## THE TWISTED TRAJECTORY OF BT COTTON

Relevant for: Indian Economy | Topic: Major Crops, Cropping Patterns and various Agricultural Revolutions

Cotton has been woven and used in India for thousands of years. Cotton fabric from around 3,000 BCE has been excavated from the ruins of Mohenjo-daro, and archaeological findings in Mehrgarh, Pakistan, show that cotton was used in the subcontinent as far back as 5,000 BCE. Indian cotton fabrics dominated the world trade during the succeeding millennia and were exported to many places, including Greece, Rome, Persia, Egypt, Assyria and parts of Asia.

Much of the cotton cultivated until the 20th century was of the indigenous 'desi' variety, Gossypium arboreum. From the 1990s, hybrid varieties of G. hirsutum were promoted. These hybrids cannot resist a variety of local pests and require more fertilizers and pesticides. Cotton suffers from plenty of infestation from moth pests (Lepidopteran) such as the Pink Bollworm (PBW) and sap-sucking (Hemipteran) pests such as aphids and mealy bugs. With increasing pressure to buy hybrid seeds, the indigenous varieties have lost out over the years. But recently, there has been some resurgence of interest.

## Comment | The flawed spin to India's cotton story

The increasing use of synthetic pyrethroids (group of man-made pesticides) to control pests and the rising acreage under the American long-duration cotton led to the emergence of resistant pests. Resistant Pink and even American Bollworm (ABW), a minor pest in the past, began increasing, leading to a growing use of a variety of pesticides. Rising debts and reducing yields, coupled with increasing insect resistance, worsened the plight of cotton farmers. It was in this setting that Bt cotton was introduced in India in 2002.

Genetically modified (GM) cotton, the plant containing the pesticide gene from the bacteria Bacillus thuringiensis (Bt), has been grown in India for about twenty years. This pesticide, now produced in each Bt plant cell, ought to protect the plant from bollworm, thereby increasing yields and reducing insecticide spraying on the cotton plant. According to the Ministry of Agriculture, from 2005, adoption of Bt cotton rose to 81% in 2007, and up to 93% in 2011. Many short-duration studies examining Bt cotton, in the early years, pronounced that Bt was a panacea for dwindling yields and pesticide expenses. The two-decade mark now provides an opportunity to review GM cotton in India more comprehensively.

In March this year, K.R. Kranthi and Glenn Davis Stone published a review in the scientific journal Nature Plants, analysing the entire picture of the use of Bt cotton in India. Earlier studies had attributed to Bt the tripling of cotton yield between 2002-2014 in India. However, one detail that sullied such a conclusion was that yield differences between farmers who were the early adopters of Bt cotton and those who were not suffered from selection bias.

## Comment | A case of wholehearted biotechnology adoption

Controlling for such bias showed (in 2012) that the contribution of Bt cotton to yield increase was only about 4% each year; still, since yields vary annually by over 10%, the benefits claimed were dubious. Kranthi and Stone's review examines data over 20 years, studying each State separately and correcting for illegal Bt cotton planting.

There are discrepancies between yield and the deployment of Bt cotton. For instance, the Bt acreage was only 3.4% of the total cotton area in 2003, not sufficient to credit it for the 61% increase in yield in 2003-2004. Furthermore, with only 15.7% Bt cotton coverage by 2005, yield

increases were over 90% over 2002 levels. While Bt cotton adoption corresponded to a drop in spraying for bollworms, the study states, "countrywide yields stagnated after 2007 even as more farmers began to grow Bt. By 2018, yields were lower than in the years of rapid Bt adoption."

Individual State data are more helpful in understanding subnational trends. In Maharashtra, yields climbed in the decade after 2000, with no change in the rate of increase when Bt cotton was introduced. In Gujarat, Andhra Pradesh and Madhya Pradesh as well, there is no correlation between the adoption of the variety and increase in yields. For instance, Gujarat's surge in cotton yields was 138% in 2003, even as Bt cotton was used only for 5% of land under cotton. Similar findings are seen in Punjab, Haryana and Rajasthan, where yield increase is incongruous with the spread of Bt cotton.

