Bt brinjal – ban or boon?

G. Padmanaban

The Genetic Engineering Approval Committee (GEAC) cleared *Bt* brinjal for commercialization on 14 October 2009. The activists are up in arms terming the approval as a shame. The government has chosen to go slow and states that it would consult the stakeholders before making a decision on the release. It is not clear as to how this consultation process would help, because this process has been gone through earlier. Besides, the stake holders have taken hardened positions and would not relent. The arbiters would be the farmers. They would accept it if they can make profit, as has been the case with *Bt* cotton, clandestine or otherwise. The *Bt* brinjal trials have indicated a significant gain in terms of reduced insecticide sprays and increased marketable yields of *Bt* Brinjal.

The *Bt* brinjal trials have been reviewed by two expert committees, EC-I (2006) and EC-II (2009). Gilles-Eric Seralini, a French scientist and President of the Committee of Independent Research and Information on Genetic Engineering (CRIIGEN) and commissioned by Green Peace, has contributed his bit on behalf of the activists by stating that *Bt* brinjal is potentially unsafe for human consumption. But, if one were to go through carefully the points raised by Seralini[1], it is in the nature of picking holes on the extensive environmental and food safety studies carried out by the developers of *Bt* brinjal since 2002. The comments range from describing the *Bt* gene used as an unknown chimeric toxin containing *Cry1Ac* and *Cry1Ab*, whose safety remains unsubstantiated, to the use of prohibited antibiotic resistance markers and significant alteration of blood chemistry in the experimental animals used. Every parameter assessed from gene flow in non-target organisms to duration of the animal experimentation studies has been questioned, revealing a mindset to oppose anyway. It would be instructive to go through the assessment provided by the Expert Committee (EC-II)[2], which has given a positive evaluation of the product, to each of the points raised by Seralini. First of all, the gene product is not an unknown toxin. It is 99.4% identical to that produced by *cry1Ac* gene and the 0.6% difference is due to replacement of one amino acid in the entire sequence, although amino acids 1 to 466 are derived from *cry1Ab* and 467–1178 are derived from *cry1Ac*. The antibiotic resistance markers used, *npt11* and *aad* genes, are poorly expressed in the plant and widely accepted in other countries including USA, EU, Australia, Philippines, etc. Many of the so-called adverse changes highlighted by Seralini are within normal variations seen in control animals. This is typical of biological systems and Seralini states that calculation of statistical significance is not possible, since the differences vary by 237% in a given case.

The EC-II report is exhaustive and covers every aspect of the trials carried out for the last seven years. More than 150 scientists have been involved in this trial and two dozen environmental and food safety studies have been carried out since 2002. After all, nobody, least of all scientists, would want to compromise on food safety. The government should also be guided by the fact that there is extensive international experience with the use of *Bt* genes since mid-1990s and enormous number of safety field trials and health-related safety studies have been conducted. More than 25 countries including USA, Canada, China, Brazil, European countries, Egypt and Australia, even those with reservations, have agreed to try GM technology. GM-crops were grown in 125 mha in 2008. *Bt* gene products would constitute 30–40% of the total GM-crops in the form of *Bt* cotton and *Bt* corn. There has been no report of adverse consequences in environmental or health parameters in different countries as a result of *Bt* crop cultivation. It also needs to be recognized that spraying of the organism *Bacillus thuringenesis*, a bio-pesitcide which produces the *Bt* toxins, is an age-old practice and is still prevalent. There has been a recent report entitled 'Failure to Yield' (2009) generated by Doug Gurian–Sherman[3] in a study commissioned by the Union of Concerned Scientists. The study comes to the overall conclusion that GM technology, as such, has not significantly contributed to an increase in yields. This is a large-scale analysis of the picture in the USA emerging from the use of genetic engineering as a technology in different crops with different traits. The study has elicited critical responses on several counts[4], but even so, interestingly it makes the point that *Bt* corn is the only exception, showing a 7–12% operational yield advantage compared to typical conventional practices including insecticide use, under conditions of high insect infestation. The limited point of relevance here is the positive conclusion that can be drawn for the commercialization of *Bt* brinjal, a heavily pest-infested crop. The EC-II report states that in India the brinjal crop has required 40 pesticide sprays in a season and in Bangladesh, brinjal crop was sprayed with pesticides 84 times in a span of 6–7 months! *Bt* brinjal has been developed by Mahyco (a private company) and UAS, Dharwad/TNAU, Coimbatore (Public Sector academic institutions) with other collaborators as well. Should we not recognize the toil of our own outstanding Agriculture Universities and a private partner, who is equally committed? The scientists involved in generating the EC-II report are outstanding and internationally recognized for their contributions. Why should we ever think that they will compromise on the environmental and health safety of the nation? There is no reason for the government to delay the release of *Bt* brinjal. In a couple of years one would know its success or otherwise in the field and farmers would provide the answer. A second green revolution is necessary for the country.

The government should actually use this occasion to come up with a policy framework on the commercialization of GM-crops. While there can be no bar on any aspect of GM-crop research, commercialization needs a well-deliberated policy issue. To start with *Bt* brinjal, how would the government ensure an affordable price for *Bt* seeds? What would be the mechanism for technology advice to the farmer, year after year? What next? Would it be *Bt* bhindi? *Bt* rice is on the horizon and is almost ready. China is ahead of us and will eventually go for *Bt* rice in a big way. With all the international trade and many countries going for GM technology, what is the point in trying to put irrational obstacles without a scientific basis?

