PRACTICE PAPER – 5

SOLUTIONS

SECTION – A

1. Compare transpiration and evaporation.

Ans.	Transpiration	Evaporation
	1. Transpiration is the loss of water in the form of water vapour from aerial parts of the plant into atmosphere.	1. Evaporation is the loss of water in the form of vapour directly from water.
	2. It is a physiological process.	2. It is a physical process.
	3. It is controlled by environmental factors as well as physiological factors.	3. It is a entirely driven by environmental factors.

2. What is transformation ? Who discovered it and in which organism ?

Ans. Uptake of naked DNA fragments from the surrounding environment and their incorporation into the recipient cell is called ***transformation***. It was discovered by ***Frederick Griffith*** in ***Streptococcus pneumoniae*** (1928).

3. Define true breeding. Mention its significance.

Ans. All offsprings has the same phenotype as its parents is called the breeding. They express characters for several generations.

4. What is meant by Capping and Tailing ?

Ans. Adding of an unusual nucleotide (methylguanosine triphosphate) to the 5'-end of heterogenous nucleae RNA (hn RNA) is called capping.

Adding of Adenylate residues to the 3'-end in a template independent manner is called tailing.

5. Write any two chemical differences between DNA and RNA

DNA	RNA
1. DNA consists of a ploy-nucleotide chains. 2. Deoxyribose sugar is present. 3. Nitrogen bases are adenine, guanine, thymine and cytosine.	1. RNA consists of only one polynucleotide chain. 2. Ribose sugar is present. 3. Nitrogen bases are adenine, uracil, guanine and cytosine.

6. Give different types of *cry genes* and pests which are controlled by the proteins encoded by these genes ?

Ans. The proteins encoded by the genes ***cry IAC*** and ***cry II Ab*** control the cotton bollworms, cry IAb controls corn borer. [***Cry protein*** is a protein toxin produced by ***Bacillus thuringiensis*** that kills insects]

7. For which variety of Indian rice, has a patent been filed by a USA company ?

Ans. Basmati Rice.

8. What do you understand by vernalization ? Write its significance.

Ans. The method of inducing flowering quantitatively or qualitatively on exposure to low temperature is called vernalizaton. It prevents precocious reproductive development late in the growing season, and enables the plant to have sufficient time to reach maturity. It specially refers to the promotion of flowering. It also timulates a subsequent photo periodic flowering response in biennials. [cabbage, carrot].

9. Give two important contributions of Dr. M.s Swaminathan.

Ans. He and his team developed short duration, high yielding varieties of rice including scented Basmati. He introduced Mexican varieties of wheat in India.

10. Name any two fungi which are used in the production of Antibiotics.

Ans. Penicillium notatum

Penicillium guiseo fulvam

SECTION – B

11. Give a brief account of Bt. Cotton.

Ans. Some strains of Bacillus thuringiensis produce proteins that kill certain insects such as lepidopterans (tabacco budworm, armyworm), coleopterans (beetles) and dipterans (files, mosquitoes). Bacillus thuringiensis forms protein. Crystals which contain a toxic insecticidal protein. The gene responsible for the production of this toxic protein is introduced genetically into the cotton seeds protects the plants from Bollworm, a Major pest of cotton. The worm feeding, on the leaves of Bt. Cotton plant becomes lethargic and sleepy thereby causing less damage to the plant. Use of Bt. Cotton has led to 3-27% increase in cotton yield in countries where it is grown.

The toxin is coded by a gene named 'cry'. The proteins encoded by the genes cry IAc and cry IIAb control the cotton boll worms and cry IAb controls corn borer.

12. Define transformation in Griffith's experiment. Discuss how it helps in the Identification of DNA as genetic material.

Ans. Frederick Griffith (1928) conducted experiments on streptococcus pneumoniae and observed a transformation in bacteria. When streptococcus were grown on a culture plate, some produced smooth shiny colonies (s) while others produced rough colonies (R). Mice injected with 's' shain (mucous coat) die from pneumonia infection but mice injected with R strain do not develop pneumonia.

He injected heat killed 's' strain bacteria to mice, It is healthy. Finally he injected heat killed S and R strains, the mice died. He concluded that the R strain bacteria had been transformed by heat killed 's' strain bacteria. Some transforming principle transferred from heat killed strain to R strain to synthesize a mucous coat and become virulent. This is due to the transfer of genetic material.

