

Microbial control of crop pest by employing viruses and fungi

VIRUS

- Virus diseases of insects and their role in the natural regulation of insect populations have been recognized for many years.
- There are three types of virus that are entomopathogenic.
- They are considered to be harmless to humans and sufficiently virulent for use as control agents.

ENTOMOGENOUS VIRUS

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graph TD; A[ENTOMOGENOUS VIRUS] --> B[INCLUSION VIRUSES(I V)]; A --> C[NON-INCLUSION VIRUSES(NIV)]; B --> D[POLYHEDROSES VIRUSES(PV)]; B --> E[GRANULOSIS VIRUSES(GV)]; D --> F[NUCLEAR POLYHEDROSIS VIRUSES(NPV)]; D --> G[CYTOPLASMIC POLYHEDROSIS VIRUSES(CPV)];
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INCLUSION
VIRUSES(I V)

NON-INCLUSION
VIRUSES(NIV)

POLYHEDROSES
VIRUSES(PV)

GRANULOSIS
VIRUSES(GV)

NUCLEAR
POLYHEDROSIS
VIRUSES(NPV)

CYTOPLASMIC
POLYHEDROSIS
VIRUSES(CPV)

- Out of 6 groups only 3 are safe:-
 - Nuclear polyhedrosis virus(NPV)
 - Cytoplasmic polyhedrosis virus(CPV)
 - Granolosis virus(GV)
- Of these NPVs and GVs are widely used.
- They are family specific and need to be ingested.
- Many highly specific entomopathogenic viruses are known, which generally infect the insect in larval stage and act through ingestion.

- Their action is not immediate , so the infected insects are still able to feed for some time , causing further damage.
- The most commonly used virus is the granulosis virus , active on *Cydia pomonella* or the Codling moth.
- More than 400 insect species ,mostly in the Lepidoptera and Hymenoptera have been reported as host to Baculoviruses.
- European spruce sawfly was permanently controlled through introduction of an NPV.

BACULOVIRUSES

- The family Baculoviridae includes the nuclear polyhedrosis virus and granulosis virus.
- These are double stranded DNA virus with rod-shaped nucleocapsid.
- MODE OF ACTION:
 - Infection occurs when susceptible host eats polyhedra or granules which are dissolved in the basic digestive gut juices.
 - The virions are released when the protein matrices dissolve.
 - The virus enter the nuclei of midgut cells and infect tissues and organs in the insect.

POLYHEDROSIS VIRUS

- They are known to infect 500 species of insects, and are best known from the Lepidoptera.
- The virus particles of NPVs can be enveloped singly or in groups and are occluded in protein bodies, polyhedra.
- In India a number of companies , agricultural universities produce NPVs of *H.armigera*, *S.litura* and supply commercially to farmers to control pests.

- FORMULATION:

- Biovirus marketed in India is a wettable powder formulation of *H. armigera* NPV containing 700 PIB/g having a storage stability for 2 years at 40°C.
- It is applied 300-500g/ha, 2-3 times at 10-15 day interval.

- Other than this dust formulations are suitable for viruses.
- Baculoviruses are available as aqueous suspensions in water.
- The storable formulation does not contains any other ingredients except the filtered virus prepared from ground diseased larvae.
- Baculovirus formulation should be stored under cool dark conditions.

GRANULOSIS VIRUS

- They are closely related to NPVs and are similar in structure and pathogenesis.
- The difference is that the virions are singly occluded in granules.
- 3 major genetic types:
 - Type1-infects midgut cell and fat body cells.
 - Type2-parallels NPV infection.
 - Type3-infects only midgut tissues.

INSECT VIRUSES

- *Borrelinavirus* - NPV
- *Smithiavirus* – CPV
- *Bergoldiavirus* – GV
- *Moratovirus* - NIV



Virus agent	Target pest	Status¹
<i>Heliothis</i> NPV	Cotton bollworm/budworm	EPA Registered
Douglas-fir tussock moth NPV	Douglas-fir tussock moth	EPA Registered
Gypsy moth NPV	Gypsy moth	Gypchek/EPA Registered
Pine sawfly NPV	Pine sawfly	EPA Registered
<i>Choristoneura occidentalis</i> NPV	Western spruce budworm	Experimental
<i>Galleria mellonella</i> NPV	Wax moth	Experimental
<i>Spodoptera frugiperda</i> NPV	<i>Spodoptera frugiperda</i>	Experimental
<i>Spodoptera exigua</i> NVP	<i>Spodoptera exigua</i>	Spod-X [®] EPA registered

FUNGI

CLASSES

PHYCOMYCETES	ASCOMYCETES	BASIDIOMYCETES	DEUTEROMYCETES
<i>Coelomomyces</i>	<i>Cordyceps</i>	<i>Septobasidium</i>	<i>Beauveria</i>
<i>Entomophthora</i>			<i>Metarrhizium</i>
<i>Massospora</i>			<i>Aspergillus</i>
			<i>Spicara</i>
			<i>Hirssutella</i>
			<i>Isara</i>
			<i>Paecilomyces</i>

- The more potent fungi that can be used belong to the class *Fungi imperfecti* (*Beauveria*, *Metarrhizium*).
- They are internal parasites of insects and reproduce by conidia.
- Different tissues and organs are not attacked simultaneously.
- Some fungi confine themselves to blood , others can penetrate tissues like muscles, trachea , gut fat body etc.
- They need a high degree of atmospheric humidity

MODE OF ACTION

- Most common portal entry is through the integument through invasion via respiratory or alimentary tract.
- The infective unit is a spore , conidium.
- Conidium germinates into a short germ tube which gives out small swellings , appressoria.
- This attaches to the cuticle and sends an infection peg
- Hyphae penetrate the layers and enter to various organs.

- Death is by choking of tissues and by the toxins produced by insects.

- **SYMPTOMS:**

- Loss of appetite
- Decreased irritability
- Partial paralysis
- Discoloured patches on integument
- Body hardens
- Death occurs within a week or even within 24 hours.



HOST RANGE

- Lepidoptera (larvae)
- Homoptera (aphids, cicadas, scale insects)
- Hymenoptera (bees)
- Coleoptera (beetles)
- Diptera

Fungal pathogen	Target pest(s)	Commercial name/status¹
<i>Aschersonia aleyrodis</i>	White flies/Scale insects	Experimental
<i>Beauveria bassiana</i>	Colorado potato beetle, Whiteflies, Aphids, Grasshoppers, Locusts	Boverin [®] (Russia) Mycotrol [®] WP (USA) Mycotrol [®] GH-ES (USA) BotaniGard [®] (USA)
<i>Beauveria brogniartii</i>	Cockchafer	Experimental
<i>Culicinomyces clavisporus</i>	Mosquito larvae	Experimental
<i>Hirsutella sphaerospora</i>	Mealy bug	Experimental
<i>Laegenidium giganteum</i>	Mosquito larvae	EPA Registered
<i>Metarhizium anisopliae</i>	Cockroaches, Termites	Biopath [®] , Bioblast [®] , BioGreen [®] (Australia)
<i>Verticillium lecanii</i>	Whiteflies, Aphids	Vertalec [®] , Mycotal [®]

Thankyou.....