

Mibo-111

- Q.1. Define microbiology and explain the role of microorganisms in agriculture with example. or Define microbiology Give the brief account of its scope and importance in agriculture and allied fields.

Ans:- Microbiology :-

It is the study of microscopic living organisms and their activities. It concern with form, structure, reproduction, physiology, metabolism and identification.

Scope of microbiology :-

In agriculture :-

1. Organic matter decomposition
2. Nitrogen fixation in plants
3. Phosphorous solubilization of insoluble phosphates in soil
4. Sulphur oxidation and transformation of other elements
5. Biogas production
6. Biological control of plant disease
7. Biological control of insect pests
8. Mushroom production

In allied fields :-

1. Industrial products, biogas, etc.

- 2 Preparation of fermented milk products
 3 Sewage treatment and disposal
 4 Use in space
 5 Biological warfare
 6 Antibiotics and vaccines production.

Q.2 Define biogenesis and explain the theory of spontaneous generation including contribution of scientists. or
 Describe spontaneous generation theory and its disproval by different scientist.

Ans:-

Biogenesis :-

Living things originate from the living things only.

Theory of Spontaneous generation :-

Living things originate spontaneously from the non-living ones.

Aristotle :- He thought that organism/ animal might originate spontaneously from the soil, plants or other unlike animals.

Vitgill :-

He gave directions for the artificial propagation of bees. It was accepted muggots could be produced by exposing meat

warmth and air.

Francesco Redi :-

Performed experiment and showed that muggots that develop putrefying meat if it are the larval stage of flies and will never develop in putrefying meat if it is protected from flies laying eggs.

Lazzaro Spallanzani :-

He was the first to provide evidence that microorganisms do not develop spontaneously. He boiled beef broth for an hour and then sealed the flasks. No microbes appeared following incubation.

John Needham :-

Insisted that air was essential for spontaneous generation of microbes. By sealing flasks, the air had been excluded.

Louis Pasteur :-

He developed a flask with a long narrow goose neck opening through which untreated and unfilled air could pass in or out, but germs

Settled in gooseneck. As germ free air entered no microbes appeared in the infusion.

Q.3 Explain the brief contribution of scientists to the germ theory of diseases.

Ans:- Germ theory of diseases :-

Fracastoro :-

He suggested that the diseases might be due to invisible organisms transmitted from one person to the other.

Plenciz :-

He proposed that the living agents are the cause of diseases and different germs may be responsible for different diseases.

Semmelweis :-

He used a dilute solution of antiseptic in obstetrical practice. The deaths due to childbirth infections were reduced in the handle according to his instructions.

Joseph Lister :-

He used a dilute solution of phenol to soak the surgical

dressings and sprayed the operating room. The wound became ~~early~~ rarely infected and healed rapidly.

Louis Pasteur :-

Pasteur worked on silkworm disease and isolated the parasite causing disease. Petrolia is caused by protozoan rather than by bacteria. He also worked on anthrax a disease of cattle and sheep. He isolated the microbes from diseased animals.

Robert Koch :-

He concluded the germ theory of disease by working on anthrax disease of animals. His experiments and observations led to the establishment of Koch's postulates

Koch's postulates :-

1. Association :-

The specific microorganism must be present in every case of disease

2. Isolation :-

2 Isolation :-

The microorganism can be isolated from the diseased host and grown in pure culture.

3 Inoculation :-

The specific disease can be reproduced when a pure culture of microorganism is inoculated into a healthy susceptible host.

4 Resolution :-

The microorganism must be recoverable once again from the experimentally infected host.

Q.4 Write in brief about fermentation

Ans:- Fermentation :-

It is defined as the incomplete oxidation produced by microorganisms acting on compounds which are carbohydrates or carbohydrate like in nature. It is biological process and anaerobic process. Final products are H_2O and CO_2 .

