

Bt Brinjal

# Scientists Speak Out



Recent approval of Genetic Engineering Approval Committee (GEAC) of the Ministry of Environment and Forests, Government of India for commercial cultivation of Bt Brinjal led to an expression of a variety of opinions in the popular media.

Biotech News asked some of India's most respected scientific personalities to comment on the issue of Bt Brinjal and the controversy that has been created around the same.

While we were going to press, Ministry of Environment & Forests announced a indefinite moratorium on commercial cultivation of Bt Brinjal in India, pending further testing.

For the record, these views were elicited before the moratorium was announced.



### V.L. Chopra

Former Member (Science) Planning Commission and former DG, Indian Council of Agricultural Research

For introduction of a relevant and important trait, Bt is among the most extensively researched and best understood genes. Release of appropriately labelled and effectively regulated Bt brinjal will economize on production cost, reduce post-production wastage, eliminate hazards from residues of noxious chemical pesticides and give a choice option for a quality product. It will surely find a welcome place on my food plate.



### G. Padmanaban

Emeritus Professor and former Director, Indian Institute of Science, Bangalore

There is no reason to delay the release of Bt-Brinjal that has gone through extensive trials. There is evidence for decreased pesticide use and increased marketable yields. Bt genes are safe and have been tested internationally with different crops for over 15 years. For a detailed analysis, refer to Current Science vol. 97, p 1715 (2009)



### Raj Paroda

Chairman, Trust for Advancement of Agricultural Sciences and former DG, Indian Council of Agricultural Research

India needs to enhance its agricultural productivity and bring succour to the farmers and numerous others who are largely dependent on agriculture. Biotechnology is certainly a powerful tool to help produce more per unit of land. The genetically modified (GM) crops are not a new phenomenon. In fact, most of the improved varieties and hybrids bred through plant breeding methods are also genetically modified. Even in nature, cross breeding occurs in most of the crop plants leading to genetic variation/modification as a process of natural evolution. Hence, on the basis of scientific reasoning any undue apprehensions about GM crops are indeed unfounded. Environmental or health safety become a concern only when genes are transferred from unrelated genera or from species across plant kingdom such as micro-organisms or animal/fish species. Hence, any useful product, once tested rigorously and found safe, should be acceptable provided it helps the resource farmers by cutting costs and delivering higher productivity.

After development and commercialization of first Bt cotton hybrids in 2002, we now have Bt brinjal which is also based on the well tested and widely used cry1Ac gene (that also imparts bollworm resistance to Bt cotton).

Biosafety testing and approval system laid down by GEAC is one of the most stringent and elaborate. Tests on Bt Brinjal have been carried out at reputed public and private sector institutions and have been reviewed by two Expert Committees constituted to review the studies, evaluate comments received from various stakeholders regarding biosafety, evaluate adequacy of protocols, recommend additional safeguards and make any other recommendations on related aspects. The fear that Bt will pose a threat to indigenous diversity of brinjal and its relatives is rather unfounded. Local brinjal varieties and their wild relatives have been co-existing and evolving in nature on account of their being cross pollinated under diverse ecologies and environments for thousands of years. There is no conceivable reason to suggest that Bt gene will change this equilibrium. In fact, far greater threats to our flora and fauna is anthropogenic habitat degradation.

Biotechnology has a greater relevance to the needs of agriculture in developing countries like India. High yield; drought, flooding and salinity resistance; and nutritional improvement are some of the traits which are required to be incorporated in crop plants using diverse biotechnological tools. The need is to facilitate adoption and implementation of new technologies as part of a larger strategy to improve agricultural productivity and profitability in a systematic, focused and mission mode approach.



### Manju Sharma

President & Executive Director, Institute of Advanced Research, Gandhi Nagar, Gujarat and former Secretary, DBT

The great advantage of Bt brinjal would be the reduction in the use of insecticides. The field trials have also demonstrated a significant increase in productivity. Once a crop is fully tested scientifically and it has economic importance specially for the farming community, we should be harnessing the advantage of the technology for the benefit of farmers. Transgenic crops with novel traits for example, reduced consumption of insecticides and increased productivity as also higher nutritional value would be essential to meet our food and nutrition requirements in future.



