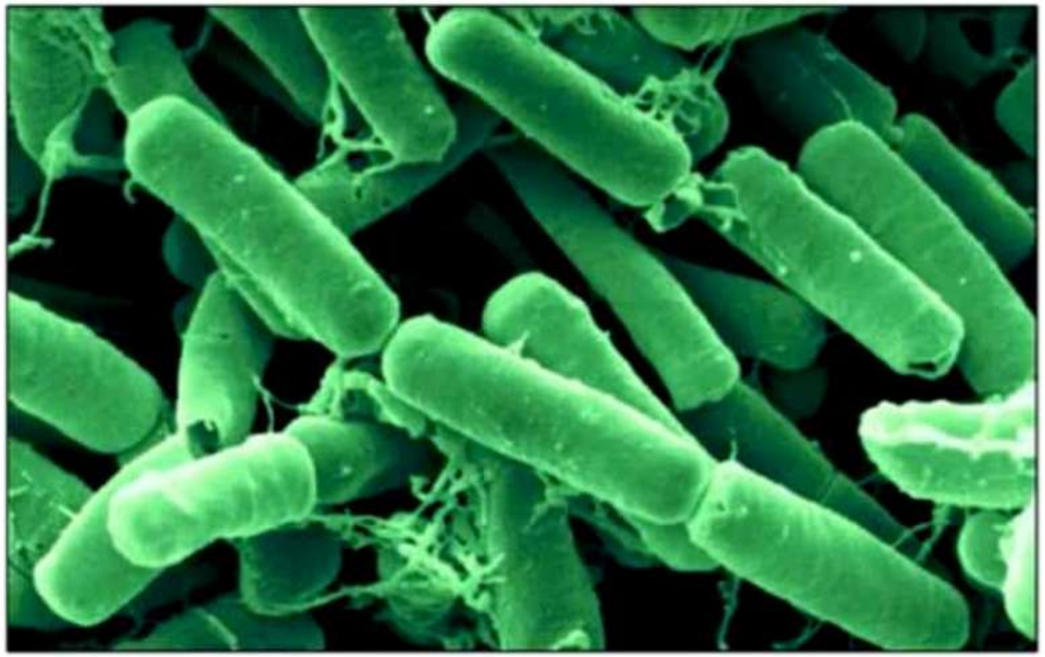
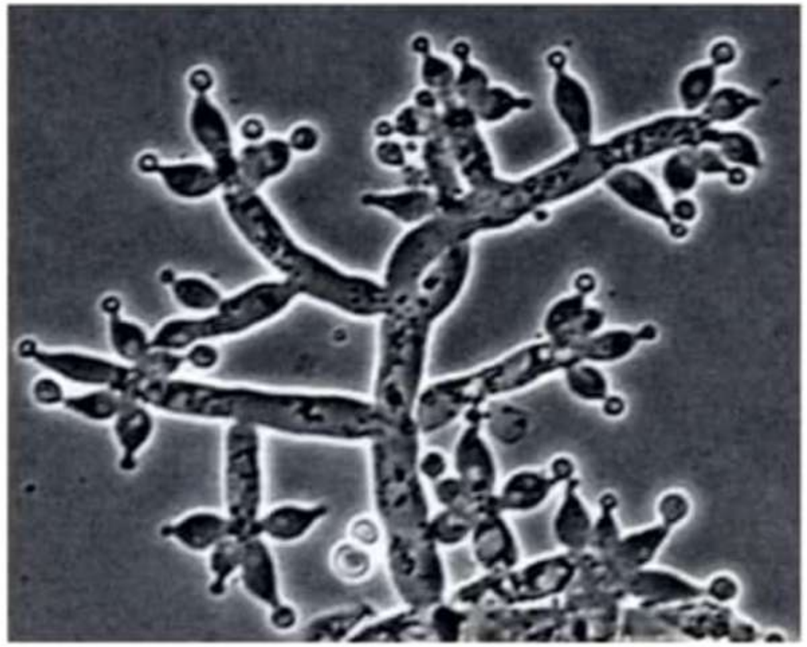
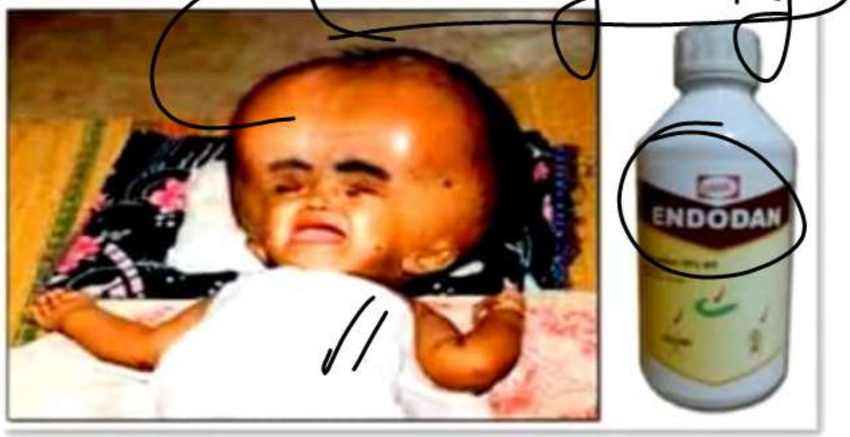