Bacteria, fungi and yeasts can carry fermentation process. Some of these microbes are :-

Bacteria :-

1. Lactobacillus
2. Streptococcus
3. Pseudomonas lindneri
4. Sarcina ventricis

Fungi :-

1. Aspergillus
2. Mucor
3. Rhizopus

Ans:- Yeasts :-

Saccharomyces cerevisiae
Saccharomyces ellipsoides.

Q.5 Differentiate between prokaryotic and Eukaryotic Cells.

Ans:- Prokaryotic Cells Eukaryotic Cells

- | | |
|---|---|
| 1. Nucleoid is present. | - well defined nucleus |
| 2. Nuclear membrane and nucleolus are absent. | - Nuclear membrane and nucleoli are present |
| 3. Cell wall of diamino-pimelic acid and muramic acid | - Cell wall is made up of cellulose and non-cellulose compounds |
| 4. Direct cell division takes place. | - Complicated mechanism of cell division |
| 5. Organellar ribosome are absent. | - Organellar ribosome are of 70S size |
| 6. Vacuolar system is lacking. | - Vacuolar system of is well developed. |

- Q.6. Draw a neat labeled diagram of typical bacterial cell. comment on cell wall and mesosome. OR
 draw a neat diagram of bacterial cell and explain different parts of cell.

Ans:-

Different parts of bacterial cell :-

Capsule :-

In many bacteria, cells develop an enclosing cover of gummy material forming a layer of considerable thickness. This layer is known as capsule.

Cell wall :-

It is a thin, sharply defined and relatively firm structure beneath capsule. Bacterial cell wall is rather

stable and resistant to the action of substance except strong acids and alkalies. It is composed of complex carbohydrates, cellulose, chitin and other polysaccharides.

Cytoplasmic membrane :-

Extremely thin but distinct membrane surrounding the cytoplasm. It functions as selective membrane. It is responsible for gram staining reaction.

Cytoplasm :-

Inside the cytoplasmic membrane there is a colloidal substance containing 70-90% water known as cytoplasm. It is usually clear or watery or slightly viscous in consistency.

Nuclear region :-

Presence of nucleus has shown that all bacteria contain intracellular bodies with the chemical properties expected of DNA which divide coordination with division of cell. The nucleus consist of tiny granules of chromatin scattered throughout the cytoplasm.

Q.6. Draw bacterial flagella and explain the action of flagella.

Ans:-

These are the organs of locomotion in bacteria. They are long, whip-like appendages extending from the surface of the cell. The presence of hair known as flagella. They move by undulating motion and thus propel forward.

These are smaller, shorter, numerous, hair like structures as compared to flagella. They cannot produce regular waves. They are visible only with electron microscope and are present in motile bacteria.

VII. Plasmid :-

Similar molecules of DNA exist, apart from the chromosome in circular units called as plasmids.

Q.7. Note on function/role of plasmid.

Ans:- Role of plasmid :-

Plasmids have fewer genes, which may be transferred from one cell to another during bacterial recombinations. They carry traits for drug resistance and are used as vectors in genetic transfers.

Q.8. Differentiate between gram +ve and gram -ve.

Ans:-

Cell wall components	Gram +ve	Gram -ve
Peptidoglycan layer	Contributes 80% of the cell wall	5-15%
Diaminopimelic acid	Present in a few, as it is replaced by lysine	Present in almost all species
Phospholipids, protein and lipopolysaccharide	Very little	Upto 90%
Tetrahydrofuran	Upto 20%	Absent
Thickness	2.5-3.0 μm	1.0-1.5 μm

Q.9.

Draw a neat and labeled diagram of flagella of bacterial cell and explain in detail the structure and function of flagella.

Q.10

Define 'bacterial growth' and explain various phases with suitable diagram.

Ans:-

Bacterial growth :-

It may be defined as a permanent and irreversible

change in mass, size or volume of a living structure with an accompanied increase in dry weight.

Growth phases :-

Stationary phase :-

After some time, the

growth rate falls, mainly due to limitation of one or more constituents in the medium and/or accumulation of toxic or unwanted chemicals or changes pH. For a brief period, increase in cell mass is balanced by cell death.

