Previous IPE

SOLVED PAPERS

MARCH -2020 (AP)

PREVIOUS PAPERS

IPE: MARCH-2020(AP)

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

SECTION-A

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

1. How does ABA bring about the closure of stomata under water stress conditions?
2. Where does the photolysis of H_2O occur? What is its significance?
3. What is transformation? Who discovered it and in which organism?
4. What is the genotype of wrinkled phenotype of pea seeds?
5. Distinguish between heterochromatin and euchromatin. Which of the two is transcriptionally active?
6. What is the function of the codon-AUG.
7. How does one visualize DNA on an agar gel.
8. Give one example for each of transgenic plants which are suitable for food processing and those with improved nutritional quality.
9. Name two semi-dwarf varieties of rice developed in India.
10. Why does 'Swiss cheese' have big holes. Name the bacteria responsible for it.

SECTION-B

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

11. "Transpiration is a necessary evil". Explain.
12. Explain the nitrogen cycle giving relevant examples.
13. Explain the mechanism of Enzyme action.
14. What are the physiological processes that are regulated by ethylene in plants.
15. Explain the chemical structure of viruses.
16. Differentiate between the following:
    a. Dominant and Recessive b. Homozygous and Heterozygous
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 AP MARCH-2020
SOLUTIONS

SECTION-A

1. How does ABA bring about the closure of stomata under water stress conditions? **[AP 20]**

A: Under water stress conditions, ABA(Abscisic acid) drives the K^+ ions out of guard cells and makes them close.

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2. Where does the photolysis of H_2O occur? What is its significance? **[AP 17,20][TS 19,22]**

A: **1)** Photolysis of H_2O occurs in grana of chloroplast.

2) Significance: During photolysis oxygen is evolved.It is the main source of atmospheric oxygen.

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3. What is transformation? Who discovered it and in which organism? **[AP 20]**

A: 1) Transformation is the uptake of naked DNA fragments from the surroundings environment.

2) Frederick Griffith discovered it in streptococcus pneumonia.

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4. What is the genotype of wrinkled phenotype of pea seeds? **[AP 15,20]**

A: r r is the genotype of wrinkled phenotype of pea seeds.

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5. Distinguish between heterochromatin and euchromatin. Which of the two is transcriptionally active? **[TS 22]S[AP 20]**

A:

Heterochromatin	Euchromatin
1) The chromatin that is more densely packed and stains dark is called Heterochromatin.	1) The chromatin that is loosely packed and stains light is called Euchromatin.
2) It is transcriptionally inactive.	2) It is transcriptionally active.

6. 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.

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7. How does one visualize DNA on an agar gel. [AP 15,20]

A. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide, followed by exposure to UV radiation.

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8. Give one example for each of transgenic plants which are suitable for food processing and those with improved nutritional quality. [AP 20]

A. 1)Transgenic plant suitable for food processing: "Flavr Savr" variety of tomato.

2)Transgenic plant with improved nutritional value: Taipi golden rice with vitamin A rich nature.

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9. Name two semi-dwarf varieties of rice developed in India. [AP 20]

A: Jaya and Ratna

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10. 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.

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. Explain the nitrogen cycle giving relevant examples.

A: **Nitrogen Cycle:** The cyclic movement of nitrogen from the atmosphere to the soil and from the soil back into the atmosphere through plants, animals and micro organism is called as Nitrogen cycle. It includes five steps.

1. Nitrogen fixation 2. Nitrogen assimilation 3. Ammonification 4. Nitrification 5. Denitrification

1. Nitrogen fixation: Conversion of molecular nitrogen into ammonia or nitrites or nitrates is known as Nitrogen fixation.

a. Biological nitrogen fixation: Conversion of molecular ntirogen into ammonia by prokaryotes is called biological nitrogen fixation.

$$N \equiv N \xrightarrow{\text{Nitrogenase}} NH_3$$

Ex: Free living nitrogen fixing anaerobic microbes - Rhodospirillum.

b. Physical nitrogen fixation: In nature, lightening and ultraviolet radiation provide energy to convert nitrogen into nitrogen oxides. Industrial combustion, forest fires, automobile exhausts and power generating stations are also source of nitrogen oxides.

$$N_2+O_2 \rightarrow 2NO;\ 2NO+O_2 \rightarrow 2NO_2$$

2. Nitrogen assimilation: The nitrates and ammonia absorbed by plants are converted into amino acid, proteins, enzymes, nucleic acids and hormones in the plant body.

These organic constituents are eaten by animals.

3. Ammonification: Decomposition of organic nitrogen of dead plants and animals into ammonia is called Ammonification. This is done by ammonifying bacteria.

