Bacterial Insecticide - Bt

Most farmers and home gardeners are aware of the biological insecticide Bacillus thuringiensis or "Bt" for short. Bt is often used to control plant damaging insect larvae and is preferred because it has a minimal effect on many beneficial insects and is non-toxic to humans, pets, wildlife, and other non-target organisms. Bt products are available at garden centers and can be ordered from catalogs and Internet suppliers. It is sold in various formulations (spray, dust, and granule) and strains (*tenebrionis*, *kurstaki*, *israelensis*, *aizawai*, and *san diego*). Each strain is effective on a specific order of insects.

Bt is a naturally occurring soil bacterium and was discovered in diseased flour moth caterpillars in 1915. Work began on it during the 1950s and it was first sold commercially in 1961. Bt kills susceptible insects with proteins called insecticidal delta-endotoxins. After feeding on these Bt-proteins, the digestive system becomes paralyzed and the infected insect stops feeding within hours. Bt-affected insects generally die from starvation: a process which can take several days.

The most commonly used strain of Bt (*kurstaki* strain) will kill only leaf and needle-feeding caterpillars. Some of the specific crop pests controlled are European corn borer, cabbage looper, tomato hornworm, alfalfa caterpillar, tent caterpillar, fall webworm and leafrollers.

In the past decade, additional Bt strains have been developed that control certain types of fly larvae (*israelensis* strain also known as Bti). These are used to control larvae of mosquitoes, black flies and fungus gnats. Bti has become one of the standard mosquito control tools in the battle against West Nile and Zika viruses.

More recently, strains have been developed with activity against some leaf beetle larvae, such as the Colorado potato beetle and elm leaf beetle (*San Diego* strain and *tenebrionis* strain). Among the various Bt strains, insecticidal activity is quite specific (i.e., Bt strains developed for mosquito larvae do not affect caterpillars).

Bt is susceptible to degradation by sunlight and most Bt formulations persist on foliage less than a week following application. Some of the newer strains developed for leaf beetle control become ineffective in about 24 hours. This could be viewed as a disadvantage; on the other hand, it may be desirable for protecting non-target organisms. Manufacturers are experimenting with techniques to increase its persistence. One involves inserting Bt delta-endotoxin genes into other species of bacteria that can better survive on leaf surfaces. As with any pesticide, users should always read and follow label directions.

As strictly a stomach poison insecticide, Bt must be eaten by an insect larva to be effective. Coverage of vulnerable plant parts must be thorough. This limits Bt's usefulness against pests that are susceptible but rarely have an opportunity to eat it in field use, such as codling moth or corn earworm that tunnel into plants. Additives (sticking or wetting agents) can be used with Bt applications to improve coverage and resist washing.

Bt users will likely see insect larvae that are still alive a day or two after treatment, and may assume the pesticide was ineffective. This is a common misperception because Bt-affected insects eat little or nothing before they die yet it takes a few days for them to expire.

Bt-based products also tend to have a shorter shelf life than other insecticides. Manufacturers generally indicate reduced effectiveness after two to three years of storage. Liquid formulations are more perishable than dry formulations. Shelf life is greatest when the product is stored under cool, dry conditions and out of direct sunlight.

Bt is a safe and effective tool for managing susceptible insect species. It has also reduced inputs of chemical insecticides in our environment, made food safer for consumers, and reduced the risks of pesticide exposure for farm workers and subsequent food processors. Bt also provides an easy and effective method of mosquito control in water features and horse troughs.

Additional Resources

Colorado State University Extension
Mosquito Management

University of Arizona
Fungus Gnat Integrated Pest Management

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