

# Transgenics in Indian Agriculture: Experiences so far and implications of KIA proposals on Indian Farmers

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Post Green Revolution, transgenic crops (or Genetically Modified crops) have become the key driving force for the modern agriculture. Since ages humans are manipulating nature to suit their needs and agriculture has developed in the process. But the current situation is unprecedented and unique because never before have the tools been available to redesign nature at such a large scale and with the speed that the new agricultural biotechnologies permit. The new technologies allow rapid movement of diverse genetic materials across previously insurmountable biological, chemical and physical barriers to create microorganisms, plants and animals in a manner desired and designed by humans and their organizations. In essence, genetic material can now be exchanged among virtually all living organisms. This makes all of the world's genetic diversity into raw material to be used in research and development. Expanding claims to intellectual property rights for genetic resources are privatizing what was once public.

The entry of Mahyco-Monsanto's Bt cotton marked the beginning of Genetically Modified crops in Indian Agriculture. The During mid 90s when the cotton growers were in serious crisis due pest outbreaks and problems associated with high pesticide use Bt cotton was brought in as a magic solution. During the field trials itself, the future of GM crops in India was set – legal violations and unscientific studies shrouded in secrecy became the norm since then. The Indian National Agriculture Research System which is the largest of its kind in the world and played the key role in green revolution became a second fiddle to the private seed industry.

On one hand there is much hype in public and private research institutions that the ultimate weapon to solve all the problems faced by agriculture has arrived with genetic engineering. On the other hand, there are serious concerns expressed by farmers, activists and consumer organizations about the safety of the genetically modified foods. Are such concerns simply emotionally driven or they under girded by bonafide issues of scientific uncertainty, health risks and ecological dangers? Is Genetic Engineering a dream come true or a nightmare, which may become a ghastly reality?

## I. Transgenics - Reductionistic and imprecise science

The 'cut and paste' GM science as an agricultural technology is an imprecise and imperfect technology which offers no real solutions to real-life agricultural problems facing Indian farmers. The technology is fraught with many environmental, social and political problems.

Transgenics are supposed to be developed by precisely identifying the individual gene that governs a desired trait, extracting, copying and inserting the copy into another organism. That organism and its offspring (called transgenic) will then have the desired trait.

The actual transfer of genes into the plant is not a very precise operation. Any one of a variety of methods can be used: the genetically-engineered DNA can be injected into the nucleus of a cotton cell with a tiny needle, or plant cells can be soaked in the DNA and electrically shocked, or the DNA can be attached to small metal particles and shot into the cells with a gun, or viruses and bacteria can be engineered to infect cells with the DNA. In all cases, the genetically engineered DNA has to find its way to the nucleus, and become incorporated into the plant chromosomes. The number of copies of the inserted genes and their locations on the plant chromosomes are unpredictable, and how well the new genes will function hangs in the balance. The Gene position within the genome is crucial to the strict regulatory controls it is subjected to.

Genes inserted at random into the genome are outside of these regulatory controls - they are unregulated

a. Genetic Determinism: The development of transgenic crops is based on a highly reductionistic genetic deterministic philosophy which believes that all the characters in an organism are determined by genes, these genes can be identified, isolated, extracted and inserted into any other organism and yet gets the same expression. This view completely ignores the role played by the environment (both internal and external to the organism) in expression of characters. It is similar to the traditional religious and racial philosophy which believed that the characters of human beings are determined by the caste, religion or race in which the person is born. This genetic determinism philosophy is widely disproved by many of the modern biologists and social scientists. The birth/genes only determine the presence of the characters the expression of which depends on the environment.

Moreover, there are enough of scientific evidences which disprove the assumptions of the GM science. The human genome and rice genome projects have clearly shown that the link between genes and characters is more complex.

b. The performance

Till now many plant varieties/hybrids are released for commercial cultivation across the world, but only two characters are popular in the market. The herbicide resistance varieties occupy about 78 % of the total area under GE crops and rest is with insect resistant Bt transgenics.

