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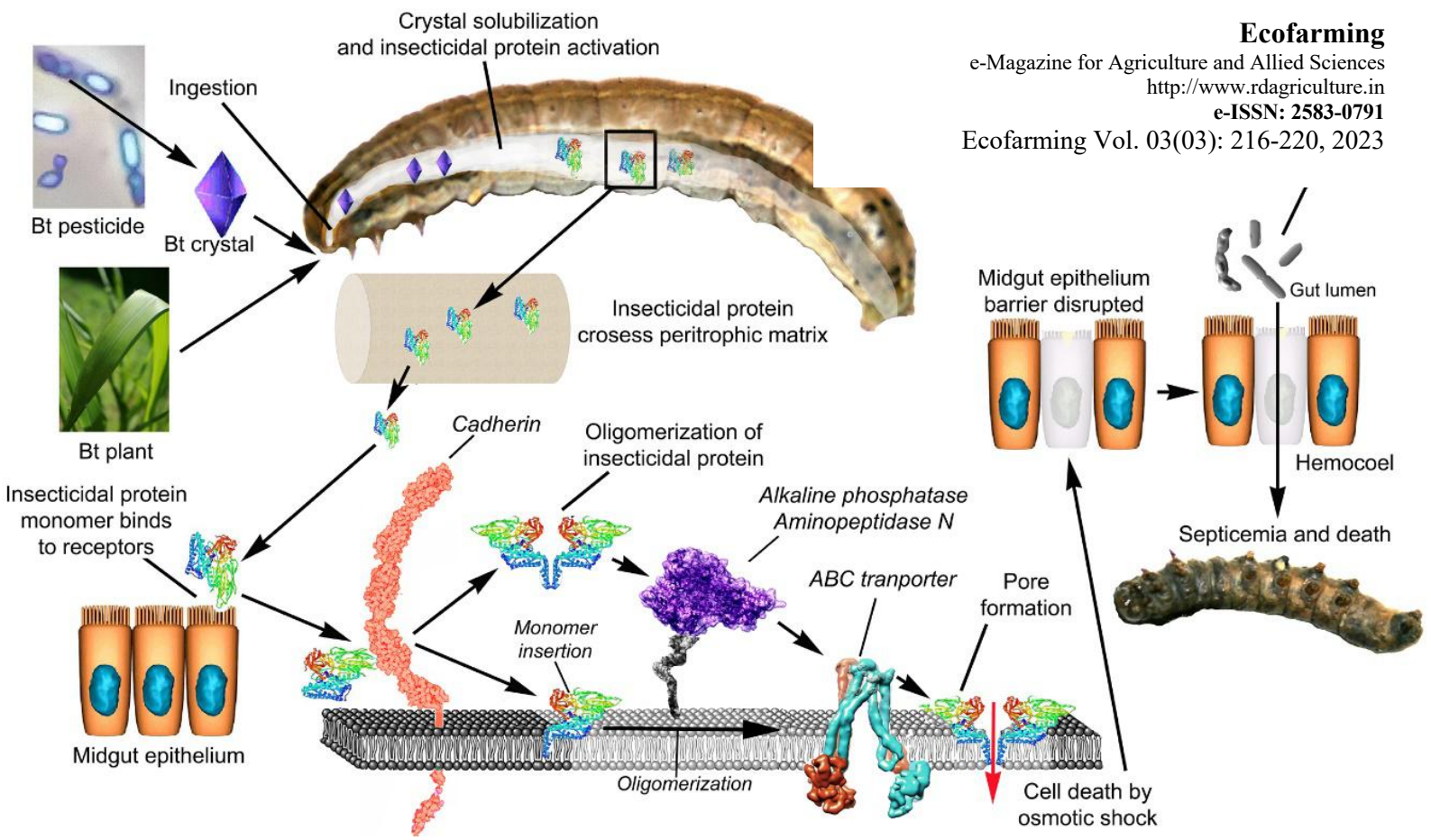

Bt toxins and their efficiency against sucking pests

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Introduction

In agriculture, a major problem was insect-pest management for that control many types of biological methods were developed. In particular, the *Bt* toxin was very effective against insect-pest management. *Bacillus thuringiensis* (*Bt*) is a common Gram-positive, rod-shaped, sporulating bacteria that has been isolated from a wide range of environments, including soil, water, dead insects, silo dust, deciduous tree leaves, various conifers, insectivorous mammals, and human tissues

with severe necrosis (Hofte and Whiteley, 1989; Knowles and Dow 1993; Raymon *et al.,* 2010). *Bt* strains produce a wide variety of insecticidal proteins active against larvae of very diverse insect orders as well as, in some cases, against species from other phyla. This has led *Bt*-based products to become the bestselling biological insecticides to date (Roh *et al.,* 2007; Schnepf *et al.,* 1998) since the genes encoding insecticidal protein have been successfully used in novel insecticidal formulations and the construction of transgenic crops (Sanchis, 2011).

