

## **Quadrant II – Transcript and Related Materials**

**Programme:** Bachelor of Science (Third Year)

**Subject:** Botany

**Paper Code:** BOC 107

**Paper Title:** Microbiology and Plant Pathology

**Unit:** 09

**Module Name:** Biological systems for disease management

**Module No:** 48

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### **Notes:**

#### **Introduction**

Biological control of plant diseases is carried by use of antagonists (natural enemies of pests or pathogens) to control or eradicate plant diseases. Induction of plant resistance for pathogen. It is the best, environmentally safer and cheaper method. Pathogen activity is reduced by using other living organisms. The term applies to the use of microbial antagonists to suppress diseases as well as use of host specific pathogens to control pathogen.

Phyllosphere is the immediate vicinity of leaf surface, as rhizosphere is the zone of immediate vicinity of roots, where microbial communities are constantly in dynamic state due to exo-and endogenous sources of nutrients.

Several methods have been developed which bring about artificial manipulation of rhizosphere, phyllosphere and soil environment. Consequently number of antagonistic microorganism is increased. This can be done by (i) artificial introduction of antagonists in soil or spraying these antagonists on the aerial parts of plants, (ii) modification of soil environment by organic amendments, (iii) green manuring, changing soil pH, C : N ratios, temperature, and (iv) adding the selective chemicals or heat treatment of plant tissues.

#### Antagonism - The Mechanism of Biocontrol

Biological control is principally achieved through antagonism (the inhibitory relationships between microorganisms including plants) which involves :

- (i) Amensalism i.e. antibiosis and lysis
- (ii) Competition
- (iii) Parasitism and predation.

#### ***Amensalism (Antibiosis and Lysis)***

Amensalism is a phenomenon where one population adversely affects the growth of another population whilst itself being unaffected by the other population. Generally amensalism is accomplished by secretion of inhibitory substances. Antibiosis is a situation where the metabolites secreted by organism A inhibit organism B, but organism A is not affected. Metabolites penetrate the cell wall and inhibit its activity by chemical toxicity. Generally antimicrobial metabolites are produced by underground parts of plants, soil microorganisms, plant residues, etc. antimicrobial substances (antibiotics) produced by microorganisms (soil bacteria, actinomycetes, fungi) are aldehydes, alcohols, acetone, organic acid, nonvolatile and volatile compounds which are toxic to microbes. Changes in microbial structures (cell wall, hyphae, conidia, etc.), may occur when microorganisms lack resistance against the

attack by deleterious agents or unfavorable nutritional conditions. A chemical substance (*i.e.* melanin) is present in their cell walls to resist the lysis.

### ***Competition***

Among micro-organisms competition exists for nutrients, including oxygen and space but not for water potential, temperature, or pH. Amensalism involves the combined action of certain chemicals such as toxins, antibiotics and lytic enzymes. Success in competition for substrate by any particular fungal species is determined by competitive saprophytic ability and inoculum potential of that species. Competitive saprophytic ability is "the summation of physiological characteristics that make for success in competitive colonization of dead organic substrates".

characteristics which are likely to contribute to the competitive saprophytic ability

- (i) Rapid germination of fungal propagules and fast growth of young hyphae towards a source of soluble nutrients,
- (ii) Appropriate enzyme equipment for degradation of carbon constituents of plant tissues
- (iii) Excretion of fungistatic and bacterio-static growth products including antibiotics
- (iv) Tolerance of fungistatic substances produced by competitive microorganisms.

### ***Predation and Parasitism***

Predation is an apparent mode of antagonism where a living microorganism is mechanically attacked by the other with the consequences of death of the former. It is often violent and destructive relationship. Parasitism is a phenomenon where one organism consumes another organism, often in a

subtle, non-debilitating relationship. These aspects are dealt with the example of fungi, nematodes and amoebae.

### **Mycoparasitism**

When one fungus is parasitized by another one the phenomenon is called as mycoparasitism. The parasitising fungus is called hyperparasite and the parasitized fungus as hypoparasite. Mycoparasitism commonly occurs in nature. As a result of inter-fungus interaction *i.e.* fungus-fungus interaction, several events take place which lead to predation viz., coiling, penetration, branching, sporulation, resting body production, barrier formation and lysis. In coiling (A) an antagonist, the hyperparasite (*a*) recognizes its host hyphae *i.e.* the hypoparasite (*h*) among the microbes and comes in contact and coils around the host hyphae. As a result of coiling, the host hypha loses the strength. If the antagonist has capability to secrete cell wall, degrading enzymes, it can penetrate the cell wall of host hyphae and enter in lumen of the cells. The event of entering in lumen of host cell is known as penetration. Depending upon nutrition, the antagonist forms branches and sporulates (*s*) inside the host hypha. Until the host's nutrients deplete, the antagonist produces resting bodies, the survival structures, for example, chlamydospores (*c*) inside the host hypha. Finally post-infection events lead to lysis of the host hypha due to loss of nutrients and vigor for survival.

### **Nematophagy**

This is the phenomenon of eating upon nematodes by fungi. However, several nematode eating *i.e.* nematophagous fungi (NF) are known which develop different kinds of trap (T), arrest the pathogenic nematodes (N) and finally kill them. Examples of nematode trapping fungi are *Arthrobotrys*, *Dactylaria*, *Dactyleela*, etc.

## **Mycophagy**

Mycophagy is the phenomenon of feeding on fungi by amoebae. In recent years, mycophagy has become a new field of research as far as biocontrol of soil-borne plant pathogens is concerned. Many soil amoebae are known to feed on pathogenic fungi.

Following are three major steps of feeding on fungal propagules by soil amoebae.

**(i) Attachment:** Attachment of trophozoites of amoebae (*a*) to fungal propagules *i.e.* conidia (*c*) or hyphae (*h*) appears to be a matter of chance. It takes place by chemotaxis or thigmotaxis

**(ii) Engulfment:** Fungal propagules (*e.g.* spores, conidia, fragments of hyphae) are fully engulfed by amoebae (*b*). The small trophozoites attached the hyphal wall or spore and make perforations on it.

**(iii) Digestion:** The completely or partially engulfed propagules/cytoplasm of the host fungi are digested in a large central vacuole formed inside the cyst.