Previous IPE

SOLVED PAPERS

MARCH-2024 (TS)

PREVIOUS PAPERS

IPE: MARCH-2024(TS)

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

SECTION-A

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

1. What are porins? What role do they play in diffusion?
2. Define hydroponics.
3. What is the shape of T_4 phage? What is its genetic material?
4. Explain the terms phenotype and genotype.
5. Define stop codon. Write the codons.
6. Write any two differences between DNA and RNA
7. What is the full form of PCR? How is it useful in biotechnology?
8. What is GEAC and what are its objectives?
9. Why does 'Swiss cheese' have big holes. Name the bacteria responsible for it.
10. What are fermentors?

SECTION-B

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

11. Explain the mechanism of opening and closing of stomata.
12. Write briefly about enzyme inhibitors.
13. Draw a neat labelled diagram of a chloroplast.
14. Write the physiological responses of gibberellins in plants.
15. Explain the conjugation in bacteria.
16. Explain the Incomplete dominance with example.
17. Write the important features of Genetic code?
18. Give a brief account of Bt cotton.

SECTION-C

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

19. Explain the reactions of Krebs cycle.
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-2024
SOLUTIONS

SECTION-A

1. What are porins? What role do they play in diffusion? [TS 24][AP 19]

A: 1) **Porins** are a kind of **protein channels**.

2) They form **huge pores** on the outer membranes of plastids, mitochondria and some bacteria.

3) They allow small sized protein molecules to diffuse through them.

4) Thus, porins cause **facilitated diffusion**.

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2. Define hydroponics. [TS 23,24][MAR-14]

A: **Hydroponics:** It is the technique of growing plants in a specified nutrient solution.

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3. What is the shape of T_4 phage? What is its genetic material? [TS MAR-24]

A: 1) The shape of T_4 phage virus is Tadpole shape (Polyhedral symmetry with head & helical in tail)

2) Its Genetic material is double stranded DNA

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4. Explain the terms phenotype and genotype. [TS 17,18,22] [AP 16, 17, 19, 23,24]

A: 1) The **Physical appearance** of a character is called **Phenotype.**

2) The **Genetic makeup** of an individual is called **Genotype.**

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5. Define stop codon. Write the codons. [TS 19] [AP 15, 19]

A: 1) The codons which terminates the protein synthesis are called stop codons.

2) They are UAA, UAG, UGA.

3) They donot code for any amino acid.

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6. Write any two differences between DNA and RNA. [AP 17, 19]

A: 1) DNA has deoxyribose sugar. **DNA undergoes self replication.**

2) RNA has ribose sugar. **RNA doesnot undergoes self replication.**

7. What is the full form of PCR? How is it useful in biotechnology? [TS 15][AP 18,23]

A. 1) Full form of PCR is Polymerase Chain Reaction.

2) PCR technique is used in (i) DNA cloning (ii) gene amplification (iii) DNA finger printing

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8. What is GEAC and what are its objectives? [TS 22][AP 15,17,18]

A: 1) GEAC stands for Genetic Engineering Approval Committee.

2) Objectives: To make decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.

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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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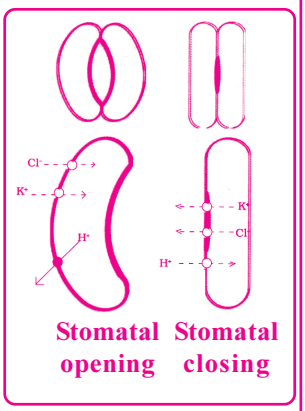
10. What are fermentors? [TS 22][AP 17,22]

A: Fermentors are 'Large vessels' used to produce beverages and antibiotics on large scale.

SECTION-B

11. Explain the mechanism of opening and closing of stomata.

A: Levitt's K^+ ion pump theory:



1) According to this theory, K^+ ions accumulate in the guard cells from the subsidiary cells in the presence of light.
2) This is coupled with efflux of protons which leads to an increase in the pH of guard cells.
3) This is also associated with passive influx of Cl^- ions, there by decreasing the water potential of guard cells.
4) Water enters into guard cells, making them turgid.
5) The outer walls of guard cells are thin and expand outwardly, leaving a minute pore in the centre to open.
6) At night, in the absence of light, K^+ and Cl^- ions move out of guard cells, due to which the water potential of guard cells increases. Hence, water moves out and stomata closes.
7) Under water stress conditions Abscisic acid (ABA), drives the K^+ions out of guard cells making them close.
8) In succulent plants, the water potential gradient is established. Accumulation of organic acids at night makes the guard cells turgid, hence somata opens at night.