Globally the experience with these transgenics is varied. This is mainly because all genetic based technologies depend on the environment for their expression. In countries like India where the variation in land fertility, climate, socio-economic status of the farmer varies a lot, the expression of the genes would vary. This is clearly experienced with the Bt cotton which has been permitted for commercial cultivation since 2002-03. The first three Mahyco Bt cotton hybrids (MECH-12, MECH162 and MECH 184) which were commercialized for three years failed miserably in delivering the promises. Various studies show that the pesticide costs have not come down as promised and the farmers suffered losses in many cases. But the hype created by the companies still continues. Based on the performance reports from Andhra Pradesh state govt, the three Mahyco Hybrids are withdrawn from commercial cultivation in the state after three years while some are still permitted in other states. Even the newer hybrids permitted are performing variedly.

c. Lessons from Bt Cotton fiasco in India

The experience with Bt Cotton in the past three years has shown extremely uneven performance across different states, across different districts within each state, across varieties and also across the past three years. Bt Cotton, as per AP government's official data, has failed in the first year. In the third year also, compensation has been ordered for loss-incurring farmers. A variety of agronomic and other problems have been witnessed with Bt Cotton including increased outbreak of pests and diseases, compared to other non-Bt hybrids. Their ability to withstand stress has also been found to be relatively low. There are informal reports from farmers that in those cases where Bt Cotton has been grown in all the past three years, bollworm incidence is noted to be increasing indicating resistance build-up. The scientific reports from ICAR confirm that there has been a shift in pest complex and now sucking pests are becoming a major problem not only in cotton but in other crops as well.

Any variety or technology that is not stable or uniform is a failure and Bt Cotton has therefore failed in India.

#### d. Field reports ignored

Since the release of Bt cotton farmers and activists have brought out several health and environment concerns to the notice of the researchers and regulatory bodies which were conveniently ignored. The farmers and agriculture workers have reported skin allergies while working in the Bt cotton fields in Andhra Pradesh and Madhya Pradesh. The farmers from all the regions reported reduction in yield of any subsequent crop after Bt cotton. Even the call centre of Acharya NG Ranga agriculture University, Hyderabad has registered several such enquiries. The scientists never paid any interest to such complaints.

There were reports of sheep mortality after feeding on bt cotton from Warangal dist. of Andhra Pradesh at the end of the crop season during 2005 and 2006. The fact finding team investigations by CSA and ANTHRA have shown mortality of sheep to the extent of 20 %. All the suspicions point out to bt cotton as the culprit. The local veterinary hospital has mentioned it in their case histories and ruled out any infection or pesticide poisoning. There was a statement in the parliament by the state minister for agriculture admitting that there were sheep deaths after feeding on bt cotton based on the reports received from AP govt. The industry, agricultural department and scientists have ruled it out as yet another 'activist propaganda' while the investigations of the Veterinary Biological Research Institute, Hyderabad points out to the high nitrate content in the bt cotton leaves. The agriculture university scientists ignored their own reports.

## II. Regulatory failures all along

### a. The regulations

In India GM crops are mainly regulated by

- n The Environment Protection Act's 1989 Rules lay down the procedures, conditions, institutions etc., that will govern the use, production, export, import, distribution & so on of GMOs
- n Genetic Engineering Approval Committee under the MoEF is the main authority
- n Dept. of Biotechnology under Ministry of Science & Technology is the one promoting the technology – its research and application – the Supreme Court has just now ordered that it stop giving permissions for trials

### b. The biosafety concerns

All the failures that one has witnessed in the regulation of Bt Crop, right from the time Monsanto imported its gene into India in 1995 inform us about the disaster that GE would mean for our environment and for the livelihoods of our farmers. There have been legal violations and regulatory failures again and again in this case. Not only have decisions been based on unscientific evidences and data, but also on falsified data. While the cases filed on these trials are still pending in the Supreme Court and Andhra Pradesh High Court, the three Bt cotton hybrids were permitted and withdrawn after large scale failure.

The main concerns are

- n Living organisms capable of unpredictable results and impacts – irreversible process
- n Agriculture is the basis of livelihood for millions – life and death question
- n Concern about becoming a 'testing/dumping ground' – double standards
- n Biodiversity hotspots/Centres of Origin
- n Trade implications-loss of markets: the rice exporters association has already filed a writ petition in the Supreme Court on the Bt rice field trials.

