Previous IPE

SOLVED PAPERS

MARCH -2020 (TS)

PREVIOUS PAPERS

IPE: MARCH-2020(TS)

Time: 3 Hours **SR BOTANY** **Max. Marks: 60**

SECTION-A

I. Answer ALL the following VSAQ: **10 × 2 = 20**

1. Define water potential. What is the value of water potential of pure water?
2. Distinguish between apoenzyme and cofactor.
3. What are pleomorphic bacteria? Give an example.
4. Who proposed the Chromosome theory of Inheritance?
5. What is the function of the codon-AUG.
6. What are the components of a nucleotide?
7. Name the nematode that infects the roots of tobacco plants.
   Name the strategy adopted to prevent this infestation.
8. What is green revolution? Who is regarded as Father of green revolution?
9. Why does 'Swiss cheese' have big holes. Name the bacteria responsible for it.
10. What is Nucleopolyhedrovirus is being used for now a days?

SECTION-B

II. Answer any SIX of the following SAQs: **6 × 4 = 24**

11. "Transpiration is a necessary evil". Explain.
12. Describe in brief photorespiration.
13. Explain the steps involved in the formation of root nodule.
14. Write a note on agricultural/horticultural applications of auxins.
15. Explain the structure of T-even bacteriophages.
16. Mention the advantages of selecting pea plant for experiment by Mendel.
17. What are the differences between DNA and RNA
18. Give a brief account of Bt cotton.

SECTION-B

II. Answer any TWO of the following SAQs: **2 × 8 = 16**

19. Give an account of glycolysis. Where does it occur? What are the end products? Trace the fate of these products in both aerobic and anaerobic respiration.
20. Give a brief account of the tools of recombinant DNA technology.
21. Describe the tissue culture technique and what are the advantages of tissue culture over conventional method of plant breeding in crop improvement programmes?

IPE TS MARCH-2020

SOLUTIONS

SECTION-A

1. Define water potential. What is the value of water potential of pure water? [TS 20]

A: 1) **Water potential (ψ_w):** Water potential is the measure of movement of water from one part to the another part within the plant. It involves diffusion, osmosis.

2) The value of water potential of pure water is taken as zero.

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2. Distinguish between apoenzyme and cofactor. [MAR-14][TS 17,20]

A: 1)**Apoenzyme:** Protein part of a holo enzyme is called apoenzyme. It is chemically proteinaceous.

2)**Co-factor:** Non-protein part of a holo enzyme is called co-factor.

It makes the enzyme catabolically active.

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3. What are pleomorphic bacteria? Give an example. [TS 18,20][AP 17]

A: 1) The bacteria which are capable of changing their shape depending on the environmental conditions, nutrition are called pleomorphic bacteria.

2) **Ex:** Aceto bacter.

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4. Who proposed the Chromosome theory of Inheritance? [TS 20,22] [AP 17, 19,22]

A: Sutton and Boveri.

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5. What is the function of the codon-AUG. [AP 20,22][TS 20]

A: AUG has two functions:

1) It acts as initiation codon of mRNA.

2) It codes for the amino acid methionine.

6. What are the components of a nucleotide? [TS 17,18][AP 17,18,19,22]

A: A nucleotide has 3 components:

Nitrogenbase, pentose sugar and phosphate molecule.

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7. Name the nematode that infects the roots of tobacco plants. Name the strategy adopted to prevent this infestation. [TS 18,20][AP 16, 19]

A: 1)The nematode is Meloidegyne incognitia .

2)RNA interference (RNAi) is adopted to prevent the infestation.

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8. What is green revolution? Who is regarded as Father of green revolution? [TS 15,17,20,23]

A. 1)The creation and utilisation of high yielding varieties in the field of agriculture, substantial and dramatic increase in agricultural production is called green revolution.

2)Norman Borlaug is regarded as Father of green revolution.

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9. Why does 'Swiss cheese' have big holes. Name the bacteria responsible for it. [TS 17,18,20][AP 16,18,20]

A: 1) Large holes in 'Swiss cheese' are due to the production of large amounts of CO_2 .