MICROBES AS BIOCONTROL AGENTS

MICROBES AS BIOCONTROL AGENTS



- Biocontrol is the use of biological methods for controlling plant diseases and pests.
- E.g. Lady bird (beetle) controls aphids. Dragon flies control mosquitoes.
- Chemical pesticides and insecticides kill both useful and harmful organisms and cause pollution. Biocontrol method has no such problems.

MICROBES AS BIOCONTROL AGENTS

MICROBIAL BIOCONTROL AGENTS

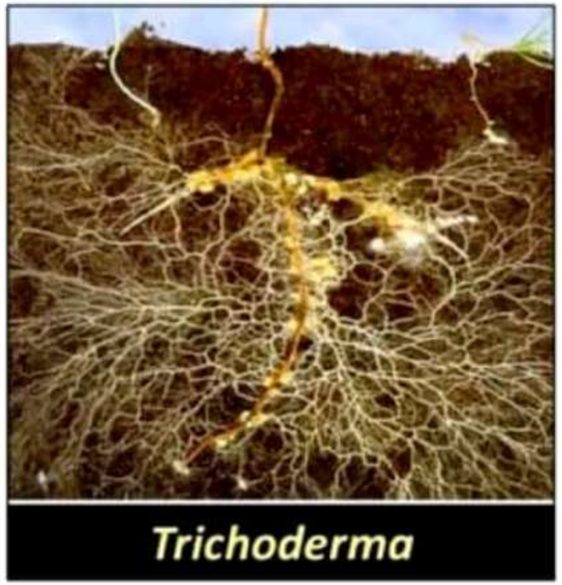
1. *Bacillus thuringiensis* (Bt)

- To control butterfly caterpillar.
- The dried spores of Bt (available in sachets) are mixed with water and sprayed on to vulnerable plants such as brassicas and fruit trees. These are eaten by the caterpillar. In their gut, the toxin is released and the larvae get killed.
- Scientists have introduced *B. thuringiensis* toxin genes into plants. E.g. Bt cotton.

