BIOLOGICAL CONTROL - DEFINITION – HISTORY - CLASSICAL EXAMPLES - FACTORS GOVERNING BIOLOGICAL CONTROL

C. Microbial Control

Defined as control of pests by use of microorganisms like viruses, bacteria, protozoa, fungi, ricketsia and nematodes, which kill their host or debilitate the future generations

Qualities of Insect pathogens…

- Host specificity/suitable strain
- Virulence
- Toxin production
- Rapid Spreading of disease
- Persistent for long time (self-life)
- Amenability to mass culture
- Cost effective and Economical
- Safe to non-target organisms

Microbial Agents

I. Entomopathogenic fungi

- Fungi that can act as parasites of insects and kill or seriously disable them
- Over 950 species are pathogenic to arthropods
- 20 have been exploited

Symptoms of fungal infection

- Loss of appetite, irritability and paralyses
- Discoloured patches on integuments and increased acidity in blood
- The body hardens and covered by dense white mycelial mat
- Mummified larvae adhere to leaves, stem and fruiting body with upright position on its prolegs at the time of death
- Death occurs with in 4-7 days depending on host insects and environmental conditions

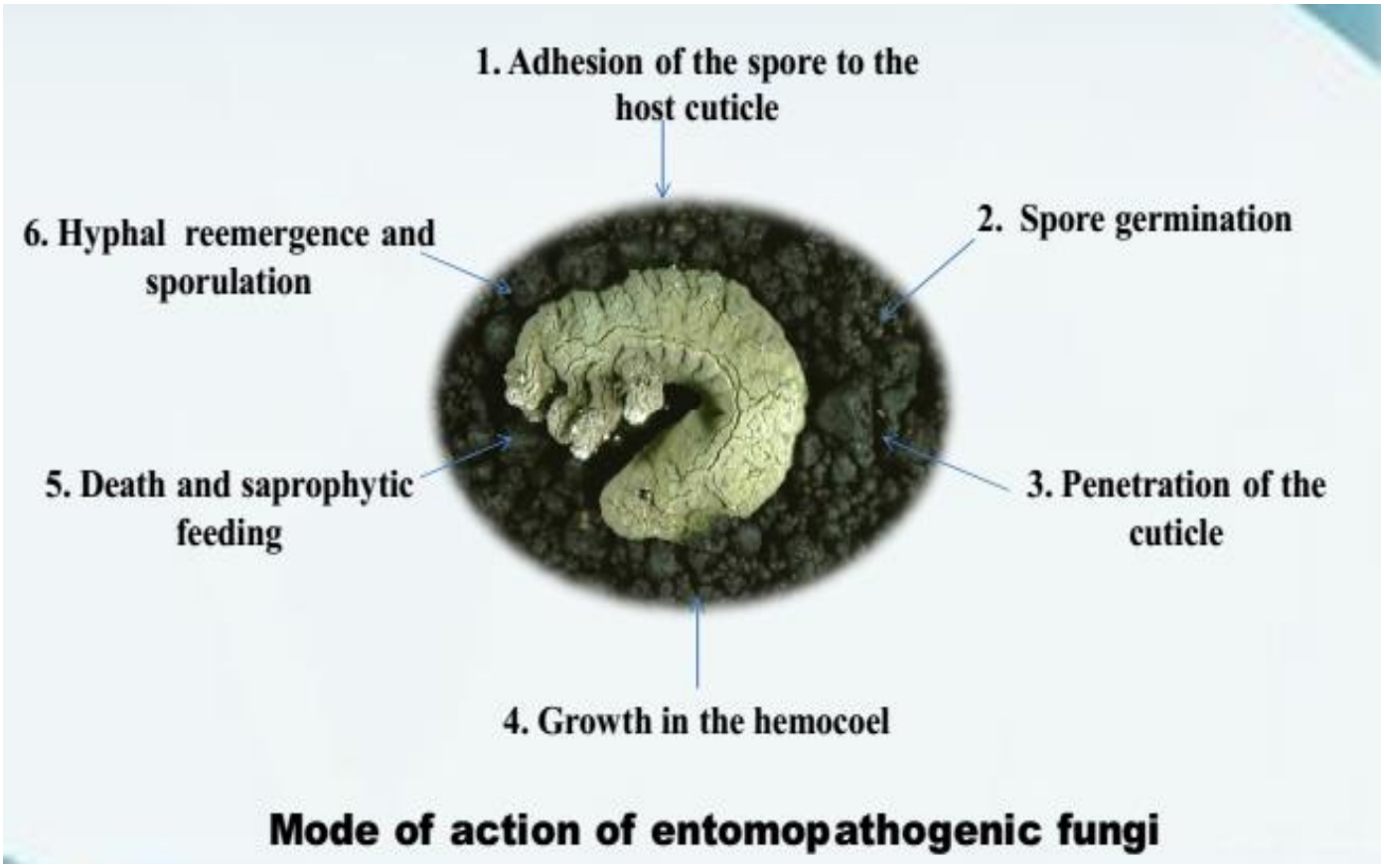
Fungi	Target host	
Metarhizium anisopliae	Coleopterans, soil inhibiting pests, BPH, Grasshoppers	Green muscardine fungus
Beauveria bassiana	Lepidopetrans, Coleopterans, leaf hoppers, plant hoppers, whiteflies	White muscardine fungus
Verticillium lecanii	coffee green scale	White halo fungus
Nomuraea rileyi	Sucking pests	
Hirsutella thompsani	Mites	

