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Entomopathogenic Fungi: A Promising Tool for Insect Pest Control

Ashwini D. Matte
Assistant Professor, Dr. Ulhas Patil College of Agriculture, Jalgaon (M. S.)

SUMMARY

The necessity for sustainable crop production through ecofriendly pest management techniques is being largely felt in recent time. Thus, exploitation of biocontrol agents is considered as a suitable alternative to the use of chemical pesticides. Among the various biocontrol agents, entomopathogenic fungi are being a major component of an IPM approach that can provide significant and selective insect control. Entomopathogenic fungi are a soil inhibiting microorganisms that infects and kills insects and other arthropods through cuticle penetration. They are currently used as biocontrol agents against insect pests and play a vital role in their management. In this present article, we discussed about various entomopathogenic fungus, their mode of formulation and targeted pest, its benefits and limitations also.

INTRODUCTION

An entomopathogenic fungus (EPF) is a microorganism with the ability to infect, parasitize, and kill arthropod pests. Now a days Agricultural pests continue to be a major problem responsible for tremendous losses in productivity. Traditionally, chemical pesticides such as DDT and Endosulfan have been used to kill unwanted insects. The use of chemical pesticides, however, has resulted in numerous problems. Many insects develop resistance to chemical poisons making this compound less effective and therefore required in higher concentrations. Extensive application of chemicals into the environment often has deleterious effects on non-target organisms including beneficial insects such as pollinators and natural predators of the target pest. Finally chemical pesticides display significant health risk to workers who are exposed to the chemicals in the fields as well as to consumers who purchase food products with residual pesticides. Thus, there is great interest in alternatives to chemical pesticides.

The use of biological pesticides such as entomopathogenic fungi is growing in popularity because it is able to alleviate many of the concern associated with chemical poisons. Also entomopathogenic fungi are effective and environmentally safe biological control agents that can be used against many important pest species in both agriculture and forestry because they are safe for animals, plants and environment.

However, it is suitable to confer them with fungi as they were long regarded to be fungi and are ecologically very similar. Entomopathogenic fungi are found out in the divisions of Zygomycota and Ascomycota as well as Chytridiomycota and Oomycota which were earlier classified within the fungi many of the taxa of entomopathogenic fungi currently under research either fit into the class Entomophthorales in the Zygomycota or the class Hyphomycetes in the Deuteromycota.

Division	Class	Order	Family	Genus
Zygomycota	Zygomycetes	Entomophthorales	Entomophthoraceae	*Entomophaga*
				Entomophthora
				Erynia
				Eryniopsis
				Furia
				Massospora
				Strongwellsea
				Pandora
				Tarichium
				Zoophthora
Ascomycota	Sordariomycetes	Hypocreales	Clavicipitaceae	*Beauveria spp.*
				Metarhizium
				Nomurae
				Lecanicillium

Table: Current classification of the genera of entomopathogenic fungi.

Some of the Important Entomopathogenic Fungi:

Green muscardine fungus (*Metarhizium anisopliae*)

This is commonly called as green muscardine fungus. *Metarhizium anisopliae* author family is also a very potential pathogen on insect pests and is explored for mycobiocontrol of notorious insect pests. This fungus is widely distributed and recorded in more than 300 hosts. The affected cadavers show typical green aerial mycelia. Initially the colony appears white in colour and latter turns to green in colour. Mycelium is composed of hyline, septate, branched hyphae. Conidiophores are short, erect, hyline, septate, simple or b ranched, terminating in single or cluster of phialides. Conidia are single celled, hyline, smooth and long avoid to cylindrical.

Fig.1 *Metarhizium anisopliae* growth culture, spores under microscope and infection on insect pest.

White muscardine fungus (*Beauveria bassiana*)

The fungus is otherwise called as white muscardine fungus. *Beauveria bassiana*, a filamentous fungus. Belong to a class of insect pathogenic deuteromycetes also known as imperfect fungus. Strains of Beauveria are highly adapted to particular host insects. Broad ranges of *B. bassiana* spp. have been isolated from a variety of insects worldwide which are of medicinal or agricultural importance. *Beauveria bassiana* is fungus grows naturally in soil throughout the world and act as pathogen on various insect species causing white muscardine disease. The colour of fungus are white in colour with cottony aerial mycelium. Conidiophore are single or branched, oblong, cylindrical, or flask shaped bearing laterally or at extremity vesicles giving rise to sporogenous cells, phialides generally globose, sometimes cylindrical, flask like, and curved or straight. Conidia are globose to oval shape.

Fig.2 *Beauveria bassiana* growth culture, spores under microscope and infection on insect pest.