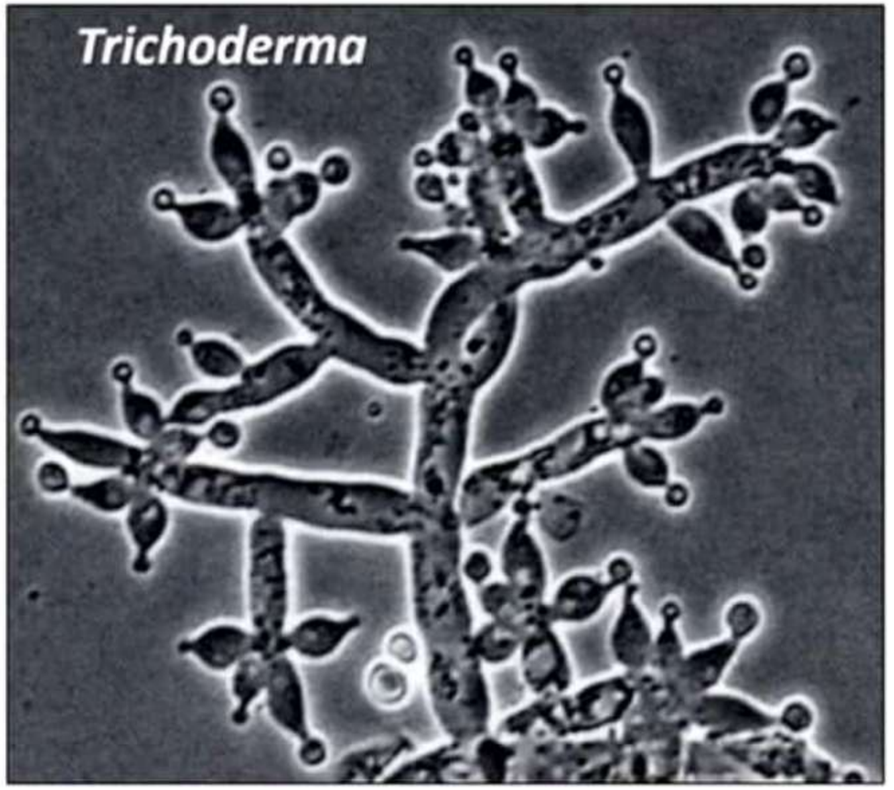
MICROBES AS BIOCONTROL AGENTS

MICROBIAL BIOCONTROL AGENTS

2. *Trichoderma sp (fungus)*



Trichoderma



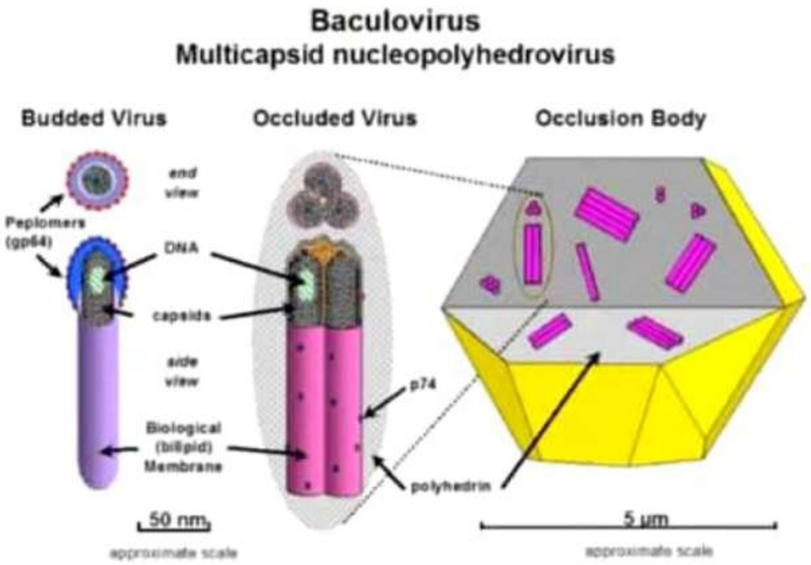
- They are seen in the root ecosystems.
- They control several plant pathogens.

MICROBES AS BIOCONTROL AGENTS

MICROBIAL BIOCONTROL AGENTS

3. Baculoviruses (Especially genus Nucleopolyhedro virus)

Baculoviruses



- **Attacks insects and other arthropods.**
- **It is suitable for species-specific, narrow spectrum insecticidal applications and desirable in IPM (Integrated Pest Management) program to conserve beneficial insects.**

MICROBES IN HUMAN WELFARE

10.1 *Microbes in Household Products*

10.2 *Microbes in Industrial Products*

10.3 *Microbes in Sewage Treatment*

10.4 *Microbes in Production of Biogas*

10.5 *Microbes as Biocontrol Agents*

10.6 *Microbes as Biofertilisers*

Besides macroscopic plants and animals, microbes are the major components of biological systems on this earth. You have studied about the diversity of living organisms in Class XI. *Do you remember which Kingdoms among the living organisms contain micro-organisms? Which are the ones that are only microscopic?* Microbes are present everywhere – in soil, water, air, inside our bodies and that of other animals and plants. They are present even at sites where no other life-form could possibly exist – sites such as deep inside the geysers (thermal vents) where the temperature may be as high as 100°C, deep in the soil,

"Biomagnification"
↳ Accumulation of toxic substance in food chains.

Biocontrol refers to the use of biological methods for controlling plant diseases and pests. In modern society, these problems have been tackled increasingly by the use of chemicals – by use of insecticides and pesticides. These chemicals are toxic and extremely harmful, to human beings and animals alike, and have been polluting our environment (soil, ground water), fruits, vegetables and crop plants. Our soil is also polluted through our use of weedicides to remove weeds. → unwanted plants.