13. With the help of an example, differentiate between incomplete dominance and Co-dominance.

Incomplete Dominance	Co-Dominance
It is the condition when one allele of a gene is not completely dominant over the other allele and results in the hetero- zygotes having phenotype different from the dominant and recessive homo-zygotes. **Eg. :** Cross between red flowered (RR) and white flowered (rr) plants results in pink flowered plants (Rr).	The phenomenon where heterozygotes have features of both the homozygotes i.e., an alle is neither dominant nor recessive to the other. **Eg. :** Cross between spot-ted lentils and dotted lentils pro-duce heterozygotes that are both spotted and dotted.

14. What is ICTV ? How are viruses named ?

Ans. International Committee on Taxonomy of Viruses [ICTV] regulates the norms of classification and nomenclature of viruses. The ICTV has only three hierarchial levels, The ***family, Genus*** and ***Species***. The family names end with the 'suffix viridae' while the Genus name ends with virus and the Species names are common English expressions . Viruses are named after the disease they cause. **Eg : *Polio virus***.

15. What are the physiological processes that are regulated by ethyline in plants ?

Ans. 1) Ethylene promotes the ripening of fruits.

2) Ethylene promotes the senescence and abscission of leaves and flowers.

3) Ethylene breaks seed and bud dormancy, initiates germination in peanut seeds and sprouting of potato tubers.

4) Ethylene promotes rapid internode/petiole elongation in deep water rice plants.

5) It also promotes root growth and root hair formation, thus helping plants to increase their absorption surface.

6) Ethylene is used to initiate flowering (mango) and for synchronising fruit set in pineapples.

7) It promotes female flowers in cucumbers, thereby increasing the yield.

16. Explain the importance of [ES] complex formation.

Ans. Each enzyme [E] has a substrate [S] binding site in its molecule so that a highly reactive enzyme substrate complex [ES] is produced. This complex is short lived and dissociates into its products [P] and the unchanged enzyme with an intermediate formation of the enzyme product complex [EP].

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

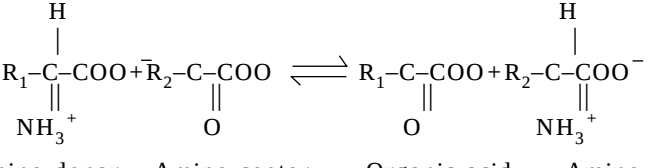
17. Write in brief how plants synthesize aminoacids.

Ans. Amino acids are synthesized into two ways. They are :

Reductive Amination : In this Ammonia reacts with α - ketoglutaric acid and forms glutamic acid.

$$\alpha\text{-ketoglutaric acid} + NH_4^+ + NADPH \xrightarrow[\text{Dehydrogenase}]{\text{Glutamate}} \text{Glutamate} + H_2O + NADP$$

Transamination : In this transfer of an amino group from an Amino acid to the keto group of a keto acid. Glutamic acid is the main amino acid from which the transfer of NH_2 takes place and other Amino acids are formed in the presence of transaminase.



Amino donar Amino ceptor Organic acid Amino acid

18. How does ascent of sap occur in tall trees ?

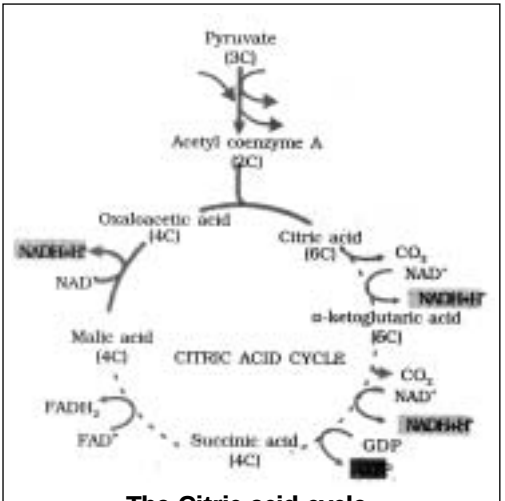
Ans. Upward movement of water through xylem aganist gravitational force is called accept of sap. The transpiration driven ascent of xylem sap depends on (a) cohesion mutual attraction between water molecules. (b) Adhesion - attraction of water molecules to palar surfaces. (c) Transpiration

pull driving force for upward movement of water. These properties give water high tensile strength and high capillarity. In plants capillarity is aided by the small diameter of the tracheary elements. As water evaporates through the stomata. Since the thin film of water over the cells is continuous, it results in pulling of water, molecule by molecule, into the leaf from the xylem. Also, because of lower concentration of water vapour in the atmosphere, water diffuses into the surrounding air. This creates 'transpiration pull'. The forces generated by transpiration can creates pressures sufficient to lift a xylem sized column of water over 130 metres high.

