Microbes as Biofertilisers

(1) The extensive utilization of chemical fertilizers to fulfill the escalating demand for agricultural yield has made a substantial contribution to environmental degradation. The overuse of chemical fertilizers poses numerous challenges, necessitating a transition towards organic farming practices.

(2) Organic farming entails the cultivation of crops utilizing biofertilizers, which offer optimal nutrient provision to crop plants.

(3) Biofertilizers comprise organisms that enhance the nutrient composition of soil. Key sources of biofertilizers include bacteria, fungi, and cyanobacteria.

(4) Bacteria:
   (i) Rhizobium forms a symbiotic relationship with the root nodules of leguminous plants. These bacteria convert atmospheric nitrogen into organic compounds, which are utilized by plants as nutrients.
   (ii) Bacteria such as Az spirillum and Azotobacter have the capability to fix atmospheric nitrogen while residing freely in the soil, thereby augmenting the nitrogen content of the soil.

(5) Fungi: Fungi also establish symbiotic associations with the roots of higher plants, known as Mycorrhiza. Numerous members of the genus Glomus form mycorrhizal associations. The fungal symbiont absorbs phosphorus from the soil and transfers it to plants. Plants engaged in such associations also exhibit resistance to root-borne pathogens, resilience to salinity and drought, and an overall enhancement in growth and development. In return, fungi derive shelter and nourishment from this association.

   Types of Mycorrhiza:
   (i) Ectomycorrhizae (also known as Ectotrophic or Entophytic): In this type, the hyphae of the fungus exclusively form a mantle on the outer surface of the root. This arrangement enhances the absorption of water and minerals. Examples of plants that form ectomycorrhizae include Pinus and oak. Mycorrhizae play a crucial role in absorbing and storing essential nutrients such as nitrogen, phosphorus, potassium, and calcium. Typically, the fungi involved belong to the basidiomycetes group.
   (ii) Endomycorrhizae (also known as Endotrophic or Endophytic): In this type, fungal hyphae penetrate into the cortex cells of the root. Plants such as orchids, coffee, and woody plants often form endomycorrhizal associations. These are also referred to as vesicular arbuscular mycorrhizae (VAM), as cortical cells undergo swelling and form vesicles or arbuscles. Endomycorrhizae play a significant role in the phosphorus nutrition of plants. The fungi involved in this type usually belong to the zygomycetes group.

(6) Cyanobacteria, a group of autotrophic microorganisms, are widely distributed in both aquatic and terrestrial environments. Many cyanobacteria species possess the ability to fix atmospheric nitrogen, such as Anabaena, Nostoc, and Oscillatoria. In agricultural settings like paddy fields, cyanobacteria play a crucial role as biofertilizers. Notably, Aulos Ira stands out as the most active non-symbiotic nitrogen fixer in rice fields in India. Furthermore, blue-green algae (BGA), a type of cyanobacteria, contribute to soil fertility by adding organic matter and reducing soil alkalinity.

(7) Presently, a variety of biofertilizers are commercially available in the market. Farmers routinely utilize these biofertilizers in their fields to replenish soil nutrients and decrease reliance on chemical fertilizers.

Example: What is meant by the concept of organic farming?

Solution: Organic farming refers to the cultivation of crops utilizing biofertilizers, which offer optimal nutrient provision to crop plants.