

Reconstructing Facts in Bt Cotton

Why Scepticism Fails

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The case that the “triumph narrative” of Bt cotton in India comes mainly from economists, the biotech industry and their academic allies is a difficult one to sustain when dozens of studies show the positive effects of insect resistance in Bt cotton. Yields are driven by numerous factors, and there will be variance – field-to-field, season-to-season. Despite this, Bt cotton has been agro-economically successful because of the lower cost of production per unit and thus higher net returns – facts that are consistent with the near universal adoption of Bt technology by farmers.

Bt cotton has assumed a surprisingly large place in both global debates around genetic engineering and in Indian politics. Controversies have raised important questions in the sociology of knowledge and politics of science – how are facts relevant to public policy settled? More radically, are “facts” socially constructed in instrumental ways such that they themselves are a modernist fiction? Extreme scepticism characterises a postmodernist and constructivist unsettling of the very notion of facticity (Latour 2003).

What Is At Stake?

Politics that follow from epistemic scepticism are often powerful. Naomi Oreskes and Erik Conway (2010) demonstrated in *Merchants of Doubt* how small numbers of scientists tied to industry were able to create doubt about the science behind global warming, the link between smoking and cancer, ozone depletion and other phenomena in which settled science would hurt corporate interests if not strategically unsettled. Doubt has its uses. The critical move is to flatten the terrain intellectually – all studies are weighted equally, there are always dissenting “studies” and there is no way to judge among them. More powerfully, opponents of the climate science consensus charge that scientists have a vested interest in finding dangers to get funding to study them. Attaching an interest to researchers is a strategy for undermining conclusions without accepting any burden of proof.

Convergence around these important problematics appeared in the pages of the EPW via Glenn Stone’s “Constructing Facts: Bt Cotton Narratives in India” (Stone 2012). Chandrasekhara Rao and I are implicated via our own EPW article (Herring and Rao 2012) “On the ‘Failure of Bt Cotton”.

Stone’s scepticism seems at first blush sweeping and radical – “we simply cannot say how Bt seed has affected cotton production in India” (2012: 63). Why? “Facts” as presented in the numerous peer-reviewed articles on Bt cotton are “constructed” within narratives and contaminated by interests. There is then no way to adjudicate between a non-governmental organisation (NGO) – constructed narrative of Bt failure and a “triumph narrative” of peer-reviewed journal articles. The important question for social scientists and policymakers would then be to find the interests and mechanisms of distortion, since permanent agnosticism is not a viable strategy for dealing with the world.

What does Stone discover? The “triumph narrative” of Bt cotton in India “flows mainly from economists and the biotech industry (and its academic allies)” in “industry-journal authentication systems” (peer-reviewed journals) which “serve the interests of their constituent parties” (2012: 62). This system “creates pro-GM facts through the interaction of a different set of interested parties”. The convergence of multiple studies with different methods on the success of a single trait – insect resistance – improving agro-economic results is produced by this conspiracy. “The triumph narrative...has been generated, authenticated, and disseminated by a particular system of interacting parties with overlapping interests”. This astonishing feat of coordination among notoriously idiosyncratic researchers and journals across several continents is done by and for “the biotech industry (and its academic interlocutors)”. The mechanism is a “cosy alliance between GM manufacturers and ostensibly independent researchers” (ibid: 69).

These are strong claims, even by the standards of conspiracy theories. What is the evidence? How do we know that researchers in dozens of studies showing positive effects of insect resistance in Bt cotton are part of some “cosy alliance” and only “ostensibly” independent? What exactly makes peer-reviewed journals normatively predisposed to “pro-GM

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facts?" Are journals, like researchers, only ostensibly independent?

This is an especially awkward case for Stone to sustain. One of the journals that publishes "pro-GM facts" is *World Development* – cited twice in his reference list. But Stone (2011) himself publishes in *World Development*. Should we discount his good empirical work in Warangal district because it is published in the "industry-journal authentication system"? Do authors published in *World Development* really get cheques from Monsanto? The breadth of journals indicted for having published "pro-GM facts" strains credulity – from the *Economic & Political Weekly* to the *Proceedings of the National Academy of Sciences*.

