Chapter-14 Microbes in Human Welfare

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

A: *cryIAC, cryIIAb* and *cry IAb*

cryIAC, cryIIAb control the cotton bollworms

cry IAb control cor n bore

2. Can a disease be detected before its symptoms appear? Explain the principle involved?

A: Yes.

After the infection and before the development of symptoms pathogen is present in very low amounts or antibodies are present in the host. Detection of the pathogen or antibodies at this stage can establish the link with the infection.

3. What is GEAC and what are its objectives?

A: Genetic Engineering Approval Committee.

Objectives:

1. It will make decisions regarding the validity of GM research in India.
2. It regulates GM research in India.
3. It will take decisions regarding safety of introducing GM organisms for public services.

4. Name the nematode that infects the roots of tobacco plants. Name the strategy adopted to prevent this infestation?

A: *Meloidegyne incognita*

RNA interference.

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

A: Basmati rice

6. Give one example for each of transgenic plants which are suitable for food processing and those with improved nutritional quality?

A: 'Flavr Savr' tomato. Transgenic 'Golden rice' variety.

7. Name any two genetically modified crops?

A: Bt-cotton, Bt-brinjal.

8. Name any two industrially important enzymes?

A: Pectinases, Proteases, Lipases.

9. Name an immunosuppressive agent. From where it is obtained?

A: Cyclosporin A

From fungus *Trichoderma polysporum.*

10. What is the group of bacteria found in both the rumen of cattle and sludge of sewage treatment?

A: Methanogens

11. Name the scientists who were credited for showing the role of penicillin as an antibiotic?

A: Ernest Chain

Howard Florey.

Short Answer Questions

1. How do mycorrhizal fungi help the plants harbouring them?

Ans: Symbiotic association of fungi with roots of plants is known as **mycorrhizae**. Many members of the genus ***Glomus*** form mycorrhiza with many plant species.

The fungus may present on the surface of the plant or in some forms enter cortical cells. In some forms fungi may be present on the surface as well as intracellularily.

Benefits to the plant harbouring them:

1. Fungal hyphae absorb water and nutrients for the plant.
2. It increases the **surface area of absorption**.

3. The fungal symbiont in these associations **absorbs phosphorus** from soil and passes it to the plant.

4. Overall nutrition status of the plant increases.

5. Plants having such associations show **resistance to root-borne pathogens**.

6. **Tolerance to salinity** and drought increases and an overall increase in plant growth and development.

7. The **yield** of the plant increase.

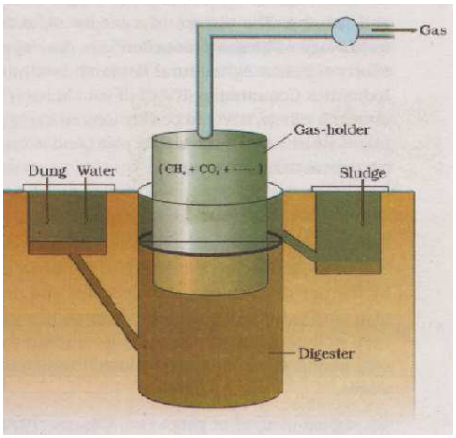
8. Plants with mycorrhizal association can grow in different kinds of soils.

9. Longevity of the plant increases.

2. What is chemical nature of biogas? Explain the process of biogas production?

Ans: Biogas is a mixture of gases containing predominantly **methane** produced by the microbial activity and which may be used as fuel. Biogas production is a fermentation process. Microbes produce different types of gaseous end-products during growth and metabolism. Certain bacteria, which grow anaerobically on cellulosic material, produce large amount of methane along with CO_2 and H_2. These bacteria are collectively called **methanogens**, and one such common bacterium is ***Methanobacterium***.

These bacteria are present in the rumen of cattle. In rumen, these bacteria help in the breakdown of cellulose and play an important role in the nutrition of cattle. The excreta (dung) of cattle, is rich in these bacteria. Dung can be used for generation of biogas, commonly called ***gobar gas***. Any plant refuge or kitchen waste also can be used in the production of biogas.



Structure of Biogas plant:

The biogas plant consists of a concrete tank (10-15 feet deep) in which bio-wastes are collected and slurry of dung is fed.

A floating cover is placed over the slurry, which keeps on rising as the gas is produced in the tank due to the microbial activity.

The biogas plant has an outlet, which is connected to a pipe to supply biogas to nearby houses.

The spent slurry is removed through another outlet and may be used as fertilizer. The biogas thus produced is used for cooking and lighting.

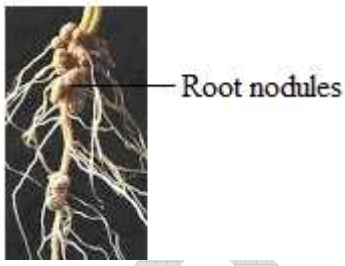
3. What are biofertilizers? Write a brief note on them?

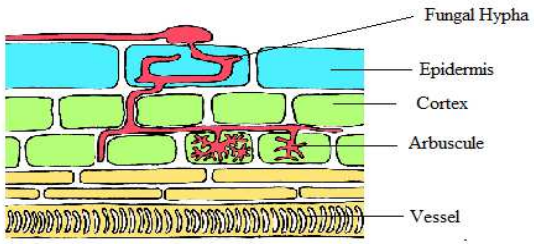
Ans: Biofertilisers are organisms that **enrich the nutrient quality of the soil**.