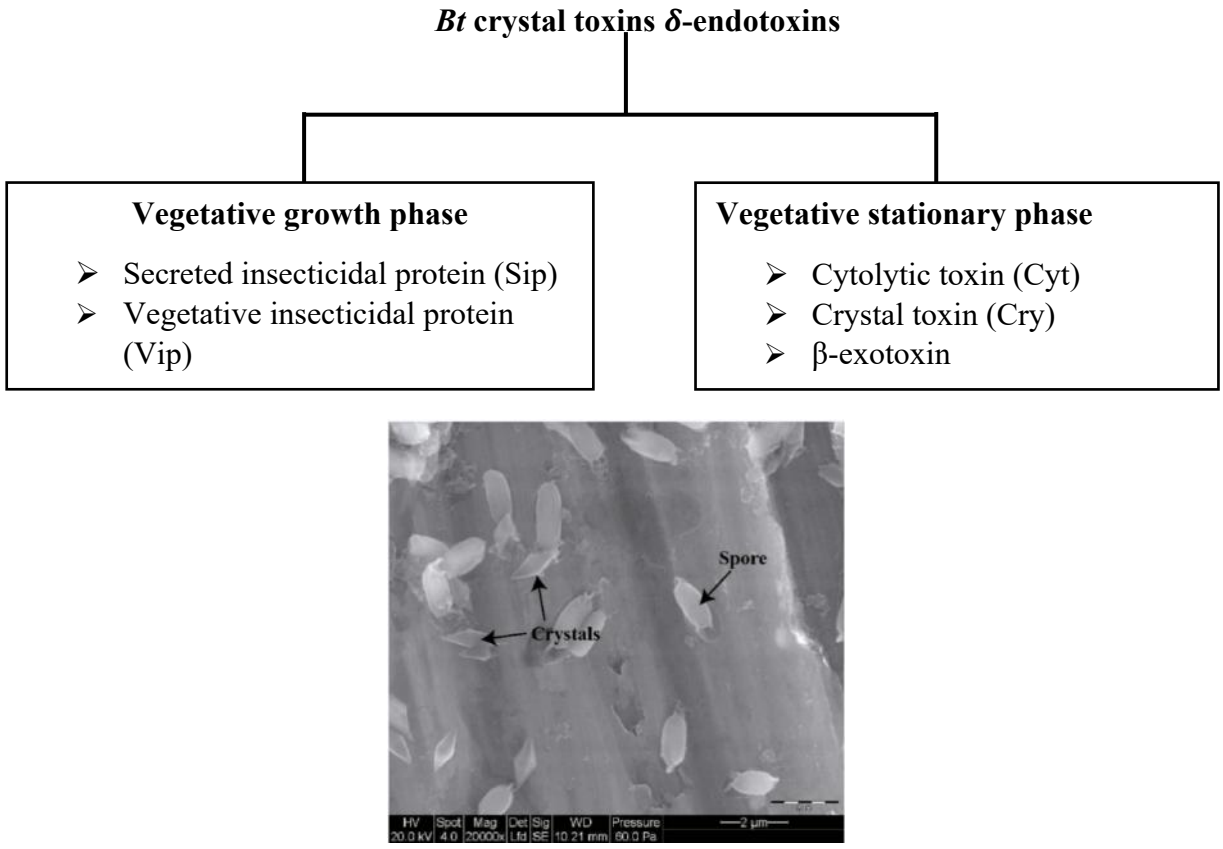

Figure 1: Protein crystals (bipyramidal) mixed with spores from Bt strain H29.3.

Bt toxin mode of action

- Even though Cry toxins have been extensively used commercially, the specifics of their mode of action are still controversial.
- The Cry protein is ingested by a susceptible insect, which then undergoes solubilization and processing in the digestive fluid, changing it from a protoxin to an activated toxin core.
- The toxin core passes through the peritrophic matrix and attaches to particular cadherin receptors on the brush border membrane of the gut cells. (Toxin binding to cadherin proteins activates an oncotic cell death

pathway and/or forms toxin oligomers that bind to GPI-anchored proteins and concentrate on regions of the cell membrane called lipid rafts.)

