

## The white gold called Bt cotton

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Most plants on which the world depends for food and fiber lack in-built mechanisms for protection. To protect such plants against pests, insecticides and pesticides are used indiscriminately. Bt technology offers a solution

### Genesis

Bt stands for *Bacillus thuringiensis* bacterium. It is named after the place Thuringia region of Germany where it was first isolated almost 100 years ago. The first successful use of Bt protein in plants were reported in 1987. Bollgard cotton, developed by Monsanto, was first field tested in 1992.

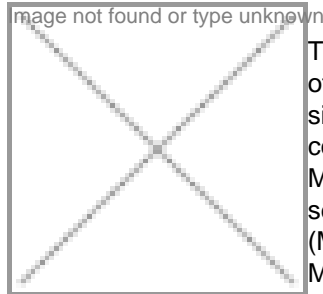
### The Technology

The cry1Ac protein is produced as an insoluble crystal in the bacteria *B. thuringiensis*. The insecticidal activity of this protein requires that the protein be ingested by the insect and inside the gut, a high-pH environment renders the solubilization of the protein, which is then cleaved to the active form of protein. This active form of protein binds to specific receptors on the midgut of lepidopteran insects, inserts into the membrane and forms ion-specific pores. The digestive tract of non-target organisms do not contain these receptors and thus the protein is non-toxic for them.

### The Impact

India has the highest-ever hectareage of cotton, 12.1 million hectares in 2011-12. The increase in hectares is credited to the introduction of Bt technology that spurred hybridization, from three Bt cotton hybrids in 2002-03 to 884 Bt cotton hybrids in 2011-12. Consumption of insecticides exhibited a significant drop from 46 percent in 2001-02 to less than 21 percent between 2009 and 2011. The average yield of cotton increased from 308 kg per hectare in 2001-02 to 499 kg per hectare in 2011-12.

In India, the Bt technology has been successfully used on commercial scale for cotton till now. The insertion of the Bt gene into the cotton plant cells causes them to produce toxins called crystal (Cry) proteins, which when ingested by the insects kills them. Scientists have identified 60 different strains of Cry proteins that affect a wide variety of insects. Hence, Bt cotton, when compared with conventional non-Bt cotton, offers economic benefits by reducing the investment on insecticides and offering higher yield as compared



The number of events concerning the development of Bt cotton hybrids have increased significantly since 2002. First was Bollgard I (MON531) containing the cry1Ac gene. It was developed by MAHYCO and was approved for sale in 2002. The second event was the development of Bollgard II (MON15985), which too was developed by MAHYCO and featured two genes, cry1Ac and cry2Ab. It was approved for sale in 2006. The third

event was the development by JK Seeds featuring cry1Ac gene sourced from IIT Kharagpur. The event was approved for sale in 2006. GFM was developed

by Nath Seeds and the gene was sourced from China and featured the fused cry2Ab and cry1Ac. It received approval for sale in 2006. The fifth event known as BNLA-601 was approved for sale in an indigenous publicly-bred cotton variety, Bikaneri Nerma, expressing the cry1Ac gene.

It was approved for commercial release in the north, central and south cotton growing zones in India in 2008. This was the first indigenous Bt cotton event developed by the Central Institute of Cotton Research along with the University of Agricultural Sciences, Dharwad, Karnataka. MLS-9124 was developed indigenously by Metahelix Life Sciences and featured a synthetic cry1C gene. In 2009, two Bt cotton hybrids namely MH-5125 and MH-5174 were approved for commercial sale for central and southern zones.

### The way forward

India is the world's most competitive market for cotton seeds. Today, Indian farmers can choose from over 300 hybrid Bt cotton seed varieties with six competing Bt cotton technologies marketed by five technology providers.

**Vipul Murarka** in Bangalore