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ROLE OF MICROBES IN NITROGEN FIXATION

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ROLE OF MICROBES IN NITROGEN FIXATION

Nitrogen is one of the major limiting nutrients in plant growth. Nitrogen fixation refers to the conversion of atmospheric nitrogen to ammonia and then to nitrogen containing organic compounds that can be available to all forms of life. Nitrogen can be fixed by non-biological processes, such as lightning or the Haber-Bosch process used to produce fertilizer products such as urea. Biological nitrogen fixation is carried out only by prokaryotes, which are belonging to diverse groups.

Biological nitrogen fixation requires three components:

- I. a strong reducing agent,
- II. ATP to transfer hydrogen atoms to dinitrogen ($N\equiv N$), and
- III. the enzyme systems.

The reducing agent (FAD) and ATP are provided by photosynthesis and respiration.

Nitrogen fixing microbes (Diazotrophs)

Diazotrophs are generally active in rhizosphere. They are classified according to their mode of fixation.

- I. Free living nitrogen fixers
- II. Associative nitrogen fixers
- III. Endophytic nitrogen fixers
- IV. Symbiotic nitrogen fixers

I. Free living nitrogen fixers:- They are capable of fixing atmospheric nitrogen independently of other living organism.

- *Azotobacter*- obligate aerobic
- *Clostridium*- anaerobic
- Cyanobacteria- *Anabaena cylindrica*, *Gloeocapsa*, *Nostoc cmuscorum*
- *Bacillus polymyxa*- facultative anaerobic

II. Associative nitrogen fixers :-Johannah Dobreiner observed a loose association of *Azospirillum lipoferum* , a nitrogen fixer, with roots of certain Brazilian grasses and maize in 1975. These are widespread in the soils of tropical, subtropical and temperate regions. *Azospirillum* bacteria are aerobic non-fermentative chemoorganotrophic vibroid to S-shaped containing polyhydroxyalkanoate granules (PHA).

IV. Endophytic nitrogen fixers:-Endophytes multiply and spread within plant tissues without causing damage . e.g. *Gluconacetobacter diazotrophicus*: an acetic acid bacterium first isolated from sugarcane plants.

V. Symbiotic nitrogen fixers:-This is mutually beneficial relationship between microbes and plant. e.g.

- Rhizobium (Rhizobium-legume association)
- Bradyrhizobium (Bradyrhizobium-soybean association)
- Azorhizobium (Azorhizobium –*Sesbania rostrata* association)- Form stem nodule along with root nodule
- Actinomycetes
e.g. Frankia (Frankia-Casuarina association)
- Cyanobacteria
 - * Lichens (Cyanobacteria-fungus association)
 - * Bryophytes (Anabaena-Anthoceros)
 - * Pteridophytes (*Anabaena azollae*-*Azolla*)-*Azolla* is a small fast growing aquatic fern. *Anabaena azollae* , a cyanobacterium lives in cavities of *Azolla* leaves. It fixes nitrogen from the air and excretes the nitrogenous compounds into the leaf cavity of fern. *A. pinnata* is an excellent biofertiliser for rice.
 - * Gymnosperms (Nostoc-Cycads), Coralloids root
 - * Angiosperms (Nostoc-Gunnera)