Log value of bacteria

Time (in hours)

1 Lag phase :-

When an inoculum is introduced into fresh medium, increase in cell mass does not occur for some time.

This is due to the need for the inoculum culture to adapt to the

uptake of ingredients present in medium.

2 Log phase :-

The time taken for doubling is known as the generation time. It varies from about 20 minutes to a few hours for most bacteria.

Death phase :-

Net decline in cell mass occurs, leading to the death phase. The typical growth curve of bacteria in culture is shown in figure.

Note on nutritional types of bacteria:-

Ques:-

Ans:- Nutritional types of bacteria:-

A Phototrophs:-

These are the bacteria

which can use sunlight as energy source. The phototrophs divides as:-

Photolithotrophs :-

Reduce inorganic chemical

which use sunlight as electron donors.

<p>11. Photoorganotrophs :- reduce organic material such as fatty acids and alcohols as electron donors.</p> <p>12. Chemotrophs :- Bacteria which use chemical compounds as energy source. The chemotrophs again classified as-</p> <ul style="list-style-type: none"> 1. Chemolithotrophs :- Reduce inorganic chemical compounds as electron donors 11. Chemoorganotrophs :- These bacteria use organic chemical compound as electron donors. <p>C. Autotrophs :- The bacteria which can use CO_2 as their major or even sole source of carbon for assimilation.</p> <p>1. Chemoautotrophs :- Rely upon chemical compound for energy and CO_2 as a sole source of carbon for assimilation</p>	<p>11. Photautotrophs :- Can utilize solar energy and use CO_2 as sole source of carbon assimilation.</p> <p>11. Facultative autotrophs :- Bacteria which can either live as autotrophs or they can live as heterotrophs.</p> <p>D. Heterotrophs :- The bacteria can use organic chemical compounds as sole source of carbon are termed as heterotrophs.</p> <p>E. Obligate parasites :- Some bacteria can grow on artificial medium in the laboratory and need living host for their growth and multiplication.</p> <p>Q.12. Differentiate between phototrophs and autotrophs.</p>
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Q.13 Define fungus. Enlist various methods of reproduction in fungi and describe in detail any two sexual methods.
Ans:-

Fungi :-

Fungi are eukaryotic, spore bearing, non-chlorophyll organisms that generally reproduce sexually as well as asexually. Their filamentous, branched somatic structures are typically surrounded by cell wall.

Methods of reproduction :-

i) Asexual Reproduction

zoospore formation

ii) Aplanospore formation

iii) Conidia

2. Sexual Reproduction

3. Vegetative Reproduction

i) Fragmentation

ii) fission

iii) budding

iv) oidium formation

v) chlamydospore formation.

Sexual Reproduction

i) Pianogametic copulation :-

This type of sexual reproduction involves the fusion of two naked gametes one or both them are motile. The motile gametes are known as pianogametes.

ii) Gametangial contact :-

This method of reproduction is found in many lower fungi. In this method two gametangia of opposite sex come in contact and one or more gametes nuclei migrate from the male gametangium to the female gametangium.

iii) Gametangial copulation :-

In this method of sexual reproduction the fusion of the entire contents of two gametangia takes place
(e.g. Rhizopus, Mucor etc.)

iv) Spermatization

v) Somatogamy :-

The sex organs are not produced. The somatic cells take part in sexual fusion. e.g. Morchella.

Q.14 Important characteristics of fungi.

Ans:-

Characteristics of fungi

- I organic matter decomposition
- II phosphorus solubilization
- III Pharmacy
- IV Biological control of plant diseases
- V Mushroom production
- VI Beverage
- VII Bakery

Q.15 Important characteristics of algae.

Ans:- Characteristics of algae

- I Nitrogen fixation
- II Biofertilizer
- III medicine preparation
- IV used as food for humans and fish
- V Agar is use for preparation of microbiological media.

Q.16 Note on Actinomycetes.

