Bt Cotton in India

Sustainable Pest Management?

Though there is a great deal of variability in the expected performance of Bt cotton depending on the environment, the regulation and marketing of the hybrids reflects a uniformity of approach that is inexplicable. Academic studies continue to talk of the importance of studying toxicity and monitoring resistance build-up even as initial resistance management plans at the farm level fail. It is clear that all possible options for managing bollworms have not been assessed before zeroing in on Bt cotton.

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The debate on Bt cotton and its performance, on scientific claims and realities, and on the adoption of the technology by farmers should be seen in the larger context of the need for the country to adopt a sound pest management paradigm in agriculture. Any pest management technology that does not emulate nature's way of managing insect populations as closely as possible is bound to be unsustainable. Such a pest management technology should clearly look at a pest complex and not a single pest (since there is a balance between pests maintained in the farm ecology and targeting only one pest, as in the case of Bt cotton, is itself problematic); it should understand the relation between monocultures and pests as well as diseases spread by pests, soil fertility management and pest/disease incidence, predatory-prey relationships between different living organisms and so on. Therefore, to hype up one technology based on the random insertion of a gene directed against one pest as the solution to the cotton production problems of this country is highly misleading. This is especially so when vulnerable cotton farmers are being lured towards expensively-priced technology on misleading and even false claims.

While technologies like pesticides and genetic engineering of the Bt gene are going to allow pests to ultimately select for resistance, they also bring with them a lot of risks which need to be carefully evaluated for their environmental, health, economic as well as social costs. No quick fix solutions will be in the interests of Indian farmers, whatever the initial adoption rate is. The adoption rate by a certain set of farmers is not always an indicator of the effectiveness or sustainability of the technology, as the story of pesticides has shown us. The ludicrousness of the situation is reflected in the fact that more and more, there is only talk about resistance management and not pest management, whether it is pesticides or the Bt technology.

The performance of Bt cotton in India has been extremely uneven right from the beginning (defying the very requirements of uniformity and stability needed for a seed to be released in the first instance)

and this is clearly expected given the shortcomings of the technology. The efficacy of the technology is dependent on a lot of factors, including the actual expression of the toxin in the plant – for instance, in different parts of the plant, at various times of the crop season, in different ecosystems under different growing conditions, in different hybrids, in the baseline resistance of the target pests to the Bt toxin and depending on the availability of other host crops in the vicinity for the target pests, the other agronomical practices adopted by the farmers, weather conditions and so on. Therefore, a lot of variability exists in the expected performance based on the internal as well as external environment available to the plant and the gene cannot be shown to perform miracles irrespective of these varied situations.

However, the regulation as well as the marketing of Bt cotton hybrids in this country reflects a kind of "uniform application of decisions" which is inexplicable. Genetic Engineering Approval Committee (GEAC), sitting in Delhi, allows Bt cotton hybrids to be grown in different zones irrespective of the differential baseline resistance levels of different bollworms to the Bt toxin, the presence or absence of alternate host crops, relative area of Bt cotton in a given region, the toxicity expressed by particular hybrids and so on. In Australia, for example, there was a 30 per cent cap on the area of Bt cotton within total cotton area as a resistance management measure. Lack of such precautions and allowing a large area of monoculture of Bt cotton meant that the crop has been made very vulnerable to pests and diseases this year, as reports emerging from various states indicate.

Decisions clearly do not even involve consultations in a decentralised manner, based on scientific evidence before regulators. Even if the GEAC at the centre gives environmental clearance to particular Bt cotton hybrids, the respective state governments do have the authority to provide or reject licences for marketing in the state. Academic studies meanwhile only talk about why it is important to study toxicity or susceptibility and monitor resistance build-up, without a mention of any sound resistance management plans, even though questionable initial resistance management plans at the farm level – in the form of refugia in each plot – are definitely not being implemented and failing. The proliferation of illegal Bt cotton all over the country certainly complicates the situation. It also shows that even if scientists do come up with resistance management plans, they will not be implemented at the ground level. This is one more reason for why we should go back to pest management, instead of resistance management.

Routine Studies?

It is in this overall context that Bt cotton and any scientific studies on it should be looked at, including the latest Central Institute for Cotton Research (CICR) study published in the July 25 edition of *Current Science* and the debate carried out in some sections of the media on the subject (for example, *The Hindu*, August 29, September 5 and 20, 2005). First of all, it is not clear how this can be termed a routine study, when the findings reflect what has been found elsewhere. The obvious questions that arise are: why were such routine studies not taken up before the approval of Bt cotton in India and would the decisions that were then taken have been any different. Are there similar studies on two other bollworms called spotted bollworm (E vittella) and pink bollworm (P gossypiella)? If so, what are this findings and why are such studies not available for public scrutiny? How have decisions been influenced based on this and other studies, given that inter-hybrid variability and baseline resistance variability across locations is really high in this country? Are recommendations actually being made based on different studies and are these studies based on different experiences emerging on the ground?