Metarhizium

Beauveria

Verticillium

Nomuraea



Mode of action of entomopathogenic fungi

Field applications.....

Fungus	Host insect	Dosage
Metarhizium anisopliae	White grub, sweet potato weevil, BPH, DBM, Rhinoceros beetle, termite, grass hoppers, caterpillars	1-2 kg/ac spray 10-15 kg with 50 kg FYM/ vermicompost soil application
Beauveria bassiana	Leaf hoppers, plant hoppers, whiteflies, caterpillars and DBM	0.4-1.0 kg/ac Foliar spray
Verticillium lecanii	coffee green scale, Leaf and plant hoppers, coffee berry borer etc	0.4-1.0 kg/ac Foliar spray
Nomuraea rileyi	Leaf eating Caterpillars, *S. litura, H. armigera, T. archalsia, M. separata, A. ipsilon* etc.	0.4-1.0 kg/ac Foliar spray
Hirsutella thompsani	Coconut Mites	1-5 g/ l of water

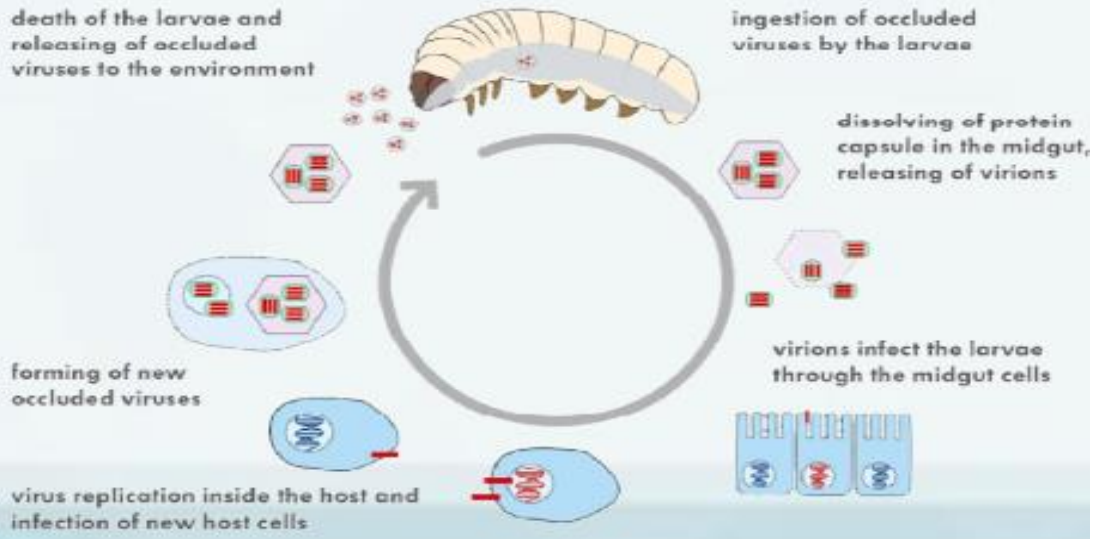
II. Entomopathogenic viruses

- Viruses coming under family *Baculoviridae* cause disease in lepidoptera larvae.

