

12th

STD

PUBLIC EXAMINATION - MARCH - 2023

PART - III
BIOLOGY

Reg. No.

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TIME ALLOWED : 3.00 HOURS]

(with Answers)

[MAXIMUM MARKS : 70

Instructions : (1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

PART - I (BIO-BOTANY) 35 MARKS

SECTION - 1

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.

- Deforestation does not lead to _____.
(a) alteration of local weather conditions
(b) quick nutrient cycling
(c) destruction of natural habitat weather conditions
(d) soil erosion
- Cardamom belongs to the family _____.
(a) Solanaceae (b) Piperaceae
(c) Fabaceae (d) Zingiberaceae
- The ideal soil for Cultivation is :
(a) Loamy soil (b) Clayey soil
(c) Sandy soil (d) Silt soil
- Virus free plants are developed from:
(a) Meristem culture
(b) Cell suspension culture
(c) Protoplast culture
(d) Organ culture

- _____ is called as "Father of Indian Green Revolution".
(a) M.S. Swaminathan
(b) P. Maheswari
(c) Mendel
(d) Nel Jayaraman
- Tephrosia purpurea* is a _____.
(a) Bio-herbicide (b) Bio-fertilizer
(c) Green manure (d) Bio-pesticide
- Which of the following represent Megagametophyte?
(a) Nucellus (b) Ovule
(c) Endosperm (d) Embryo sac
- The bacteria responsible for causing Crown Gall:
(a) *Escherichia coli*
(b) *Bacillus subtilis*
(c) *Bacillus thuringiensis*
(d) *Agrobacterium tumefaciens*

SECTION - II

Note : Answer **any four** of the following questions.

(4 × 2 = 8)

- What is Stomium?
- Give the types of Synapsis.
- Name the chemicals used in Gene Transfer.
- What is PAR?

13. Differentiate Primary introduction from Secondary introduction.

14. What is Co-evolution?

SECTION - III

Note: Answer any three of the following questions.
Q.No. 19 is **Compulsory**. (3 × 3 = 9)

15. Differentiate Grafting and Layering.
16. List any three significance of ploidy.
17. Give four examples for plants cultivated in commercial agroforestry.
18. What are the materials used to grow micro-organism like *Spirulina*?
19. Write short notes on Bio-monitoring.

SECTION - IV

Note: Answer all the questions. (2 × 5 = 10)

20. (a) Give the characteristic features of Anemophilous plants.

(OR)

(b) Explain the incomplete dominance with example.

21. (a) Enumerate the anatomical adaptations of Xerophytes. (OR)

(b) Give an account of active principle and medicinal values of any two plants you have studied.

ANSWERS

SECTION - 1

1. (b) quick nutrient cycling
2. (d) Zingiberaceae
3. (a) Loamy soil
4. (a) Meristem culture
5. (a) M.S.Swaminathan
6. (c) Green manure
7. (d) Embryo sac
8. (d) *Agrobacterium tumefaciens*

SECTION - 2

9. **Stomium:**

- (i) In an anther, cells along the junction of the two sporangia of an anther lobe lack these thickenings.
- (ii) This region is called stomium and helps in the dehiscence of anther at maturity.

10. **Synapsis is of three types :**

- (i) Procentric synapsis
- (ii) Proterminal synapsis
- (iii) Random synapsis

11. **Chemicals used in Gene Transfer :**

- (i) Polyethylene glycol.
- (ii) Dextran sulphate.

12. **PAR:** The amount of light available for photosynthesis of plants is called Photosynthetically Active Radiation (PAR) which is between the range of 400-700 nm wave length.

13.

	Primary Introduction	Secondary Introduction
1.	Introduced variety is well adapted to the new environment	Introduced variety is subjected to selection to isolate a superior variety
2.	There is no alternation to the original genotype.	The variety is hybridized with a local variety to transfer one or a few characters to them.

14. **Co-evolution:** The interaction between organisms, when continues for generations, involves reciprocal changes in genetic and morphological characters of both organisms. This type of evolution is called Co-evolution. It is a kind of co-adaptation and mutual change among interactive species.

Examples :

- (i) Corolla length and proboscis length of butterflies and moths (*Habenaria* and Moth).
- (ii) Bird's beak shape and flower shape and size.

SECTION - 3

15.

	Grafting	Layering
1.	Two different plants are involved.	Only parent plant is involved.
2.	Parts of two different plants are joined and continue to grow as one plant.	Stem of the parent plant is allowed to develop roots.
3.	Plant used for grafting is called scion.	The rooted part is cut and grown as a new plant.
4.	Eg. Citrus, Mango and Apple.	Eg. Ixora and Jasminum.

16. **Significance of ploidy:**

- (i) Many polyploids are more vigorous and more adaptable than diploids.
- (ii) Many ornamental plants are autotetraploids and have larger flowers and longer flowering duration than diploids.
- (iii) Autopolyploids usually have higher in fresh weight due to more water content.
- (iv) Aneuploids are useful to determine the phenotypic effects of loss or gain of different chromosomes.

17. **The major species cultivated in commercial Agroforestry include :**

- (i) *Casuarina*
- (ii) *Eucalyptus*
- (iii) Malai Vembu
- (iv) Teak and Kadambu trees.