What is valuable in Stone's EPW article are caveats about triumph narratives of silver bullets. Bt produces one trait; it affects only biotic stress from one class of insects. Yields are driven by numerous traits, characteristics of germplasm, and biotic and abiotic stresses that vary continually. There will be variance, field-to-field, season-to-season. Variance across studies simply reflects the nature of agriculture. Finding the yield effect of a single trait – insect resistance induced by the Bt transgene – presents special difficulties. Pest pressure varies greatly by season, influenced by many factors, including weather. Bt gives farmers one great advantage when bollworm pressure is high; when pressure is low, the trait is less valuable in protecting harvestable yield. In that case, the extra expense is comparable to an insurance policy payment. Compare irrigation water. Yield effects in years of scanty rain are large, even decisive, but add less to yield in wet years. Yet no one doubts the contribution of irrigation to agriculture. It is true that isolating the effect of one trait is difficult even conceptually – too many variables, too few degrees of freedom. And cross-sectional studies do suffer the cultivator bias problem, as Stone notes. This is the reason for longitudinal analysis, which controls for cultivator bias by using data from the same farmers in the same fields before Bt and after Bt (Herring and Rao 2012: 46-48).

Nevertheless, despite variation in field studies, there is a very strong centre of gravity around the success of Bt cotton

agro-economically – lower cost of production per unit and thus higher net returns. To draw an analogy to *Merchants of Doubt*, it is difficult to ascertain how much cancer is caused by tobacco smoking, the variables are multiple and interactive. Sample sizes are small in clinical trials, genetics play a role, and other behaviours matter, as well as environmental and other factors. Studies are always limited and flawed, and anecdotal evidence will produce exceptions to generalisation – for example, people smoking for 60 years without cancer. But problems in assessing the precise contribution of smoking to cancer would not justify concluding that we do not know if there is a relationship. Denial would be contrary to public health, as most nations now recognise, but consonant with the interests of tobacco companies who for many years sought to unsettle medical consensus. Stone wants to destabilise the dominant findings on Bt cotton by levelling the epistemic field. "Facts" from networks claiming that the failure of Bt cotton is total and "genocidal" are equated with "facts" from extensive rigorous fieldwork. Facts are all "constructed". Ironically, this epistemic relativism does not prevent Stone from constructing a refutation of the Bt success narrative.

Are Bt Yield Effects Declining?

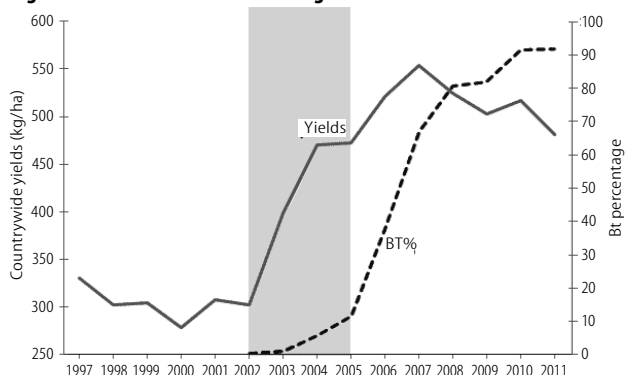
Stone's rebuttal of the Bt triumph narrative has two legs. First, he argues that Bt could not have been a major driver of dramatically higher yields because Bt adoption was low in the period of increasing yields. Second, an unexamined Figure 1 shows yields falling in recent years despite virtually universal adoption of Bt technology by farmers (Stone 2012: 68).