Two types of viruses are common.

NPV (Nucleopolyhedro virus) e.g. HaNPV, SlNPV
GV (Granulovirus) e.g. CiGV

Mode of Action



II. Entomopathogenic viruses

Symptoms

- Lepidopteran larva become sluggish, pinkish in colour, lose appetite,
- Body becomes fragile and rupture to release polyhedra (virus occlusion bodies).
- Dead larva hang from top of plant with prolegs attached (Tree top disease or "Wipfelkrankeit")

NPV

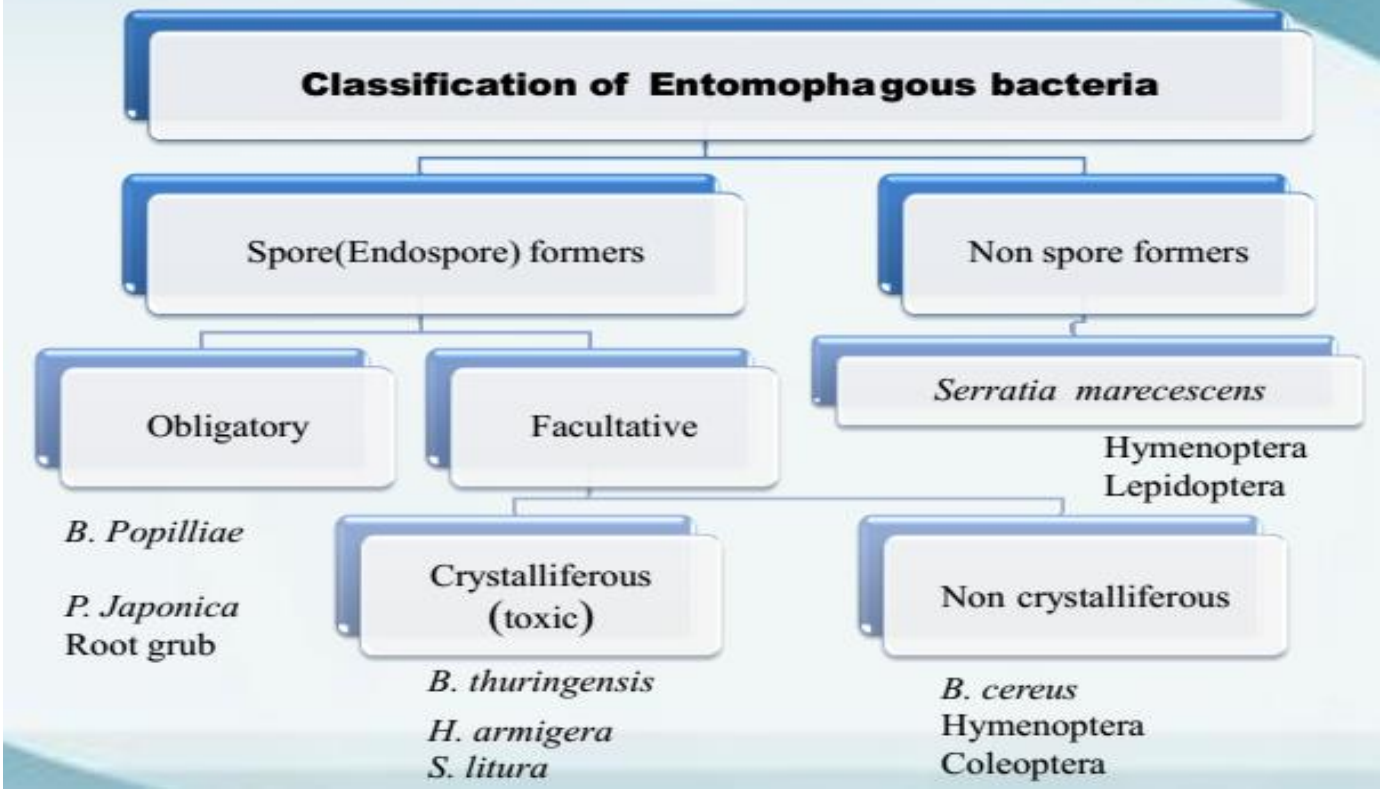
GV

CPV (Cytoplasmic Virus)

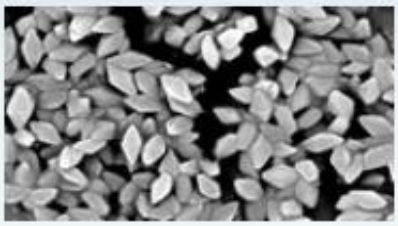
Field applications.....