SECTION – C

19. Explain the reactions of Kreb's cycle.

Ans. The acetyl CoA enters into the [mitochondrial matrix] a cyclic pathway tricarboxylic acid cycle, more commonly called krebs cycle after the scientist Hans Krebs who first elucidated it.



The Citric acid cycle

1) **Condensation :** In this acetyl CoA condenses with oxaloacetic acid and water to yield citric acid in the presence of citrate synthetase and CoA is released.

$$OAA + A.CoA + water \xrightarrow{citrate\ synthetase} CA + Co.A$$

2) **Dehydration :** Citric acid looses water molecule to yield cisaconitic acid in the presence of aconitase.

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

3) **Hydration :** A water molecule is added to cis aconic acid to yield isocitric acid in the presence of a conitase.

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

4) **Oxidation I :** Isocitric acid undergoes oxidation in the presence of dehydrogenase to yield succinic acid.

$$\text{Isocitric acid} + NADP^+ \xrightarrow{dehydrogenase} \text{oxalosuccinic acid} + NADPH + H^+$$

5) **Decarboxylation :** Oxalosuccinic acid undergoes decarboxylation in the presence of decarboxylase to form α-keto glutaric acid.

$$\text{Oxalosuccinic acid} \xrightarrow{decarboxylase} \text{a keto glutaric acid} + CO_2$$

6) **Oxidation II, decarboxylation :** α – keto glutaric acid undergoes oxidation and decarboxylation in the presence of dehydrogenase and condenses with co.A to form succinyl co. A.

$$\alpha\text{-keto glutaric acid} + NADP^+ + \text{co.A} \xrightarrow{dehydrogenase} \text{succinyl co.A} + NADPH + H^+ + CO_2$$

7) Cleavage : Succinyl co.A splits into succinic acid and co.A in the presence of thiokinase to form succinic acid. The energy released is utilised to from ATP from ADP and PI.

$$\text{Succinyl co A} + ADP + Pi \xrightarrow{\text{thiokinase}} \text{Succinic acid} + ATP + \text{co.A}$$

8) Oxidation – III : Succinic acid undergoes oxidation and forms Fumaric acid in the presence of succinic dehydrogenase.

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

9) Hydration : A water molecule is alcohol to Fumaric acid in the presence of Fumarase to form Malic acid.

Fumaric acid + H_2O $\xrightarrow{\textbf{\textit{Fumerase}}}$ Malic acid

10) Oxidation IV : Malic acid undergoes oxidation in the presence of malic dehydrogenase to form oxaloacetic acid.

Malic acid + NADP $\xrightarrow{\textbf{\textit{Malic dehydrogenase}}}$ Oxaloacetic acid + NADPH + H^+

In TCA cycle, for every 2 molecules of Acetyl co.A undergoing oxidation, 2 ATP, 8 NADPH+ H^+, 2$FADH_2$ molecules are formed.

20. Explain briefly the various processes of recombinant DNA technology.

Ans. The important method in recombinant DNA technology are performed through genetic engineering.

They are :

i) Isolation of a desired gene

ii) Insertion of isolated gene into a suitable vector

iii) Introduction of recombinant vector into a host and

iv) Selection of the transformed host cells.

I) Isolation of a desired gene :

→ The desired gene is isolated from the donor cell. Normally bacteria are the source of desired genes.

→ The cell walls of bacteria are degraded with the help of enzymes.

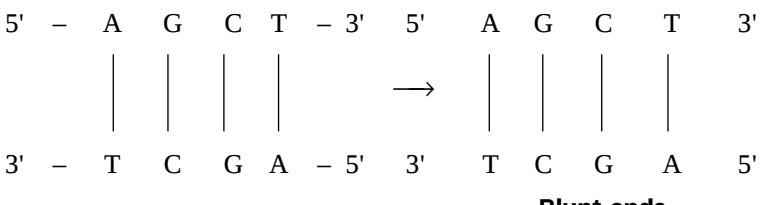
→ The cell membranes are lysed with the help of detergents.

→ By treating the cellular constituents with ***phenols*** and suitable nucleases and by subjecting to ***gradient centri- fugation,*** pure DNA is isolated.

→ The purified DNA is cut into a number of fragments by ***restriction endonucleases.***

→ The ***restriction enzymes*** cleave DNA molecules in two ways.

i) In one way they cut both strands of DNA at exactly opposite points to each other. This results in DNA fragments with ***blunt ends*** or flush ends, where two strands end at the same point. Such cut is generally termed as even cut.