2) The Bacterium Propionibacterium is responsible for it.

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10. What is Nucleopolyhedrovirus is being used for now a days? [TS 17,20] [AP 19]

A: 1) The **Nucleopolyhedroviruses** are used for biological control of insect pests.

2) This is desirable in integrated pest management (IPM) programme

SECTION-B

11. **"Transpiration is a necessary evil". Explain.** **[AP 17,17,20,22][TS 16, 17,20]**

A: Transpiration has both advantages and disadvantages as well, to plants. So it is a 'necessary evil'.

I) Advantages of Transpiration:

1) It creates 'transpiration pull' for absorption and transportation of water in plants.

2) It supplies water for photosynthesis.

3) It transports minerals from the soil to all parts of the plant.

4) **It cools leaf surfaces by evaporative cooling.**

5) It maintains the shape and structure of plants by keeping cells turgid.

II) Disadvantages of Transpiration:

1) Excessive transpiration makes the cells flaccid.

2) This retards growth of the plants.

3) More amount of water is evaporated by transpiration.

4) Thus photosynthesis is limited by the availibility of water.

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12. **Describe in brief photorespiration.** **[TS 19,20]**

A: $RuBP + CO_2 \xrightarrow{RuBisCO} 2 \times 3PGA$

1) RuBisCO is the most abundant enzyme in the world.

2) Its active site can bind to both CO_2 and O_2 hence the name.

3) RuBisCO has a much greater affinity for CO_2 than for O_2.

4) If O_2 concentration is more, RuBisCO functions as oxygenase, and binds with O_2.

5) Instead of forming two molecules of PGA, it forms one molecule of phosphoglycerate and one molecule of phosphoglycolate.

6) This pathway is called photorespiration.

7) In photorespiration pathway there is synthesis of neither sugar nor ATP nor NADPH.

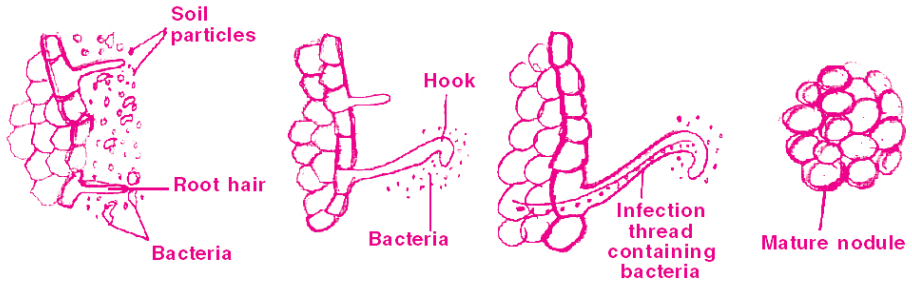
8) Moreover, there is a release of CO_2 with the utilisation of ATP.

9) Therefore photorespiration is a wasteful process.

13. **Explain the steps involved in the formation of root nodule.**

A: Steps involved in the formation of root nodule: **[AP 17, 19,23][TS 16,17,20,23]**

1) The roots of host Legume release sugars and amino acids.
2) These sugars attract Rhizobia.
3) They multiply, colonise and get attached to the epidermis of root hair cells.
4) The root hairs curl and bacteria spread into the cortex of the root.
5) Then an infection thread is produced.
6) It carries the bacteria into the cortex.
7) The bacteria initiate nodule formation in the cortex of the root.
8) Then the bacteria present in the cortical cells, stimulate the host cells to divide.
9) This leads to the differentiation of specialised nitrogen fixing cells, which form root nodule.
10) The nodule thus formed establishes a direct vascular connection with the host, for exchange of nutrients.