18. **Materials used to grow *Spirulina* are:**

- (i) Waste water from potato processing plants (containing starch)
- (ii) Straw
- (iii) Molasses
- (iv) Animal manure
- (v) Sewage

19. **Bio-monitoring :**

- (i) The act of observing and assessing the current state and ongoing changes in ecosystem, biodiversity components, landscape including, natural habitats population and species.

- (ii) An agricultural drone is an unmanned aerial vehicle applied to farming in order to help increased crop production and monitor crop growth.
- (iii) It can reveal many issues such as irrigation problems, soil variation and pest and fungal infestations.
- (iv) It is also used for cost effective safe method of spraying pesticides and fertilizers, which proves very easy and non-harmful.

SECTION - 4

20. (a) **Characteristic features of Anemophilous plants:**

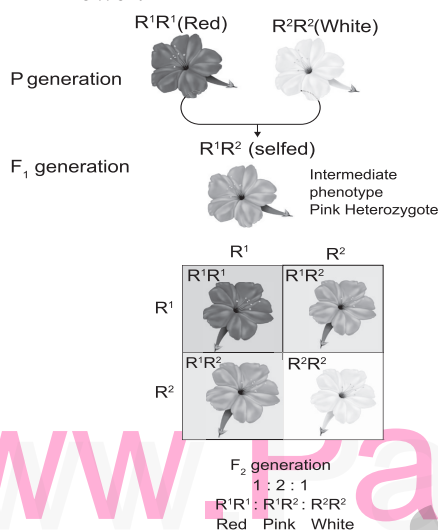
- (i) The flowers are produced in pendulous, catkin-like or spike inflorescence.
- (ii) The axis of inflorescence elongates so that the flowers are brought well above the leaves.
- (iii) The perianth is absent or highly reduced.
- (iv) The flowers are small, inconspicuous, colourless, not scented, do not secrete nectar.
- (v) The stamens are numerous, filaments are long, exerted and versatile.
- (vi) Anthers produce enormous quantities of pollen grains, which are minute, light and dry so that they can be carried to long distances by wind.
- (vii) In some plants anthers burst violently and release the pollen into the air. Example: *Urtica*.
- (viii) Stigmas are comparatively large, protruding, sometimes branched and feathery, adapted to catch the pollen grains. Generally single ovule is present.
- (ix) Plant produces flowers before the new leaves appear, so the pollen can be carried without hindrance of leaves.

(OR)

(b) **The German Botanist Carl Correns's (1905) Experiment :**

- (i) In 4 O' clock plant, *Mirabilis jalapa* when the pure breeding homozygous red (R^1R^1) parent is crossed with homozygous white (R^2R^2), the phenotype of the F_1 hybrid is heterozygous pink (R^1R^2).

- (ii) The F_1 heterozygous phenotype differs from both the parental homozygous phenotype. This cross did not exhibit the character of the dominant parent but an intermediate colour pink.
- (iii) When one allele is not completely dominant to another allele it shows incomplete dominance. Such allelic interaction is known as incomplete dominance. F_1 generation produces intermediate phenotype pink coloured flower.



Incomplete dominance in 4 o'clock plant

- (iv) When pink coloured plants of F_1 generation were interbred in F_2 both phenotypic and genotypic ratios were found to be identical as 1 : 2 : 1 (1 red : 2 pink : 1 white).
- (v) Genotypic ratio is 1 R^1R^1 : 2 R^1R^2 : 1 R^2R^2 . From this we conclude that the alleles themselves remain discrete and unaltered proving the Mendel's Law of Segregation.
- (vi) R^1 allele codes for an enzyme responsible for the formation of red pigment. R^2 allele codes for defective enzyme. R^1 and R^2 genotypes produce only enough red pigments to make the flower pink.
- (vii) It is very clear that Mendel's particulate inheritance takes place in this cross which is confirmed by the reappearance of original phenotype in F_2 .

21. (a) Anatomical adaptations of Xerophytes:

- Presence of multi-layered epidermis with heavy cuticle to prevent water loss due to transpiration.
- Hypodermis is well developed with sclerenchymatous tissues.
- Sunken shaped stomata are present only in the lower epidermis with hairs in the sunken pits.
- Scotoactive type of stomata found in succulent plants .
- Vascular bundles are well developed with several layered bundle sheath.
- Mesophyll is well differentiated into palisade and spongy parenchyma.
- In succulents, the stem possesses a water storage region.

(OR)

(b) Active principle and Medicinal values of the plants :

(i) Keezhanelli

Botanical name : *Phyllanthus amarus*

(i) **Active principle:** Phyllanthin is the major chemical component.

(ii) Medicinal Values:

- It is used in Tamil Nadu for the treatment of Jaundice.
- It's extract is effective against hepatitis B virus.

(ii) Nilavembu:

Botanical name : *Andrographis paniculata*.

(i) **Active principle:** Andrographolides

(ii) Medicinal Values :

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



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PART - I

Note : (i) Answer **all** the questions. (15 × 1 = 15)

(ii) Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer.

