INTERRELATIONSHIP OF MICROBES IN SOIL

The microorganisms that inhibit the soil, exhibit various kinds of association or interaction. Some of these associations are indifferent or neutral, some are beneficial or positive, where as others are detrimental or negative. They are discussed below-

1. ***Neutral association or neutralism:***

In this type of association, two different species of microorganisms occupy the same environment without affecting each other. e.g. each could utilize different nutrients without producing metabolic end products that are inhibitory for the other. Such a condition may be transitory, as condition change in the environment, the relationship might be changed.

2. ***Positive association:***

Positive association are such type of association in which one or both the members get benefit from the association. This may be of the following types-

a) ***Mutualism:***

It is defined as a positive association in which both the organisms get benefit from the association. This is an obligatory relationship in which the two organisms are metabolically dependent on each other.

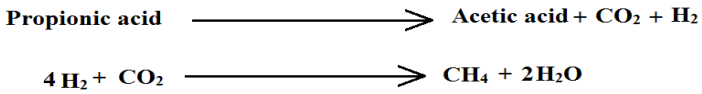
e.g. Lichens are excellent example of mutualism. They are the association between specific Ascomycetes (fungus) and certain genera of either green algae or cyanobacteria. The algal or cyanobacterial partner is known as phycobiont which is a photoautotroph that depends upon light CO_2 and certain mineral nutrients. The fungal partner or mycobiont can get its organic carbon directly from the phycobiont. The fungus often obtains nutrients from the alga by haustoria that penetrate the algal cell wall. It also uses the O_2 produced during phycobiont photosynthesis to carry out respiration. In turns the mycobiont protects the phycobiont from excess light intensity, provides minerals and water and creates a

firm substrate within which the phycobiont can grow, protected from environmental stress.

b) Syntrophism:

It is an association in which growth of one organism either depends on or is improved by growth factors, nutrients or substrates provided by another organism growing nearby. Sometimes both organisms get benefit. This is also known as cross feeding or satellite phenomenon.

e.g. various fermentative bacteria produce low molecular weight fatty acids that can be degraded by various anaerobic bacteria, such as *Syntrophobacter* to produce H_2. The bacteria gains sufficient energy for growth only when the H_2 it generates is consumed. The products H_2 and CO_2 are consumed by methanogenic bacteria to produce methane. Thus *Metahnospirillium* maintains a low H_2 concentration. Continues removal of H_2 promotes further fatty acid fermentation and H_2 production. If H_2 is not consumed, it will inhibit the growth of *Syntrophobacter*. Because increased H_2 production and consumption stimulate both the bacterial growth, both participants become benefitted.



c) Protocooperation or synergism:

It is a mutually beneficial relationship but the relationship is not obligatory. The organisms involved in this type of relationship can be separated and if the resources provided by the complementary microorganism are supplied in the growth environment, each microorganism will function independently.

e.g. the association of *Desulfovibrio* and *Chromatium* is an example of protocooperation. The organic matter and SO_4^{2-} required by *Desulfovibrio* are produced by *Chromatium* and CO_2 and H_2S required by *Chromatium* is provided by *Desulfovibrio*. But if the substrates are provided in the growth environment, they can both grow independently.

d) Commensalism:

It is a type of relationship in which one organism (commensal) gets benefit from the association but the other organism is unaffected i.e. neither harmed nor benefitted. Thus it is a unidirectional association. Usually it is not obligatory for the two populations involved.

e.g. non-pathogenic strains of *E. coli* present in human colon. When O_2 is used by facultative anaerobic *E. coli*, obligate anaerobes such as *Bacteroides* are able to grow in the colon. Thus the anaerobic bacteria get benefit but *E. coli* derives no benefit from the anaerobes, neither harmed.

♣ ***Cometabolism:***

It is a process in which one organism on a particular substrate gratuitously oxidizes (i.e. oxidizes without any motive) a second substrate which is of no use for it. The oxidized products however are well used by other organisms.

e.g. *Mycobacterium vaccae* while growing on propane cometabolizes cyclohexane to cyclohexanone which is then used by *Pseudomonas sp.* The later population is thus benefitted since it is unable to oxidize cyclohexane. *Mycobacterium* remains unaffected since it does not assimilate cyclohexanone.

3. Negative association:

In such association, one organism gets benefit but the other becomes harmed to a greater or lesser extent. They are as follows –

a) Antagonism or ammensalism:

In this association one species adversely affect the environment for the other by producing antibiotics or other inhibitory substances which affect the normal growth or survival of the other organisms.

e.g. *Staphylococcus aureus* and *Pseudomonas aeruginosa* both are antagonistic towards *Aspergillus terreus*. Certain pigments of *Pseudomonas* inhibit germination of *Aspergillus* spores where *S. aureus* produce a diffusible antifungal material that causes distortion or hyphal swelling of *Aspergillus terreus*.

b) Parasitism:

It is defined as a relationship in which one organism lives in or on other organisms which is commonly harmed. The

organisms that feeds on the cells and tissues of other organisms is called parasite and the second organism is called host which is commonly harmed.

But here, there is a degree of coexistence between the host and the parasite. In necrotrophic parasitism, the parasite makes contact with its host, exerts a toxic substance which kills the host cell and utilizes the nutrients that are released. But in biotrophic parasitism, the parasite obtains its nutrients from the living host cells.

e.g. *Alternaria alternata* is a parasite of *Phytophthora megasperma*.

c) Predation:

It is defined as negative association in which one organism (predator) engulfs and digests another organism (prey) and the predator derives nutrition from the prey. However the distinction between predation and parasitism is not sharp.

e.g. a Gram negative predaceous bacteria *Bdellovibrio bacteriovorus* penetrates the cell wall and multiplies between the cell wall and plasma membrane of other susceptible bacteria, followed by lysis of the prey and release of progeny.

d) Competition:

Competition arises when different microorganisms within a population or community try to acquire the same resource whenever this may be a physical location or a particular limiting nutrient. In such situation, the best adapted species will predominate and eliminate other species.

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