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THE BOLLWORM RETURNS

Is Bt-based resistance collapsing?

Studies from China and the US show the limitations of Bt-based resistance. The bollworm evolves to resist the toxin eventually, and a number of secondary pests remain unaffected. Suman Sahai argues that this is not really a workable strategy except in the first few years.

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24 February 2007 - A recent study from China, reported at the American Agricultural Economics Association's annual meeting in July 2006, indicates that the Bt cotton crop there is failing, and farmers are incurring losses rather than making profits from its cultivation. The study, conducted by Cornell University, found that Bt cotton farmers cut pesticide use significantly for the first three years of cultivation. After that, however, they had to spray just as much as conventional farmers, and ended up with a net average income of 8 percent less than conventional cotton farmers, partly because the cost of Bt seed is triple that of conventional seed. Also, after seven years of Bt cotton, populations of other insects - such as mirids - have increased so much that farmers now have to spray their crops up to 20 times in a growing season. The Cornell researchers anticipate that the emergence of secondary pests is likely to become a major threat in countries where Bt cotton has been widely planted.

Published at almost the same time as the China study, other reports from Arkansas in the United States (see here) show that bollworm were found to be feeding in large numbers in Bt cotton fields. These pests should have been killed by the toxin that is engineered into the plant to kill them, and their presence indicates they may have become immune to the genetic treatment. This breakdown is happening roughly ten years after Bt cotton was first planted there. Unlike in Arkansas, the problem in China is not due to the bollworm developing resistance to Bt cotton. Instead, secondary pests - that were previously controlled by the broad-spectrum pesticides that were common earlier - began reappearing with the shift to gene-based control.

In India an ad hoc research agenda, in the absence of any policy on genetically engineered crops, has led to wide use of the Bt gene. Over forty two per cent of the research projects in crop biotechnology in India are based on the Bt gene. Ranging from cotton to potato, rice, brinjal, tomato, cauliflower, cabbage, even tobacco, to maize, the Bt gene is everywhere.

Presumably, the crops that are being researched will reach the fields one day. If that happens, a wide range of crops grown in both the Rabi and Kharif seasons will contain the Bt gene; as a result, throughout the year there will be standing crops containing the Bt endotoxin. Not just that, in the same season, there will be various Bt crops juxtaposed with each other in small fields when farmers grow a variety of different crops, particularly vegetables. When the bollworm is exposed to the endotoxin constantly, season in and season out, naturally its resistance to the toxin will build up rapidly. As it is, resistance-delaying strategies - such as maintaining a 20 per cent non-Bt crop belt - are not followed by cotton farmers, and resistant pests are already appearing, as the laws of biology dictate they would.

Bt cotton in India has been around for the last seven years - four of them legally and at least three years illegally before that.

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In India too we are beginning to see the first indications that the the Bt-based insect resistance management strategy is failing. Bt cotton in India has been around for the last seven years - four of them legally and at least three years illegally before that, particularly in Gujarat where the illegal Bt cotton called Navbharat 151 originated and where it has been cultivated steadily since then. Since farmers are not practicing the recommended cultivation practices, we are seeing the emergence of resistance in the bollworm, as well as problems created by other pests like pink bollworm and sucking pests, and disease factors like wilt.

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Given the complex management strategy of the Bt approach, and the wide range of pests found in the tropics, is the Bt gene approach workable in a developing country situation for any length of time, and can it provide a viable disease resistance strategy? Bollgard II, with a higher number of Bt genes in it, is ready, but even this second round will eventually face the same problems - the targeted pests will develop resistance, and crops remains vulnerable to unpredictable attacks by pests over which Bt toxin has no effect.

Cotton scientists at the Central Institute of Cotton Research, Nagpur have warned that it is only a matter of time before the widespread emergence of resistance in bollworms will cause the Bt cotton technology to collapse, unless corrective measures are not taken immediately. The only long term feasible and sustainable approach to controlling pests in cotton would appear to be not the Bt gene but an integrated pest management approach including a mix of strategies. This could include introducing natural predators, a combination of chemical and plant based pesticides such as the oil of Karanj seed (Pongamia species) or any of the other natural pesticide combinations including the traditional Panchgavya which is a preparation based on the urine and dung of cow mixed with plant extracts and which has recently been awarded a patent in the US. ⊕

Suman Sahai
24 Feb 2007

Dr Suman Sahai is President of Gene Campaign, based in Delhi.

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