (C)
71. (A)	72. (D)	73. (C)	74. (C)	75. (D)	76. (D)	77. (B)	78. (B)	79. (A)	80. (A)

## Explanatory Notes

2. Lysosomes are membrane-bound vesicles produced by a Golgi apparatus that contain hydrolytic digestive enzymes.
3. The outermost meristematic layer of the young growing region is known as protoderm, which develops into epidermis and epiblema.
4. In xerophytes mostly water storage tissues possess thin-walled cell having a few inter-culluar spaces, Eg : *Opuntia*, *Euphorbia* etc.
6. In the algal plastids (chloroplasts) the thylakoids are only of one kind and restricted to the stack itself. They are not closely packed or fused as in the grana of higher plants.
7. Abiogenesis theory of origin of life stated that different types of organisms are formed automatically due to chemical reactions in presence of high energy. The spontaneous generation or abiogenesis of life was visualized as beginning with either inorganic materials or with putrefying organic matter.
14. Some bacteria, including *E. coli*, have the full complement of enzymes for the glyoxylate and citric acid cycles in the cytosol. *E. coli* can, therefore, grow with acetate as its sole source of carbon and energy.
15. During anaphase-II of meiosis-II, The centromeres divide and the daughter chromosomes move towards the spindle poles.
16. Plants bearing evergreen foliage throughout the year are called evergreen plants. Popularly, needle-leaved tree (Pine, Juniper, etc.) are called ever-green plants.
20. Symbiosis is also established by *mycorrhiza*, but in this case symbiosis is always established between fungus and the roots of higher plants.
22. In certain classes of fungi such as Ascomycetes and Basidiomycetes, as a result of plasmogamy (fusion of the protoplasm of two compatible gametes) the nuclei of the opposite strains get themselves arranged in pairs but do not fuse. This phase in life cycle is termed as dikaryophase and the process is called dikaryotization.
24. Apricot (*Prunus persica*) is a kind of drupe fruit.
25.  $C_4$  plants are more efficient at photosynthesis than  $C_3$  plants in hot, dry conditions.
28. In prokaryotic protein synthesis, the initiation of polypeptide chain is always brought about by an amino acid, methionine, which is coded by the codon AUG.
30. POP is an abbreviation of 'Persistent organic pollutants'. The WHO estimates an annual death toll of around 20000 due to poisoning from POPs and other pesticides.
32. Haploid plants possess only one set of chromosomes. Haploid produced from microspores or pollen grains (anthers) are called androgenic haploids. Maheshwari and Guha (1964, 65) successfully reported anther cultured plants from *Datura innoxia*.
35. Rhynia, which belongs to division Psilophyta, was discovered in 1917 by Kidston and Lang from Rhynie chert bed of Middle Devonian.
36. Exothermic refers to the release of heat (DH is negative). Exothermic reactions are generally, but not always, exergonic.
40. Lateral meristems are present along the lateral sides of stem and roots. Interstellar cambium ring formed by intrafascicular and interfascicular cambium and cork cambium are examples of lateral meristem.
41. Chromatin (Chromosome) has a special region called nucleolus where ribosomal RNA (r-RNA) is produced.
44. CAM plants use PEPCase to fix  $CO_2$  at night, forming a  $C_4$  molecule, which is stored in large vacuoles in their mesophyll cells until the next day.
45. The process of formation of m-RNA from DNA is called transcription, which involves promoters (P), binding to the promoters site, RNA chain initiation and elongation, and RNA chain termination.

12<sup>th</sup>  
STD.

Register Number

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## GOVT. MODEL QUESTION PAPER - 2019-20

TIME ALLOWED : 2.30 hrs

## BIOLOGY

MAXIMUM MARKS : 70

**Instructions:**

- Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.
- Use **Blue** or **Black** ink to write and underline and **pencil** to draw diagrams:

**PART-1 (Bio-BOTANY)****(35 MARKS)****SECTION – I**

- Note :** (i) Answer **all** the questions: **(8 × 1 = 8)**  
 (ii) Choose the most suitable answer from the given **four** alternatives and write the option code with the corresponding answer.

- Size of pollen grain in *Myosotis* is \_\_\_\_\_ micrometer.  
 (a) 10 (b) 20  
 (c) 200 (d) 2000
- How many different kinds of gametes will be produced by a plant having the genotype AABbCC?  
 (a) Three (b) Four (c) Nine (d) two
- EcoRI cleaves DNA at  
 (a) AGGGTT (b) GTATAC  
 (c) GAATTC (d) TATAGC
- Choose the correct match from the following

	Column-I		Column - II
1.	Totipotency	A	Reversion of mature cells into meristem.
2.	Dedifferentiation	B	Biochemical and structural changes of cells.

3.	Explant	C	Properties of living cells develops into entire plant.
4.	Differentiation	D	Selected plant tissue transferred to culture medium

- |     |   |   |   |   |
|-----|---|---|---|---|
|     | 1 | 2 | 3 | 4 |
| (a) | C | A | D | B |
| (b) | A | C | B | D |
| (c) | B | A | D | C |
| (d) | D | B | C | A |
- Photosynthetically active radiation wave length between the range of  
 (a) 200-700nm (b) 300-700nm  
 (c) 400-700nm (d) 500-700nm
  - For the given statements with respect to *Eichhornia* select the suitable answer.  
**Statement A :** It drains of oxygen from water and is seen growing in standing water.  
**Statement B :** It is an indigeneous species of our country.  
 (a) Statement A is correct and statement B is wrong.  
 (b) Both the statement A and B are correct.  
 (c) Statement A is wrong and statement B is correct.  
 (d) Both the statement A and B are wrong.
  - Which of the following is incorrectly paired?  
 (a) Wheat - Himgiri  
 (b) Milch breed - Sahiwal  
 (c) Rice - Ratna  
 (d) Pusa komal - Brassica

12<sup>th</sup>  
STD.

