**Bacillus thuringiensis**

Bacillus thuringiensis (Bt) is a Gram-positive bacterium naturally found in soil, water and grain dust, and can be cultivated in liquid, solid and semi-solid media. B.t is a gram positive sporultaing bacterium that produces crystalline inclusion known as parasporal crystal in sporulating cells.

Commercial formulations differ but they essentially contain a mixture of B.t spores and crystals which are sprayed on plants. Suscetptible insects feed on sprayed plant foliage resulting in gut paralysis, stoppage of feeding and death within 3-5 days death within 3-5 days due o the endotoxins ingested by the insects.

Different strains of B.t have different crystal morophologies and a single strain can contain more than one type of crystal. The strain of B.t. var. kurstaki produces a small cuboidal crystal, which may be attached to a large bypyramidal crystal, each containing different types of protein possessing different immunological and insecticidal properties. The bipyramidal crystal contains a protein of 130 to 140 KDa size and is designated as PI type while cuboidal protein contain a protein of about 65 KDa designated as P2 type. PI active against lepidopteran insects whereas P2 protein seems to be active against certain dipterans , especially mosquito and lepidopterans as well. The PI protein in bipyramidal crystal is a protoxin that is at first inactive but upon prolonged incubation gets activated by proteases of midgut of insects converting it into 65-70 activated KDa protein that is presumed to be actively toxic.

Toxicity varies depending upon the three types of Lepidopterans classified on the basis of susceptibility to B.thuringiensis endotoxin-type 1 insects are killed by the endotoxin alone, type II killed by endotoxin but toxicity enchanced by spores and type III killed only when both spores and endotoxin are present.

Plasmids control endotoxin production. The Cry or deltaendotoxin crystal protein genes from B.t code for highly active, linear polypeptide insecticidal proteins. These protein binds to receptors on midgut epithelial cells and cause disrupted metabolism, resulting in cessation of insects feeding, paralysis and death in 24 hours. The crystal producing (Cry+) B.t. strains can serve as plasmid donors to B.t strain can serve as plasmid donors to B.t.s strains cured of Cry+  plasmid or to other bacterial species such as *Bacillus cereus* grown in broth cultures where matings are allowed to take place. The genes that control PI protein production have been cloned to *E.coli* and *B. subtilis* host vector systems.

Mass production of B.t insecticides is carried out in liquid broth fermentation tanks inoculated with a selected strain. The broth is then concentrated and formulated into an aqueous oil-based flowable product.