NPTN General Fact Sheets are designed to answer questions that are commonly asked by the general public about pesticides that are regulated the U.S. Environmental Protection Agency (US EPA). This document is intended to be helpful to professionals and to the general public for making decisions about pesticide use.

National Pesticide Telecommunications Network

Bacillus thuringiensis

(General Fact Sheet)

Please refer to the **Technical Fact Sheet** for more technical information.

The Pesticide Label: Labels provide directions for the proper use of a pesticide product. *Be sure to read the entire label before using any product.* A signal word, on each product label, indicates the product's potential hazard.

CAUTION - low toxicity **WARNING - moderate toxicity** **DANGER - high toxicity**

What is *Bacillus thuringiensis*?

- *Bacillus thuringiensis*, commonly referred to as *B.t.*, is a microorganism that produces chemicals toxic to insects (1, 2). *B.t.* was registered in the United States for use as a pesticide in 1961 and reregistered in 1998 (3).
- *B.t.* occurs naturally in the environment. Scientists have isolated it from soil, insects, and plants surfaces (2, 3, 4).
- *B.t.* toxicity is insect specific. Scientists have identified *B.t.* subspecies that differ in toxicity to insects. Examples of *B.t.* subspecies and the insects they affect are *aizawai* (moths), *kurstaki* (moths), *israelensis* (mosquitoes and flies) and *tenebrionis* (beetles) (3, 5).
- Plant researchers place *B.t.* genes in some crops (*B.t.* crops) to combat insects (6). Examples of *B.t.* crops include corn, cotton, and potatoes (6). **This fact sheet does not address *B.t.* crops.**
- *B.t.* pesticides are used for food and non-food crops, greenhouses, forests, and outdoor home use (3). *B.t.* pesticides exist in granular, powder, dust, suspension, and flowable forms (3). See the **Pesticide Label** box above.

How does *Bacillus thuringiensis* work?

- *B.t.* must be eaten by insects to be effective and works by interfering with digestion. Insects are most sensitive to *B.t.* when they are larvae, an immature life stage (7).
- Insects that eat *B.t.* die from hunger or infection (7, 8). It does not cause disease outbreaks in insect populations (3).
- *B.t.* may produce toxic chemicals that are released from the organism (3, 9). *B.t.* pesticide manufacturing is designed and monitored to minimize the presence of these released chemicals (10).

What are some products that contain *Bacillus thuringiensis*?

- Able™
- Biobit®
- Cutlass™
- Dipel®
- Foray®
- Javelin®
- Thuricide®
- Vectobac®

How toxic is *Bacillus thuringiensis*?

Animals

- *B.t.* is very low in toxicity when eaten by rats. Researchers did not detect adverse effects in rats fed a *B.t.* pesticide (11). See boxes on **Laboratory Testing, LD50/LC50,** and **Toxicity Category**.

- Investigators observed that after rats ate *B.t.*, the microorganism remained in the digestive system until it was eliminated from the body (12).

- *B.t.* is low in toxicity when inhaled by rats (12).

- *B.t.* is very low in toxicity when applied to the skin of rats (12). Scientists exposed the skin of rabbits to *B.t.* and detected mild skin irritation (12).

- Researchers exposed the eyes of rabbits to *B.t.* and detected temporary eye irritation (12).

- Laboratory workers injected male and female mice with *B.t.* Some mice exposed to the highest dose died. Workers did not detect toxicity or disease at the lower doses (12).

Exposure: Effects of *Bacillus thuringiensis* on human health and the environment depend on how much *Bacillus thuringiensis* is present and the length and frequency of exposure. Effects also depend on the health of a person and/or certain environmental factors.

Laboratory Testing: Before pesticides are registered by the U.S. EPA, they must undergo laboratory testing for short-term and long-term health effects. Laboratory animals are purposely fed high enough doses to cause toxic effects. These tests help scientists judge how these chemicals might affect humans, domestic animals, and wildlife in cases of overexposure. When pesticide products are used according to the label directions, toxic effects are not likely to occur because the amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

- Scientists injected rats with *B.t.*, and none of the rats died. Following injection, rats displayed liver inflammation and temporary decreased activity (13).

- Investigators injected immune-suppressed mice with *B.t.* and detected no mortalities after 27 days (14). Researchers believe that immune-suppressed people are not at a greater risk to *B.t.* (14).

- Female rats fed *B.t.* for 2 years exhibited decreased weight gains. Researchers did not detect disease in the rats over the study period (12).