1. In soil, water available for plants is :

- (a) Capillary water
- (b) Gravitational water
- (c) Hygroscopic water
- (d) Chemically bound water

2. Which one of the following is the first cell of female gametophyte?

- (a) Microspore
- (b) Primary endosperm Nucleus
- (c) Nucleus
- (d) Functional megaspore

3. Match the following :

(1)	Exonuclease	(i)	add or remove phosphate
(2)	Endonuclease	(ii)	binding the DNA fragments
(3)	Alkaline Phosphatase	(iii)	cut the DNA at terminus
(4)	Ligase	(iv)	cut the DNA at middle

- (a) (1)-(i), (2)-(iii), (3)-(ii), (4)-(iv)
- (b) (1)-(i), (2)-(ii), (3)-(iii), (4)-(iv)
- (c) (1)-(iii), (2)-(iv), (3)-(i), (4)-(ii)
- (d) (1)-(iii), (2)-(iv), (3)-(ii), (4)-(i)

4. Tamarindus indica is indigenous to :

- (a) South America, Greece
- (b) Tropical African region
- (c) India alone
- (d) South India, Sri Lanka

5. The phenotypic ratio of complementary genes :

- (a) 9 : 7
- (b) 9 : 3 : 3 : 1
- (c) 9 : 3 : 4
- (d) 9 : 6 : 1

6. Solidifying agent used in plant tissue culture is :

- (a) EDTA
- (b) Nicotinic acid
- (c) Agar
- (d) Cobaltous chloride

7. "The Father of Indian Green Revolution" is :

- (a) Dr. M.O.Parthasarathy
- (b) Dr. Verghese Kurien
- (c) Dr. M.S. Swaminathan
- (d) Dr. M.S.Sabarinathan

8. Depletion of _____ gas in the atmosphere can lead to an increased incidence of skin cancer.

- (a) Nitrous oxide
- (b) Ammonia
- (c) Ozone
- (d) Methane

9. Ruminant endosperm is found in :

- (a) *Vallisneria*
- (b) *Cocos*
- (c) *Arachis*
- (d) *Areca catechu*

10. "Gametes are never hybrid". This is a statement of:
- Law of Segregation
 - Law of Dominance
 - Law of Random Fertilization
 - Law of Independent Assortment
11. Groundnut is native of _____.
- North America
 - Philippines
 - Brazil
 - India
12. Pedogenesis refers to:
- Population
 - Fossils
 - Water
 - Soil
13. Which one of the following represents the flow of genetic information?
- RNA → Protein → DNA
 - DNA → RNA → Protein
 - Protein → RNA → DNA
 - RNA → DNA → Protein
14. Initiation Codon is:
- UAG
 - UUU
 - AUG
 - UGA
15. For efficient photosynthesis which colours of light are absorbed by the plants?
- Blue, Green
 - Blue, Red
 - Green, Pink
 - Red, Green
19. What is gene mapping?
20. Draw the structure of pBR 322.
21. What is Somatic Hybridization?
22. What is seed ball?
23. Write a note on green manuring.
24. Which of the two phenomena are considered as inherent capacities of living plant cell?

PART - III

Note: Answer any six of the following questions. Question number 33 is compulsory. (6 × 3 = 18)

- Differentiate Grafting and Layering.
- Draw diagram of different types of aneuploidy.
- What is meant by Capping and Tailing?
- Write the benefits and risks of Genetically modified food.
- What are the objectives of afforestation?
- What is Ecological Hierarchy? Name the levels of Ecological hierarchy.
- How are microbial inoculants used to increase the soil fertility?
- Pyramid of energy is always upright. Give reasons.
- Differentiate Embryoids and Artificial Seeds.

PART - IV

Note: Answer all the questions. (5 × 5 = 25)

- (a) Draw the structure of ovule and label it.
(OR)
(b) Write the significance of plant succession.
- (a) Bring out the inheritance of chloroplast gene with example.
(OR)
(b) Describe RNA Editing in plants.

Note: Answer any six of the following questions. Question number 24 is compulsory. (6 × 2 = 12)

- What is Cantharophily?
- Give the names of the scientists who rediscovered Mendelism.
- What is intragenic gene interaction? Classify gene interaction.

36. (a) Mention the applications of Bio-Technology.

(OR)

(b) Explain the steps involved in Protoplast Culture.

37. (a) Suggest a solution to water crisis and explain its advantages.

(OR)

(b) Explain different types of Hydrophytes with examples.

38. (a) List out the new breeding techniques involved in developing new traits in plant breeding.

(OR)

(b) Write the economic importance of Rice and Teak.

ANSWERS

PART - I

- (a) Capillary water
- (d) Functional megaspore
- (c) (1)-(iii), (2)-(iv), (3)-(i), (4)-(ii)
- (b) Tropical African region
- (a) 9 : 7
- (c) Agar
- (c) Dr. M.S.Swaminathan
- (c) Ozone
- (d) *Areca catechu*
- (a) Law of Segregation
- (c) Brazil
- (d) Soil
- (b) DNA → RNA → Protein
- (c) AUG
- (b) Blue, Red

PART - II

16. **Cantharophily** : The cross pollination of flowers by beetles is called cantharophily. These beetles feed on the pollen or on some juicy tissues of the flowers.

17. Mendel died in 1884. In 1900 the work of Mendel's experiments were rediscovered by three biologists,

- Hugo de Vries – Holland
- Carl Correns – Germany
- Erich von Tschermak – Austria

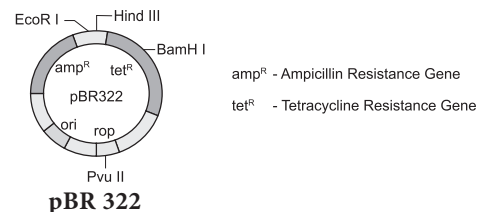
18. **Intragenic gene interaction**: Interactions take place between the alleles of the same gene i.e., alleles at the same locus is called intragenic or intralocus gene interaction.