Register Number

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## QUARTERLY COMMON EXAMINATION - 2019-20

TIME : 2.30 Hours

## BIOLOGY

MAXIMUM MARKS : 70

**Instructions:**

- Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.
- Use **Blue** or **Black** ink to write and underline and **pencil** to draw diagrams.

**Note :** (i) Answer **all** the questions. **(8 × 1 = 8)**  
 (ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

**PART-I (BIO-BOTANY)****SECTION – I**

- A plant called "X" possesses small flower with reduced perianth and versatile anther. The probable agent for pollination would be  
 (a) Water (b) Air  
 (c) Butterflies (d) Beetles
- "Gametes are never hybrid". This is a statement of  
 (a) Law of dominance  
 (b) Law of independent assortment  
 (c) Law of segregation  
 (d) Law of random fertilization
- Match the following

	Column-A		Column - B
i	Syngenesions	A	pollen grain
ii	Androecium	B	anther wall
iii	Male gametophyte	C	Asteraceae
iv	Primary Parietal Layer	D	Stamens

- |       |    |     |    |
|-------|----|-----|----|
| i     | ii | iii | iv |
| (a) D | A  | B   | C  |
| (b) C | D  | A   | B  |
| (c) C | D  | B   | A  |
| (d) C | A  | D   | B  |

- Match the following

	Column-A		Column - B
i	Exonuclease	A	Add or remove phosphate
ii	Endonuclease	B	binding the DNA fragment
iii	Alkaline Phosphatase	C	cut the DNA at terminus
iv	Ligase	D	cut the DNA at middle

- |       |    |     |    |
|-------|----|-----|----|
| i     | ii | iii | iv |
| (a) A | B  | C   | D  |
| (b) C | D  | B   | A  |
| (c) A | C  | B   | D  |
| (d) C | D  | A   | B  |

- Which of the following sentences are correct?

- The offspring exhibit only parental combinations due to incomplete linkage.
  - The linked gene exhibit some crossing over in complete linkage.
  - The separation of the two linked genes are possible in incomplete linkage.
  - Crossing over is absent in complete linkage.
- (a) (1) and (2) (b) (2) and (3)  
 (c) (3) and (4) (d) (1) and (4)

- Which of the following statement is correct?

- Agar is not extracted from marine algae such as seaweeds.
- Callus undergoes differentiation and produces somatic embryoids.
- Surface sterilization of explants is done by using mercuric bromide.
- pH of the culture medium is 5.0 to 6.0



12<sup>th</sup>  
STD.

Register Number

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## SURA MODEL QUESTION PAPER

TIME ALLOWED : 15Min + 3.00 Hours

## BIOLOGY

MAXIMUM MARKS : 70

## BIO-BOTANY

(35 MARKS)

## Instructions:

- Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.
- Use **Blue** or **Black** ink to write and underline and **pencil** to draw diagrams:

## PART - I

Note : (i) Answer **all** the questions: (8 × 1 = 8)

- Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

## 1. Identify the correctly matched pair

- Tuber – *Allium Cepa*
- Sucker – *Pistia*
- Rhizome – *Musa*
- Stolon – *Zingiber*

## 2. Select the period for Mendel's hybridization experiments

- 1856-1863
- 1850-1870
- 1857-1869
- 1870-1877

## 3. Consider the following statements:

I. Recombinant DNA technology is popularly known as genetic engineering is a stream of biotechnology which deals with the manipulation of genetic materials by man *invitro*.

II. pBR322 is the first artificial cloning vector developed in 1977 by Boliver and Rodriguez from *E.coli* plasmid.

III. Restriction enzymes belongs to a class of enzymes called nucleases.

Choose the correct option regarding above statements.

- I & II
- I & III
- II & III
- I, II & III

## 4. Read the given statements and select the correct option.

**Statement A** : Cattle do not graze on weeds of *Calotropis*.

**Statement B** : *Calotropis* have thorns and spines, as defense against herbivores.

- Both statements A and B are incorrect.
- Statement A is correct but statement B is incorrect.
- Both statements A and B are correct but statement B is not the correct explanation of statement A.
- Both statements A and B are correct and statement B is the correct explanation of statement A.

## 5. Match the following

A	Carbon cycle	(i)	Sedimentary cycle
B	Phosphorous cycle	(ii)	Gaseous cycle
C	Biogeochemical cycle	(iii)	Micro consumers
D	Decomposers	(iv)	Nutrient cycle

- |     |     |     |    |     |
|-----|-----|-----|----|-----|
|     | A   | B   | C  | D   |
| (a) | i   | iii | ii | iv  |
| (b) | ii  | iii | iv | i   |
| (c) | ii  | i   | iv | iii |
| (d) | iii | ii  | i  | iv  |

## 6. Find the wrongly matched pair.

- Endemism - Species confined to a region and not found anywhere else.
- Hotspots - Western ghats
- Ex-situ Conservation - Zoological parks
- Sacred groves - Saintri hills of Rajasthan
- Alien sp. of India - Water hyacinth