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12. Write briefly about enzyme inhibitors. [TS 17,17,19] [AP 17, 19,23]

A: Enzyme Inhibitors: These are the chemicals which2 stop the activity of the enzymes. Those chemicals are called "inhibitors" and the process is called inhibition. The inhibitors are three types. They are 1) Competitive inhibitors 2) Non-competitive inhibitors 3) Feed back inhibitors.

1) Competitive inhibitors: The inhibitors that resemble the substrate molecules and prevents the activity of the enzyme are called competitive inhibitors.

Ex: Malonic acid resembles the substrate succinate and it inhibits the succinic dehydrogenase.

2) Non-competitive inhibitors: The inhibitors having no structural similarity with the substrate and binding to an enzyme of locations other than the active sites so that the globular structure of the enzyme is changed are called non-competitive enzyme inhibitors.

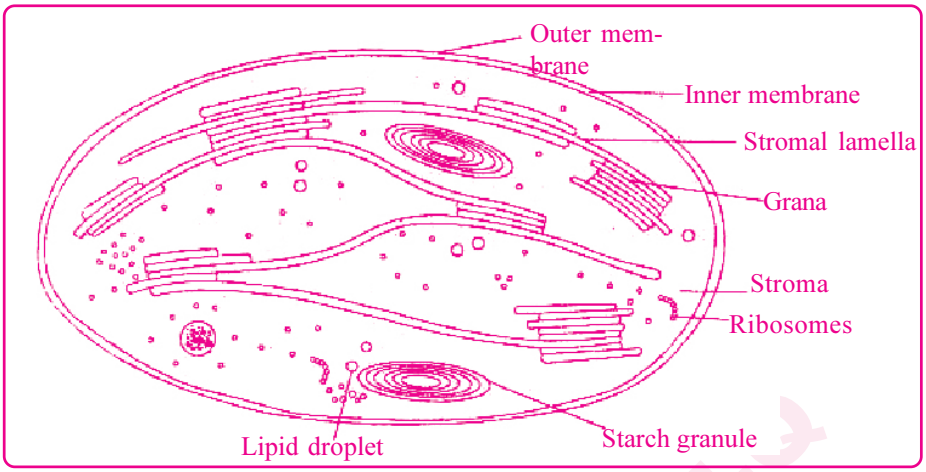
Ex: Metal ions of Copper, Mercury.

3) Feed back inhibitors: Feed back inhibition is a cellular control mechanism in which an enzyme's activity is inhibited by the enzyme's end product.

It is a part of homeostatic control metabolism.

13. Draw a neat labelled diagram of a chloroplast.

A:



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14. Write the physiological responses of gibberellins in plants. [AP 19,24][TS 15]

A: 1) **Gibberellins** are Growth Hormones that stimulate Fruit repining , Stem elongation, Termination, Flowering, Sex expression, Enzyme induction, Leaf & Fruit senescence.

2) Gibberellins are denoted by GA_1, GA_2, GA_3 and so on.

3) GA hastens the maturity period of conifers thus leading to early seed production.

4) GA_3 is used to speed up the malting process in brewing industry.

5) Gibberellins increase the length of the axis, thus used to increase the length of grape's stalks.

6) Gibberellins cause fruits like apple to elongate and improve their shape.

7) They delay senescence.

8) Spraying GA on sugarcane stems, increases the length of stem thus increasing the yield by 20 tonnes per acre.

15. Explain the conjugation in bacteria. **[TS MAR-15]**

A: 1) **Conjugation:** Transfer of genetic material (DNA) between two live bacteria is called conjugation.

2) This process was first observed in Escherischia coli bacteria.

3) In E.Coli bacteria, a small circular DNA strand called 'F plasmid' occurs in the cytoplasm.

4) The cell with F plasmid is called F^+cell and without F plasmid is called F^- cell.

5) During conjugation, F^+ and F^- cells bind with each other with the help of sex pilus which forms a bridge between them.

6) The F plasmid replicates and the replicated DNA passes through bridge to the F^- cell.

7) The F^- cell becomes F^+ cell as it receives the F plasmid.

8) After conjugation, the two cells separate from each other.

9) Conjugation is a very conservative process.

10) In conjugation, the donar bacterium retains a copy of the genetic material being transferred.

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16. Explain the Incomplete dominance with example. **[TS 15,17,18,19]**

A. 1) **Incomplete Dominance:** It is the phenomenon in which neither of the genes is completely dominant or completely recessive.