Gene interactions: Classification

- Intralocus interactions (Allelic interactions)
 - Dominant relationship
 - Lethal genes
 - Multiple alleles
- Interlocus interactions (Non-allelic interactions)
 - Epistatic / Non-epistatic interactions
 - Additive / Polygenic interactions

19. **Gene Mapping** : The diagrammatic representation of position of genes and related distances between the adjacent genes is called genetic mapping. It is directly proportional to the frequency of recombination between them. It is also called as linkage map. The concept of gene mapping was first developed by Alfred H Sturtevant.

20. **Structure of pBR 322 Plasmid:**



21. **Somatic Hybridization:** The fusion product of protoplasts without nucleus of different cells is called a cybrid. Following this nuclear fusion happens. This process is called somatic hybridization and it is done in protoplast culture.

22. **Seed Ball:**

- Seed ball is a technique of human aided seed dispersal.
- Seed ball is an ancient Japanese technique of encasing seeds in a mixture of clay and soil humus (also in Cow dung) and scattering them on to suitable ground, not planting of trees manually.
- This method is suitable for barren and degraded lands for tree regeneration and vegetation before monsoon period where the suitable dispersal agents become rare.

23. **Green Manuring :**

- It is defined as growing of green manure crops and use of these crops directly in the field by ploughing.

(ii) It is used to increase nitrogen in the soil.
Ex: *Crotalaria juncea*

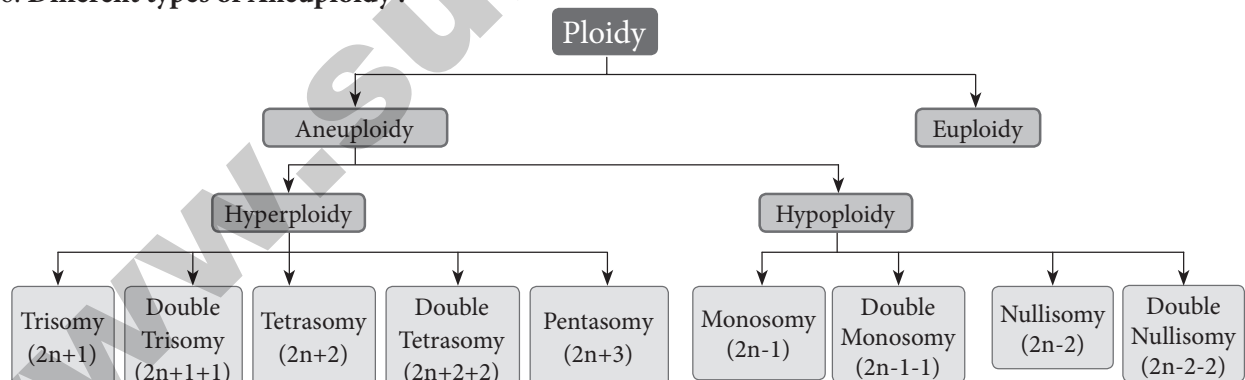
24. Re-differentiation and De-differentiation are the two phenomena are considered as inherent capacities of living plant cell. This is described as totipotency.

PART - III

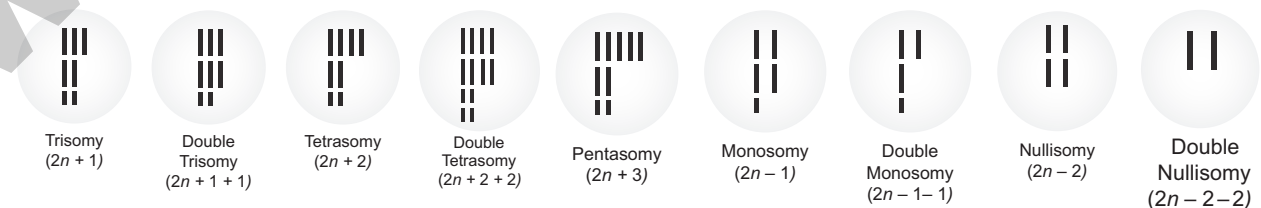
25.

	Grafting	Layering
1.	Two different plants are involved.	Only parent plant is involved.
2.	Parts of two different plants are joined and continue to grow as one plant.	Stem of the parent plant is allowed to develop roots.
3.	Plant used for grafting is called scion.	The rooted part is cut and grown as a new plant.
4.	Eg. Citrus, Mango and Apple.	Eg. <i>Ixora</i> and <i>Jasminum</i> .

26. **Different types of Aneuploidy :**



Types of Aneuploidy



27. **Capping:** Heterogenous nuclear RNA is the precursor of mRNA modification at the 5' end of the primary RNA transcript (hnRNA) with methylguanosine triphosphate is called capping.

Tailing/Polyadenylation : The 3' end of hnRNA is cleaved by an endonuclease and a string of adenine nucleotides is added to the 3' end of hnRNA (pre mRNA) is known as Poly (A) tail - Polyadenylation. This process is called tailing or polyadenylation.

28. **GM Food - Benefits:**

- (i) High yield without pest.
- (ii) 70% reduction of pesticide usage.
- (iii) Reduce soil pollution problem.
- (iv) Conserve microbial population in soil.

Risks :

- (i) Affect liver, kidney function and cancer.
- (ii) Hormonal imbalance and physical disorder.
- (iii) Anaphylactic shock (sudden hypersensitive reaction) and allergies.
- (iv) Adverse effect in immune system because of bacterial protein.
- (v) Loss of viability of seeds show in terminator seed technology of GM crops.