#### n Food consumption patterns and safety

The investigations of the independent 'Monitoring and Evaluation Committee' during 2005-06 have brought again the failures in regulation of field trials of Bt-II cotton and Bt Rice, Bt Brinjal and Bt Okra. These GM food crops are tested in the farmers' fields without full information to the farmers. While GEAC and industry agreed to take the precautions 'here after', similar lapses were observed during the field trials of Bt rice and Bt okra during 2006-07.

The report of the Independent Panel of Scientists looking into the Biosafety data submitted by the Mahyco have clearly pointed out several shortcomings, lapses and problems from the companies own data and several independent reports and research papers.

This shows that our biosafety regime inadequate and the research protocols are questionable. The risk assessment parameters are very narrowly defined and do not include socio-economic assessment. These research and field trials do not detect "early warnings" – only tests are to satisfy regulatory requirements.

There has in fact not been adequate scientific monitoring of the crop during its commercial cultivation as well and many problems that should have been assessed during the field trials stage are emerging more and more. The reports of the agriculture universities and ICAR are not shared with public. There is no healthy discussion on the issues of performance or the biosafety. Several scientists who tried to raise the issues were either silenced or pushed out of their positions in last few years. Though CICR research paper clearly shows that the bt cotton hybrids are not performing up to the expectations, when serious concerns were expressed, CICR tried to divert the issue saying it's a routine paper and Bt has a potential.

In this whole episode, accountability mechanisms were not put into place and therefore, to this day, no agency or organisation has been made answerable for the proliferation of unapproved GM varieties or for the losses that Bt cotton growers have incurred.

There is a media hype that the company has created with results that its commissioned surveys have 'revealed'. There is a general non-transparent way of functioning that the government itself is adopting. There is no independent assessment happening and no recognition to data produced by other agencies.

On top of this are questions related to broad-based assessment of the GM crop in all its implications. The sampling being used by the monitoring systems is questionable as well as the times at which such monitoring is being done.

Any strategy development, without taking these lessons on board, would be meaningless. Now government is proposing a new single window system. If a failure of regulation can happen in a set up which (on paper) has multi-tiered processes and institutions, it would be a disaster to further simplify the institutional mechanisms and approaches in order to benefit the industry and to blindly promote biotechnology in agriculture.

#### d. The new biotechnology policy

Genetically Modified Organisms used in agriculture are living beings that grow and reproduce. They cannot be contained. Once released, they cannot be recalled. There are numerous examples to show that GM crops are unpredictable and can have potentially dangerous effects on the environment and to animal and human health. But there is no mention of such aspects to the technology in the policy document.

Talking about Agri-biotechnology in the context of Nutrition and Diet (GM Golden Rice for example) is also a fragmented approach to the problem, short of an understanding of a socio-political context in which nutrition and diet problems occur.

A quick look at the scene of genetically engineered crops in the world today gives us the true picture. 71% of GE seeds planted worldwide in 2002 were designed to be herbicide resistant. In 2001, 91% of the GE hectares worldwide were planted with the seeds of just one multinational company. As is known, the company's strategy includes selling GE seeds intended to be used with its herbicide. Given this situation, it is absurd to believe that investments into biotechnology in India will move into other directions in the future.

To believe that at least the public sector will take up more altruistic themes in their research and promotion of GM crops is also ungrounded in reality since all of biotechnology is also involved in a quagmire related to IPRs.

There is also no evidence from the GM traits' experimentation and crops in the pipeline for approval in India that even the public sector knows why it is prioritizing certain traits, based on what? For instance, there are some public sector bodies in this country that are experimenting on herbicide tolerant rice and herbicide tolerant mustard.

In addition, the overall research outlays for public sector are shrinking while private sector investments are growing rapidly. This means a constant competition between known technologies and "rapidly emerging" technologies and it is not clear how investments can be apportioned between these, on what basis. Realizing this, the policy paper in question comes up with disastrous recommendations in the form of "enabling work conditions for scientists to take up industry-oriented research" and so on.

### III. Farmers' choices

'The choice to farmers' is one of the major planks used to promote the GM crops. It is often said that farmers can decide. But in reality having such choice is very limited. They are influenced by the aggressive marketing tactics of the company. Lots of mis-propaganda is in air with respect to performance and promises.

The failure of regulation can also be clearly seen from the fact that illegal bt cotton is spreading as much as the regular approved bt cotton hybrids.