Also read | Supreme Court backs Monsanto on GM cotton patents

The rise in cotton yields can be explained by improvements in irrigation, for instance in Gujarat, and a dramatic growth across the country in the use of fertilizers. Gross fertilizer use for cotton more than doubled from 2007-2013; the average rose from 98 kg/ha in 2003 to 224 kg/ha in 2013.

There is a strong correlation between the rise in use of fertilizers in individual States and yields, and this bias increases when it is combined with improvements in irrigation.

The total insecticide expenditure per hectare reduced in 2006, and Lepidopteran spraying expenditures continued to fall until 2011. While the ABW that feeds on different plants does not appear to have developed a resistance to Bt, the PBW developed a resistance by 2009 in India. In a few years, the situation was dreadful. Bollworm spraying began to climb again. Sap-sucking insects have surged for the hybrids, as the hirsutum Bt cotton hybrids are quite vulnerable. With rising acreage under Bt cotton cultivation, expenditures for spraying for sucking pests also went up. By 2018, farmers were spending an average of \$23.58 per hectare on insecticide — 37% more than the pre-Bt levels.

It is tough to isolate one particular aspect of a technology and evaluate it properly. A technology that works in the lab may fail in fields since real-world success hinges on multiple factors, such as different kinds of pests and local soil and irrigation conditions. The benefits of Bt cotton have been modest and short-lived. Changes to the agricultural systems correlate better with positive yields, and countrywide yields have not improved in thirteen years. India's global rank for cotton production is 36 despite heavy fertilizer use, irrigation, chemicals and Bt cotton usage. This is below the national average of some resource-poor African countries that don't have Bt, hybrids or good access to inputs.

The cost of ignoring 'desi' varieties for decades has been high for India. These varieties resist many pests and don't present the problems faced with hybrids. Research suggests that with pure-line cotton varieties, high density planting, and short season plants, cotton yields in India can be good and stand a better chance at withstanding the vagaries of climate change. But government backing for resources, infrastructure and seeds is essential to scale up 'desi' varieties. It is time to pay attention to science and acknowledge that Bt cotton has failed in India, and not enter into further misadventures with other Bt crops such as brinjal or herbicide resistance.

Sujatha Byravan is a scientist based in Chennai and the former President of the Council for Responsible Genetics, Cambridge, Massachusetts.

You have reached your limit for free articles this month.

To get full access, please subscribe.

Already have an account ? Sign in

Start your 14 days free trial. Sign Up

Find mobile-friendly version of articles from the day's newspaper in one easy-to-read list.

Move smoothly between articles as our pages load instantly.

Enjoy reading as many articles as you wish without any limitations.

A one-stop-shop for seeing the latest updates, and managing your preferences.

A select list of articles that match your interests and tastes.

We brief you on the latest and most important developments, three times a day.

\*Our Digital Subscription plans do not currently include the e-paper ,crossword, iPhone, iPad mobile applications and print. Our plans enhance your reading experience.

Dear reader,

We have been keeping you up-to-date with information on the developments in India and the world that have a bearing on our health and wellbeing, our lives and livelihoods, during these difficult times. To enable wide dissemination of news that is in public interest, we have increased the number of articles that can be read free, and extended free trial periods. However, we have a request for those who can afford to subscribe: please do. As we fight disinformation and misinformation, and keep apace with the happenings, we need to commit greater resources to news gathering operations. We promise to deliver quality journalism that stays away from vested interest and political propaganda.

Dear subscriber,

Thank you!

Your support for our journalism is invaluable. It's a support for truth and fairness in journalism. It has helped us keep apace with events and happenings.

The Hindu has always stood for journalism that is in the public interest. At this difficult time, it becomes even more important that we have access to information that has a bearing on our health and well-being, our lives, and livelihoods. As a subscriber, you are not only a beneficiary of our work but also its enabler.

We also reiterate here the promise that our team of reporters, copy editors, fact-checkers, designers, and photographers will deliver quality journalism that stays away from vested interest and political propaganda.

Suresh Nambath

Please enter a valid email address.

Subscribe to The Hindu now and get unlimited access.

Already have an account? Sign In

Start your 14 days free trial Sign Up

You can support quality journalism by turning off ad blocker or purchase a subscription for unlimited access to The Hindu.

Sign up for a 30 day free trial.

## END

Downloaded from crackIAS.com © Zuccess App by crackIAS.com