BIOLOGICAL CONTROL

Biological control is defined as the use of microbial antagonists (including bacteria or fungi) to suppress plant pathogens.

In phytopathology, antagonism refers to the action of any organism (including bacteria or fungi) that suppress or interfere the normal growth and activity of a plant pathogen. These organisms can be used for pest control and are referred to as biological control agents.

Importance of biological control

- ♣ Alternative method of disease control
- ♣ Can be used in where other methods are not applicable.
- ♣ Biocontrol agents are nontoxic to man and the environment.
- ♣ Act on selective target organism.
- ♣ Biocontrol agents are self-sustaining-easy adaptation
- ♣ Diversify mode of actions
- ♣ Reduced possibility of inducing resistance in pathogens
- ♣ Cost effective
- ♣ Long term effects.

Mode of actions of biocontrol

1. Direct mechanism: Direct lysis or killing of pathogen by biocontrol agent

- ♣ Antibiosis
- ♣ Parasitism

2. Indirect mechanism: Exclusion of plant pathogen as a result of the presence, activity or products of biocontrol agent.

- ♣ Competition
- ♣ Induced systemic resistance

Antibiosis

An antagonistic association between two organisms (especially microorganisms), in which one is adversely affected. The antibiotic compounds secreted by the biocontrol agent that can suppress the growth of plant pathogens. e.g. Phenazine-1-carboxylic acid is produced by *Pseudomonas*

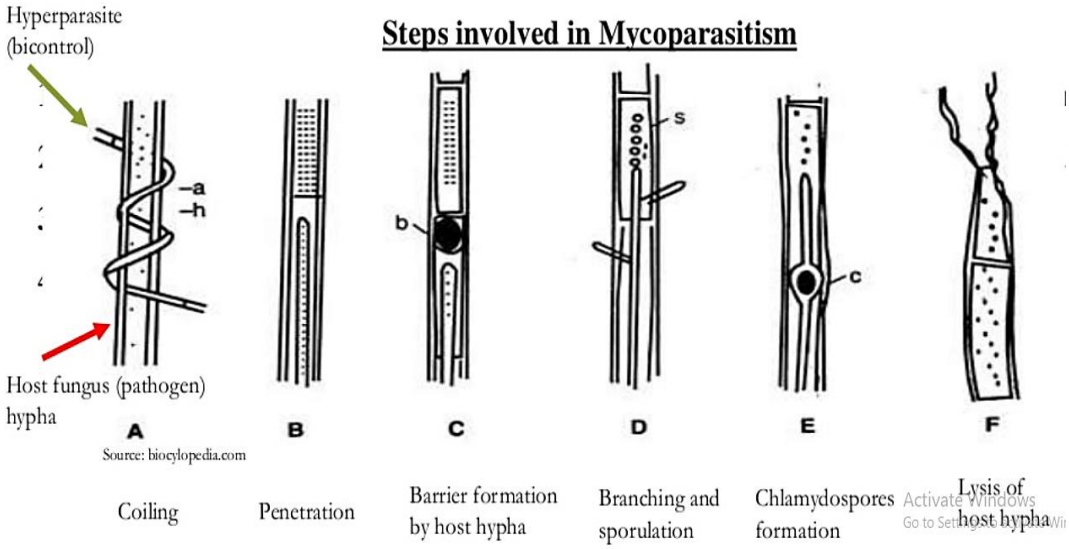
fluorescens. This compound plays an important role in suppressing the take all disease (*Gaeumannomyces graminis* var. *tritici*) of wheat.

Parasitism

Parasitism describes a relationship between two organisms where one benefits, and the other is harmed. Mycoparasitism refers to association in which a parasitic fungus (hyperparasite) live as a parasite to another fungus (hypoparasiste). Also known as Hyperparasitism, when hyperparasites (biocontrol fungi) utilize hypoparasites (pathogenic fungi) as source of nutrients. Hyperparasites produce parasitizing hyphae to acquire host nutrients. The biocontrol agent parasitizes the pathogen by coiling around the hyphae. Different kinds of bacteria and fungi secrete hydrolytic enzymes for degradation of cell wall of the pathogen. e.g. *Trichoderma* sp. produces chitinases and β-1, 3 glucanases which lyses the cell wall of *Rhizoctonia solani.*

Steps involved in Mycoparasitism

1. Chemotropic growth: the biocontrol fungi grow toward the target fungi chemical stimuli.
2. Recognition stage: interaction between biocontrol receptors and that of the host fungus
3. Attachment and cell wall degradation (chitinases and glucanases).
4. Penetration (appressoria-like structures).



Competition

The biocontrol bacteria and fungi compete for food and essential elements with the pathogen thereby displacing and suppressing the growth of pathogen.

e.g. The competition for nutrients between *Pythium aphanidermatum, P. ultimum* and bacteria (*Bacillus* sp.) suppress the damping off disease in cucumbers.

Induced systemic resistance (ISR)

Induced systemic resistance also known as systemic acquired resistance (SAR), resistance in plants to varieties of pathogens induced by the presence or products of biocontrol agent. ISR biocontrol agent may be

♣ Necrogenic pathogen (applied on leaf).

♣ Non-pathogenic bacteria (PGPR- Plant growth promoting rhizobacteria) (applied to root or seed).

♣ Metabolites of pathogenic or saprophytic bacteria.

Microbial metabolites able to induce

♣ Polyacrylic acid

♣ Ethylene

♣ Salicylic acid

♣ Acetyl salicylic acid

♣ Amino acid derivatives

♣ Harpin (*Erwinia amylovora*)

Induced systemic resistance- defense responses

Physical thickening of cell walls by;

♣ Lignification.

♣ Deposition of callose.

♣ Accumulation of antimicrobial low-molecular-weight substances (e.g., phytoalexins).

♣ Synthesis of various proteins (e.g., chitinases, glucanases, peroxidases, and other pathogenesis related (PR) proteins).

Methods of Application

- Seed treatment
- Dipping
- Drenching
- Foliar spray
- Drip irrigation

Requirements for successful biocontrol agents

1. Able to compete and persist
2. Able to colonize and proliferate
3. Must be non-pathogenic to host and environments
4. Must have excellent shelf life
5. Must be inexpensive
6. Must be able to produce in large quantities
7. Able to maintain viability
8. Delivery and application methods must support product establishment.

Limitations of biological control

1. Expensive/difficult to develop
2. Handling requires training
3. High Selectivity/Host Specificity
4. Variability in effectiveness
5. More susceptible to environmental conditions
6. Short shelf-life of formulations
7. Slow action
8. Storage Problem