The choices are also limited as more and more companies are moving towards these GM technologies. For example, this cropping season in districts like Warangal and Karimnagar estimates put bt cotton up to 60 to 70 % of the cultivated area (approved and illegal put together). Here raises the issue of coexistence. The genetic contamination happening at farm level, marketing and processing is already raising serious problems across the world.

Many of the promises being made by the companies as well as sellers of illegal varieties do not get covered by the existing legislations which ostensibly exist to protect farmers' interests. The failure of Bt Cotton in Andhra Pradesh, if there is political will, could have been brought under the purview of the PVPFR Act or the MoU system. However, governments were not willing to do so instead advised farmers to move to consumer court. There are a variety of propaganda and marketing mechanisms being used by the companies which cannot be easily controlled by the government.

On the other hand, there are issues related to bio-safety too. Refuge criteria laid down during the approval are being violated openly given the practical constraints that Indian farmers face.

More worrisome issue specially Indian context is that the public is going towards GE research in a big way. This further curtails the choices of the farmers as majority of the farmers depend on the public bred varieties and hybrids at least in food crops.

#### IV. Intellectual Property Rights

Intellectual Property Rights and Genetic Engineering goes hand in hand. One of the main reasons for aggressive pushing of the GM technologies by private industry is the exclusive monopoly control over technology. There are patents over genes, methods of transfer, promoters, markers etc. Even if the public sector in India develops few varieties using GM technology, the farmers end up paying huge royalties. The bt cotton hybrids sold in market today carry a trait fee (royalty ?) of Rs. 1250/- per packet of 450 g (while the cost of the seed is Rs. 1818/ packet of 450 g) which amounts to more than 68 %. This is with just one character being introduced. If more than one character or more than one gene are introduced one can imagine the costs involved.

The IPRs also brings in issues like infringing onto farmers' rights. There are already several cases pending on farmers across the world for 'using' the seed without paying royalties. The famous Percy Schmeiser case is already well known.

IPRs coupled with Terminator like Genetic Use Restriction Technologies (GURT) will really make the farmers completely dependent on these multinational companies.

##### a. AP Governments case in MRTP-a case of crocodile tears

The trait fee is part of the agreement the seed companies make with Mahyco Monsanto Biotech (MMB). The terms and conditions of this agreement include one time payment of Rs. 50 lakhs plus an annually prefixed amount (Rs. 1250 in 2005 and Rs. 880 during 2006) on each packet sold. This left the local companies who suddenly jumped into Bt bandwagon with no option but to share two thirds of the income with the MMB (of the Rs. 1800 price per packet MMB gets Rs. 1250 and seed company gets Rs. 550). Realizing this AP Government has filed a case with Monopoly and Restrictive Trade Practices commission alleging that Monsanto is playing a monopoly in the bt cotton market and urging the commission to declare the agreements illegal.

The MRTP investigations showed that Monsanto indeed is playing the monopoly in the market and asked the company to reduce the trait fee/royalty to the level charged in China. The company ignored the MRTP directive and moved to Supreme Court. In the mean time AP govt passed an order fixing the maximum price at Rs. 750/per packet of 450 g. Only those companies who agreed to this were permitted for commercial sale in the state during Kharif 2006. Soon other states followed the same path.

The MMB maintained its stand that the seed companies have to pay the trait fee of Rs. 880/packet of 450 grams. The case is still pending in the Supreme Court. In the mean time the companies suddenly increased the recommended seed rate from 1 packet (450 g) to 2 packets (900 g) per acre and reducing spacing from 4 x 4 m to 2 x 3 m. Now farmers need to buy two packets instead of one packet. This leaves us with several unanswered questions what have the agronomic trials of all these hybrids under the supervision of DBT, GEAC and ICAR revealed during the trials period about seed rate? Or were no such lessons learnt during that period? What connection does it have with particular companies trying to make their profits mostly in Andhra Pradesh?

## V. National Agricultural Research System: The Lost Empire

The research agenda of the National Agricultural Research System is also largely shifted to working on transgenic crops. The Government, political parties and their allied farmers' organizations were always arguing that strengthening the public sector research to promote 'transgenic crops' would solve all the problems of biosafety and monopoly.