Scientists should also deliberate on the consequences of creating a *Bt* world. Even if the different *Bt* genes code for different proteins, they all seem to act through the gut receptor in the insect, although binding to different sites. What would happen if the receptor protein gets mutated? Resistance to different *Bt* gene

products may result simultaneously. In a laboratory study, it has been shown that among insects selectively bred for resistance to Cry2Ab protein, some showed resistance to *Cry1Ac* also and the resistance could have involved the common step of activation through a protease[5]. Should we not go for genes acting through entirely different mechanisms for purposes of pyramiding? Monsanto may be far ahead of us in this game, but encouraging indigenous research to reach commercial potential would be the answer to this bogey of MNC monopoly. Is there a policy on the commercialization of GM-crops with herbicide degrading genes? In fact, many of the controversial issues of GM-technology are with the use of herbicide-resistant genes rather than with the use of *Bt* genes to protect against insect infestation. With a large number of women labour being involved in manually removing weeds and with the use of biocontrol agents, do we really need GM-technology for this purpose in India? It may not be a good idea to totally remove the weeds. Should not India give priority to commercialize GM-crops with improved nutrition and to protect against abiotic stresses (low rainfall, saline soil, etc.)? Would not *Bt* rice with adequate β-carotene, micronutrients and survival in low rainfall conditions be a boon to the community? These are much more challenging areas, because multiple genes will govern these parameters. Despite the availability of several genes to protect against abiotic stresses, none is anywhere near commercialization. Is it because of the fact that it is not a priority for MNCs? The issue of labelling of GM product needs discussion. If we really believe that a GM-crop is as safe as its non-GM counterpart and contributes to increased productivity in agriculture, mainly benefitting the poor, do we need to confuse the masses with labelling the product?

More than just giving permission for the commercial release of *Bt* brinjal, the government should use the occasion to put in place an institutional framework to deal with issues involved in the commercialization of GM-crops in the country. An independent National Authority is being talked about, which would take over the function of GEAC. But, we need an institution that would act as a think tank on our priorities in the area and monitor the situation in the field after GM crops are released for commercialization. It should address the issues discussed earlier. Specifically, such an autonomous institution should address issues such as: (1) Choice of GM-crops and traits relevant for commercialization in the country; (2) Registration of GM-crops for a finite period, and reassessment of their performance and the ground situation, before extending the registration for another finite period; (3) Inputs for determining the price of GM seeds sold to farmers; (4) Technical help and advice to farmers on a continual basis; (5) Positioning of *Bt*-crops with Integrated Pest Management (IPM) strategies and also handling of secondary infections, and (6) Education of the public on the pros and cons of the use of GM technology in agriculture.

Regarding the continual assessment of GM-crops in the field, it would be instructive to learn as to how the Environmental Protection Agency (EPA) in the USA undertakes such an exercise. For example, EPA undertook an exercise in 2001 to assess the performance of GM-crops in the preceding five years[6]. Inputs were obtained in terms of human health assessment, insect resistance management, environment assessment in terms of gene flow, etc. Additionally, it performs a watchdog function on even laboratory findings, which may have an implication for the field situation. There is a recent report entitled '*Bt* cotton in India – A status report' generated by the Asia-Pacific Consortium on Agricultural Biotechnology (APCOAB)[7]. The status report examines all the publications on the performance of *Bt* cotton in India and endorses the significant increase in yield and revenue to the farmer and provides statistics for the phenomenal acceptance and adoption of this GM crop in the country. It also discusses the concerns and strategies to sustain GM-crop cultivation in future.

However, one needs a statutory body with regulatory authority and R&D capabilities to govern all aspects of GM crop cultivation in the country, once they are released for commercialization. The government can decide on the design of the institutional structure, but it would take considerable effort to put an autonomous institution in place, not just with authority, but with expertise to analyse data from the field and to generate data in the laboratory.

The institution suggested should play a major role in providing authentic and correct information to the public on GM-technology. Many unsubstantiated reports ranging from failure of germination of *Bt* seeds to death of goats eating *Bt* crop residues are engineered to appear in the press. Several months ago, I was appalled to read a report that activists had approached the Supreme Court to stop scientists from introducing genes to bring about male sterility in plants, a combiner required for plant breeding, stating that it is terminator technology! Ingo Potrykus, the discoverer of golden rice to improve β-carotene (vitamin A source) content was criticized either way, first projecting that children could be poisoned by excess vitamin A and later stating that 4 kg of rice is the daily requirement for a therapeutic effect! This story of the loss of biodiversity due to introduction of a couple of foreign genes is overstated. Can anyone define, what is a pure line of rice or brinjal at the gene level? Do we know how many genes they have acquired during evolution? Ever since man started practising agriculture, there has been such a large-scale transfer of genes, horizontal and vertical, I wonder as to how introducing a couple of genes can change biodiversity. How did the 2000 varieties of brinjal evolve? In addition, at present the *Bt* gene has been introgressed into at least 40 varieties of cotton, and I am sure this will happen to *Bt* brinjal as well. Seven *Bt* brinjal varieties have already been field tested.

Finally, GM technology is not a panacea for all our problems with agriculture and farmers. It is one of the powerful tools available that needs to be used wisely. But, we should not throw the baby with the bath water.

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G. Padmanaban is in the Department of Biochemistry, Indian Institute of Science, Bangalore 560 012, India
e-mail: geepee@biochem.iisc.ernet.in