DNA cleavage by restriction endonucleases resulting in blunt ends.
The vertical arrows indicate the site of cut in DNA strand.

ii) But commonly, most enzymes cut the two strands of DNA double helix at different locations. Such a cleavage is generally termed as ***staggered cut.*** This generates protruding ends i.e., one strand of DNA double helix extends some bases beyond the other. Since the target site is palindromic in nature, the protruding ends generated by such a cleavage have complimentary base sequence. As a result, they readily pair with each other and such ends are called ***cohesive*** or ***sticky ends***. This stickyness of the ends facilitates the action of the enzyme DNA ligase. When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky ends' and these can be joined together readily by using ***DNA ligases.*** **E.g. :** The restriction enzyme E coRI.

E - The first letter, represents the name of genus ***Esche- richia.***

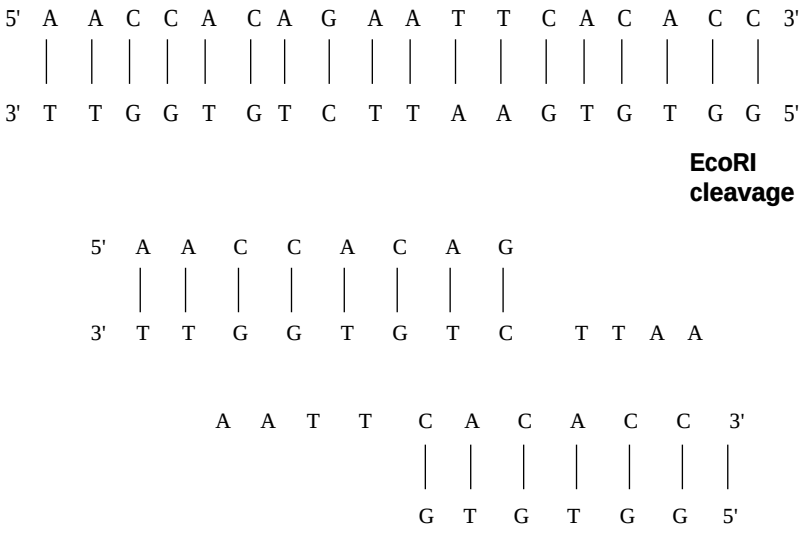
Co - The next two letters, represent the species ***Esche- richia Coli.***

The letter R is derived from the name of strain.

Roman numbers following the names indicate the order in which the enzymes were isolated from the strain of bacteria.

This enzyme specifically recognises **GAA** sites on the **DNA** and cuts it between **G** and **A** (G↓A)

(EcoRI recognizes 5' G A A 3')



Staggered clevage of a double stranded DNA fragment, producing single stranded sticky ends.

→ The resultant fragments are separated from each other by ***gel electrophoresis.***

→ The desired fragments are selected by ***Southern blotting technique.***

II) Insertion of isolated gene into a suitable vector :

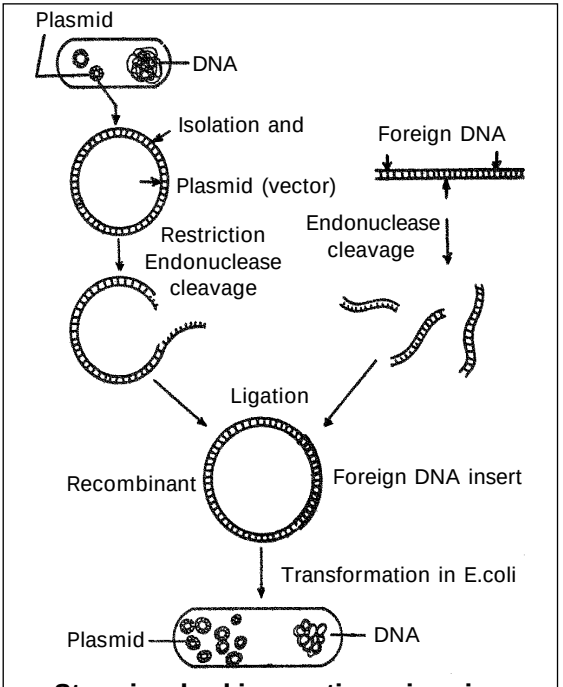
→ The selected fragments of DNA are inserted into a suitable vector to produce a large number of copies of genes. This is called ***gene cloning***.

→ There are two major types of vectors, namely plasmids and bacteriophages.

→ Among the two types, plasmids are the ideal cloning vectors.

→ To isolate a plasmid, the Bacterial cell is treated with EDTA (Ethylene diamine tetra acetic acid) along with lysozyme enzyme to digest the cell wall.