Ans:- Actinomycetes

Morphology :-

Actinomycetes are regarded as transitional form between fungi and bacteria known as 'Ray fungi'.

- Filamentous, branching pattern; conidial formation resembles fungi.
- Size and spore formation resembles bacteria.
- But now actinomycetes are grouped with eubacteria because of prokaryotic nature and cell wall formation.
- many actinomycetes produce pigments.

Q.17 what is mean by genetic recombination? Explain the types of gene transfer in bacteria.

Ans:-

Genetic Recombination :-

It is the formation of new genotype by reassortment of genes following an exchange of material between two different chromosomes which have similar genes at corresponding sites.

Types of genetic recombination :-

1 Transformation :-

Transfer of cell naked free or naked DNA from one cell to another recipient cell.

2

Conjugation

Transformation

Transduction

Recombination

Transformation

2 Conjugation :-

Transfer of genes between cells that are in physical contact with one another by means of conjugation tube.

3 Transduction:-

Transfer of genes from one cell to another by bacteriophage

Q.18 Explain gene transformation in bacteria through conjugation.

Ans:- gene recombination by conjugation

Conjugation process in bacteria is a mechanism for gene transfer that requires cell to cell contact.

- Conjugation in bacteria is process of genetic recombination that involves cell to cell contact.
- The contact between the cells via protein tube called an F or S pilus & transfers genetic material
- The first demonstration recombination in bacteria conjugation was achieved by Lederberg and Tatum in 1940

Luria and Delbrück had demonstrated in 1943 that bacteria have a stable hereditary system but at that time there was no knowledge of any mating system bacteria.

Figure of genetic recombination by Conjugation in bacteria:-

Q. 19 Define bacteriophage. Explain the lytic cycle of bacteriophage with example.

Bacteriophage :-

Viruses which attack bacteria and multiply are referred to as bacteriophages.

Lytic cycle of bacteriophage :-

After production of new bacteriophages in an appropriate number, the bacterial host cell burst, open and the phage particles are released.

The lytic cycle is divided into several stages

- I Absorption of the phage particles to the host cell
- II Penetration of the phage particle or its nucleic acid into bacterium.
- III Transcription and replication of the virus nucleic acid.
- IV Production of protein capsomeres
- V Assembly of nucleic acid and protein capsomeres into new virus
- VI Release of mature virus particles or viroids from the cell.

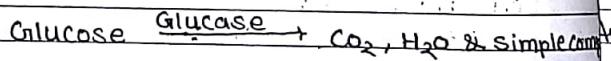
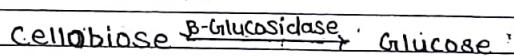
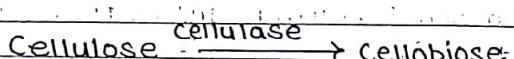
Q. 20 Describe the detail process of decomposition of organic matter.

Ans:- Decomposition of organic matter,

The organic matter consist of residue of plant and animal.

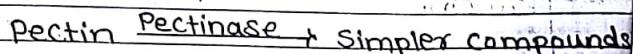
Microbiology of cellulose degradation :-

The cellulose is degraded to simple compound as follows by the enzymatic activities of different microbes.



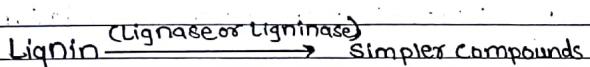
Microbiology of hemicellulose degradation :-

Hemicelluloses are various polymers of simple sugar hexoses, pentoses and sometimes uronic acids with monomers like xylose and mannose.



iii) Microbiology of lignin degradation :-

Lignin is third most abundant constituent of plant parts. Lignin is much more complex than the cellulose and hemicellulose. It consists of three elements like C, H and O.



Organisms responsible:-

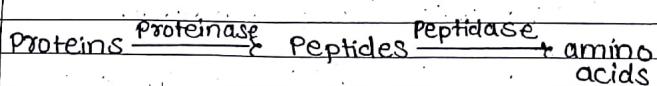
Pseudomonas, Flavobacterium (Bacteria), Humicola, Clavaria (fungi).