4. Nitrification: Conversion of Ammonia into Nitrites and Nitrates is called Nitrification. It occurs in two steps.

Step 1: Ammonia is oxidised to nitrite by bacteria called Nitrosomonas and Nitrococcus.

$$2NH_3 + 3O_2 \rightarrow 2NO_2^- + 2H^+ + 2H_2O$$

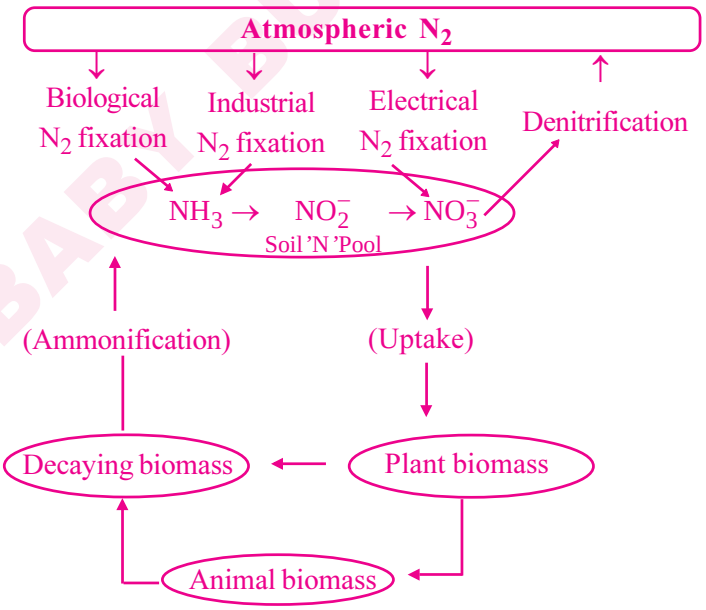
Step 2: The nitrite is further oxidised to nitrate by bacteria called Nitrobacter.

$$2NO_2 + O_2 \rightarrow 2NO_3^-$$

The nitrates are absorbed by plants and are transported to leaves.

They are reduced to form ammonia and finally converted into Amino acids.

5. Denitrification: A small quantity of Nitrates and Ammonia is converted into free nitrogen by harmful bacteria called pseudomonas and Thiobacillus. This process is called denitrification.



13. **Explain the mechanism of enzyme action.** **[AP 20]**

A: 1. Each enzyme (E) has substrate (S) binding site in its molecule with in a given cleft.

2. The substrate has to diffuse towards the active site leading to formation of enzyme substrate complex with in a short time .

3. This transition state structure soon dissociates into enzyme product complex.

4. The energy required for the substrate to get converted into products is called activation energy which is available from heat, ATP's etc.

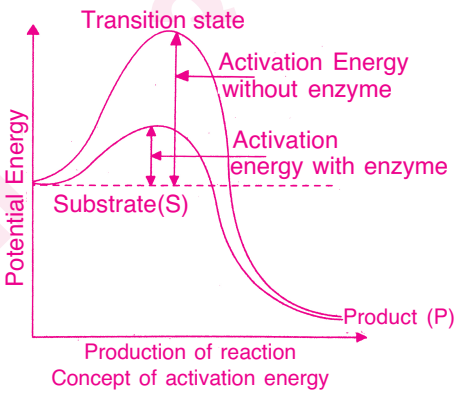
5. The structure of substrate gets transformed into the structure of products.

$$E+S \rightarrow ES \rightarrow EP \rightarrow E+P$$

6. When we represent this pictorially through a graph by taking potential energy on Y-axis and progress of reaction on X-axis, we notice the energy level difference between 'S' and 'P'.

7. If 'P' is at lower level than S, it is an exothermic reaction. One need not supply energy to form the product.

8. If 'P' has higher energy level then 'S' it is an endothermic or energy requiring reaction.



Concept of activation energy

9. Then 'S' has to go through a much higher energy state or transition state.

10. Each enzyme E has a substrate (S) binding site in its molecule so that a highly reactive enzyme substrate complex (ES) is produced .

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14. What are the physiological processes that are regulated by ethylene in plants.

[TS 17][AP 15,20]

A: 1) Ethylene is a simple gaseous plant growth regulating hormone.

2) Ethylene effects horizontal growth of seedlings, swelling of axis and apical hook formation in dicot seedlings.

3) Ethylene promotes senescence and abscission of leaves and flowers.

4) **Ethylene is effective in fruit ripening.**

5) Ethylene rises the rate of respiration and it is called respiratory climactic.

6) Ethylene breaks seed and bud dormancy.

7) Ethylene initiates germination in pea nut seeds and sprouting of potato tubers.

8) In water plants, ethylene promotes rapid petiole and internode elongation.

9) Ethylene also promotes growth of root and root hair formation.

15. Explain the chemical structure of viruses. **[AP 20]**

A: 1) All viruses consist of two basic components. a) Core b) Capsid

2) Core of nucleic acid forms the genome.

3) Capsid is the surrounding protein coat.