### Kiran Mazumdar-Shaw

CMD, The Biocon Group

The ultimate aim of any GM crop, including Bt brinjal, is to increase productivity, reduce the use of pesticides and make food genetically healthier. This approach is environmentally friendly and ecologically sustainable. Since fewer pesticides are used, not only is there less pollution, but the carcinogenic effects of pesticide-sprayed foods are also mitigated. As far as the economic sustainability of Bt brinjal is concerned, I believe that it will need to compete with non-GM brinjal in the market. Farmers will cultivate it only if it brings them profits. If not, they will go back to non-GM brinjal.



### R.P. Sharma

Former Project Director & INSA Senior Scientist, National Research Centre on Plant Biotechnology Indian Agricultural Research Institute, New Delhi

Bt-brinjal is the product of scientific innovation which helps in achieving the production potential of the crop and the product derived therefrom is safe for the environment and human and animal health, as testified by the Regulatory Authority of Govt. of India. Bt-brinjal is inherently resistant to the devastating fruit and shoot borer and therefore, I would prefer and opt for its inclusion in human food chain as compared to pesticide-loaded brinjal currently available in the market.



### K.P. Gopinathan

Dept. of Microbiology & Cell Biology, Indian Institute of Science, Bangalore

The recent development of "Bt Brinjal" for mass scale cultivation may be considered as an agricultural revolution with respect to that crop, economically helping the farmer and hygienically benefitting the consumer by avoiding the inadvertent intake of pesticides. The Bt gene encoded product has been established to be nontoxic to human, cattle, sheep, goat etc. The practice of transferring several desired genetic traits from other species to the crop plants has been routinely practiced right from the beginning of organized agriculture. The Bt gene transgenic technology essentially involves the introduction of a single beneficial gene to the crop plant and therefore, warrants no apprehension. None the less, it is desirable to examine the expression levels of the Bt gene product in the edible portions of the fruit (since the introduced gene is under the control of a promoter that is ubiquitously expressed in all the tissues). Further, the antibiotic resistance markers (Kanamycin/Hygromycin) used as selection markers for generating the transgenic plant is of some concern. In the next generation of the transgenic crop, however, if attempts are made to eliminate the antibiotic resistance gene and confine the expression of the Bt gene to the non-edible portions of the transgenic plants, that will prove to be a greater boon.



### K.V Peter

Former Vice Chancellor, Kerala Agricultural University

India is lagging far behind China in technology adoption. Let us not prevent our farmers from accessing newer technologies including GM. Differing views reflect maturity of our democratic system but remember 280 million Indians go to bed without a meal and 650 million are anaemic. Cost of vegetables is shooting up making life miserable to *Aam Aadmi*. The GEAC cleared Bt brinjal for commercialization on 14th October, 2009 after being reviewed by two expert committees in 2006 and 2009. These committees consisted of eminent Indian scientists who are as patriotic as anyone else. The buck should stop somewhere for the *kisan* to produce more and the consumer to get insecticide residue-free clean brinjal at affordable price.



### Seyed Hasnaian

Vice Chancellor, University of Hyderabad

Clearly Bt Brinjal, based on extensive trials conducted at multiple locations both by Government as well as seed companies, has reported much less requirement of insecticide coupled with doubling of average marketable yield. This would translate into a substantive gain to Brinjal farmers.

While all this is very good, going strictly by newspaper reports there appears to be a lack of involvement of the stake holders during the trial. In states such as Bihar, which has a substantive brinjal cultivation, the farmers are resisting or are apparently not willing to adopt the Bt Brinjal on account of certain apprehensions, all of which could have been easily alleviated had the farming community been involved during the Bt Brinjal evaluation process.

Learning from this experience, I firmly believe that to fully exploit the potentials of biotechnology in agriculture we must involve the farming community, particularly those who would be directly impacted, from the very early stages of development.

The discoveries made in the laboratory must be translated and in this process the end user must become a stake holder.



### Akhilesh Tyagi

Director, National Institute for Plant Genome Research, New Delhi

A transgenic brinjal expressing cry gene, leading to significant reduction in the use of pesticides in fields, effective control of pests, substantial protection of yield loss and shown to be safe for consumption and the environment, deserves to reach farmers at the earliest.