Q.21 Explain the nitrogen cycle with example of microorganism involved.

Ans:- Nitrogen cycle :-

i. Proteinolysis :-

The process of enzymatic breakdown of proteins by the microorganism with the help of proteolytic enzymes is known as proteinolysis.



organisms :-

Clostridium histolyticum, Proteus, Pseudomonas, Bacillus, micrococcus.

2. Ammonification :-

i. The process of deamination which leads to the production of ammonia is termed as ammonification.

The degradation is achieved by deammoniation i.e. removal of amino group and end product is ammonia.



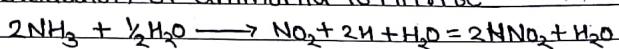
ii. Nitrogen immobilization :-

Sometimes when plant residues or pure carbohydrates are added to the soil there is rapid decrease in the amount of available inorganic nitrogen.

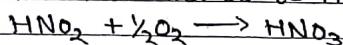
3. Nitrification :-

The oxidation of ammonia to nitrite and further oxidation of nitrite to nitrate is called nitrification.

i. Oxidation of ammonia to nitrite



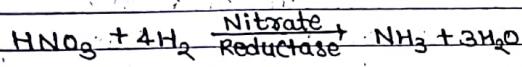
ii. Oxidation of nitrite to nitrate



4. Nitrate reduction :-

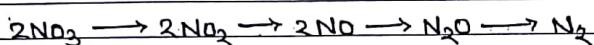
Several heterotrophic bacteria are capable of converting nitrates

into nitrites or ammonia normally under anaerobic conditions i.e. in waterlogged conditions.



5 Denitrification:-

The transformation of nitrates to gaseous nitrogen by microorganisms in a series of biochemical changes is called denitrification.



Organism:- Pseudomonas, Thiobacillus, Agrobacterium, micrococcus denitrificans, Thiobacillus denitrificans.

Q.22 Enlist microorganisms involved and describe the different steps in Sulphur cycle with diagram.

Ans:- Sulphur Cycle

1 Mineralization :-

Decomposition or breakdown of large organic sulphur compounds to smaller units and their conversion into inorganic compound is brought about by microorganisms. This is called mineralization

2 Immobilization :-

Microbial conversion of inorganic sulphur compounds to organic sulphur compounds takes place.

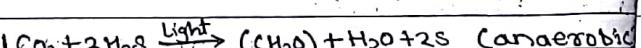
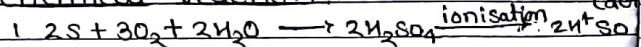
3 Oxidation :-

The biological oxidation of elemental sulphur and inorganic sulphur compounds such as H_2S , $(\text{SO}_4)^{2-}$ sulphites, Thiosulphate ($\text{S}_2\text{O}_3^{2-}$) is brought about by chemo trophic & photosynthetic bacteria.

• microorganism involved:-

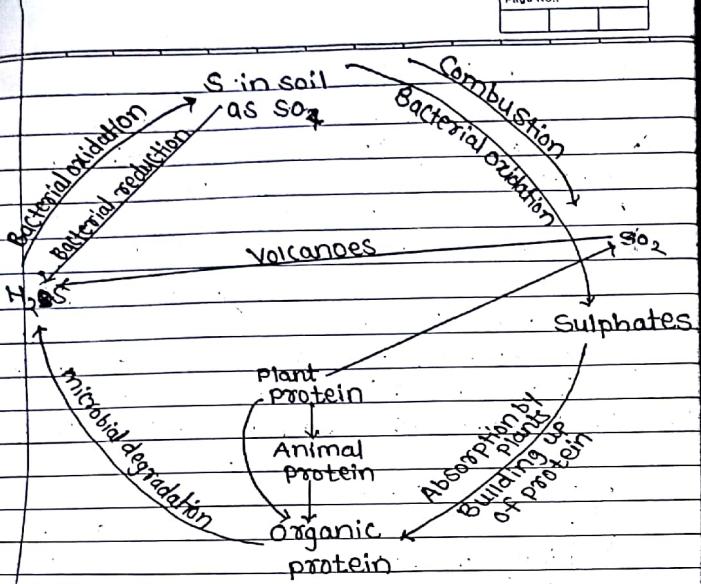
members of ~~#~~Thiobacillus genus oxidise S. Heterotrophic bacteria, actinomycetes and fungi.