4) Capsid gives shape and protection to the virus.

5) Capsid is madeup of **protein subunits** called **capsomeres.**

6) The number of capsomeres is the characteristic feature for each type of virus.

7) The genome of virus is either single stranded DNA (or) double stranded DNA.

8) In general, **plant virus** has **ssRNA** and **animal virus** has **dsDNA.**

9) Viral nucleic acid molecules are either circular or linear.

10) Most viruses have a single nucleic acid molecule, but a few have more than one.

11) **Ex:** HIV has two identical molecules of RNA.

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16. Differentiate between the following: **[AP 20]**

a) Dominant and Recessive

b) Homozygous and Heterozygous

A: a) The character which is expressed in F_1 generation is called dominant character and which is unexpressed is called recessive character.

b) An individual having two similar alleles for a single character is called homozygous.

An individual having two dissimilar alleles for a single character is called heterozygous.

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

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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. 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

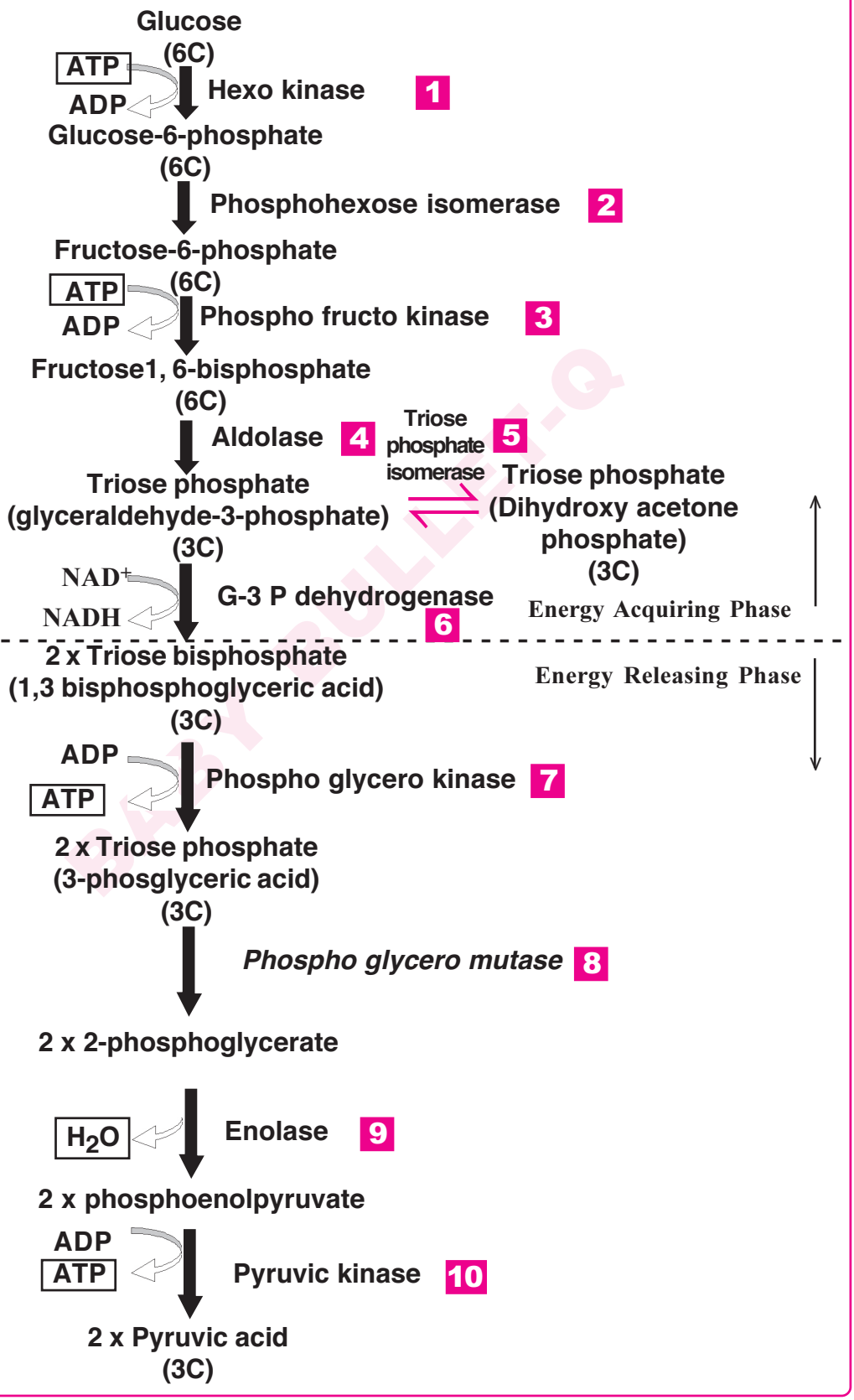
Step-9 (Dehydration):

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