Bt Cotton: Benefits for Poor Farmers?

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DEMOCRATISING BIOTECHNOLOGY

Cotton genetically engineered to express the insecticidal toxin *Bacillus thuringiensis* (Bt cotton) has been celebrated as a success story for poor farmers in developing countries. Bt cotton varieties have been adopted by commercial and smallholder farmers in several developing countries, including China, South Africa and India. In 2002, Bt cotton varieties occupied 20% of the global cotton area and more than half of the national cotton acreage in China. An estimated 90% of smallholder cotton farmers in the Makhatini Flats area of KwaZulu-Natal, South Africa, planted Bt cotton.

Transgenic Bt technology is popular with farmers because it appears to provide effective control of important cotton pests, principally bollworms. Consequently it has been adopted very rapidly and it is now possible to review the experiences of Bt cotton farmers over several growing seasons. A number of recent studies have claimed there are clear benefits for cotton farmers (see box).

An open-and-shut case?

On the face of it, Bt cotton appears to be a success story and a powerful advert for the benefits of GM technology for poor farmers in developing countries. Yet, questions remain. It is not possible to conclude, on the basis of a few favourable studies and a few years' experience, that Bt cotton can be relied upon to produce benefits for poor farmers.

- The positive results shown by Bt cotton in the first few years are likely to be highly contingent. The experience of India serves as a reminder that the Bt gene cannot protect cotton against diseases or non-target pests, which can wipe out profit margins. Paying the higher price for GM seeds remains a risky choice, especially for cash-poor farmers.

- The performance of transgenic crops depends heavily on the local suitability of the varieties into which the gene constructs are inserted. In Zimbabwe, Bt cotton was originally introduced into varieties to which Monsanto had access, rather than the locally-adapted hairy cotton varieties, which are resistant to other pests. Similarly, North American Bt varieties commercialised by Monsanto in China are arguably ill-suited for hand-picking or long, humid Chinese summers.

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BT COTTON IN THREE DEVELOPING COUNTRIES

China: Cotton is an important export crop for the Chinese economy. A high proportion of it is produced by the country's vast population of smallholders, for whom, in some provinces, cotton is an important source of income. Separate Bt cotton varieties developed by the American company Monsanto and the Chinese Academy of Agricultural Sciences have been commercialised in China, beginning in 1997.

By 2002 the area planted to GM cotton varieties had grown to 2.1 million hectares (mha) out of a total cotton area 4.1 mha. Bt cotton is reported to have contributed to increased yields, financial and labour savings, and a reduction in poisonings linked to pesticide use. The total benefits were calculated at US$334 million nationally, most of which was captured by farmers.

South Africa: Bt cotton varieties developed by the US firm Delta and Pine, using a Bt gene owned by Monsanto, have been planted since 1997 by smallholder farmers in the Makhatini Flats with apparent success. The trials have become an important demonstration project for the potential of GM crops for smallholder farmers in Africa as a whole. Reportedly, the higher cost of Bt cotton seed was offset by lower chemical use and yield increases in the order of 20–40%.

India: Varieties of Bt cotton developed by the Indian seed company MAHYCO using Monsanto genes, only received formal approval for commercialisation in 2002. However, in the same year it was discovered that an unauthorised variety had been marketed and planted during two growing seasons on an estimated 10,000 hectares in Gujarat and elsewhere, without being detected. The rapid adoption of this illegal Bt variety indicates a high level of demand for GM cotton among some farmers.

- Ecosystems are dynamic and the cotton pest complex is constantly coevolving. Research in China has indicated that success in controlling bollworm as the primary pest may lead to their place being taken by an increase in the number of secondary pests such as aphids and red spider mites. The particular ecological dynamics of cotton pests requires dynamic, ongoing management.

- There is concern in both China and India that pest resistance to the Bt toxin may already be emerging. Pest refuges are recommended as a way of controlling this problem, but these may be unworkable or ineffective on the tiny plots of land farmed by smallholders.

- Most seed varieties only remain competitive for a few seasons, before giving way to newer and better ones. The length of time required to negotiate intellectual property rights, carry out biosafety testing and bring GM varieties to the market can mean that the background variety into which the transgene is inserted may be 'out of date' by the time it is available. This may mean that they do not perform as well as some conventional varieties, despite having the advantage of being genetically modified.

Transgenic technology has been criticised for reflecting a simplistic view – that one gene can be responsible for one trait, and that one or two traits can guarantee an extensive range of benefits (see Briefing 8). A closer examination of the cases demonstrates that a range of factors, besides the Bt gene, are important. It is especially important not to assume that the Bt cotton experience can be taken to indicate that other GM crops will bring benefits to poor farmers.

- In India and South Africa, the smallholders adopting Bt varieties tend to be the richer and better-established farmers who have access to productive land and credit, and can afford the higher up-front costs of GM cotton-seed. In many countries, cotton is an important export crop which is supported by an infrastructure of input supply and marketing support. In this respect it is not a typical smallholder or subsistence crop.

- As a non-food crop, transgenic cotton has been insulated from consumer resistance to GM food crops in some export markets. The adoption of transgenic food crops for export could expose smallholders to the risk of exclusion from some markets, such as the EU (see Briefing 5).

- Cotton prices have fallen to historic lows on world markets, with agricultural subsidies and protectionism in rich countries helping to keep commodity prices down. In these circumstances, can cotton continue to be a key crop for smallholders or developing countries? Diversification could be a less risky strategy for smallholder livelihoods.

Adopting Bt cotton varieties may be beneficial for some cotton farmers in some places, provided the economic conditions are right and a supportive infrastructure is in place. It remains to be seen whether, and for how long, Bt cotton's benefits can be sustained against the emergence of pest resistance and in the face of unfavourable world markets. The extra costs of GM seed mean that the potential benefits for smallholders have to be weighed against substantial risks, especially debt. GM seeds are often marketed with an obligation that fresh seeds must be purchased each year; this undermines an important source of insurance – seed-saving and informal exchange – which in the past has served to protect poor farmers against such risks. The early evidence on Bt cotton serves as a timely reminder that GM crops can never be a 'magic bullet' against poverty and hunger.

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This paper was written by Dominic Glover (IDS). It draws on papers 2, 4, 5, 13 and 14 (see publications list). These are available at: **www.ids.ac.uk/biotech**

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