• chemical reaction :-



4 Reduction of sulphate :-

Plant utilize sulphur in the form of sulphur and reduce to H_2S within cells to be utilized in synthesis of amino acids, vitamins etc. Thus sulphate present in the soil is assimilated by plants



23 Define rhizosphere. Describe in detail the factors affecting microflora of rhizosphere.

Rhizosphere :-

It can be defined as the region or zone of soil immediately surrounding the plant roots together with living root surface surfaces.

Factors affecting microflora of rhizosphere :-

1. Soil type and soil moisture :-
 - In general, microbial activity and population is high in the rhizosphere of plants grown in sandy soils but least in the soils with high humus content.
 - Rhizosphere organisms are more when soil moisture is low.
2. Soil Amendments and Fertilizers :-

Crop residues, animal manure and chemical fertilizers applied to the soil cause no appreciable effect on the quantitative and qualitative differences in the microflora of rhizosphere.
3. Soil pH / Rhizosphere pH :-

Respiration by the rhizosphere microflora may lead to the change in soil rhizosphere pH. If the activity and population of the rhizosphere microflora is more, then the pH of the rhizosphere region is lower than that of surrounding soil.
4. Proximity of root with soil :-

Soil samples taken progressively closer to the root system have increasingly greater population.

Q.24 Write note on R:S Ratio.

Ans:- R:S Ratio :-

H. Katznelson suggested the R:S ratio to find out the degree of influence of plant roots on microorganisms. It is defined as follows:-

$$R:S \text{ ratio} = \frac{\text{No. of microorganism in rhizosphere}}{\text{No. of microorganism in non-rhizosphere soil}}$$

$$R:S \text{ ratio} = \frac{R}{S}$$

Definition :-

It is defined as the ratio of microbial population per unit weight of rhizosphere soil to the microbial population per unit weight of adjacent non-rhizosphere soil.

The bacteria have greater R:S ratio as compared to fungi and other microbes.

Q.25 What are the methods of purification of waste water and describe biological treatment.

Ans:- Methods of purification of waste water:-

- i) Physical treatment
- ii) Biological treatment
- iii) Chemical treatment

Biological treatment :-

1. Sewage processing for small sewage plant for single dwelling unit :-

For ~~single~~ single dwelling unit for four family members, septic tank of volume 75 gallons is adequate.

2. Municipal sewage treatment plant :-

Municipal waste water treatment plant carry out a series of treatment processes and are summarized as follows:-

i) Primary treatment :-

The physical process is carried out to remove coarse solids or Settable solids & colloidal matter present in sewage.

ii) Secondary treatment :-

In this process oxidation of organic matter present in the sewage is carried out with the help of microorganisms. This reduces BOD of sewage.

iii) Advanced treatment :-

This process further removes additional objectionable substances including nutrients and further reduces BOD of sewage.

iv) Final treatment :-

This process is used for disinfection of liquid waste of sewage and disposal of liquid effluent.

v) Solids processing :-

Solids removed from final treatment are stabilized, dewatered and finally disposed off.

Q.26 Enlist the methods for food preservation and explain any one of them.

Ans:- Methods of food preservation

1) Aseptic methods :-

These methods are followed to eliminate source of contaminants, e.g. washing and cleaning of fruits and packing in sterilised pack.

2) Microbiostatic Methods :-

Inhibit the growth of undesirable microorganisms.
e.g. dehydration, chilling of pasteurized food.

3) Microbifidical Methods :-

To eliminate the microorganisms from food.
e.g. irradiation with UV rays, adding antimicrobial chemicals like benzoic acid, sulphides etc. in the food.

