

# Beneficials and Biologicals

**Question:** *Will entomopathogenic (beneficial) fungi and bacteria indirectly affect biological control agents?*

**Answer:** Greenhouse producers are interested in integrating microbial pesticides derived from entomopathogenic (beneficial) fungi and bacteria with biological control agents (natural enemies). Commercially available products registered for use in greenhouse production systems include: *Beauveria bassiana* (BotaniGard), *Isaria fumosorosea* (Preferal), *Isaria fumosoroseus* (NoFly), *Metarhizium anisopliae* (Met52), *Bacillus thuringiensis* subsp. *kurstaki* (Dipel) and *Bacillus thuringiensis* subsp. *israelensis* (Gnatrol).

Although direct effects of entomopathogenic fungi and bacteria are well known, less information is available on their indirect effects. Indirect effects are associated with any negative effects on longevity, mobility, reproduction, foraging behavior, prey acceptance, development time and sex ratio (female:male).

In general, microbial insecticides including entomopathogenic fungi and bacteria are not indirectly harmful to most biological control agents (natural enemies); however, indirect effects may vary depending on concentration, natural enemy type (parasitoid or predator), life stage (egg, larva, nymph, pupa or adult) exposed, application in relation to space (spatial) and time (temporal) and environmental conditions (temperature, relative humidity, and light intensity).

Any indirect effects may also take longer to be expressed than other types of pesticides due to the slow-acting nature of microbial insecticides. Moreover, indirect effects affiliated with either entomopathogenic fungi or bacteria may be associated with altering the availability of the food source or killing prey before parasitoid immatures have completed development. For instance, the bacterium *Bacillus thuringiensis* has been reported to have indirect effects on certain parasitoids; however, the indirect effects are dependent on the formulation.

Natural enemies may consume fungal spores (conidia) when grooming (cleaning themselves) or when feeding on contaminated prey, although the extent of any indirect effects is primarily dependent on the spore concentration present. Furthermore, entomopathogenic fungi may indirectly impact certain natural enemies when feeding on prey that have been sprayed (contaminated prey). For example, 50 percent of

mealybug destroyer (*Cryptolaemus montrouzieri*) larvae were killed after consuming mealybugs that were sprayed with *Beauveria bassiana* (BotaniGard). A study reported that exposure to *Beauveria bassiana* reduced reproduction of the predatory mite, *Neoseiulus californicus* females. A study, conducted under laboratory conditions, found that

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exposure to *Metarhizium anisopliae* (Met52) resulted in no indirect effects on prey consumption (fungus gnat larvae) by the adult rove beetle, *Dalotia coriaria*. Exposure to *Isaria fumosoroseus* (NoFly) at a relative humidity of 55 humidity resulted in no indirect effects; whereas, exposure to *Isaria fumosoroseus* at a relative humidity greater than 95 percent indirectly affected the foraging behavior and longevity of the aphid parasitoid, *Aphelinus asychis*, which could impact the ability of the parasitoid to regulate aphid populations. Furthermore, egg-laying females may avoid prey infected by entomopathogenic fungi. The predatory mite, *Phytoseiulus persimilis*, avoided twospotted spider mite (*Tetranychus urticae*) individuals infected with *Beauveria bassiana*; indicating that the predatory mite can detect the presence of the entomopathogenic fungus. The aphid parasitoid, *Aphidius colemani* was indirectly affected when exposed to *Beauveria bassiana*; whereas, the greenhouse whitefly (*Trialeurodes vaporariorum*) parasitoid, *Encarsia formosa*, predatory bug, *Orius insidiosus*, and predatory mite, *Phytoseiulus persimilis*, were not indirectly affected.

So, to answer your question, natural enemies exposed to certain entomopathogenic fungi and bacteria may suffer indirect effects; therefore, be cognizant of the fact that applying products with entomopathogenic fungi and/or bacteria as the active ingredient may indirectly impact your biological control program. [gpn](#)



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