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Bt Cotton

Major challenges and solutions

Gopal Kalwan, Ankit*, Deachen Dolma and Praveen Kumar

ICAR-Indian Agricultural Research Institute, New Delhi-110012

*Corresponding author email: ankitdahiya827@gmail.com

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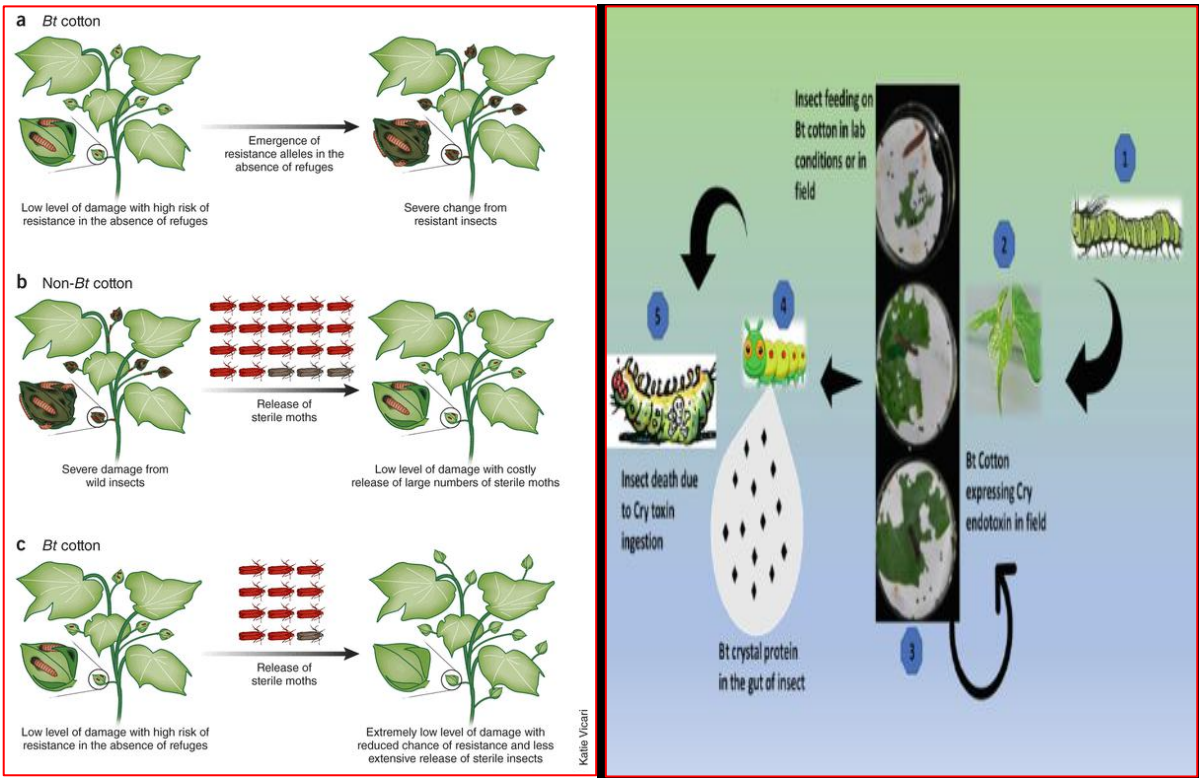
Why Bt cotton

A significant cash crop that has a significant impact on the Indian economy is cotton. Bollworms were a serious threat to cotton cultivation, which reduced production and productivity and increased reliance on insecticides. In 2002 Bt cotton was first introduced in India with all these goals in mind. Shigetane Ishiwatari made the discovery of this insecticidal bacterium in 1901. Cry protein, also known as insecticidal crystal protein (ICP), is created by Bt. Due to the alkaline ph environment in the insect gut, this protein becomes activated when it enters. Cotton is genetically modified with the ICP encoding gene to impart insecticidal action.