Virus	Target pest	Crop	Dosage
*Ha*NPV	*H. armigera*	Tomato, Lablab, Chickpea, Groundnut, Sunflower, Tur, Cotton	250 LE/ha
*Sl*NPV	*S. litura*	Groundnut, Tobacco, Soybean, Crucifers, Cotton	250 LE/ha
*Ma*NPV	*M. separata*	Maize, Sorghum	250 LE/ha
*Aa*NPV	*A. albistriga*	Groundnut	250 LE/ha
GV	*C. infusculetus*	Sugarcane	250 LE/ha

III. Entomopathogenic bacteria



Mechanism of action of Bacillus thuringiensis



Bt (Bacillus thuringiensis)

Bs (Bacillus sphaericus)

Pf (Pseudomonas fluorescens)

Symptoms of bacterial infection

- Stoppage of feeding
- Regurgitation and diarrhea due to gut paralysis
- Body darkens with dark body fluid, tissue disintegrated and with putrefied odour

Entomopathogenic nematodes (EPNs)

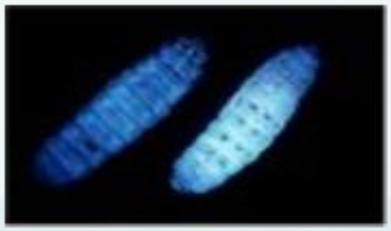
- Nematodes which are capable of killing, sterilizing or seriously hampering the development of insect and completing at least one stage of their life cycle in the host.

Other Names: Entomogenous, Entomophilic, Insect parasitic nematodes etc.

Important groups of EPNs

1. Family: Mermithidae :(Order: Enoplida)
2. Family: Steinernematidae (Order; Rhabditida)
3. Family: Heterorhabditidae (---- ,,----------)