Biological control of pests and diseases: In agriculture, there is a method of controlling pests that relies on natural predation rather than introduced chemicals. A key belief of the organic farmer is that biodiversity furthers health. The more variety a landscape has, the more sustainable it is. The organic farmer, therefore, works to create a system where the insects that are sometimes called pests are not eradicated, but instead are kept at manageable levels by a complex system of checks and balances within a living and vibrant ecosystem. Contrary to the 'conventional' farming practices which often use chemical methods to kill both useful

and harmful life forms indiscriminately, this is a holistic approach that seeks to develop an understanding of the webs of interaction between the myriad of organisms that constitute the field fauna and flora. The organic farmer holds the view that the eradication of the creatures that are often described as pests is not only possible, but also undesirable, for without them the beneficial predatory and parasitic insects which depend upon them as food or hosts would not be able to survive. Thus, the use of biocontrol measures will greatly reduce our dependence on toxic chemicals and pesticides. An important part of the biological farming approach is to become familiar with the various life forms that inhabit the field, predators as well as pests, and also their life cycles, patterns of feeding and the habitats that they prefer. This will help develop appropriate means of biocontrol.

The very familiar beetle with red and black markings – the Ladybird, and Dragonflies are useful to get rid of aphids and mosquitoes, respectively. An example of microbial biocontrol agents that can be introduced in order to control butterfly caterpillars is the bacteria *Bacillus thuringiensis* (often written as *Bt*). These are available in sachets as dried spores which are mixed with water and sprayed onto vulnerable plants such as brassicas and fruit trees, where these are eaten by the insect larvae. In the gut of the larvae, the toxin is released and the larvae get killed. The bacterial disease will kill the caterpillars, but leave other insects unharmed. Because of the development of methods of genetic engineering

of biocontrol.

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Ladybird (Beetle) → Aphids

Dragonflies: → Mosq.

A biological control being developed for use in the treatment of plant disease is the fungus *Trichoderma*. *Trichoderma* species are free-living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

Non-parasitic

Baculoviruses are pathogens that attack insects and other arthropods. The majority of baculoviruses used as biological control agents are in the genus *Nucleopolyhedrovirus*. These viruses are excellent candidates for species specific, narrow spectrum insecticidal applications. They have

Baculoviruses are pathogens that attack insects and other arthropods. The majority of baculoviruses used as biological control agents are in the genus *Nucleopolyhedrovirus*. These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications. They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects. This is especially desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme, or when an ecologically sensitive area is being treated.

10.6 Microbes as Biofertilisers

With our present day life styles environmental pollution is a major cause of concern. The use of the chemical fertilisers to meet the ever-increasing

demand of agricultural produce has contributed significantly to this pollution. Of course, we have now realised that there are problems associated with the overuse of chemical fertilisers and there is a large pressure to switch to **organic farming** – the use of **biofertilisers**. Biofertilisers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilisers are bacteria, fungi and cyanobacteria. You have studied about the nodules on the roots of leguminous plants formed by the symbiotic association of *Rhizobium*. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient. Other bacteria can fix atmospheric nitrogen while free-living in the soil (examples *Azospirillum* and *Azotobacter*), thus enriching the nitrogen content of the soil.

Fungi are also known to form symbiotic associations with plants (**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

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Fungi are also known to form symbiotic associations with plants (**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. *Can you tell what advantage the fungus derives from this association?*

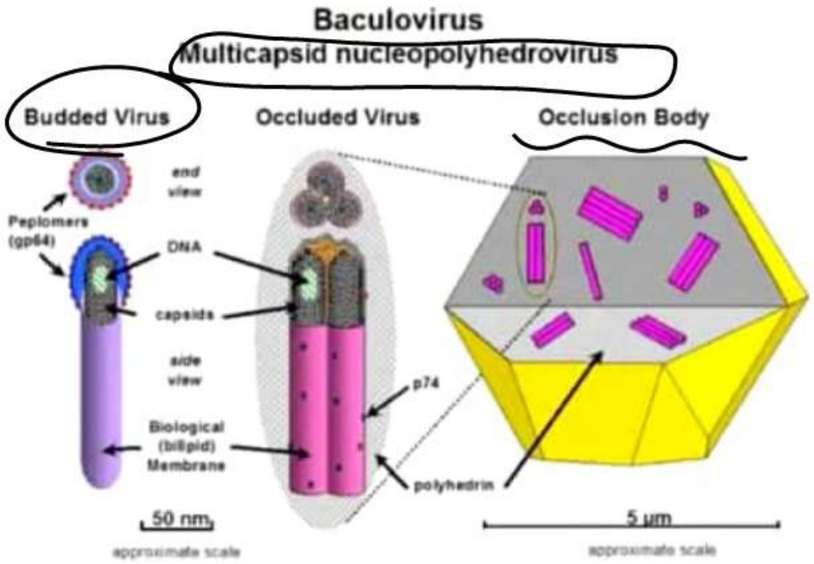
Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen, e.g. *Anabaena*, *Nostoc*, *Oscillatoria*, etc. In paddy fields, cyanobacteria serve as an important biofertiliser. Blue green algae also add organic matter to the soil and increase its fertility. Currently, in our country, a number of biofertilisers are available commercially in the market and farmers use these regularly in their fields to replenish soil nutrients and to reduce dependence on chemical fertilisers.

