Bacillus Thuringiensis, Insecticide Encyclopedia Article

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Contents

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Bacillus thuringiensis is a Gram-positive rod-shaped bacterium. This bacterium is most noteworthy because of its use to kill butterfly and moth caterpillars (Lepidoptera), the larvae of mosquitoes, and some species of black fly, that are a damage to economically important plants or a health threat.

The basis of the bacterium's insecticidal power is a protein endotoxin (an endotoxin is a toxin that remains inside the bacterium). More correctly in terms of the lethal activity, the toxin is actually a so-called protoxin. That is, the molecule must be processed to some other form before the toxic activity is present.

Inside the bacterium the protoxin molecules collect together to form a crystal. These crystals are visible as two pyramids associated with each other when the **bacteria** are examined in light microscopy. Often the bacteria contain a bright spot under light microscopic illumination. This spot is an endospore (a spore that is contained within the bacterium).

The presence of an endospore is very useful. Like the spores of other bacterial species, the endospore of *Bacillus thuringiensis* allows the organism to survive inhospitable conditions in a dormant state. Endospores that contain the protoxin crystal can be applied to fields via crop-dusting aircraft.

The protoxin crystal is a hardy structure, and does not readily dissolve. However, in the gut of insects, where the **pH** is very basic, the protoxin can go into solution. When this happens an insect enzyme splits the molecule. One of the toxin fragments, the delta endotoxin, confers the lethal effect to the insect.

The delta endotoxin binds to the epithelial cells lining the gut wall of the insect. By creating holes in the cells, the toxin destroys the functioning of the gut, and causes massive cell death. The larva is unable to eat. Another consequence of the destruction is a modification of the pH to a more neutral level that is hospitable for the germination of the endospores. The resuscitation and growth of *Bacillus thuringiensis* within the insect gut kills the larva.

The use of *Bacillus thuringiensis* as an insecticide has been practiced since the 1930s. In the recent three or four decades, with the advent of techniques of molecular rearrangement, the specificity of the bacterium for target insect pests has been refined. These products now represent some one percent of the worldwide use of **fungicides**, herbicides and insecticides.