The main sources of biofertilisers are **bacteria**, **fungi** and **cyanobacteria**.

Rhizobium bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient.

Other bacteria also can fix atmospheric nitrogen while **free-living** in the soil e.g. ***Azospirillum*** and ***Azotobacter***. They enrich the nitrogen content of the soil.





Fungi are also known to form symbiotic associations with plants e.g.**mycorrhiza**.

Many members of the genus ***Glomus*** form mycorrhiza. The fungal symbiont in these associations **absorbs phosphorus** from soil and passes it to the plant. Plants having such associations show other benefits also, such as **resistance to root-borne pathogens**, **tolerance to salinity** and drought, and an overall increase in plant growth and development.

Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen, e.g. ***Anabaena, Nostoc,***

Oscillatoria, etc. In paddy fields, cyanobacteria serve as an important biofertiliser. Blue green algae also **add organic matter to the soil and increase its fertility**.

Long Answer Question

1. Write a brief essay on microbes in sewage treatment?

Ans: Large quantities of waste water are generated everyday in cities and towns. A major component of this waste water is human excreta. This municipal waste-water is also **called sewage**. It contains large amounts of organic matter and microbes. Many of which are pathogenic.

This cannot be discharged into natural water bodies like rivers and streams directly.

Microbes play a major role in treating millions of gallons of waste water everyday across the globe. This methodology has been practiced for more than a century now, in almost all parts of the world.

Till date, no manmade technology has been able to rival the microbial treatment of sewage.

Due to increasing urbanisation, sewage is being produced in much larger quantities than ever before.

Untreated sewage if discharged directly into rivers leads to their pollution and increase in water-borne diseases.

Before disposal sewage must be treated in sewage treatment plants (STPs) to make it less polluting. Treatment of waste water is done by the heterotrophic microbes naturally present in the sewage.

This treatment is carried out in two stages:

1. **Primary treatment**
    - **a) Sequential filtration**
    - **b) Sedimentation**
2. **Secondary treatment or Biological treatment**
    - **a)Growth of flocs**
    - **b) Anaerobic sludge digesters**

1.Primary treatment : These treatment steps basically involve physical removal of large and small particles from the sewage through filtration and sedimentation.

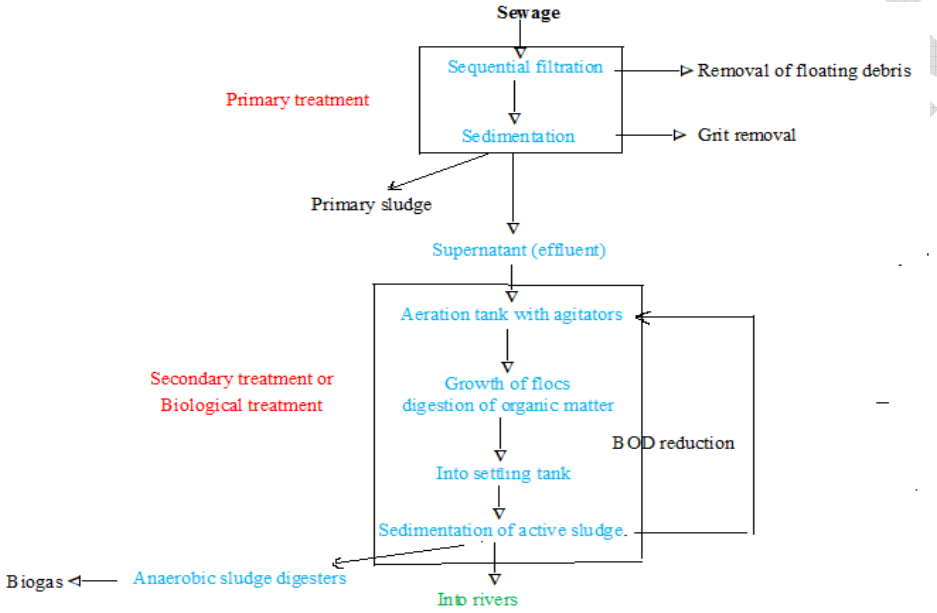
These are removed in stages;

Initially, floating debris is removed by **sequential filtration**.

Then the grit (soil and small pebbles) are removed by **sedimentation**.

All solids that settle form the **primary sludge**, and the supernatant forms the effluent.

The effluent from the primary settling tank is taken for secondary treatment.



2. Secondary treatment or Biological treatment: The primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into **flocs.**

Flocs is masses of bacteria associated with fungal filaments to form mesh like structures.

While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the **BOD (biochemical oxygen demand)** of the effluent. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria.

The sewage water is treated till the BOD is reduced. The BOD test measures the rate of uptake of oxygen by micro-organisms in a sample of water and thus, indirectly, BOD is a measure of the organic matter present in the water.

The greater the BOD of waste water, more is its polluting potential.

Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called **activated sludge**.

A small part of the activated sludge is pumped back into the aeration tank to serve as the **inoculum**.

The remaining major part of the sludge is pumped into large tanks called **anaerobic sludge digesters**.

Here, other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge.

During this digestion, bacteria produce a mixture of gases such as **methane**, **hydrogen sulphide** and **carbon dioxide**.

These gases form **biogas** and can be used as source of energy as it is inflammable.

The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams.

The Ministry of Environment and Forests has initiated **Ganga Action Plan** and **Yamuna Action Plan** to save these major rivers of our country from pollution.