14

Fungi for the Biological Control of Insect Pests: Factors involved, Mechanism, and Regulation

INTRODUCTION

Fungi are a diverse group of organisms with close ties to agriculture. Some fungi create devastating diseases in crops, while others are crops themselves (mushrooms). Other fungi are used successfully to protect crops from a variety of pests. Among the most prominent of these are the fungi that are used against insects and other related pests.

Myco-biocontrol is an environmentally sound and effective means of reducing or mitigating insect-pests and its effects through the use of natural enemies. Pest-related damages result in a heavy loss, millions of rupess annually in agricultural production in the field and storage in India. Myco-biocontrol is the use of fungi in biological processes to lower the insect density with the aim of reducing disease-producing activity and consequently crop damage. All groups of insects may be affected and over 700 species of fungi have been recorded as pathogens. Some of these fungi have restricted host ranges, for example, Aschersonia aleyrodes infects only scale insects and whiteflies, while other fungal species have a wide host range, with individual isolates being more specific to target pests. Some species are facultative generalist pathogens, such as Aspergillus and Fusarium. However, most species are obligate pathogens, often quite specific and rarely found, for example, many species of Cordyceps.

Entomopathogens such as *M. anisopliae* and *B. bassiana* are well characterized in respect to pathogenicity to several insects and have been used as myco-biocontrol agents for biological control of agriculture pests worldwide. About 11 companies offer at least 16 products based on the entomopathogenic fungi *B. bassiana* at Columbia. These products are not only used in coffee crop but also in other crops such as bean, cabbage, corn, potato, and tomato. They are used to treat haematophagous insect pests and vectors of diseases like mosquitoes and

flies. Under natural conditions, fungi are the frequent and often important natural mortality factor in insect populations. Unlike other potential biocontrol agents, fungi do not have to be ingested to infect their hosts but invade directly through the cuticle, and so can, potentially, be used for control of all insects including sucking insects.

Most fungi used for the control of insect pests belong to the group hyphomycetes. Some species have been developed as commercial products because of their ability to be mass produced. Most fungi in this group are usually found in the soil and can cause natural outbreaks on their own when environmental conditions are favorable. They can infect a wide range of insect hosts. Specific fungal strains in commercial products target thrips, whiteflies, aphids, caterpillars, weevils, grasshoppers, ants, Colorado potato beetle, and mealybugs. Currently allowable products containing the hyphomycete fungus, *Beauveria bassiana*, that are commercially available include Mycotrol O (Emerald BioAgriculture), Naturalis Home and Garden (H&G) and Naturalis L (Troy BioSciences, Inc.). Before applying any pest control product, make sure to include what you might want to use and how you intend to use it in your organic system plan and get your certifier's approval. (Caution: the use of an unapproved material can result in the loss of certification. Always check with your certifier before purchasing or using a new product or material to ensure that it is permitted for use in your organic farming system.

There is another commonly encountered group of fungi called the entomophthorales. Fungi in this group can cause natural outbreaks in the populations of their insect hosts, but they are difficult to mass produce and as yet are not in commercial production. They tend to be much more host specific; one well known species only infects aphids. Despite the difficulties in producing them commercially, they can still have a large impact on the pest populations they infect. There are currently no commercially-based products available for organic vegetable production.

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LIFE CYCLE OF FUNGI INFECTING INSECTS

Fungi that infect insects are found in the environment as spores. Insects can become infected when they come into contact with spores on the surface of