### Soumitra Sen

Professor, Advanced Lab for Plant Genetic Engineering, Indian Institute of Technology, Kharagpur

I briefly analyze some of the misconceptions that dominate the debate concerning GM foods in general.

First, there is an erroneous belief that GM crops confer a benefit only to the producer, not to the consumer. The farming communities are themselves a significant part of the rural consumer base, and there is not enough attention paid to how their productivity and their living standards will be enhanced by these techniques. Indeed, even the urban consumer stands to benefit from these techniques by way of lower prices, a greater shelf life of the foodstuffs, as well as the possibility of consuming organically grown food.

Second, the people who normally frame the public discussion are usually lay urbanites, and they rarely have a full understanding of the issues involved, leading to exaggerations and distortions. There are misconceptions about the inefficacy of transgenic techniques, the purported imprecision of the r-DNA technology and the absence of adequate oversight of agricultural biotechnology. There is the belief that GM foods are “unnatural”, that GM crops would erode natural biodiversity and harm the environment and that yield-enhancing GM crops actually produce no more than the nonGM crops.

I find it unfortunate that scientists involved in the risk assessment of transgenic insecticidal plants on non-target organisms use inappropriate methods and display a lack of ecological context in presenting their claims. In fact the new biotech is actually part of a continuum of breeding technologies, much of which is already in use and non controversial. Many of the purportedly grave risks, such as the the introduction of allergens or toxins into the food supply, are in fact no different than they would be in the classical breeding methods already in place.

I conclude by saying that the GM technology is one of the most potent tools in fulfilling the goals of sustainable agriculture and in organic farming of food crops. Once the acute necessity and benefits of biotechnology and in particular genetic engineering for the long-term benefits of Indian agriculture is understood, the public's fears will be significantly reduced. As a scientist dealing with such issues, I fervently hope a public consensus about the topic will emerge based entirely on scientific facts and reasons, and not swayed by ill-informed fears.



## A. S. Kolaskar

Former Vice Chancellor, University of Pune and Former Advisor, National Knowledge Commission.

Indian agriculture productivity per hectare is one of the lowest, which makes our farmers poorest in the world. There is therefore a need to use modern technology in agriculture. These technologies should be such that their utilization must increase the productivity but with least damage to the environment and soil as well at a least input cost. Biotechnology has the potential to improve agricultural productivity providing all the benefits mentioned above. One of the reason in semi arid region to decrease the productivity is the infestation of different insect pests.

Doubts have been raised that the Bt Brinjal are not safe for human consumption, mainly because the Cry1Ab gene will produce a protein and if that protein can kill BSFB then it will be harmful to human also. However comparison of Cry1Ab of Bt with all human genes and proteins show very little similarity indicating clearly that there are no corresponding receptors in human for this protein. Secondly this protein is also not heat stable and therefore when we eat cooked brinjal, it will not be in the same 3D confirmation and thus the doubts raised are not scientifically correct. There is no other change in the Bt Brinjal and the brinjal of good quality that we get in the market today.

I therefore suggest that without waiting for the approval of other developed countries, we should believe on our scientific data and its analysis and become at least in this area the first country to commercialize the production of Bt Brinjal and help the farmers.



## Vibha Dhawan

Executive Director,  
The Energy &  
Resources Institute,  
New Delhi

*Bacillus thuringiensis* has been frequently used as a biological control measure to control insect pest by farmers and no negative effect has been reported so far. Bt protein gets solubilised at high pH of 9.5 and above in the insect gut and generates toxic elements causing a disruption of the digestion resulting in leakage of mid gut content thus resulting in the death of larvae. Since Bt protein acts as mid gut toxin, it practically has no impact on most other insects and human where the gut system is acidic. The farming and the scientific community is looking forward to the commercial release of Bt Brinjal and to the success of the first transgenic food crop in the country.