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14. **Write a note on agricultural/horticultural applications of auxins.** **[TS 20,22][AP 17,19,22]**

A:
1) Auxins are powerful growth hormones produced in the stems and root tips of plants.
2) In stem cuttings, initiation of roots is noticed. This application is widely used for plant propagation in horticulture.
3) Auxins stimulate fruit growth in tomatoes.
4) Auxins prevent premature fruit drop.
5) Auxins control xylem differentiation and help in growth.
6) Auxins(2,4–D) are used to prepare lawns.
7) Removal of shoot tip results in the growth of lateral buds.
8) This phenomenon is applied in Tea plantation and hedge-making.

15. **Explain the structure of T-even bacteriophages.** **[AP 17,19][TS 18,19,20]**

A: 1) The viruses which attack bacteria are called bacteriophages.

2) Bacteriophages are tadpole-shaped .

3) The head is hexagonal and is capped by hexagonal pyramid.

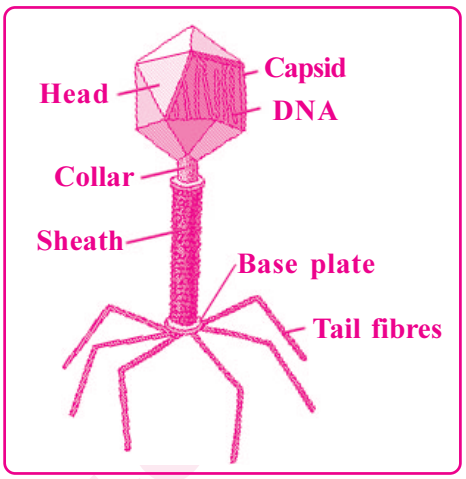
4) The tail is composed of a tail sheath, a base plate, pins and tail fibres.

5) The tail helps injecting viral DNA into the host cell.

6) The head and tail are joined by collar .

7) At the tip of the tail, hexagonal tail plate is present with six tail pins and tail fibres.

8) With the help of tail fibres the virus attaches to the host cells.



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16. **Mention the advantages of selecting pea plant for experiment by Mendel.** **[TS 19,20,22][AP 17,18,23]**

A: Mendel selected garden pea for his experiments due to following advantages:

1) It has many contrasting characters.

2) It can be grown and crossed easily.

3) It has bisexual flowers containing both female and male flowers

4) It can be self pollinated conveniently.

5) It has a short life cycle and produces large number of off springs.

6) It has less number of chromosomes

7) It may be conducted in simple laboratory conditions.

17. What are the differences between DNA and RNA **[AP 20] [TS 17,20,22]**

A: DNA	RNA
1) DNA stands for Deoxyribo Nucleic Acid.	1) RNA stands for Ribo Nucleic Acid.
2) DNA is double stranded Helix.	2) RNA is single stranded Helix.
3) DNA is stable under alkaline condition.	3) RNA is unstable under alkaline condition.
4) DNA contains the sugar Deoxyribose	4) RNA contains the sugar Ribose.
5) DNA is made up of more than 4 million nucleotides.	5) RNA is made up of 75-2000 nucleotides.
6) DNA undergoes self replication.	6) RNA does not undergo self replication.
7) DNA is genetic material.	7) RNA is non-genetic material.
8) DNA does not participate directly in protein synthesis.	8) RNA participates directly in protein synthesis.
9) DNA is of one type (metabolically).	9) RNA is of three types(metabolically).
10) The base pairing is A=T and G≡C	10) The base pairing is A=U and G≡C

18. Give a brief account of Bt cotton. **[AP 15,20][TS 16,17,18,20,22,23]**

A: 1) Bt cotton is a genetically modified organism (GMO) cotton variety, which produces an insecticide bollworm.

2) Bt cotton is created by using some strains of a bacterium, Bacillus thuringiensis (Bt in short form)

3) This bacterium produces proteins that kill certain insects such as lepidopterans (tobacco bud worm), coleopterans(beetles) and dipterans (flys, mosquitoes)

4) Bt forms protein crystals during a particular phase of growth. These crystals contain a toxic insecticidal protein.

5) Bt toxin protein exist as inactive protoxins, but once an insect ingests the inactive toxin, it is converted into an active form of toxin due to alkaline pH of the gut which solublises the crystals.

6) The activated toxin binds to the surface of mid gut epithelial cells and create pores that cause cell swelling and lysis leading to death of an insect.

7) Specific Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into several crop plants.

8) Most Bt toxins are insect group specific. Hence, the toxin is coded by a gene named 'Cry'. For example, the protein encoded by the genes Cry I Ac and Cry II Ab control the cotton bollworms and Cry I Ab controls corn borer.

SECTION-C

19. Give an account of glycolysis. Where does it occur? What are the end products? Trace the fate of these products in both aerobic and anaerobic respiration. [or] Describe the process of various biochemical reactions that occur during Glycolysis.

[AP 15, 17,20], [TS 15, 17,20]

A: **1) Glycolysis:** Glycolysis is the first step of **respiration** in all living organisms. It takes place in cytoplasm of cells. During Glycolysis, Glucose molecules break down to **release energy**. Glycolysis is the **partial oxidation** of one glucose molecule to form two molecules of pyruvic acid.The end products of Glycolysis are **pyruvic acid (PA), ATP, NADPH +H^+**

2) Fate of Pyruvic acid: In aerobic respiration, where oxygen is available, pyruvic acid will be completely oxidised into CO_2 and H_2O by **Krebs cycle**.

In anaerobic respiration, where oxygen is not available, pyruvic acid will be converted into Ethylalcohol or Lactic acid by **Fermentation.**

Glycolysis involves a chain of '10- step catalysed reactions' by various enzymes.

3) Glycolysis Process:

Step-1 (Phosphorylation):

Glucose + ATP $\xrightarrow{\text{Hexo kinase}}$ Glucose–6 phosphate + ADP

Step-2 (Isomerisation):

Glucose –6–phosphate $\xrightarrow{\text{Hexo phosphate isomerase}}$ Fructose–6–phosphate.

Step-3 (Phosphorylation):

Fructose–6–phosphate + ATP $\xrightarrow{\text{Phospho fructo kinase}}$ Fructose1,6 –biphosphate + ADP

Step-4 (Cleavage):

Fructose1,6–biphosphate $\xrightarrow{\text{Aldolase}}$ Glyceraldehyde–3 -phosphate+DHAP

Step-5 (Isomerisation):

DHAP $\xrightarrow{\text{Triose phosphate isomerase}}$ G–3P

Step 6 (Oxidation) :

G–3P + $H_2PO_4^-$ + NAD^+ $\xrightarrow{\text{G–3P dehydrogenase}}$ 1,3–biphospho glyceric acid +NADH + H^+

Step-7 (Dephosphorylation):

1,3biphospho glyceric acid + ADP + iP $\xrightarrow{\text{Phospho glycero kinase}}$ 3–phospho glyceric acid +ATP

Step-8 (Intramolecular shift):

3–PGA $\xrightarrow{\text{Phospho glycero mutase}}$ 2–PGA

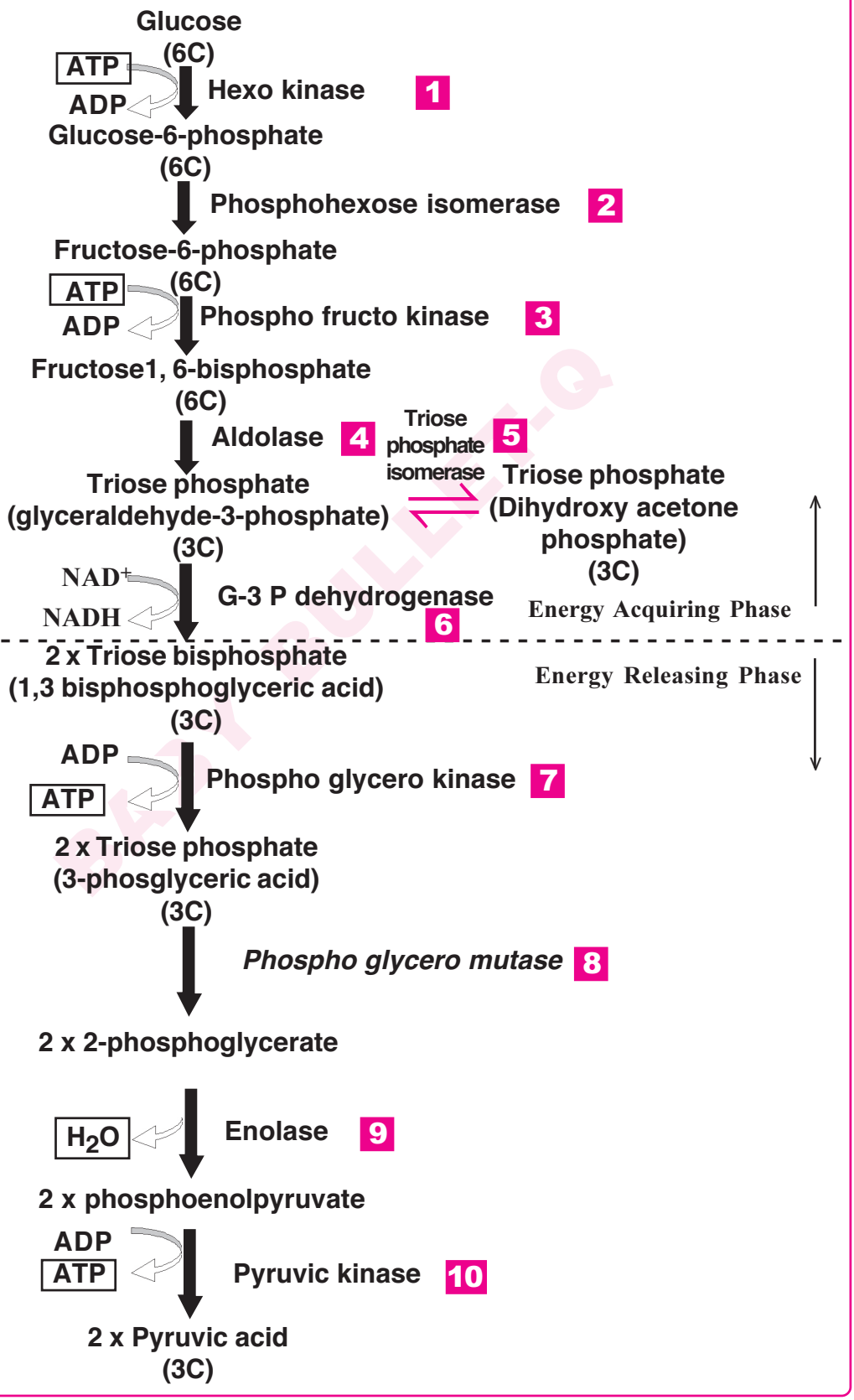
Step-9 (Dehydration):

2– PGA $\xrightarrow{\text{Enolase}}$ Phospho enol pyruvic acid(PEP) + H_2O

Step-10 (Dephosphorylation):

PEP + ADP $\xrightarrow{\text{Pyruvic kinase}}$ Pyruvic acid + ATP.

SCHEMATIC REPRESENTATION OF GLYCOLYSIS



20. Give a brief account of the tools of recombinant DNA technology.

[TS 17,19,20, 23][AP 15,17,19,20,23]

A: Tools of recombinant DNA technology:

1) Restriction enzymes 2) Polymerase enzymes 3) Ligases 4) Vectors 5) Host organism

1) Restriction enzymes: Restriction enzymes belong to a larger class of enzymes called nucleases. These are two kinds

(i) Exonucleases: Exonucleases remove nucleotides from the ends of the DNA

(ii) Endonucleases: Endonucleases make cuts at specific positions within the DNA.

Each restriction endonuclease recognises a specific palindromic sequence in the DNA.

The palindrome in DNA is a sequence of base pairs, that reads the same on the two strands

Ex: EcoRI recognises 5^1 GAATTC 3^1 sites on the DNA and cuts in between G and A

5^1 G A A T T C 3'

3^1 C T T A A G 5'

2) Polymerase enzymes:

(i) In polymerase chain reaction multiple copies of gene of interest are synthesized by using primers and DNA polymerase.

(ii) In this process the replication of DNA is repeated many times and 1 billion copies can be produced.

(iii)Such amplification is achieved by Taq polymerase which remain active at high temperatures.

(iv) The amplified fragment, if desired, can now be used to ligate with a vector for further cloning.

3) Ligases: The enzyme DNA ligase, joins the ends of plasmid DNA with that of desired gene by covalent bonding. It regenerates a circular hybrid called rDNA.

4) Vectors: The DNA used as a carrier, for transferring a fragment of foreign DNA, into a suitable host called vector.

(i) Vectors used for multiplying the foreign DNA sequences are called cloning vectors.

(ii) Commonly used cloning vectors are plasmids, bacteriophages, cosmids, BAC, YAC.

Properties of cloning vectors:

(i) They must have low molecular weight

(ii) They must have unique cleavage site for the activity of restriction sites.

(iii)They must be able to replicate inside the host cell after its introduction.

(iv)They require a 'selectable marker' which helps in identifying and eliminating non transformants.

5) Host organisms: Competent host for transformation with r-DNA is made by treating host with Ca^{+2} ions

21. Describe the tissue culture technique and what are the advantages of tissue culture over conventional method of plant breeding in crop improvement programmes?

[AP 15,16,17,19,19,20,22,23][TS 15,17,19,20]

A: I) Tissue Culture: The technique of growing, culturing and maintaining cells, tissues and organs in vitro is known as tissue culture. It is based on the cellular totipotency.

Plant tissue culture techniques:

1) Preparation of nutrient culture medium. 2) Sterilization of the culture medium.
3) Preparation of explant. 4) Inoculation of explant.
5) Incubation for growth 6) Acclimatization of plantlets and transfer to pots.

1) Preparation of nutrient culture medium: The nutrient medium must provide a carbon source such as sucrose and also inorganic salts, vitamins, aminoacids and growth regulators like auxins, cytokinins etc.

2) Sterilization of the culture medium.: The culture medium is rich in nutrients and therefore attracts micro organisms. So the medium should be sterilised. Sterilisation is carried out in an autoclave for 15 min, at 121ºC and 15 lb pressure.

3) Preparation of explant: Any living part of the plant such as root, stem etc which is used as inoculum is called explant.

4) Inoculation of explants: The transfer of explants onto the sterile medium is called inoculation. It is carried out in the laminar air-flow chamber.

5) Incubation for growth:

(i) The cultures are incubated for 3 to 4 weeks. During thie period the cells of the explant absorb nutrients, grow and undergo repeated mitotic divisions. They produce an undifferentiated mass of cells known as callus.

(ii) Auxins and Cytokinins are added to the culture media, so that the callus is induced to produce organs like roots and shoots. This phenomenon is called organogenesis.

(iii)The explant develops an embryonic callus through embryogenesis, from which embryoids are produced.

(iv)Since, these embryoids develop from somatic tissues they are referred to as somatic embryos.

6) Acclimatization of plantlets and transfer to pots: The plants generated through organogenesis need to be acclimatized before they are transferred to pots.

II) Advantages of Tissue Culture:

(i) More number of plants can be produced in a short time.
(ii) Virus diseases can be prevented by producing virus free plants from shoot-tip cultures.
(iii) Seedless plants can be multiplied
(iv) Female plants are selectively produced through tissue culture.
(v) Somatic hybrids can be raised by tissue culture, where sexual hybridisation is not possible.
(vi) Tissue culture of medicinal plants produce high value products of industrial and medicinal importance.

PLANT TISSUE CULTURE TECHNIQUE