Let us examine these two claims, beginning with Stone's adoption data. The data are systematically inaccurate in purporting to give us the national area under Bt cotton yearly, and thus the extent of diffusion of the technology. Measuring diffusion of cultivars is easy if there is a single source or

effective control. Bt cotton violated these conditions egregiously. It was in fields illicitly for three years before the Government of India discovered it, even though none could be grown legally without government approval (Scooness 2006; Jayaraman 2001). Once the "desi Bt" of Navbharat Seeds was banned by the Genetic Engineering Approval Committee in Delhi, "Bt variants" diffused underground from growers engaged by Navbharat to produce hybrids containing the cry1Ac Bt transgene. As farmers found the seeds successful, underground diffusion accelerated – best documented in Gujarat (Roy 2006). How do we then know the area under Bt seeds? Stone confidently presents International Service for the Acquisition of Agri-biotech Applications (ISAAA) data to generate the curve of area under Bt cotton nationally in his Figure 1. ISAAA quite explicitly recognises the ubiquitous illegal diffusion of biotech seeds in various countries, including India, but their figures exclude uncountable stealth seeds.

Stealth seeds seriously complicate analysis of India, Brazil, China, Argentina, Ukraine, Thailand, Vietnam, Pakistan and other countries – the area under illegal biotech seeds is unrecorded (Herring 2007; Herring and Kandlikar 2009). This was especially true in India before the big price drop in Bt cotton hybrids in 2006, when the price advantage of illicit/desi seeds was reduced significantly. Three Bt hybrids became legal in March 2002. Jayaraman (2004) cited "industry sources" as estimating that more than half the transgenic cotton in India came from illegal hybrids in 2004. Gujarati seed producers and farmers suggested to me

Figure 1: Cotton Yields and Percentage of Fields Planted to Bt Seed



Source: Yield data are from the Cotton Corporation of India, Bt adoption data are from ISAAA. Reproduced from Stone (2012: 68).

a much higher figure for that state. Data from the Gujarat State Seeds Producers' Association indicated that about 34% of the cotton-seed packets sold nationally were transgenic in the 2004-05 growing season. Of this 34%, less than a third were legal, more than two-thirds illegal.¹ The Press Trust of India reported on 10 February 2004 that "an illegal variety of Bt cotton covers nearly 90% of the cotton area in Gujarat". Questions in Parliament revealed widespread knowledge of – and concern about – diffusion of illegal Bt but no conclusive data on extent. One especially knowledgeable observer of the cotton sector estimated 2.5 million hectares under stealth Bt seeds in 2005, that is, almost twice the area in official statistics. All estimates point in the same direction – rapid expansion of Bt acreage below the radar of official statistics and uncounted in ISAAA data (Herring 2005).

Estimates of unofficial Bt diffusion are imprecise, but conservative in that they apply only to packaged and branded stealth seeds (Agni, Kavach, Captain F1, Luxmi, Vaman, Rakshak and so on). There is no estimate of the area planted to F2 (second filial generation) seeds saved or traded by farmers for replanting – an ironic phenomenon at the height of demonisation of Bt as "terminator technology" by NGOs. Bt F2s were planted especially in the early years after Navbharat 151 was banned by Delhi. These were often gathered at the gin after fibre extraction and differentiated linguistically from approved Mahyco Bt seeds, sometimes called "government seeds". In Andhra Pradesh, some seeds were diverted by farmers who grew Bt seeds for the major seed companies – distributed unlabelled and uncounted in cloth bags. The reason for the more rapid adoption of illegal hybrids was primarily price – as little as 30% of the cost of legal Mahyco-Monsanto hybrids. The prices of official seeds dropped dramatically in 2006, after which the stealth market contracted but did not disappear.²

Adding stealth Bt seed acreage to official acreage would move the diffusion curve of Stone's Figure 1 up and thus address part of his puzzle. The diffusion curve should be much steeper. Data on illicit seeds are inherently problematic, but are we on firmer ground with yield data?