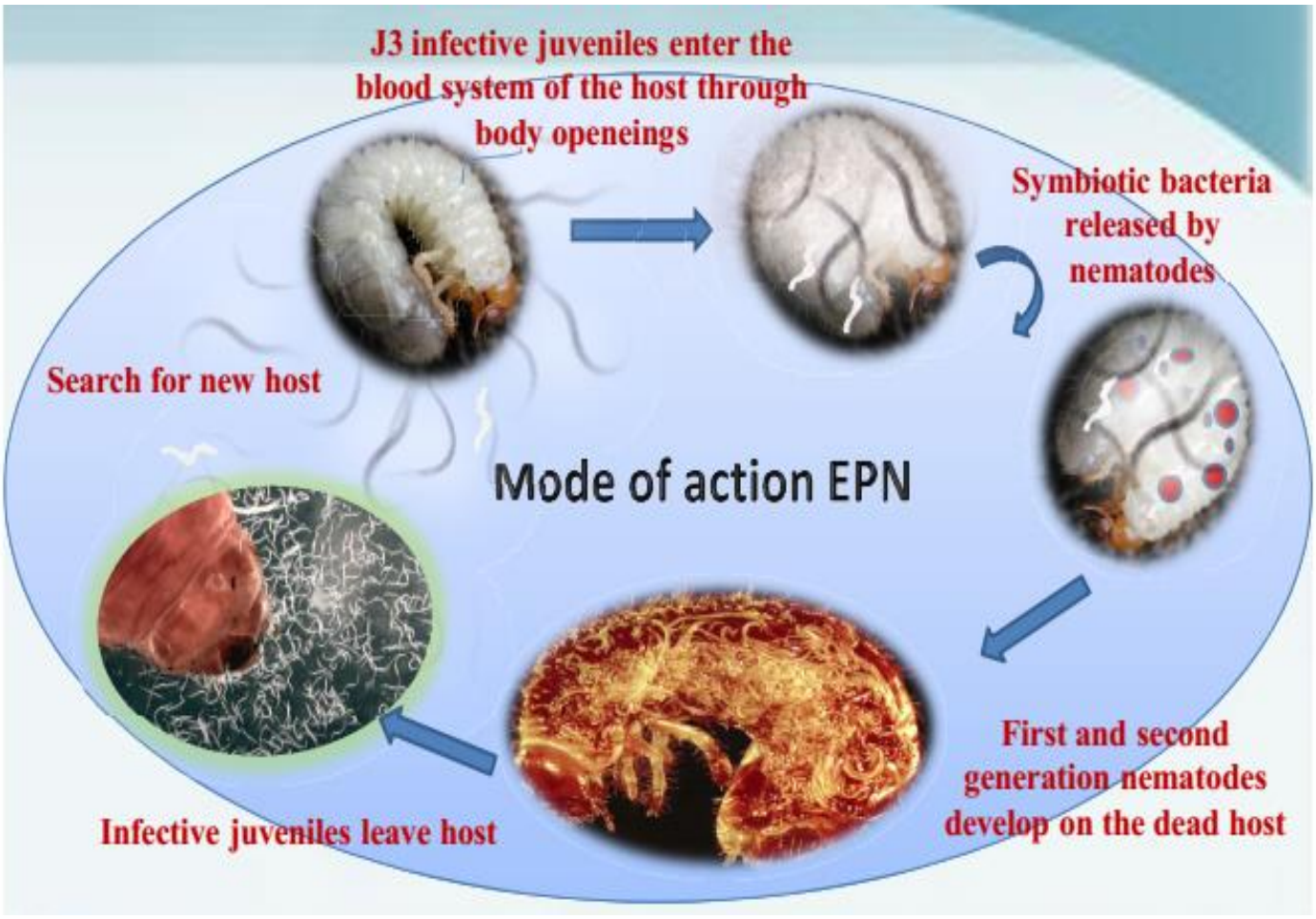
Steinernema



Heterorhabditis

Special qualities of Steinernematidae and Heterorhabditidae

- Quick mortality of the host (24 – 48 hr)
- Wide host range (> 200 insect species of 10 Orders)
- Wide distribution – found all parts of the world except Antarctica
- Symbiotic association with bacteria (*Xenorhabdus;* Steinernematidae and *Photorhabdus;* Heterorhabditidae)
- Infective stage (3rd stage) is non feeding, free living, durable and capable of withstanding adverse climatic changes
- Can be mass produced both on natural host and artificial diet
- Good shelf life
- Easy to apply
- Safer to non target organisms



Advantages of microbial agents as component in IPM

- Exploitation for pest control is environmentally safety due to host specificity
- Microorgansims have natural capability of causing epizootic levels due to their persistence in soil and efficient transmission
- Compatible with chemicals insecticides
- The cost of development and registration of microbial insecticide is much less than that of chemical insecticides
- Large scale culture and application is relatively easy and inexpensive
- No resistant development

Factors affecting biological control

1. Tolerance limit of crop to insect injury - Successful in crops with high tolerance limit
2. Crop value - Successful in crops with high economic value
3. Crop duration - Long duration crops highly suitable
4. Indigenous or Exotic pest - Imported NE more effective against introduced pest
5. If alternate host available for NE, control of target pest is less
6. If unfavourable season occurs, reintroduction of NE required
7. Presence of hyperparasites reduces effectiveness of biocontrol
8. Tritrophic interaction of Plant-Pest-Natural enemy affects success of biocontrol, e.g. *Helicoverpa* parasitization by *Trichogramma* more in tomato than corn
9. Use of pesticides affect natural enemies
10. Selective insecticides (less toxic to NE required)
11. Identical situation for successful control does not occur
12. Depends on life cycle of NE

General Limitations of Biological Control include:

- The host (pest) population will continue to exist at a level determined by the properties of the host, its natural enemies and of the habitat they occupy
- The effectiveness of natural enemies must be considered relative to man's economic thresholds
- The attainment of biological control of one major pest on a crop necessitates the elaboration of a system of integrated control for other pests of the crop, if any exist; and
- The research necessary in seeking a biological control solution to a problem is often demanding in terms of scientific and technical staff, funds, and time, and a solution cannot be guaranteed in advance.