29. **Objectives of Afforestation :**

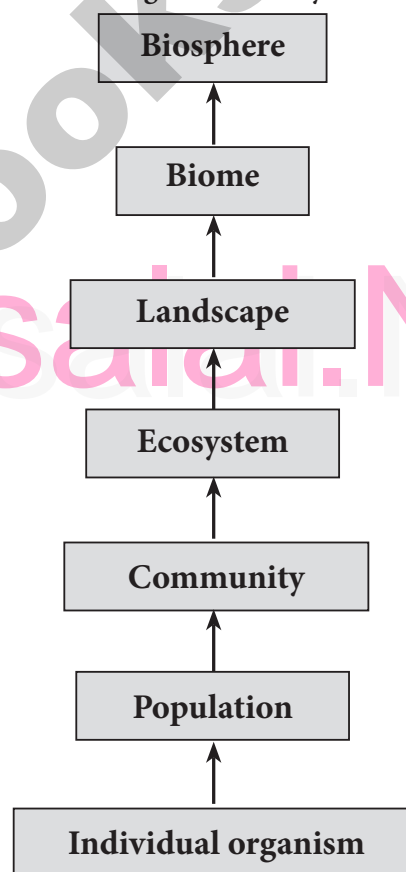
- (i) To increase forest cover, planting more trees, increases O₂ production and air quality.
- (ii) Rehabilitation of degraded forests to increase carbon fixation and reducing CO₂ from atmosphere.
- (iii) Raising bamboo plantations.
- (iv) Mixed plantations of minor forest produce and medicinal plants.

(v) To increase the level and availability of water table or ground water and reduce nitrogen leaching in soil and nitrogen contamination of drinking water, thus making it pure not polluted with nitrogen.

30. (i) The interaction of organisms with their environment results in the establishment of grouping of organisms which is called ecological **hierarchy** or **ecological levels of organization**.

(ii) The basic unit of ecological hierarchy is an individual organism.

Levels of ecological hierarchy:



31. (i) Biofertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil.

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Sura's ■ XII Std - Bio - Botany & Botany - Public Examination - March - 2023 Question Paper with Answers

- (ii) **Other name for biofertilizers:** Microbial cultures, bioinoculants, bacterial inoculants or bacterial fertilizers.

Types of biofertilizers or microbial inoculants.

- (I) **Rhizobium biofertilizers:** It is best suited for the paddy fields which increase the yield by 15 – 40%.

- (II) **Azolla:** It is used for wetland rice cultivation and is known to contribute 40 – 60 kg/ha/ crop. It increases the yield of rice crop as it quickly decompose in soil.

- (III) **Arbuscular mycorrhizae:** It has the ability to dissolve the phosphates found in abundance in the soil. It provides necessary strength to resist disease, germs and unfavourable weather conditions. It also assures water availability.

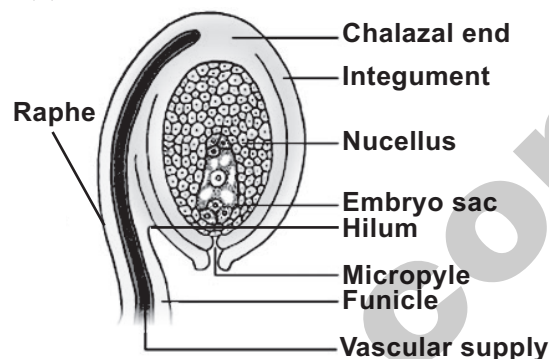
32. The bottom of the pyramid of energy is occupied by the producers. There is a gradual decrease in energy transfer at successive tropic levels from producers to the upper levels. Therefore, the **pyramid of energy is always upright.**

33.

Sl. No.	Embryoids	Artificial Seeds
1.	Process of tissue culture in which the callus cells undergoes differentiation and produces somatic embryos, known as Embryoids.	Artificial seeds are produced by using embryoids through in-vitro culture. They are coated with inert materials like agarose and sodium alginate to obtain artificial seeds
2.	It is used for the production of synthetic seeds.	It is used to produce identical plants.

PART - IV

34. (a)



Structure of an ovule

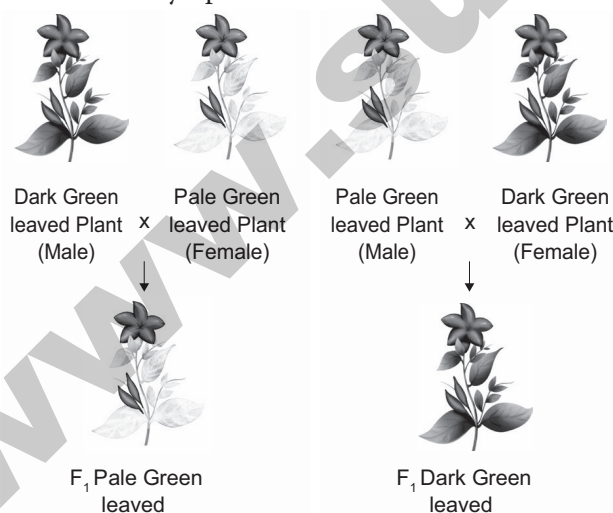
(OR)

- (b) **Significance of Plant Succession :**

- (i) Succession is a dynamic process. Hence an ecologist can access and study the seral stages of a plant community found in a particular area.
- (ii) The knowledge of ecological succession helps to understand the controlled growth of one or more species in a forest.
- (iii) Utilizing the knowledge of succession, even dams can be protected by preventing siltation.
- (iv) It gives information about the techniques to be used during reforestation and afforestation.
- (v) It helps in the maintenance of pastures.
- (vi) Plant succession helps to maintain species diversity in an ecosystem.
- (vii) Patterns of diversity during succession are influenced by resource availability and disturbance by various factors.
- (viii) Primary succession involves the colonization of habitat of an area devoid of life.
- (ix) Secondary succession involves the reestablishment of a plant community in disturbed area or habitat.
- (x) Forests and vegetation that we come across all over the world are the result of plant succession.