White halo fungus (*Verticillium lecanii =Lecanicillium lecanii*)

Another entomopathogenic fungus *Verticillium lecanni* commonly called as White halo fungus. It is widely distributed fungus which can cause large epizootics in tropical and sub-tropical regions, as well as in warm and humid environments. It is known primarily as a pathogen of aphids, scales, white flies, thrips and red spider mites. The fungus is characterized by the presence of conidiophores in verticilliate whorls and on which conidia are borne in slime or mucus balls.

Fig.3 *Verticillium lecanii* growth culture, spores under microscope and infection on insect pest.

Mode of action of Entomopathogenic fungi

Entomopathogenic fungus typically cause infection when spores come in contact with the arthropod host. Under ideal conditions of moderate temperatures and high relative humidity, fungal spores germinate and break the insect cuticle through enzymatic degradation and mechanical pressure to gain entry into the insect body. Once inside the body, the fungi multiply, invade the insect tissues, emerge from the dead insect and produce more spores. These insect pathogenic fungi produce many toxins and extracellular enzymes such as proteases and chitinases which aid penetration of the host physical defences. Cuticle is the main hurdle to infection in insects as it is the main path of fungus penetration.

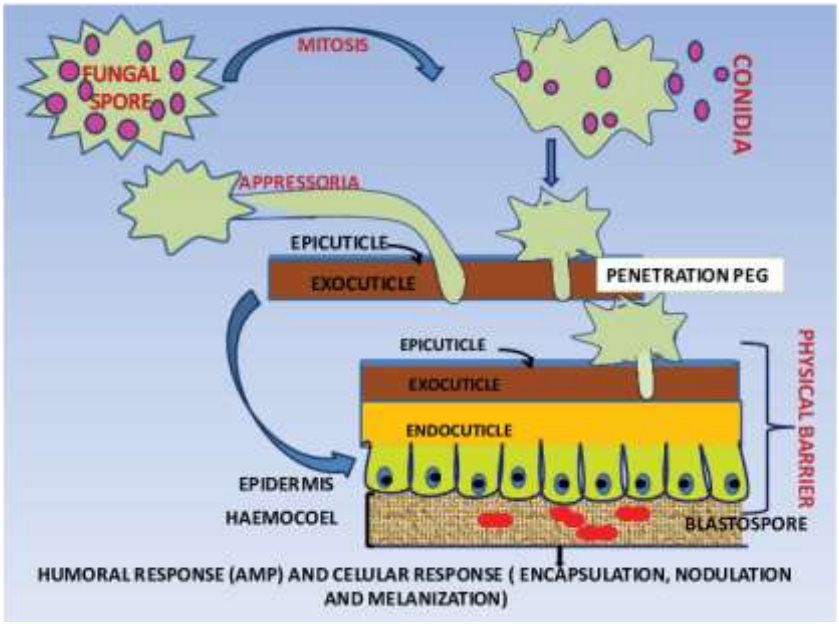

Fig.4 Structure of insect cuticle and mode of penetration.

Formulations and targeted Pest of Entomopathogenic Fungi

Sr. No.	Entomopathogenic fungi	Formulation available	Target pests
1.	*Metarhizium anisopliae*	Solid and Liquid Formulation	White grub and Termite
2.	*Beauveria bassiana*		Pod borer, Leaf eating caterpillar, Semi-looper
3.	*Lecanicillium lecanii*		Aphid, Leaf hopper, Thrips, White fly

Benefits of Entomopathogenic Fungi

- Their residues have no known adverse effects on the environment.
- Entomopathogenic fungi are little or non-toxic to non- target organisms.
- They have narrow area of toxic action, mostly specific to a single group or few species.
- They can be used in combination with synthetic chemical insecticides. They are self-perpetuating under ideal environmental conditions.
- Reduce chemical insecticide use.
- Potential development of pest resistance to myco-insecticide is less common or may develop more slowly due to unique mode of action.

Limitations of Entomopathogenic Fungi

- They need specific environmental conditions to germinate and cause infection.
- Can be very costly to produce for commercial use.
- They have short shelf life
- The pest must be present before the pathogen can be usefully applied thus making preventive treatment difficult.
- Lack of persistence and low rate of infection under challenging environmental conditions.
- Often slow acting and require high application rate and through spray coverage.

CONCLUSION

From the present article, it was concluded that the biopesticides still represents a very small portion of plant protection but their role has been considered significant. Because fungi penetrate the insect body, they can infect sucking insects. Biological pest management with the help of entomopathogenic fungi is ecofriendly, cost effective, increase the yield of agricultural product, minimizes the usage of chemical pesticides. Therefore, entomopathogenic fungi is a promising tool for insect pest control and important key for sustainable agriculture production.

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