K R Kranthi in his September 5 response in *The Hindu* says that the article did not mention a "commonly known fact that majority of bollworm eggs are laid on leaves of the upper canopy and neonate larvae scrape and feed on the surface of the leaf….". As experience over centuries shows, the ovi-position behaviour of the pest is an important factor in effective pest management and this cannot be brushed aside as an insignificant matter. Studies and observations, including a four-year "Helicoverpa scheme" in Andhra Pradesh, have shown that the fruiting parts (squares, bolls, flowers, etc) also harbour a large number of eggs amongst different plant parts. What is also interesting to note is that larval development in several studies is found to be significantly higher on squares, rather than leaves, indicating a certain level of migration within the plant. Further, discussing the effectiveness of Bt cotton against bollworm in the limited context of the current CICR study poses some constraints since the said paper does not study two other bollworms (other than American bollworm) – the spotted bollworm and pink bollworm. A literature search indicates that while eggs are laid on flower buds, brackets, tender leaves and on stalks of young green bolls, soon after emergence, the larvae enter flower buds, flowers and the bolls, especially in the case of pink bollworm. The literature indicates that since the female moth of the pink bollworm has greater longevity, it is able to await the development of fruiting bodies on young cotton plants before laying eggs. This raises fresh questions about the effectiveness of the technology, given that CICR's own study points out to the sub-critical toxin production in these critical parts of the plant.

Implications for Biosafety

The fact that there is a high degree of variability (statistically significant) of two to sevenfold in the toxin expression across different hybrids also has serious implications for biosafety. In India, the preferred approach so far has been to assess biosafety only initially and for later releases, to assess only agronomic suitability. The CICR's findings show that the toxin expression varies significantly across different hybrids into which the gene has been inserted, which means that there could be different biosafety implications for different hybrids. This brings into question the accepted premise of "an event approved once in a crop will not have to go through bio-safety tests for other varieties within the crop".

Bt cotton is also lauded by scientists for its unmatched bio-safety profile. For civil society activists who have been asking for data that was initially produced on the biosafety of Bt cotton in India, this is only rhetoric since no data is available for independent scrutiny. On the other hand, the field experiences of farmers put a question on the "unmatched bio-safety" of Bt cotton. For instance, there are many reports from Madhya Pradesh, Punjab and Andhra Pradesh from farmers who are experiencing soil quality deterioration after growing Bt cotton. There are also reports of skin allergies from Bt cotton as well as adverse impacts on livestock feeding on Bt cotton. Such reports are not being investigated by concerned officials or scientists despite repeated requests.

While academic studies look at the variability of Bt toxin expression within a season, across hybrids and across different parts of the Bt cotton plant, the biggest shortcoming is that this has been done in recommended agronomic and crop management conditions, in the fields of a research

institute campus. A true picture of farmers' experience would have emerged if the study was conducted across seasons, locations as well as hybrids in real life conditions. The results would then have had more serious implications for the introduction of Bt cotton as "the best available option". As farmers' experience in India shows, the performance is extremely uneven within a season, across years, hybrids and locations. What's worse, there are no accountability mechanisms for such uneven performance. Mahyco-Monsanto had to be prohibited from Andhra Pradesh when they failed to compensate farmers for losses.

We would like to point out from the experience of establishing non-pesticidal management (NPM) of crops very successfully on farmers' fields on more than 10,000 acres across different districts of Andhra Pradesh and across many crops, that in India, all possible safer and effective options have not been assessed before zeroing in on Bt cotton as the answer. NPM, for instance, has been witnessed by senior agriculture scientists from ICAR bodies and ICRISAT, by well known social scientists and economists and by the agriculture minister of Andhra Pradesh who wanted it to be replicated with many more farmers. Their reviews indicate that there are certainly many more potent, sustainable and better options available for bollworm as well as other pest management.

Our analysis and experience shows that the CICR scientists as well as other scientists in India have to be more cautious before passing their positive verdicts on Bt cotton, lest we repeat the story of pesticides again. They should certainly put in more effort to study all other options available before making any categorical statements on the technology. NPM and organic farming methods for cotton are two such examples which have to be understood and supported better. EPW

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