Methods of food preservation

1) Dehydration :-

To reduce water content upto less than 10% dry of food should be done. e.g. drying of red chillies, pod vegetables.

2) Heat processing :-

Canning of fruits, vegetables, fish, meat etc. Sealed cans are autoclaved at 5-10 lbs. steam pressure per sq.inch and stored at cool temperature.
e.g. Milk is pasteurised and stored at chilling temperature.

3) High osmotic pressure :-

Fruit slices are preserved in 70% concentration of sugar or syrup e.g. jams, jellies. Vegetables are preserved in concentrated salt solution containing upto 20% salt.
e.g. Pickles of mango and chilli.

4 Preservation by Irradiation :-

Cold storage rooms are filled with germicidal UV tubes to destroy organism on surface.

5 Chemical preservation :-

Na-metabi-sulphite is added in fruit products and boric acid in butter as preservatives.

Q.27 Enlist and describe various processes of food spoilage alongwith microbes responsible.

Ans:- Processes of food spoilage :-

1 Putrefaction :-

Degradation of protein food by proteolytic organisms is known as putrefaction.

Protein food $\xrightarrow[\text{MOs}]{\text{Proteolytic}}$ AA + amines + ammonia

Proteolytic microbes are Pseudomonas, Clostridium, proteus

2 Fermentation :-

It is the anaerobic oxidation of Carbohydrate compound by

the enzymatic action of microorganisms.

Carbohydrate fermenting acids + Alcohol + Gases
microbes food

Carbohydrate fermenting bacteria are Streptococcus, Leuconostoc, Micrococcus.

3 Rancidity :-

It is the hydrolytic degradation or decomposition of fatty foods by lipolytic microorganisms. Rancid orders is caused due to fatty acids.

Fatty acids $\xrightarrow{\text{Lipolytic microorganisms}}$ Fatty acids + Glycerol

Lipolytic microorganisms are Pseudomonas, Lipolyticum & Achromobacter.

Q.28 Define Biofertilizers. State their different types and explain in detail their methods of application of biofertilizer and their role in agriculture.

Ans:- Biofertilizers :-

Biofertilizers are the preparations containing live or latent cells of efficient strains of microorganisms fixing, solubilizing, mobilizing plant nutrients.

Types of Biofertilizers :-

1. Nitrogen fixers :-
Symbiotic, non-symbiotic
and associatively symbiotic nitrogen
fixers.
2. Phosphate solubilizers :-
Ex. Fungi, bacteria
3. sulphur oxidisers :-
Ex. Thiobacillus,
thiomoxidans
4. organic matter decomposers :-
Ex. Bacteria, fungi and actinomycetes.
5. VAM fungi :-
Ex. Glomus, Gigaspora,
sclerocystic, Acaulospora etc.
6. BGA - Azolla system:-
Anabaena Azollae
and Azolla pinnata

Methods of application of Biofertilizers:-

slurry method:-

Prepare 10% solution of sugar/jaggery or 40% solution of gum arabica as an adhesive. Take one litre of this solution and add about 200-250mg of inoculant and mix thoroughly to make homogenous slurry. Sprinkle this slurry on the seeds covering uniformly all the seed surface.

Pelleting seeds :-

Prepare the inoculant slurry as mentioned in slurry method by dissolving 100g. gum arabica in 250ml water and mix 200-250g of biofertilizer and sprinkle this inoculant slurry over seed and mix thoroughly immediately. Then to this inoculant Coated seeds add a little quantity of 600mesh CaCO_3 and mix for two minutes. Seeds appearing as white tablets are allowed to harden for a hour by spreading thinly on clean surface.

seedling inoculation :-

The slurry of inoculant either in plain water or jaggery solution is prepared. Complete seedling or root of seedling are dipped for about 10-12 m. in slurry and transplant

4. Soil application :-

Granular biofertilizers are broadcasted in furrows between two rows of standing crop in the field or powdered biofertilizers are mixed with 10-15kg fine soil and mixture is broadcasted in field.