## K.K. Narayanan

Managing Director,  
Metahelix Life  
Sciences Private  
Limited, Bangalore

Vegetable cultivation in our country is beset with several problems, a major one being the losses due to insect pests. Brinjal is one of our major vegetable crops and its production is seriously affected by the Fruit and Shoot Borer (FSB), a pest which can be effectively and safely tackled using the Bt brinjal technology which increases the production of marketable fruits while significantly saving on pesticide use. Thus, it brings not only tangible economic benefits to the cultivator, but also benefits to the consumers in the form of pesticide-free vegetable and to the environment in the form of lower pesticide loads. I therefore do not understand why should anyone, least of all the environmental activist, have an issue with this technology?



## Kailash Bansal

Professor &  
Principal Scientist,  
National Research  
Centre on Plant  
Biotechnology,  
Indian Agricultural  
Research Institute, New Delhi

Clean environment and healthy food are prerequisites for a healthy life. In my opinion, any technology that nurtures life needs to be promoted. Bt brinjal is a product of modern biotechnology that has the potential to enhance the income of farmers by reducing the use of pesticides and increasing the quantity of marketable produce. In addition, the cultivation of Bt brinjal, as witnessed with Bt cotton in our country, may help increase the population of friendly insects and support integrated pest management (IPM). It is surely one of the best ways towards sustainable agriculture and green way of life.



### H.K. Jain

Former Director, Indian Agricultural Research Institute and Deputy Director General, International Service for National Agricultural Research

I think what we need is a National Policy on genetically modified crops and organisms. Brinjal will be only one of them. We can look forward to a future when many other GM varieties of a diverse range of cultivated plants will be produced by the scientists. The second generation genetically modified crop varieties may be carrying genes for such traits as abiotic stress and for yield itself. What we need most at this stage is a regulatory framework of testing for bio-safety which will be transparent and inspire confidence of the general public. Once we have this, it will become easier to take decisions. I don't believe that India can isolate itself from other major countries like China, U.S.A., Australia, Argentina and Mexico, where GM crops are now widely grown.



### M. Mahadevappa

Former Chairman, Agricultural Services Recruitment Board and former Vice Chancellor, University of Agricultural Sciences, Dharwad and Director, JSS Rural Development Foundation, Mysore.

Lack of awareness (and misinformation) about Bt brinjal seems to have created some strong opponents. This is not scientifically acceptable.

The safety of a scientific product cannot be assessed on the basis of public votes or signature campaigns. The final authority should rest with government assisted by a competent scientific panel comprising of practicing scientists who work in public interest.



### P. Balasubramanian

Professor, Department of Plant Molecular Biology and Biotechnology, Tamil Nadu Agricultural University, Coimbatore

Considering the quantum of pesticide residues on the brinjal fruits available at the subzi mundies, this country must switch to

Bt brinjal which sure is going to be more organic in terms of reduced pesticide levels.

The Bt brinjal variety seeds would be a boon to brinjal farmers who are mostly small and marginal. They could save the seeds for next sowings still retaining the insecticidal property of their future brinjal crops against the target pest, the fruit and shoot borer. This enables them practically not to spend, for ever, to protect their future brinjal crops from the fruit and shoot borer.



### Malathi Lakshmikumar

Lakshmikumar & Sridharan, Advocates

Bt Brinjal has undergone several environmental and toxicity assessment studies which clearly show that it is biosafe and can be consumed without any harm to humans. It is, in fact, much safer than conventional Brinjal, due to lower usage of insecticides, which are harmful to environment and humans, during its cultivation.

I regard Bt Brinjal as a boon to farmers as well as consumers.



### P.N. Tandon

Scientist Emeritus, National Brain Research Centre, Manesar, Haryana.

Bt Brinjal should be permitted as to the best of my knowledge there is no scientific evidence that indicates that it has any adverse health effects for humans. A large number of genetically produced edible crops are already in use globally which have not revealed any adverse effects. A report produced by seven international academies including Indian National Science Academy expressed no contra indication to their use.



### Swapan Kumar Datta

Deputy Director General, Indian Council of Agricultural Research

BT Brinjal, with built-in plant protection against Fruit and Shoot Borer, has demonstrated the performance of modern molecular breeding against insect pests. However, some people would still like to see agriculture practices in the context of the nostalgic past while ignoring the economic benefits to and livelihood enhancement of farmers.