Toxicity Category (*Signal Word*) (15)

	High Toxicity (*Danger*)	Moderate Toxicity (*Warning*)	Low Toxicity (*Caution*)	Very Low Toxicity (*Caution*)
Oral LD50	Less than 50 mg/kg	50 - 500 mg/kg	500 - 5000 mg/kg	Greater than 5000 mg/kg
Dermal LD50	Less than 200 mg/kg	200 - 2000 mg/kg	2000 - 5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50	Less than 0.05 mg/l	0.05 - 0.5 mg/l	0.5 - 2 mg/l	Greater than 2 mg/l
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible within 7 days	Minimal effects, gone within 24 hrs
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation

LD50/LC50: A common measure of acute toxicity is the lethal dose (LD50) or lethal concentration (LC50) that causes death (resulting from a single or limited exposure) in 50 percent of the treated animals. LD50 is generally expressed as the dose in milligrams (mg) of chemical per kilogram (kg) of body weight. LC50 is often expressed as mg of chemical per volume (e.g., liter (L)) of medium (i.e., air or water) the organism is exposed to. Chemicals are considered highly toxic when the LD50/LC50 is small and practically non-toxic when the value is large. However, the LD50/LC50 does not reflect any effects from long-term exposure (i.e., cancer, birth defects, or reproductive toxicity) that may occur at levels below those that cause death.

Humans

- Eighteen human volunteers ingested a *B.t.* pesticide daily for 5 days. Five of the volunteers also inhaled the pesticide for 5 days. Scientists did not detect any adverse effects in the volunteers (11).

- Researchers studied the health effects of *B.t.* on people who lived in areas aerially treated over a 2-year period with *B.t.* Approximately 120,000 people lived in the spray areas. For three people, *B.t.* could neither be ruled in nor out as the source of disease (16).

- Investigators studied workers who handled crops treated with *B.t.* pesticides. The workers did not display work-related disease when they handled crops treated with *B.t.* Investigators did detect skin and antibody reactions to *B.t.* The majority of reactions occurred in workers with the highest *B.t.* exposure. (17).

- Eight men who were exposed for 7 months to *B.t.* during the manufacture of a pesticide did not display adverse health effects (11).

- A farm worker who accidentally splashed *B.t.* in one eye developed an eye ulcer 10 days after the incident. The ulcer healed with treatment (9,13).

Does *Bacillus thuringiensis* cause reproductive or birth defects?

Animals

- The U.S. Environmental Protection Agency (EPA) only requires studies on reproductive or developmental effects for microbial pesticides that show significant adverse health effects in disease and toxicity studies (18). Due to the lack of significant disease and toxicity in studies, additional studies are not required for *B.t.* (3).

- Data is not available from animal studies evaluating the reproductive or developmental effects of *B.t.*

Humans

- Data is not available from work-related exposures, accidental poisonings, or other human studies regarding the reproductive and developmental toxicity of *B.t.*

Does *Bacillus thuringiensis* cause cancer?

Animals

- The U.S. EPA requires cancer studies for microbial pesticides that show significant adverse health effects in disease and toxicity studies (18). Due to the lack of significant disease and toxicity in studies, additional studies are not required for *B.t.* (3). See the box on **Cancer**.

- Data is not available from animal cancer studies evaluating *B.t*.

Cancer: The U.S. EPA has strict guidelines that require testing of pesticides for their potential to cause cancer. These studies involve feeding laboratory animals large *daily* doses of the pesticide over most of the lifetime of the animal. Based on these tests, and any other available information, EPA gives the pesticide a rating for its potential to cause cancer in humans. For example, if a pesticide does not cause cancer in animal tests at large doses, then the EPA considers it unlikely the pesticide will cause cancer in humans. Testing for cancer is not done on human subjects.

- Researchers often test chemicals for their ability to change the genetic material of an organism as an indication of their potential to cause cancer. Undesirable chemicals produced by *B.t.* may cause changes in genetic material (9,13). Pesticides containing *B.t.* are tested for the presence of these undesirable chemicals (10).

Humans

- Data is not available from work-related exposures or other human studies regarding the ability of *B.t*. to cause cancer.

What happens to *Bacillus thuringiensis* in the environment?

- On plant surfaces *B.t.* products degrade rapidly (3).

- *B.t.* is moderately persistent in soil and its toxins degrade rapidly (7, 14).

- The movement of *B.t.* is limited following pesticide application and it is not likely to contaminate ground water (3, 4).

- *B.t.* is not native to water and is not likely to multiply in water (3).

What effects does *Bacillus thuringiensis* have on wildlife?

- *B.t.* is practically nontoxic to birds and fish (3, 19).

- Most *B.t.* subspecies tested for toxicity to honey bees have shown minimal toxicity, but one subspecies has displayed high toxicity to bees. When *B.t.* pesticides are used according to product labels the risk to bees and other beneficial insects is minimal (3).

- The use of *B.t.* may result in temporary reductions in insect populations. The possible reduction in insect populations will not greatly affect birds and mammals that eat insects (3, 20).

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