5. Sugarcane set inoculation :-

The slurry of biofertilizers is prepared in water and sugarcane sets are dipped in the slurry for 5-10min. and planted immediately.

Role of fertilizers in agriculture :-

1. They supplement chemical fertilizers.

2. They can add 20-200 kg N/ha/year under optimum soil conditions and thereby increase 15-25% of total crop yield.

3. The N_2 fixers like azotobacter produce the growth promoting substances and vitamins in addition to N fixation and maintain soil fertility.

4. The germination and stand of crop is improved.

5. Some bio-fertilizers produce antibiotics which protect the roots from root infecting pathogen.

6. Some biofertilizers oxidise the element sulphur to sulphates which are available to the plants.

7. They are cheaper, ecofriendly and renewable energy sources.

8. They play important role in the recycling of plant nutrients.

Q.29 Note on advantages of ideal biocontrol agents?

Ans:- Advantages of biocontrol agents

1. It is the cheapest and most effective source of biocontrol.

2. It is ecofriendly and do not leave behind toxic effects.

3. Target specific pathogens and avoid unnecessary effect on beneficial microflora and microfauna.

4. Most of them is easy culturable in the lab with minimum space.
5. Inexpensive to produce large quantities of inoculum.
6. Environmental degradation is eliminated.
- Q.30. What is microbial insecticide? Write in brief about *Bacillus thuringiensis* and *Trichoderma* in relation to mode and action, target pest and method of application.

Ans:- Microbial insecticides:-

Microbial insecticides are the insecticides which use insect and pathogens as active ingredient.

Bacillus thuringiensis

Bacillus is mainly a pathogen of lepidopterous pests which includes American boll worm in cotton and stem borers in rice.

It is a stomach poison and its toxicity is due to four compound found in bacterial cell.

These are:-

1. Phospholipase C-alpha exotoxin
2. β -exotoxin
3. $Bt\alpha$ -toxin
4. $Bt\delta$ -endotoxin crystal toxin.

Crystal toxin/crystal protein/ δ -endotoxin plays main role in toxicity and death of insects.

Trichoderma :-

It is the antagonistic fungi for controlling seed-borne seedling diseases of plants like root rot, charcoal rot, fusarium wilt on oilseeds, pulses, cotton etc. It is also used for seed treatment and soil application. *T. viride* and *T. harzianum* are commonly used.

Q.31. Microbial agents for plant disease control.
Ans:- Microbial agents for plant disease control

Crop	Pest/diseases	Biopesticides
Rice	Yellow stem borer	BT
Soybean	Caterpillars	BT, NPV
Cotton	Bollworms, mites wilt and leaf spots	BT, NPV, Chrysoperla Trichoderma
Chickpea		Trichoderma
Pigeon pea	Wilt	Trichoderma,
Green gram		Pseudomonas

Crop	Pest/disease	Biopesticides
Mustard	White rust & leaf spots	Trichoderma
Brinjal, Okra	Fruit borer	BT
Potato	mites	Verticillium
	Cutworms	BT
	Early blight	Trichoderma

Q.32 Define Biogas and describe its production alongwith biochemical reactions and microbes involved.

Ans:-

Biogas :- Biogas production technology is based on the phenomenon of biological decomposition of organic materials in the absence of air.

Biochemical reactions in biogas production

1. Hydrolysis :-

The hydrolytic bacteria which catalyze carbohydrates, proteins, lipids other components of biomass of fatty acids, H_2 and CO_2 .

2. Acid formation :-

The bacteria reduce the soluble organic materials to simple soluble

organic acids. Acid producing bacteria are *Bacillus cereus*, *Clostridium dissoluans*, *Pseudomonas formicans*.

3. Methane formation :-

Methane bacteria which are strict anaerobes reduce the organic acids and other oxidized compounds to methane (CH_4) to CO_2



Common method of biogas formation can be represented as follows:

