

***Bacillus thuringiensis* delta endotoxins encapsulated in killed *Pseudomonas fluorescens* (006409, 006410, 006457, 006462) Fact Sheet**

Summary

Bacillus thuringiensis delta endotoxins encapsulated in killed *Pseudomonas fluorescens* control insect larvae on a wide range of crops. Insect larvae vary in how susceptible they are to the many different Bt endotoxin proteins. For example, certain moths are particularly sensitive to the endotoxin protein called Cry1C. Based on a large number of studies, these active ingredients are not expected to cause harm to humans or the environment.

I. Description of the Active Ingredient

The various *Bacillus thuringiensis* endotoxin proteins are at the core of the active ingredients described here. *Pseudomonas fluorescens*, a common bacterium, serves as an incubator that produces Bt proteins. To get the *P. fluorescens* to manufacture the desired Bt protein, the gene for the Bt protein is inserted into the *P. fluorescens*. As the *P. fluorescens* grows and reproduces, the imported gene codes for the desired Bt toxin.

Why Grow the Protein in *Pseudomonas fluorescens*?

There are several practical reasons for commercially producing the toxins in *P. fluorescens* rather than in the strains of Bt where they originated:

- *P. fluorescens* produces higher concentrations of the toxins than Bt;
- The endotoxins remain within the *P. fluorescens* cells ("encapsulated") when the cells are killed, making collecting the endotoxins relatively easy;
- The dead *P. fluorescens* cells protect the Bt endotoxins from decomposition induced by ultraviolet light, thereby lengthening the time the toxins remains active;
- *P. fluorescens* does not produce the large number of additional toxins made by Bt, which might harm non-target species.

How do the *Bt* Endotoxins Work?

The Bt toxins kill the larvae of certain species of insects after being ingested by the larvae. These Bt toxins cause death by attaching to specific receptors in the larval gut, eventually rupturing the gut and killing the larvae in a few days. The toxins kill only the target pests because only the target pests contain the necessary binding receptors. When organisms without the specific receptor ingest the same toxin, the toxin does no harm

II. Use Sites, Target Pests, And Application Methods

- **Use Sites:** Larvae of certain kinds of insects [See Table](#)
- **Target pests:** Virtually all agricultural crops including fruits, vegetables, corn, cotton, and nuts; turf; forests; ornamentals; landscape trees; nursery crops.
- **Application Methods:** Hand spraying, aerial spraying, ground-based methods, using irrigation systems, and other ways.

III. Assessing Risks to Human Health

EPA has evaluated *Bacillus thuringiensis* delta endotoxins encapsulated in killed *Pseudomonas fluorescens* for potential human health hazards, including effects on the skin, eyes, respiratory system, and digestive system. Based upon this evaluation, and evidence that the human gut lacks any receptors that would make the toxins hazardous, EPA finds that these active ingredients do not pose a risk to human health.

IV. Assessing Risks to the Environment

EPA has evaluated the active ingredients for potential hazardous effects on the environment, including effects on such non-target organisms as mammals, birds, fish, beneficial insects, marine animals, plants, and endangered species. EPA finds that the active ingredients do not pose a risk to the environment or to non-target organisms. Organisms other than the target insects appear to lack the gut receptors that would make the toxins hazardous.

V. Regulatory Information

Initial registration: In 1991, the first *Bacillus thuringiensis* delta endotoxins encapsulated in killed *Pseudomonas fluorescens* was registered (licensed for sale) as a pesticide active ingredient

Total Number of Products: 5

VI. Producer Information:

See Table.

VII. Additional Contact Information:

Ombudsman, Biopesticides and Pollution Prevention Division (7511P)
Office of Pesticide Programs
Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

Characteristics of Four Pesticide Active Ingredients in the Following Category

Bacillus thuringiensis strain	Delta endotoxin(s)	Target pests (larvae)	OPP ID # Year Registered Registrant
aizawai	Cry1C	Certain moths, especially armyworms and diamondback moth	006462 1996 Mycogen, Inc.
aizawai	>Cry1C; Cry1Ac	Certain moths	006457 1995 Ecogen, Inc.
kurstaki	unspecified	Certain moths	006409 1991 Ecogen, Inc.
San Diego	unspecified	Certain beetles, especially Colorado potato beetle	006410 1991 Ecogen, Inc.