BT Brinjal is scientifically safe, allows environmental friendly agricultural practices due to reduced pesticide load and can eventually help in combining organic farming with fortified micronutrients for higher crop productivity and income for the farmers predominantly with small and medium land holdings. There is no better way that integrates technology with growers and consumers within an economically viable manner.



### J Nagaraju

Centre for DNA Fingerprinting & Diagnostics, Hyderabad

Every modern development, whether it is automobile or antibiotic or nuclear power has its own potential risks and benefits. Man in his quest for better quality life has been exercising prudence to choose the one where benefit outweighs risks. In the case of Bt Brinjal benefits are shown to outweigh the unknown risks such as effect on non-target organisms, mutations in the gut receptors that render the pest insect resistant to Bt toxins, allergenicity of Cry proteins in humans etc. These 'risks', in my opinion, are blown out of proportion by the doubting Thomases who appear to have ambiguous notions that the food safety

and environmental issues are compromised by scientists, regulators and administrators. I do not mean that the scientists should be allowed to blow their trumpets without close scrutiny by stake holders and tax payers of the country. At the same time, well-structured expert-elicited opinions should not be sidelined by ill-founded popular opinion. This will prevent the flow of scientific benefits to the society at large. Scientific literature is replete with examples of gene transfer from bacteria/virus/pathogens to their hosts (including humans) and vice versa. Such 'transferred' heterologous genes have remained integral part of the genome and are quite often subjected to Darwinian selection. What about the crop improvement program being pursued by man from the time he embarked upon intensive agriculture? Many genes have been incorporated for specific traits through classical breeding protocols to the present day 'elite' varieties which have occupied the major part of the cultivated area driving many land races/traditional varieties to the confines of germplasm. Then why transgenics with a couple of heterologous genes are held in such a suspicion of "unproven" hazards!

Of course, once introduced to the cultivation scene, Bt Brinjal should be monitored closely for transgene stability, transgene expression, seed purity etc. so that farmers are not taken for a ride. Otherwise, in my opinion, caught in the cobweb of ill-defined debates, we continue to deprive millions of people in this part of the world of the application of fruits of science. Bt Brinjal, for that matter all GMO's, remain guilty until proven innocent!



### C Kameswara Rao

Foundation for Biotechnology Awareness and Education, Bangalore

The USDA had issued a missive last year that the brinjal imported from Nigeria and Israel into the US should be completely free from both *Leucinodes orbonalis* (monophagous) and *Helicoverpa armigera* (the polyphagous cotton bollworm). In India, the damage caused by the bollworm to brinjal is not well recognized. The Cry 1Ac protein in Bt brinjal controls both the pests, when no brinjal variety is resistant to them.

The chances of gene flow among the species of *Solanum* and / or varieties of brinjal are insignificant and the Bt technology does not influence this either way. If brinjal varieties bred freely among themselves or with other species of *Solanum*, we would not have had such a diversity of brinjal varieties anywhere in the world. Farmers have for centuries grown different varieties of brinjal in neighboring fields without ever complaining about dilution of the qualities of their chosen varieties. A report from China (Kong-Ming Wu et al., Science, Sept. 2008) indicates that a Bt crop also reduces pests among other nearby non-Bt crops.

The transgenic Bt technology should be regarded as an important component of Integrated Pest Management and not projected as a silver bullet solution for all the pests of any crop. The Bt genes are not related to yield increase. The increase in marketable yield of Bt crops is incidental to preventing the loss from the pest damage, which is substantial.

Ministry of Environment and Forests (MoEF) should respect the collective global scientific wisdom based on over 25 years of research experience and over 13 years of experience in commercial cultivation in over 25 countries (and their regulatory regime) that demonstrated that Bt crops are functional and safe for use. The MoEF should trust our own scientific community and the rigorously implemented biosecurity regulatory regime which involves in the process about 200 scientists and experts and over a dozen public and private sector research organizations, as Shri Prithviraj Chavan does so refreshingly in the interview and release Bt brinjal for commercialization without further delay, to greatly reduce the current heavy losses of marketable yield caused by the two important pests, in the interests of both the farmer and the consumer.