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An Overview of the Microbial Insecticide: Bacillus Thuringiensis

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COLUMN ARTICLE

Microbial insecticides are widely used to control plant diseases and pest insects. *Bacillus thuringiensis* (*Bt*), a microbial control agent, has been successfully used for many years in pest control worldwide. *Bt* was isolated in 1901 by Japanese scientist Shigetane Ishiwatari. Ishiwatari named this bacterium as *Bacillus sotto* because it caused sotto disease in silkworms. Ten years later, Berliner isolated the same bacteria in Thuringia region of Germany from *Ephestiakuehniella*, and named it as *Bacillus thuringiensis* [1]. *Bt* is a gram-positive aerobic or facultative aerobic spore-forming bacterium which produces parasporal inclusions upon sporulation [2,3]. Bt can be isolated from many ecological environments such as soil, the rhizosphere, fresh water, from plants, insects and from stored products in warehouses [4-10]. Parasporal inclusions of *Bt* are more desirable because of their target specificity compared to broad-spectrum chemical insecticides in terms of environmental protection and health concerns.

Bt products are almost exclusively active against larval stages of different insect and kills the insect by disruption of the midgut epithelial cells followed by septicemia [4]. Cry toxins binds midgut epithelium and undergo oligomerization, and holds onto the membrane to initiate the lytic phase [11]. According to this concept, Cry toxins lead to the formation of lytic pores on the plasma membrane following oligomerization of these toxins.

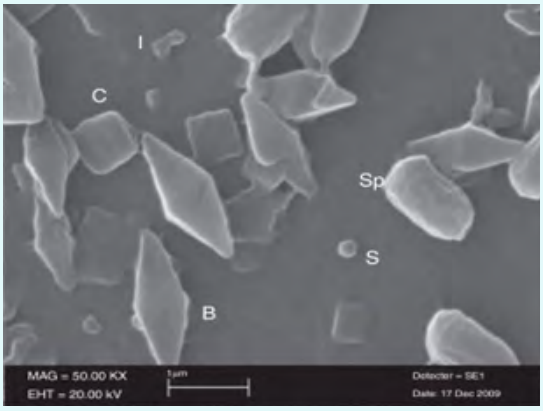

Figure 1: Parasporal inclusion morphology of BtSY49-1 strain [3].
B: Bipyramidal; C: Cubic; S: Spherical; I: Irregularly Shaped Spherical; Sp: Spore

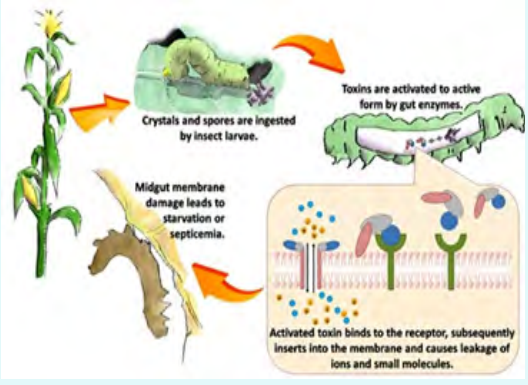

Figure 2: Mode of action of Cry toxins [12].

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Cry toxins (*Bt* product) are encoded by cry genes that are specially located on large plasmids. However, cry genes can also be integrated to the chromosomal DNA. Höfte and Whiteley [13], and Carlton [14] proposed a universal nomenclature and classification scheme for Cry toxins and their encoding genes based on the insecticidal spectra. Then, a different nomenclature was developed by Crikmore., *et al*. [15] depending on the amino acid sequence similarity. In their classification system categorized cry genes in 73 groups and subgroups [16].

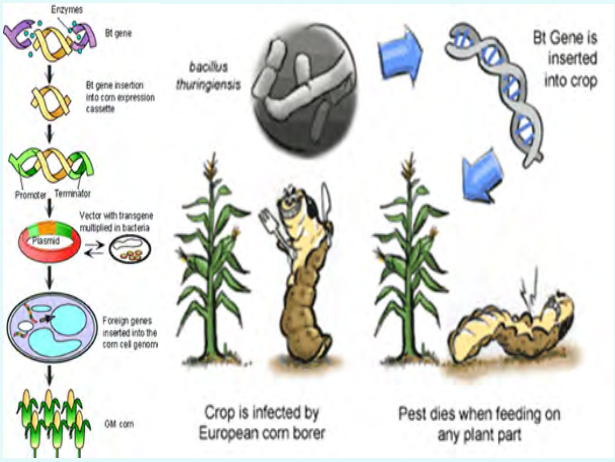

Figure 3: Bt crops production [17].

Since 1996, *Bt* crops have been began to spread worldwide. A positive side-effect of the switch to *Bt* crops has been a pronounced reduction in insecticide quantities [18,19]. According to a report by U.S. Environmental Protection Agency, *Bt* crops have reduced insecticide applications by 123 million pounds [20]. Because *Bt* can inhibit food borne pathogenic bacteria or phytopathogenic microorganisms (bacteria, fungi), and additionally can synthesize enzymes with antimicrobial activity and has the potential of releasing protein to growth media, research on this unusual microorganism were not only limited to its insecticidal feature but also focused on production of its enzymes and proteins that have potential use [21]. In conclusion, the use of *Bt* and its products should be given to importance as an alternative method to the chemical insecticide for a sustainable agriculture and environmental protection.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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