MICROBES AS BIOCONTROL AGENTS

MICROBIAL BIOCONTROL AGENTS

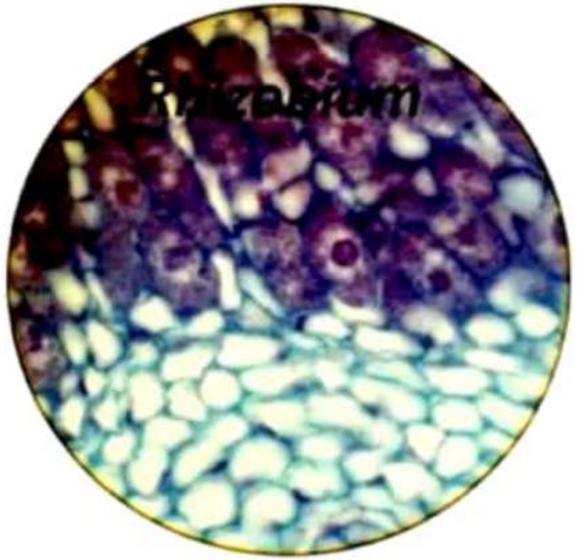
3. Baculoviruses (Especially genus Nucleopolyhedro virus)

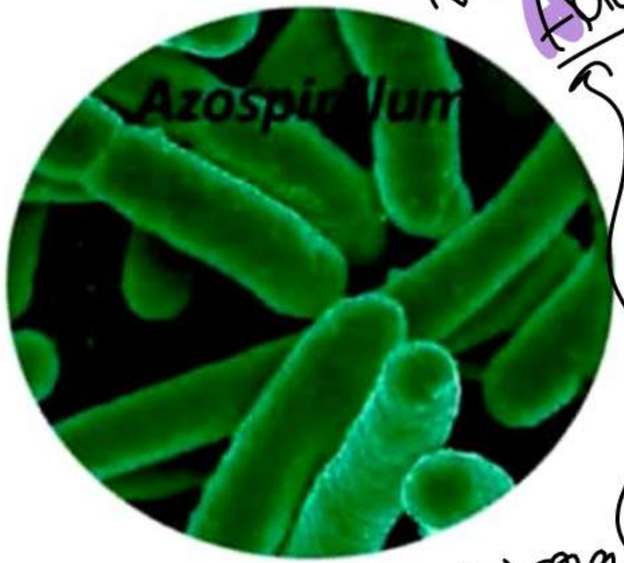
Baculoviruses



- **Attacks insects and other arthropods.**
- **It is suitable for species-specific, narrow spectrum insecticidal applications and desirable in IPM (Integrated Pest Management) program to conserve beneficial insects.**

