Bt cotton in India: Too cautious a development

Geeta Bharathan (*Curr. Sci.*, 2000, **79**, 1067–1075) has raised a controversy about *Bt* cotton in India, emphasizing various issues – scientific and societal that need to be addressed. *Bt* cotton controversy centres on some aspects given below:

Pest resistance in *Bt* cotton: Bharathan (*Curr. Sci.*, 2001, **80**, 322–323) feels that there is a clear need to lay down resistance management plan at the outset. The development of insect resistance to xenobiotics is not new to scientists. Fears that insects will develop resistance to *Bt* are not unfounded. In fact, we need to know more about insect resistance to *Bt*, since *Bt* is a natural insecticide of great potential. Bruce E. Tabashnik's article (*Proc. Natl. Acad. Sci. USA*, 2000, **97**, 12980–12984) is quoted by R. B. Barwale for absence of any sign of resistance development in bollworm species in *Bt* cotton. Tabashnik is also quoted by Bharathan in her reply (*Curr. Sci.*, 2001, **80**, 327) for using a model that missed the critical parameter to predict evolution of resistance. Studies carried out by Gujar *et al.*, (*Curr. Sci.*, 2000, **78**, 995–1001) and by Kranthi *et al.* (*Curr. Sci.*, 2000, **78**, 1001–1004) and reports of Wu *et al.* in China (*J. Econ. Entomol.*, 1999, **92**, 273) state that there is a need for continuing the studies on this aspect. Although there may not be any evidence for occurrence of bollworm resistance to *Cry1Ac*, it is too early to beat the drums. The tolerance levels of *H. zea* monitored from 1996 to 1998 in the eastern half of the US cotton belt and acreage of *Bt* cotton cultivation have shown positive correlation. Yet, this did not lead to control failures (Sumerford *et al.*, Proc. Beltwide Cotton Conf., Orlando, Florida, 1999, vol. 2, pp. 936–939). It is only the time factor and selection pressure that will decide development of resistance. Tabashnik states that 'Nothing will be gained and much can be lost if we pretend to know more about resistance management than we really do'. But there seems to be an exaggerated importance given to the development of resistance in insects in the overall context of development of *Bt* cotton. Even if the bollworms are to develop resistance, we should develop the resistance management programme, using our own studies on insect susceptibility to *Bt* toxins and drawing up on the experience of the developed countries, concurrent with *Bt* cotton cultivation.

There is no doubt that pest complex might change in *Bt* cotton ecosystem. Some insects not susceptible to *Bt* might become important pests over the years. In fact, as and when pest complex has changed (with the tobacco caterpillar becoming a pest in Gujarat, leaf miner in Tamil Nadu, whitefly in Maharashtra and recently in Rajasthan) even without *Bt* cotton, we have been able to manage them with available IPM tactics.

The controversy about *Cry1Ac vis-à-vis Cry1Ab* gene is unnecessary. *Cry1Ac* is the best available toxin for the control of the American bollworm *H. armigera*, according to our studies also. *Cry1Ac* is highly toxic to the pink bollworm and *Earias* spp. As we know more about *Cry* toxins, we might have many other *Cry* genes and fusion genes better than *Cry1Ac* gene in the near future that can be deployed for insect control.

Bharathan refers to the article of Wolfenbarger and Phifer (*Science*, **290**, 2088–2093) to state that key experiments on the environmental risks and benefits are lacking. Any experiment in a given agroecosystem which has its complexity will have its limitation to predict and/or evaluate potential risks of genetically engineered plants.

Bt cotton appears to yield 20 to 40% more than non-*Bt* cotton in field trials. The yield will depend upon the insect infestation levels and several other factors. Cost–benefit ratio will be the main criterion for the farmers to accept *Bt* cotton.

Concurrent with the development of *Bt* cotton, we should also study the effect of *Bt* cotton on biodiversity, baseline susceptibility monitoring and develop *Bt* resistance management strategy suited to local needs. Benefits mentioned by R. B. Barwale (*Curr. Sci.*, 2001, **80**, 326) need scientific scrutiny under Indian conditions.