35. (a) **Chloroplast Inheritance:**

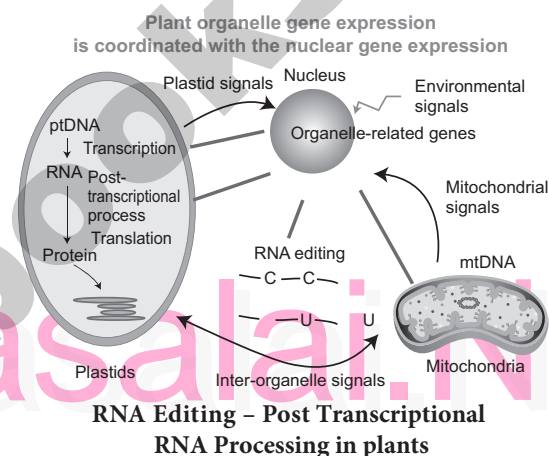
- (i) It is found in 4 O' Clock plant (*Mirabilis jalapa*).
- (ii) Two types of variegated leaves namely (i) Dark green leaved plants (ii) Pale green leaved plants.
- (iii) When pollen of dark green leaved plant (male) is transferred to the stigma of pale green leaved plant (female) and pollen of pale green leaved plant is transferred to the stigma of dark green leaved plant, the F₁ generation of both the crosses must be identical as per Mendelian inheritance.
- (iv) But in the reciprocal cross, the F₁ plant differs from each other.
- (v) In each cross, the F₁ plant reveals the character of the plant which is used as female plant.
- (vi) This inheritance is not through nuclear gene. It is due to the chloroplast gene found in the ovum of the female plant which contributes the cytoplasm during fertilization since the male gamete contribute only the nucleus but not cytoplasm.

**Chloroplast inheritance**

(OR)

(b) **RNA Editing in plants :**

- (i) Chemical modification such as (1) base modification, (2) nucleotide insertion or deletions, (iii) nucleotide replacements of mRNA results in the alteration of amino acid sequence of protein that is called RNA editing.
- (ii) This results in the change in the protein coding sequence of RNA following transcription.
- (iii) The coding properties of the RNA transcript is changed.



- (iv) The genetic information encoded in the chloroplast genome is altered by post transcriptional phenomenon which is site – specific (C → U) in chloroplast of higher plants – RNA editing occurs in plant mitochondria and chloroplast.
- (v) In plant cells, RNA editing by pyrimidine transitions occurs in mitochondria and plastids (chloroplast).

Types of RNA editing :

1. **Substitution editing** –Alteration of individual nucleotide bases. Mitochondria and chloroplast RNA in plants.
2. **Insertion / Deletion editing** – Nucleotides are added or deleted from the total number of bases.

Significance of RNA editing :

- (i) In higher plant chloroplast, it helps to restore the codons for conserved amino acids such as initiation and termination codon.
- (ii) It regulates organellar gene expression in plants.
- (ii) RNA editing results in the restoration of codons for phylogenetically conserved amino acid residues.

Year	Editing type	Organelle in Plant cell	Target	Interference/Result
1989	C → U	Plant mitochondria	mRNA	For conserved amino acids, multiple changes in codon takes place
1990	U → C	Plant mitochondria	mRNA	First report on editing (U → C)
1991	C → U	Plant chloroplast	mRNA	First report in chloroplast

36.(a) Biotechnology has wide applications in agriculture, medicine, environment and commercial industries.

Agricultural Application:

- (i) Outcome of transgenic varieties of plants. Eg: transgenic cotton (Bt-cotton), rice, tomato, tobacco, cauliflower, potato and banana.
- (ii) The development of transgenics are produced as pesticide resistant, stress resistant and disease resistant is the immense outcome of biotechnology.

Medicinal Application:

- (i) The synthesis of human insulin and blood protein in *E.coli* Used to treat for insulin deficiency disorder in human is a breakthrough in biotech industries in medicine.
- (ii) The synthesis of vaccines, enzymes, antibiotics.

Commercial Application:

- (i) Producing Dairy products and beverages.
- (ii) Biochip is based on biological computer is one of the successes of bio-technology.
- (iii) Genetic engineering is involves genetic manipulation, tissue culture involves aseptic cultivation of totipotent plant cell into plant clones under controlled atmospheric conditions.
- (iv) Single cell protein from *Spirulina* is utilized in food industries.