→ Then the bacterial cell is subjected to centrifugation in sodium lauryl sulphate to separate the plasmid.



Steps involved in genetic engineering

→ The plasmid DNA is cut with the help of restriction endonuclease.

→ The circular plasmid is converted into a linear molecule having sticky ends.

→ The two sticky ends of linear plasmid are joined to the ends of desired gene by DNA ligase.

→ The plasmid containing foreign DNA segments is called recombinant DNA (r DNA) or Chimeric DNA.

III) Introduction of recombinant vector into a suitable host :

→ The rDNA molecule is introduced into suitable bacterial host cell by transformation.

→ The cell containing r DNA is called transformed cell.

→ Bacterial cell walls are not permeable to recombinant vectors, but keeping in dil. Calcium chloride renders the bacterial cell wall permeable to recombinant vectors.

→ The rDNA replicates with in the host cell.

→ The transformed cell grows on the culture medium. Each daughter cell contains r DNA.

IV) Selection of transformed host cells :

1) Selection of transformed cells depends on the nature of gene which is cloned.

2) It can be done in two ways. They are :

a) Without using probes

b) By using probes.

a) Without using probes :

→ If the gene is cloned for antibiotic resistance, the cells are first incubated on a medium without antibiotic for one hour, to allow the antibiotic resistance gene to be expressed.

→ Then the cells are placed on a medium with an antibiotic for selection of colonies containing rDNA.

→ The cells which have expressed the gene will survive and the others die.

b) By using probes : When transformed cells are cultured on the nutrient medium, several cells are produced. To select the cells containing the desired gene colony hybridization method is used. In this gene specific probes are used. A probe is a small fragment of single stranded RNA or DNA which is tagged with radioactive, molecule. It can search out complimentary DNA sequences from an organism.

21. Modern methods of breeding plants can alleviate the global food 'shortage'. Comment on the statement and give suitable examples.

Ans. Modern methods of Breeding plants :

1) **Plant breeding for disease resistance :-** Several fungal, bacterial and viral pathogens affect the yield of cultivated crop species. In this situation, breeding and development of cultivars resistant to disease enhances food production. It also helps reduce the dependence on the use of fungicides and bacteriocides. Breeding is carried out by conventional breeding techniques or by ***mutation breeding***. The method of breeding for disease resistance is that of hybridisation and selection. By this some crop varieties are produced which were disease resistance to bacteria and fungi. They are

Crop	variety	Resistance to disease
(1) Wheat	Himgiri	Leaf and stripe rust, hill bunt
(2) Cauliflower	Pusa swarnim	White rust
(3) Cowpea	Pusa komal	Bacterial blight
(4) Chilli	Pusa sadabahar	Chilly Mosaic virus Tobacco mosaic virus and leaf curl

Mutation breeding : It is the process by which genetic information is created through changes in the base sequence within genes resulting in the creation of new character of trait not found in the parental type. **Eg :** Resistance to ***yellow mosaic virus*** in Bhendi (Abelmoschus esculentus) was transferred from a wild species and develop in a new variety called ***Parbhani Kranti***.

2) **Plant breeding for developing resistance to insect pests :** Large scale destruction of crop plants and crop produce is by insect and pest infestation. Insect resistance in Host crop plants may be due to

morphological, ***biochemical*** or ***physiological*** characteristics. Hairy leaves in several plants are resistances to insect pests. **Eg :** Resistance to Jassids in cotton and cereal leaf beetle in wheat. Smooth leaved and nectar–less cotton do not attract bollworms. High aspartic acid, low nitrogen and sugar content in maize leads to resistance to maize stem borers.

Some released crop varieties bred by hybridisation and selection, for insect, pest resistance are

Crop	Variety	Insect pests
1) Brassica	Pusa Gaurav	Aphids
2) Flat bean	Pusa sem 2	Jassids, aphids
	Pusa sem 3	and fruit borer
3) Okra (Bhendi)	Pusa Sawani	Shoot and fruit
		bores, pusa A-4

3) **Plant breeding for improved food quality :** A far greater number–Three billion people-suffer from micro-nutrients, potein, and vitamin deficiencies or ***'hidden hunger'*** because they can not afford to buy enough nutritious food. ***Biofortification*** aims at breeding crops with high vitamins and minerals or higher protein and healthier fats to improve public Health. Wheat, ***Atlas 66*** having a high protein content has been developed by this method. β carotene containing rice variety ***'Golden Rice'***, vitamin A enriched carrots, spinach, Vitamin C enriched bitter gourd mustard, tomato, iron and Calcium rich spinach, Protein rich garden peas are released IARI, New Delhi.

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