Considering the global acceptance of *Bt* cotton (5.3 m ha in 2000) in countries like USA, Australia, South Africa, Argentina, Mexico and China, and indiscriminate use of conventional insecticides in cotton ecosystem, it is necessary that we accept the fact that *Bt* cotton is one of the best options for cotton farmers. Possibly, it will reduce environmental pollution by lowering the use of conventional insecticides. Let the users decide the fate of *Bt* cotton.

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Response:

Thanks to G. T. Gujar for informed input on *Bt* cotton in India. It is, indeed, heartening that cotton experts like him are willing to participate in this discussion. He makes a point in his last paragraph that reinforces concerns regarding the management of pest resistance to *Bt* cotton in the future. He suggests that, given past indiscriminate use of conventional insecticides in cotton crops, *Bt* cotton is the best option for cotton farmers. This raises several questions in turn: How did indiscriminate use of pesticides occur? Was it the consequence of decisions, whether or not based on cost–benefit analysis, made by individual farmers? Were IPM measures not sufficiently well developed? Did the farmers not have access to those measures? Was not IPM applied widely? Will the lessons from the past inform management practices in the future? It appears that in Arizona, USA, although regulatory agencies require the planting of a minimal refuge to minimize the chances of evolution of pest resistance, cotton farmers prefer not to waste this valuable land on susceptible varieties. The consequences of such decisions are not yet known. If there is a significantly enhanced risk of evolution of pest resistance that we as a society do not want to happen, then it seems to me that we cannot 'let the users decide the fate of *Bt* cotton'.

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NEWS

GSLV launched successfully*

Indian Space Research Organization (ISRO) successfully carried out the first developmental test flight of India's Geosynchronous Satellite Launch Vehicle (GSLV), on the evening of 18 April 2001 from SHAR Centre, Sriharikota, marking a major milestone in the Indian space programme.

Sriharikota Range (SHAR), about 100 km north of Chennai, is the launch station for GSLV. The SHAR complex located at 80 km north-east of Chennai (latitude: 13°N, longitude: 80°E) is ideally positioned in the east coast of India. The vehicle and spacecraft preparations, integration, checkout and launch operations are carried out in the Launch Complex facilities at SHAR.

With this launch, India has demonstrated its capability to launch communication satellites into geostationary transfer orbits with perigee (nearest to the earth) of 180 km and an apogee (farthest to the earth) of 36,000 km. This paves the way for end-to-end capability of application-spacecraft launching in the area of communication also.

The 401 tonne, 49 m tall GSLV, carrying an experimental, 1540 kg, satellite, GST-1, lifted off from Sriharikota at 3.43 PM IST. Seventeen minutes after lift-off, GSAT-1 was successfully placed in an orbit of perigee 181 km and an apogee 32,051 km with the orbital inclination of 19.2 degree with respect to the equator. The injection of the satellite into orbit occurred about 5000 km from the launch centre.

It may be recalled that the first launch attempt of GSLV was aborted one second before the lift-off on 28 March 2001 by the Automatic Launch Processing System (ALS) after it detected that one of the strap-on boosters did not develop the required thrust. After detailed analysis and in 18 days the vehicle was made ready for re-launch by replacing the faulty engine in the strap-on stage.

The successful accomplishment of GSLV-D1/GSAT-1 mission is the culmination of a decade of efforts by ISRO centres in design and development and supported by several educational, academic as well as R&D institutions in the country. Many of the GSLV hardware, including motor cases, inter-stages, heat shield, engine components and electronic modules were manufactured by about 150 public and private Indian industries. The mission heralds a significant milestone towards the establishment of indigenous capability for launching communication satellites like INSAT. Having already established indigenous capability for launching IRS class of remote sensing satellites through PSLV, the launch of GSLV makes the Indian space programme even more self-reliant, while tuning the programme towards national development. The launch of GSLV thus fulfils the vision of Vikram Sarabhai to make the Indian space programme a self-reliant one.

A view of SHAR complex.

India's GSLV.

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