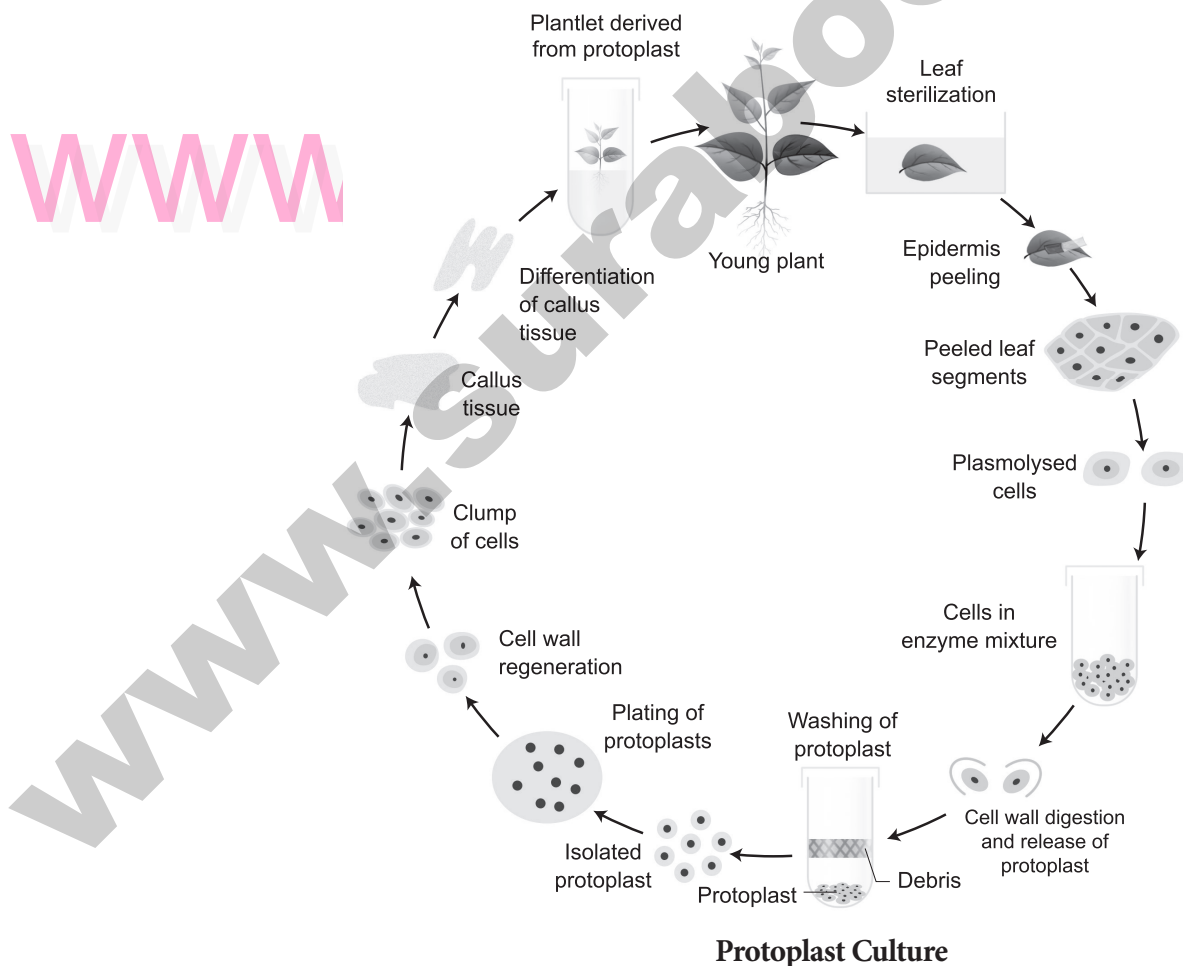
Environment Application:

- (i) Production of secondary metabolites, biofertilizers, biopesticides and enzymes.
- (ii) Biomass energy, biofuel, bioremediation, phytoremediation for environmental biotechnology.

(OR)

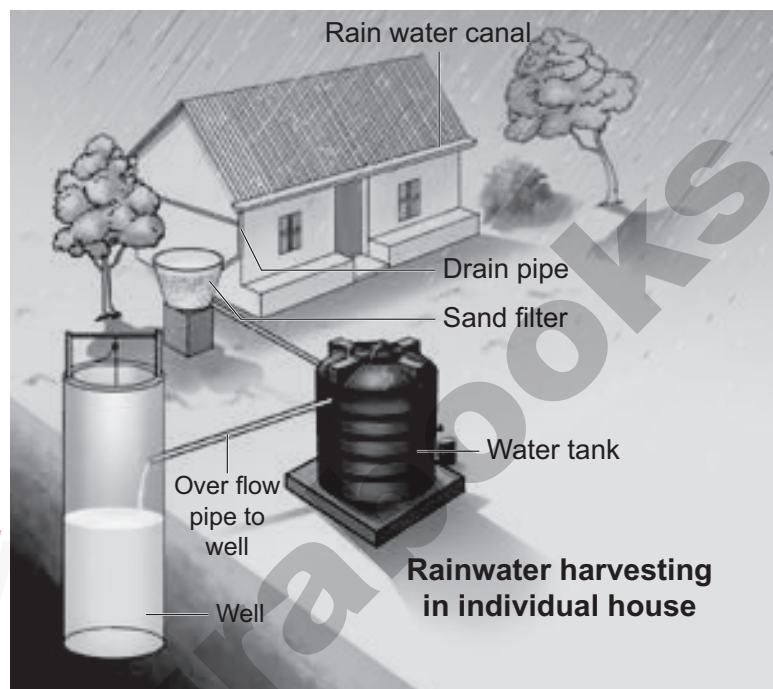
- (b) **Protoplast Culture :** Protoplasts are cells without a cell wall, but bound by a cell membrane or plasma membrane. Using protoplasts, it is possible to regenerate whole plants from single cells and also develop somatic hybrids. The steps involved in protoplast culture.