MICROBES AS BIOFERTILISERS





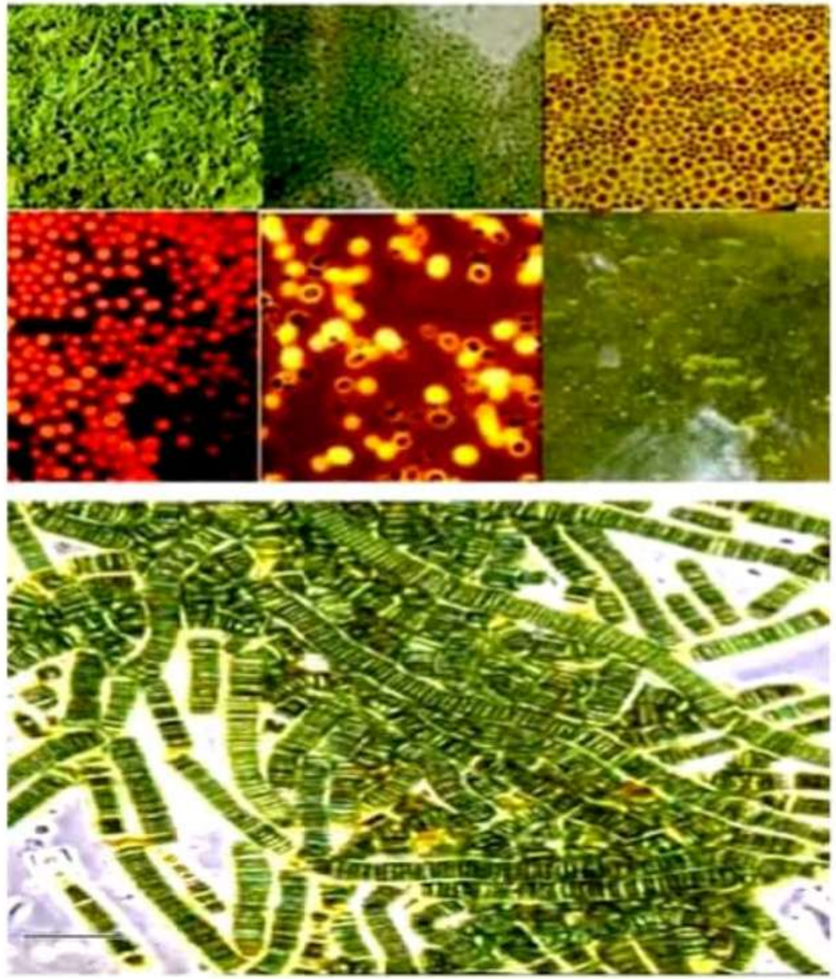
- **Biofertilisers** are organisms that enrich the nutrient quality of the soil.
- E.g. Bacteria, fungi, cyanobacteria etc.
- ***Rhizobium*** (symbiotic bacteria in root nodules of leguminous plants) fix atmospheric N_2.
- Free-livings bacteria in the soil (E.g. ***Azospirillum*** and ***Azotobacter***) enrich the nitrogen content of the soil.

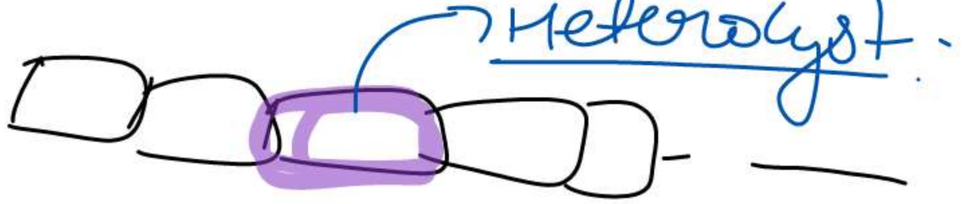
MICROBES AS BIOFERTILISERS

Mycorrhiza

- Symbiotic association of fungi (E.g. *Glomus*) with plants. The fungus gets food from the plant.
- The fungal Symbiont performs the following:
  - ✓ Absorb phosphorous from soil and passes it to the plant.
  - ✓ Give resistance to root-borne pathogens and tolerance to salinity and drought.
  - ✓ Give overall increase in plant growth and development.

MICROBES AS BIOFERTILISERS





Cyanobacteria (Blue green algae)

- Autotrophic microbes. → They Perform Photo-Syn.
- They fix atmospheric nitrogen.
- E.g. *Anabaena, Nostoc, Oscillatoria* etc.
- In paddy fields, *Cyanobacteria* serve as biofertilisers. It also adds organic matter to the soil and increases its fertility.

Rice

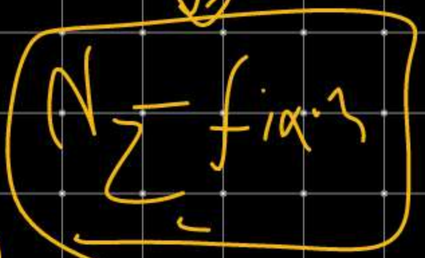
① Nodule: It is the small outgrowth on the roots of leguminous plants

→ Pea, Pulses (दाल)

→ Leguminaceae.

Reason:

Reason: Infection by Rhizobium



② Nucleopolyhedro V (Baculo V)

→ Multi capsid ⇒ Protein coat

→ Budded Virus (Outgrowth)

→ Occluded V: Occlusion body (ot)

occlusion body: Protein structures which protect the virus from external environment.

Nostoc

(4) Heterocyst: → Thick-walled cells

→ Nitrogenase (Int) → fix N_2.

→ gaseous exchange