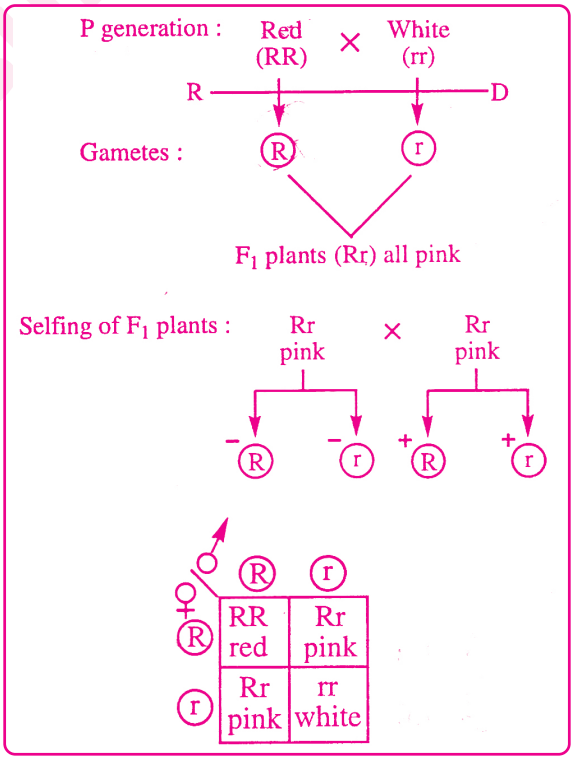
2) **Ex:** The inheritance of flower colour in the dog flower (Snapdragon).

3) In a cross between homozygous red flowered (RR) and white flowered plants (rr), the F_1 (Rr) was Pink.

4) When the F_1 was self pollinated, the F_2 resulted in 1 (RR) Red: 2 (Rr) Pink: 1 (rr) white.

5) Here genotypic ratios were exactly as in Mendelian monohybrid cross, but **phenotypic ratio had changed from 3:1 to 1:2:1.**

6) It was because of the incomplete dominance of 'R' over 'r' and this made it possible to distinguish Rr as Pink from RR (red) and rr (white).



7) Thus the Phenotypic and genotypic ratios in F_2 progeny are the same, that is 1:2:1.

17. Write the important features of Genetic code? [AP16,17,18,22,23.24][TS 15,18,19,22]

A: The important features of genetic code:

1) Genetic code is a set of instructions that direct the translation of DNA into 20 amino acids.
2) Genetic code consists of 64 triplets of Nucleotides. Each triplet is called a codon.
3) 61 codons code for amino acids. 3 codons donot code for any amino acids, hence they are called stop codons.
4) One codon codes for only one amino acid, hence it is unambiguous and specific.
5) Some amino acids are coded by more than one codon, hence the code is degenerate.
6) The codon is read in mRNA in a contiguous fashion. There are no punctuations.
7) The code is nearly universal.
8) **Ex:** From bacteria to human, UUU would code for **phenylalanine (phe).**

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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. Explain the reactions of Krebs cycle. [AP 16,17,19,19,22,23][TS 17,19,19,22]

A: **1) Krebs Cycle:** Krebs cycle is a cyclic process which occurs in all aerobic organisms to generate energy. It takes place in mitochondria.

2) In Krebs cycle, Acetyl coenzyme (CoA) is oxidised to form CO_2 and H_2O.

Also, ADP is converted into 'energy-rich' ATP.

3) Krebs Cycle- Reaction Steps:

Step 1 (Condensation):

$$\text{Acetyl CoA} + \text{Oxalo acetic acid} + \text{Water} \xrightarrow{\text{Citric Synthetase}} \text{Citric acid} + \text{Coenzyme A}$$

Step 2 (Dehydration):

$$\text{Citric acid} \xrightarrow{\text{Aconitase}} \text{Cis-aconitic acid} + H_2O$$

Step 3 (Hydration):

$$\text{Cis-aconitic acid} \xrightarrow{\text{Aconitase}} \text{Isocitric acid}$$

Step 4(Oxidation I):

$$\text{Isocitric acid} + NAD^+ \xrightarrow{\text{dehydrogenase}} \text{Oxalosuccinic acid} + NADH + H^+$$

Step 5 (Decarboxylation):

$$\text{Oxalosuccinic acid} \xrightarrow{\text{decarboxylase}} \alpha\text{-Ketoglutaric acid} + CO_2$$

Step 6(Oxidation II):

$$\alpha\text{-Ketoglutaricacid} + NAD^+ + CoA \xrightarrow{\text{dehydrogenase}} \text{Succinyl CoA} + NADH + H^+ + CO_2$$

Step 7(Cleavage):

$$\text{Succinyl CoA} + ADP + Pi \xrightarrow{\text{Thio kinase}} \text{Succinic acid} + ATP + CoA$$

Step 8(Oxidation III):

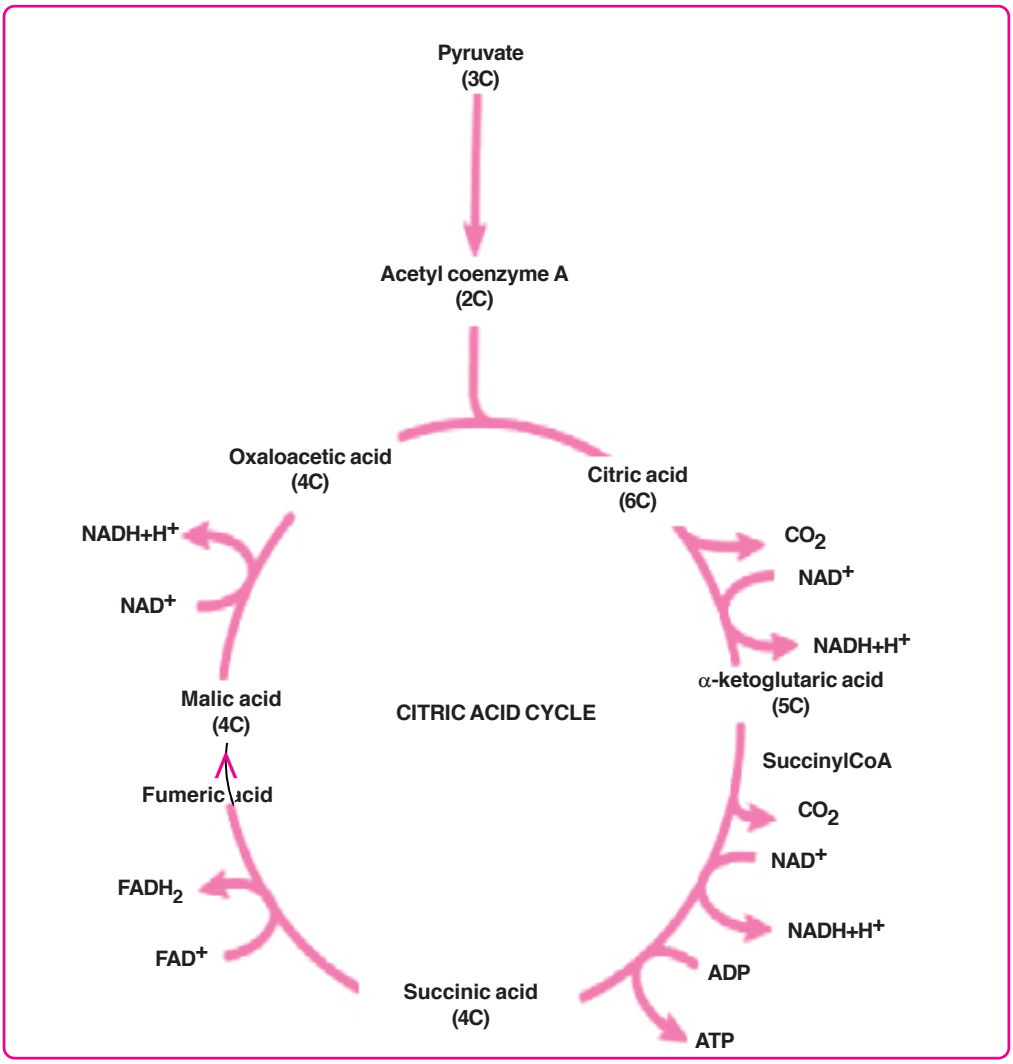
$$\text{Succinic acid} + FAD \xrightarrow{\text{dehydrogenase}} \text{Fumaric acid} + FADH_2$$

Step 9(Hydration):

$$\text{Fumaric acid} + H_2O \xrightarrow{\text{Fumerase}} \text{Malic acid}$$

Step 10(Oxidation IV):

$$\text{Malic acid} + NAD^+ \xrightarrow{\text{dehydrogenase}} \text{Oxaloacetic acid} + NADH + H^+$$


Pyruvate
(3C)
Acetyl coenzyme A
(2C)
Oxaloacetic acid
(4C)
Citric acid
(6C)
NADH+H+
NAD+
CO2
NAD+
NADH+H+
α-ketoglutaric acid
(5C)
Malic acid
(4C)
CITRIC ACID CYCLE
SuccinylCoA
CO2
NAD+
NADH+H+
ADP
ATP
Fumeric acid
FADH2
FAD+
Succinic acid
(4C)

KREB'S CYCLE

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 121°C 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