- i. **Isolation of protoplast:** Small bits of plant tissue like leaf tissue are used for isolation of protoplast. The leaf tissue is immersed in 0.5% Macrozyme and 2% Onozuka cellulase enzymes dissolved in 13% sorbitol or mannitol at pH 5.4. It is then incubated over-night at 25°C. After a gentle teasing of cells, protoplasts are obtained, and these are then transferred to 20% sucrose solution to retain their viability. They are then centrifuged to get pure protoplasts as different from debris of cell walls.
- ii. **Fusion of protoplast:** It is done through the use of a suitable fusogen. This is normally PEG (Polyethylene Glycol). The isolated protoplast are incubated in 25 to 30% concentration of PEG with Ca^{++} ions and the protoplast shows agglutination (the formation of clumps of cells) and fusion.
- iii. **Culture of protoplast:** MS liquid medium is used with some modification in droplet, plating or micro-drop array techniques. Protoplast viability is tested with fluorescein diacetate before the culture. The cultures are incubated in continuous light 1000-2000 lux at 25°C. The cell wall formation occurs within 24-48 hours and the first division of new cells occurs between 2-7 days of culture.
- iv. **Selection of somatic hybrid cells:** The fusion product of protoplasts without nucleus of different cells is called a cybrid. Following this nuclear fusion takes place. This process is called somatic hybridization.



37. (a) **Water crisis :**

- (i) Rain water harvesting (RWH) is the best solution to water crisis.
- (ii) Rainwater harvesting is the accumulation and storage of rain water for reuse in-site rather than allowing it to run off.
- (iii) The water percolates and gets stored in the pit. RWH is a sustainable water management practice implemented not only in urban area but also in agricultural fields, which is an important economical cost effective method for the future.



Pictures of Rain Water Harvesting Structures in Ooraniers

Advantages:

- (i) Promotes adequacy of underground water and water conservation.
- (ii) Mitigates the effect of drought.
- (iii) Reduces soil erosion as surface run-off is reduced.
- (iv) Reduces flood hazards.
- (v) Improves groundwater quality and water table / decreases salinity.
- (vi) No land is wasted for storage purpose and no population displacement is involved.
- (vii) Storing water underground is an eco-friendly measure and a part of sustainable water storage strategy for local communities.

(OR)

(b) **Different types of Hydrophytes :**

Hydrophytes are classified according to their relation to water and air.

They are :

(i) **Free floating hydrophytes :**

- ◆ These plants float freely on the surface of water.
- ◆ They remain in contact with water and air, but not with soil.

Examples : *Eichhornia*, *Pistia* and *Wolffia*

(ii) **Rooted floating hydrophytes :**

- ◆ The roots are fixed in mud, but their leaves and flowers are floating on the surface of water.
- ◆ Plants are in contact with soil, water and air.

Examples : *Nelumbo*, *Nymphaea*, *Potamogeton* and *Marsilea*.

(iii) **Submerged floating hydrophytes :**

- ◆ Plants are completely submerged in water and not in contact with soil and air.

Examples : *Ceratophyllum* and *Utricularia*.

(iv) **Rooted-submerged hydrophytes :**

- ◆ Plants are completely submerged in water and rooted in soil and not in contact with air.

Examples : *Hydrilla*, *Vallisneria* and *Isoetes*.

(v) **Amphibious hydrophytes (Rooted emergent hydrophytes) :**

- ◆ Plants are adapted to both aquatic and terrestrial modes of life. Grow in shallow water.

Examples : *Ranunculus*, *Typha* and *Sagittaria*.

38. (a) **NBT - New Breeding Techniques.**

NBT are a collection of methods that could increase and accelerate the development of new traits in plant breeding. These techniques often involve genome editing, to modify DNA at specific locations within the plants to produce new traits in crop plants. The various methods of achieving these changes in traits include the following.

- (i) Cutting and modifying the genome during the repair process by tools like CRISPR /Cas.
- (ii) Genome editing to introduce changes in few base pairs using a technique called Oligonucleotide-directed mutagenesis (ODM).
- (iii) Transferring a gene from an identical or closely related species (cisgenesis).
- (iv) Organising processes that alter gene activity without altering the DNA itself(epigenetic methods).

(OR)

(b) Economic Importance of Rice :

1. Rice is the easily digestible calorie rich cereal food which is used as a staple food in Southern and North East India.
2. Rice products such as Flaked rice, Puffed rice / parched rice are used as breakfast or as snack in different parts of India.
3. Rice bran oil obtained from the rice bran is used in culinary and industrial purposes.
4. Husks are used as fuel, and in the manufacture of packing material and fertilizer.

Economic Importance of Teak :

1. Teak is one of best timbers of the world. The wood does not split or crack and is a carpenter friendly wood.
2. The heartwood is golden yellow to golden brown when freshly sawn, turning darker when exposed to light. Known for its durability as it is immune to the attack of termites and fungi.
3. It was the chief railway carriage and wagon wood in India.
4. Ship building and bridge-building depends on teakwood. It is also used in making boats, toys, plywood, door frames and doors.


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