First generation

BOLLGARD (Coker312+ cry1Ac)

The initial brand name for Bt cotton was Bollgard. Agrobacterium-mediated gene transfer was used by Monsanto to introduce the gene encoding the Cry1Ac protein into Coker312. Bt 1 offers defence against damaging infestation from pink bollworm, cotton bollworm, and tobacco budworm, among others (Akhurst et al., 2003).

Second generation

Bollgard II (DP 50B + Cry II A(b))

In this case, two genes are added to offer great performance and more comprehensive control over a range of insects. CryIIA(b) gene was put into the cotton line DP50B, which already has the cry1(Ac) gene, for this reason.

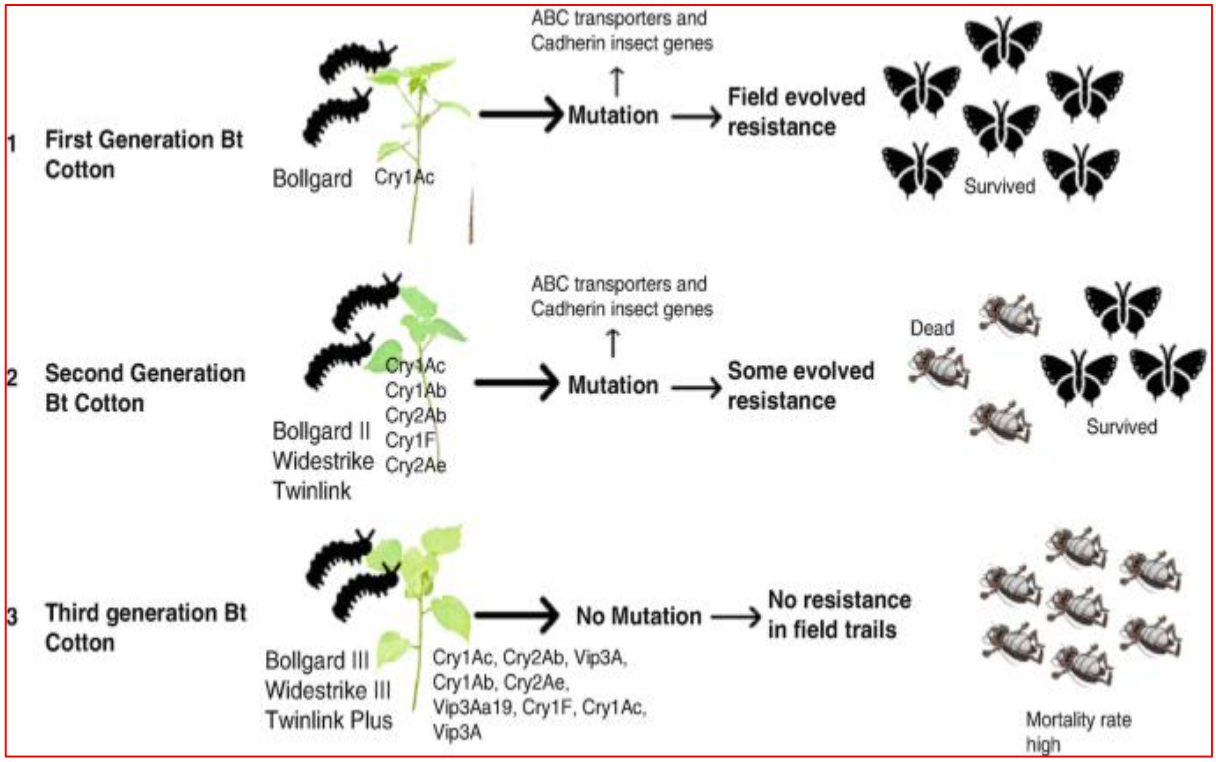
Broadly: It also includes two genes. The insecticidal activity of Cry1Ac and Cry1 Fa is comparable to that of Bollgard II. It was created by the agrochemical company Dow.