Stone rejects the Ministry of Agriculture data used by Herring and Rao (2012: 51) in favour of data from the Cotton Corporation of India. They give quite different views – opposite yield trends in recent years. Which facts are factual? It may not matter too much for two reasons. First, no national agricultural statistics for India are rock solid in any event; short-time series on crop production are problematic generally. Second, yields themselves are not the only or best indicator of technology success, especially for a technology that brings only one trait. The more important question for farmers is income, not yield. Here the Bt effect in reducing the cost of production of a marketed unit of cotton is important. An insect-resistance trait may also prevent total loss of crop – as happened in Gujarat in 2001 – but prove less necessary in normal years. Kathage and Qaim (2012) find in their longitudinal study that yield increases were 24% but income increases were 50% for Bt cotton farmers. Reduction of pesticide costs is a big part of the difference. The Bt trait will vary in effect on yields as pest pressure varies, from very large effects to low effects. That effects vary tells us nothing about the success of the technology once we understand the purpose of the trait and the inherent variability of crops in fields.

But suppose yields have recently declined – how exactly could Bt be responsible? Perhaps cotton's very profitability is bringing more marginal lands into production, lowering average yields. Between 2009 and 2012, an additional 3 million hectares came under cotton cultivation, most of it Bt. It is hard to imagine that this land stayed out of cotton if it were prime soil with water; at least some expansion of cotton must be on less productive land. Moreover, with the boom in Bt cotton, counterfeit seeds multiplied; we do not know how much "Bt" land is actually planted with authentic Bt seeds (Herring and Kandlikar 2009). More broadly, yields will be affected by changes in pest pressure, drought, and perhaps regionally, the variable effects of climate change are yet unknown.

Whatever the discrepancies between ministry and corporation data on national yields, farmers' behaviour reinforces the conclusion that Bt provides cotton with

a trait of economic value. The bulk of empirical work accords with their adoption logic. Some critics claim that adoption data mean nothing – there is no choice because non-Bt cotton has disappeared from the market. Actually, non-Bt cotton seeds are provided with Bt cotton packets for planting refugia, though farmers often throw them away. Moreover, since 2006 farmers have had the choice to buy even more expensive Bt seeds – the stacked-gene Bollgard II hybrids – but could stay with one-gene Bt, or buy cheaper stealth seeds. What have they done? Over 80% of the Bt cotton seed sold in 2011 was the more expensive 2-gene implementation, even though the original cry1Ac version is still available. We also know from producers that fewer non-Bt hybrid seeds were produced because they lost favour and eventually became unsaleable (Herring 2008).

Concluding Facts

Stone's initial objective was to destabilise the broad consensus in peer-reviewed literature that he characterises as a "triumph narrative". Yet his mechanisms are unproven and implausible – the conspiracy is too grand, the actors too diverse. He himself contradicts this initial claim with a conclusion consonant with the peer-reviewed literature he attacks. In assessing the "isolated impact" of Bt's effects on cotton yields, he concludes, "Kathage and Qaim's (2012) multi-village fixed-effects study gives us the number 24%; Stone's (2011) multi-village before-and-after analysis gives us 18%; and Gruère and Sun's (2012) trend analysis gives us 19%" (2012: 68).

That is a tight range and impressive level of measured contributions to yield increases, especially for an agricultural innovation with a single trait; it is also consistent with the behaviour of farmers. The radical scepticism of postmodern constructivist facticity is irrelevant to the Bt cotton question. Once we have these facts straight, it is clear that Bt cotton represents neither suicide seeds nor silver bullets, but a remarkably valuable technology. Stone's article does not destabilise the broad consensus on its usefulness to farmers. Nor are doubts about the facts on Bt cotton sufficiently compelling or grounded to undermine

further research and development in agricultural biotechnology, despite their political deployment for just this purpose.

NOTES

- 1 Mimeo tables and personal communication, October 2005; and conversations with D B Desai, Navbharat Seeds, June 2005.
- 2 See Roy (2006); Roy et al (2007); Ramaswami, Pray and Lalitha (2011).

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