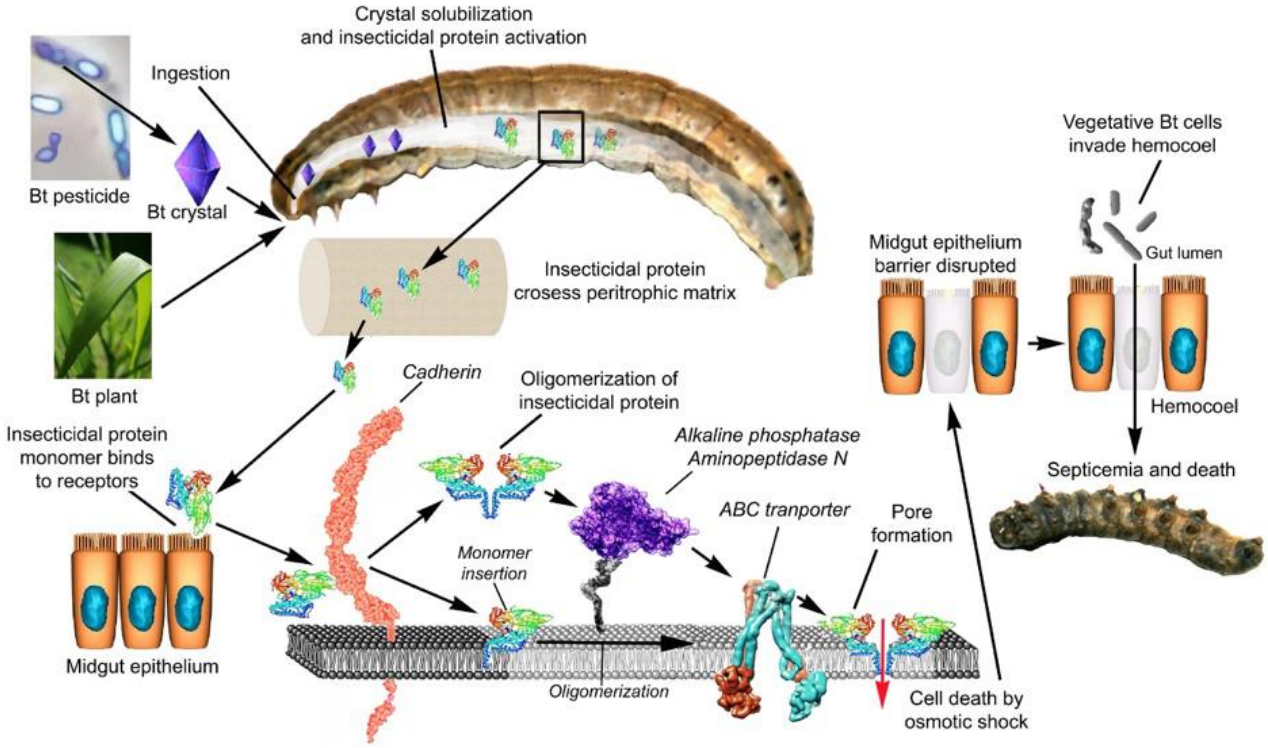

Figure 2: Bt toxin mode of action

- Accumulation of toxin oligomers results in toxin insertion in the membrane, pore formation, osmotic cell shock, and ultimately insect death.
- ATP binding cassette (ABCC) transporters play a crucial part in Cry poisoning, even though the precise nature of the toxin-ABCC protein interaction is unknown. It is still debatable whether enterocyte death is ultimately caused by oncosis, pore creation, or both mechanisms.

Evaluations of different *Bt* toxins for sucking pests

Bt toxins have been employed as bioinsecticides against flies, particularly mosquitoes and black flies, beetles, and caterpillars. During the vegetative growth phase, *Bt* also produces insecticidal proteins that are subsequently secreted into the growth media. Lepidopteran, coleopteran, and some homopteran pests are susceptible to the insecticidal activity of these proteins, also referred to as VIPs (vegetative insecticidal proteins). Many types of *Bt* toxins were developed for hemipteran pests, including Cry2A, Cry3A, Cry11A, Cry51Aa2, Cry64Ba, Cry64Ca, Cyt2Aa, Cry1Ab, Cry4Aa, Cry11Aa, Cry4 and some Vip (Vegetative Insecticidal Proteins) like Vip1Ae, Vip2Aa. Some natural strains are *Bt israelensis (Btl*) and *Bt Medellin (Btm*) for the control of mosquitoes.

Table 1. Toxicity of *B. thuringenesis* (*Bt*) toxins against sucking pests.

Sr. No	*Bt* toxin	Crop	Pest
1.	Cry51Aa2	Cotton	Thrips (Thysanoptera: -Thripidae) Tarnished Plant bug (Hemiptera: - Plant bug)
2.	Cry1Cb2		Green peach Aphid, Greenfly Peach-potato Aphid
3.	Cry64Ba Cry64Ca Cry78Aa	Rice	Small brown plant hopper (*Laodelphex striatellus*) White-backed plant hopper (*Sogatella furifera*)
4.	Cyt2Aa Cry4A		Pea aphid (*Acyrthosiphon pisum*) Green Peach Aphid (*Myzus persicae*)
5.	Cry2 Cry3A Cry4	Potato	Potato aphid (*Macrosiphum euphorbiae*)
6.	Cry11Aa		Pea aphid (*Acyrthosiphon pisum*)
7.	Vip1Ae Vip2Ae	Cotton	Cotton aphid (*Aphis gossypii*)

Conclusions

Bt toxin is a bioinsecticide produced by *Bacillus thuringiensis* (*Bt*) that targets lepidopteran, coleopteran and some homopteran pests by binding to receptors in their gut cells, leading to osmotic cell shock and insect death. Different types of *Bt* toxins have been developed for hemipteran pests, such as Cry2A, Cry3A, Cry11A, Cry51Aa2, Cry64Ba, Cry64Ca, Cyt2Aa, Cry1Ab, Cry4Aa, Cry11Aa, Cry4, and some Vip (Vegetative Insecticidal Proteins) like Vip1Ae, Vip2Aa. So *Bt* toxins are efficient tools for management of sucking pests.

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