



Assessing BT cotton (India)

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Assessing agro-technology

Simplistic to position is as a technological triumph [country-wise increase of yields and quality of cotton yarn] or an abject failure [increasing number of farmers suicides and rural indebtedness] as this is context-sensitive [vagaries of weather, insect attack].

Kranthi and Stone (2020) argue: Attributions of suicides to *Bt* seed often skirt the fact that suicides were a major problem well before the release of *Bt* seed, and that suicide rates have not risen as *Bt* cotton has been almost universally adopted in India.

Compulsory Article - Long-term impacts of *Bt* cotton in India by Kranthi and Stone, 2020

Abstract

Most scholarship on the closely-watched case of genetically modified *Bacillus thuringiensis* (*Bt*) cotton in India has focused on short-term impacts and has also ignored other major changes in India's cotton agriculture. This Perspective combines several data sources over a 20-year span to provide long-term comparisons of *Bt* adoption with yields and other inputs at both country- wide and state-specific scales. *Bt* cotton adoption is shown to be a poor indicator of yield trends but a strong indicator of initial reductions in pesticide use. Yield increases correspond to changes in fertilizer and other inputs. *Bt* cotton has continued to control one major cotton pest, but with *Bt* resistance in another pest and surging populations of non-target pests, farmers now spend more on pesticides today than before the introduction of *Bt*. Indications are that the situation will continue to deteriorate.

BT technology's farm-level effects – 20 year

- Cotton yields have been increasing due to complex series of changes [increasing application of fertilizers, pesticides, better seeds, irrigation, and better know-how among farmers]
- Desi-cotton was more pest-resistant. Since 1990s, with adoption of hybrids [(*Gossypium hirsutum*) India cotton production has been impacted by increased costs connected with purchase of seeds, fertilizers, and heavy insecticide use. Main pests impacting production are Lepidopteran caterpillars (2 varieties who eat cotton bolls) and Hemipteran sap-sucking bugs. Farmers found themselves on an insecticide tread-mill spraying more and dealing with new pests over time...
- Bt cotton was released in the US in 1995 and China in 1997*Bacillus thuringiensis* (Bt) cotton has been one of most studied cases of GMO after its introduction in central and southern India in 2002 by Monsanto and in northern India in 2005.
- Lot depends on how this technology was adopted by farmers (scale) and pests may have developed resistance over time
- Current study has a nearly 20-year time-frame for assessment
- Argue: Bt cotton has provided durable resistance to bollworm, although this is partially also linked to use of effective new insecticides that were adopted just before Bt seeds were introduced
- Argue: Unfortunately, the increase in fertilizer-intensive Bt seeds has worsened the predation by non-Lepidopteran pests. This, coupled with rapidly spreading Bt resistance pink bollworm, has led Indian cotton farmers to now spend more on insecticides than before they adopted Bt seed.

trends in cotton yields

- Costs of BT cotton production are quite high [seeds] and in many cases farmers have taken special care in application of fertilizers, pesticides and assured irrigation to ensure crop production as stakes are higher than normal hybrid varieties
- Understand short-term bias over long-term perspective about impact of BT technology to loss of yield to insect predation [not as much as increased yields]. The rising use of pesticides nullifies any conclusion about 'sustainability' of pesticide reductions with adoption of BT seeds.

Available statistical data indicates the following trends:

- By 2005, *Bt* adoption was still only 15.7%, but yields were 90% over 2002 levels
- By 2007, *Bt* adoption had risen to 81% and yields were 41% over 2004 levels
- Countrywide yields stagnated after 2007, even as adoption continued to rise. By 2018, yields were lower than in the years of rapid *Bt* adoption.
- Author looks at state-wise data for Gujarat, Karnataka, Andhra Pradesh, Haryana and Punjab to conclude that yield increases did not correspond to *Bt* adoption at either the countrywide or the state-wide level

Explanation

- **Look beyond BT seeds as farmers invest more in cultivating this cash crop**
- Costs of production have been rising: As farmers shifted to expensive BT seeds, they also ensured and were supporting the cultivation with other agro-improvements such as
 1. Improvements in irrigation infrastructure and expansion of irrigation facilities (SSP in Gujarat, check-dams, ponds, channels, ground-water)
 2. Extensive use of fertilizers
 3. Extensive use of new improved effective insecticides for a few years [2 brands used for bollworm control namely Tracer and Avaunt. More and more application of insecticides to reduce pest infestation. After 2008, the sustainable use of insecticides was not possible. Reports increase of Pink bollworms developing resistance to Bt seeds in other geographies (China and USA), and also in India by 2015 with near ubiquitous shift to Bt seeds]
- Authors find strong correlation between yields and fertilizer trends [due to a more positive fertilizer response in these relatively well-irrigated areas]

conclusions

- Cotton farming has become extremely cash-intensive in the 21 Century requiring huge capital investments by farmers even though they face higher risk due to agroecological and market conditions. They lack safety-nets and suffer greater distress
- Bt cotton did make a positive contribution in India. Bt seeds sharply reduced predations by bollworms but they were not effective against leaf-worms! So, spraying has not declined.
- Bt seeds were responsible for the sharp falloff in spraying for Lepidopterans beginning in 2005 when adoption first began to surge.
- Long-term analysis indicates, BT technology benefits have been only modest
- There are other necessary conditions that explain high yields and BT seeds are not a sufficient condition - Changes in other inputs, including irrigation, insecticides and especially fertilizer use
- Ironically, countrywide yields have not improved in 13 years, and Indian cotton farmers today are spending more per hectare on insecticide than they did before Bt began to spread.
- Ministry of Agriculture data indicates - In the decade following 2005, when *Bt* seed began its rapid spread across Indian cotton farms, per hectare costs for seed rose by 78%, for insecticide by 158%, for fertilizer by 245% and for labour by 275%, with the overall production cost of seed cotton rising by 143%