Know Your Friends

The Entomopathogenic Fungus *Metarhizium anisopliae*

Metarhizium anisopliae, formerly known as *Entomophthora anisopliae*, is a widely distributed soil-inhabiting fungus. The first use of *M. anisopliae* as a microbial agent against insects was in 1879, when Elie Metchnikoff used it in experimental tests to control the wheat grain beetle, *Anisoplia austriaca*. It was later used to control the sugar beet curculio, *Cleonus punctiventris*. A member of the Hyphomycetes class of fungi, *M. anisopliae* is categorized as a green muscardine fungus due to the green color of the sporulating colonies. It has been reported to infect approximately 200 species of insects and other arthropods. Although *M. anisopliae* is not infectious or toxic to mammals, inhalation of spores could cause allergic reactions in sensitive individuals.

M. anisopliae generally enters insects through spiracles and pores in the sense organs. Once inside the insect, the fungus produces a lateral extension of hyphae, which eventually proliferate and consume the internal contents of the insect. Hyphal growth continues until the insect is filled with mycelia. When the internal contents have been consumed, the fungus breaks through the cuticle and sporulates, which makes the insect appear "fuzzy." *M. anisopliae* can release spores (conidia) under low humidity conditions (<50%). In addition, *M. anisopliae* can obtain nutrition from the lipids on the cuticle. The fungus can also produce secondary metabolites, such as destruxin, which have insecticidal properties on moth and fly larvae.

Some insects have developed physiological mechanisms to reduce infection by fungi such as *M. anisopliae*. For example, the desert locust produces antifungal toxins, which can inhibit the germination of spores. In addition, insects can escape infection by molting rapidly or developing a new integument before the fungus can penetrate the cuticle.

The successful mass culture of *M. anisopliae* and development of methods of mass-producing infective spores has led to the commercial development of this fungus as a microbial insecticide. *M. anisopliae* is grown on a large scale in semi-solid fermentation-- similar to that used in the production of *Bacillus thuringiensis*--and the spores can then be formulated as a dust. The fungal spores can also be grown on sterilized rice in plastic bags for small-scale production. *M. anisopliae* is sensitive to temperature extremes; spore viability decreases as storage temperatures increase and virulence decreases at low temperatures.

Bioblast is a commercially available formulation of *M. anisopliae* that is used to control termites such as *Reticulitermes* sp. The fungus is applied into wood known to contain active termite galleries. Termites in these galleries are exposed to direct contact with the fungus. In addition to direct contact with the fungus, infection of other termites in the colony occurs when grooming individuals exposed to the fungus spread the pathogen to healthy, non-infected individuals in the population. Laboratory studies have shown that death occurs within 4 to 10 days, depending on temperature.

No other products containing *M. anisopliae* are currently registered, but the fungus has controlled many other insect pests in experimental trials, including Japanese beetle, black vine weevil, and mosquitoes.

Sprayable formulations have been used to control meadow spittlebug on sugar cane and coffee leafminer and the froghopper, *Tomaspis saccharina,* in Trinidad and Grenada. *M. anisopliae* is highly pathogenic to many species of ticks, and is being considered as a microbial control agent for the management of ticks and Lyme disease. However, this fungus may also infect and kill beneficial organisms. In laboratory assays, the thrips predator *Orius insidiosis* showed a high rate of susceptibility to *M. anisopliae*.

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Return to Contents Menu Vol. VI No. 7

Go To Index