Twin Link	**Cry1Ab + Cry2Ae**
Third generation	
Wide Strike 3	**Cry1F + Cry1Ac + Vip3A**
Bollgard 3	**Cry1Ac + Cry2Ab + Vip3A**
Twin Link Plus	**Cry1Ab + Cry2Ae + Vip3Aa19** Plus technology combines two Bayer proprietary *Bt* genes –Cry1Ab and Cry2Ae, both included in Twin Link – with the Vip3Aa19 *Bt* gene for effective management of major lepidopteran pests such as cotton bollworm and armyworm, including fall armyworm.

Genetically engineered crop plants are developed with the assistance of Bollgard1 and Bollgard2. Bollgard cotton has built-in defences against devastating Bollworm infestations and contains an insecticidal protein from *Bacillus thuringiensis*, a naturally occurring soil microbe (Bt).

The first biotech crop technology approved for commercialization in India in 2002 is Bollgard Bt cotton (single-gene technology).

The enhanced double-gene Cry1Ac and Cry2Ab technology found in Bollgard II technology offers defense against bollworms and Spodoptera



Failure of Bt cotton in India

Major Reasons

• Farmers must purchase fresh stock for each growing season because seeds cannot be reused and are more expensive than nearby, non-genetically modified kinds. This has given Monsanto an almost monopoly on cotton seeds in India, which has been the major concern for opponents, along with licensing arrangements with regional seed businesses.

• The spread of Bt hybrids that were unlawful and hadn't met biosafety requirements, which raised concerns about their potential toxicity to the environment

Specific Reasons:

1) Resistance breakdown

The primary tactic used in integrated pest management (IPM) to prevent or postpone insect species resistance is called refuge. There will be more opportunities for susceptible insects to mate with resistant insects created from Bt cotton since non-Bt cotton plants are planted to encourage the establishment of sensitive insects. This kind of strategy can be used to prevent or postpone insect resistance. However, Indian farmers are unable to use this method because to a lack of effective instruction and regulation, which results in ongoing problems with Bt cotton.

2) Use of Bt hybrids

Because Bt hybrids only have one copy of the gene, about 25% of Bollgard I hybrid seeds and 6% of Bollgard II hybrid seeds exhibit the absence of Bt toxins. This feature encourages the development of insect resistance as they are fed non-Bt toxin-containing plants, which reduces the effectiveness of bollworm controls.

3) Differential expression

In several studies, huge difference in level of expression was reported, same gene Cry1Ac, shows high expression in USA and Australia but low expression in India, some environmental factor may be responsible for this difference.

4) Monsoon

Monsoon season is another factor play crucial role in failure, Bt cotton seeds are not suitable under such conditions, argued by researchers.

This is unavoidable reason to improve the success of Bt cotton in India.

5) Evolution of minor pests into major

The pests might become resistant to the toxins produced by these crops and the crop production might decline. The reduction of lepidopteran pests in Bt cotton may result in an increase of other cotton pests that are not controlled by Bt cotton. This phenomenon has been observed worldwide suggesting that secondary pests can occupy the resources previously used by lepidopteran insects.

Threats

Risks include out-crossing by pollen transfer to non-transgenic plants, food safety concerns, development of resistance in target pests, and effects on non-target organisms and biodiversity.

Efforts to be made for Bt success

Rules

To control the development of resistance in Bt cotton, there is urgent need to rigorous in making guidelines and rules in favour of refuges along with the main crop. Such strategy can be beneficial up to some extent, not a permanent solution, hence some alternative is must require in immediate future.

Bt Varieties

Use of Bt varieties is a viable method to combat persistent insect invasions. In contrast to Bt hybrids, the presence of two copies of a gene will be effective. Less likely than Bt hybrids for insects to acquire resistance. The Bt cultivar has been used successfully in the USA, China, and Australia.

• Planting rainfed short season high density (SS-HD) cotton, developed at CICR, Nagpur, and other universities, is the solution. SS-HD cotton has the potential to increase yields, prevent pink bollworm infestations, which would reduce the usage of insecticides and eliminate the need for Bt technology.

- Further, in the era of globalization where indigenous varieties have become a tradition, witnessed in the ever-increasing demand of muslin cloth, indigenous varieties should be promoted. Also, infrastructure should also be promoted for local weaving and spinning, along with creating demand through e-commerce.