The past experiences show that it is only a myth. To understand this lets first take the case of cotton research. India was the first country to release hybrid cotton. Till date many varieties/hybrids were released by the ICAR and State Agricultural Universities. But one can hardly find any of them in the field. The market is completely dominated by the private sector. With all its public investments and paraphernalia the NARS failed to attract the farmers to use their seed. Same is the case with other crops (sunflower, maize, vegetables, tomato, brinjal, chillies) seed where private companies play a dominating role. One can argue that all the lines used by the private industry are taken from public sector evolved material. But it is clear that it won't help the farmers. Now if these institutions develop GM cotton what is the guarantee that they would reach farmers and help them leaving aside the technological short comings and ecological implications? The Central Institute of Cotton Research is working on Bt cotton varieties/hybrids since 1996. Nothing has come out till date. Several times the last two Directors mentioned earlier in their press releases that they are ready with a bt cotton variety which would be available at a lower price and farmers can reuse the seed. The current Director also made a similar announcement recently. In situations where Bt hybrids are fading away and Bt-II is set to release who would be the takers for these bt varieties? What would be its impact on the insect resistance and biosafety?

More fundamental questions are whether the research in NARS is problem driven or technology driven. Many cases show that it is often technology driven rather than problem driven. With advent of hybrid technology, research on every crop shifted to hybrids irrespective of the need. The crop improvement research on crops where hybrids were unsuccessful were pushed back (sesame, safflower, linseed, pulses, groundnut etc). Irony is that public sector seed is popular in only these crops. Now the research on every crop is around inserting Bt genes, so the research is on bt cotton, bt rice, bt brinjal, bt potato, bt sorghum, bt castor, bt groundnut, bt tomato, bt pigeonpea and on and on. Many times these are not based on the farmers' problems.

There is no clarity on the IPR implications of such research. For example University of Agricultural Sciences, Dharwad, Karnataka has 'successfully' evolved a Bt cotton variety with genes obtained from a donor agency. When the University was ready to release the variety they came to know that the genes were from a company and they have to pay a royalty. They dropped the idea as the university couldn't raise that money. Now they entered into partnership with Mahyco and got Bt genes to introduce into Brinjal. This is as part of the ABSP-II with Cornell University. The IPR arrangements are not yet made public but believed to have royalty components.

The research agenda in public sector research is driven by hi-technology and funding support. Government is contemplating three main ways of supporting research.

a. The National Basic and Strategic Research Fund-which is mainly to support the ICAR institutions and State Agriculture Universities. The fund outlay is about Rs. 500 crore/year, the applications are called for waiting for finalization.

b. National Agriculture Innovation: The World Bank to Indian Agriculture Research through National Agricultural Research Project (NARP), National Agricultural Extension Project (NAEP), and National Agricultural Technology Project (NATP) now comes with a new label National Agricultural Innovation Project (NAIP). This project has a financial outlay of \$250 US in which

World Bank will provide \$ 200 US as credit and Indian Government will spend \$ 50 US over six years from 2006. The project aims at transforming Indian Agriculture with Public and Private Partnership.

c. Indo US Knowledge Initiative (KIA) in Agriculture is an agreement with US [with a financial outlay of Rs. 350 crores for a three-year period] which is being touted as a deal that will result in the required institutional mechanisms, systems and content needed for the launch of India's second green revolution.

All these projects are heavily loaded with research on biotechnology especially genetic engineering and with public private partnership. This would mark the beginning of public funds being used for private research and the NARS reduced to mere outsourcing agency. This also gives private ownership to the public material as the many of the technologies used would have IPR implications.

Apart from this NARS which is supposed to monitor the performance of the transgenic crops released also failed in its duties. Whenever the issues of crop failures, new diseases, and problems are raised they only echo the companies' statements.

## VI. Safer and better alternatives ignored

Today GM crops are pushed as there is no alternative. For each of the trait marketed or researched upon there are well established alternatives in the farmers' field. They are often ignored by the mainstream science as traditional or cumbersome. For example, Bt Cotton was introduced by conveniently ignoring safer and better alternatives that exist in this country. There is very successful experience with organic and Non-Pesticidal Management (NPM) approaches to crop cultivation in states like Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka. These approaches are both eco-friendly and economically viable. The very pest management paradigm that the scientific establishment has adopted first with pesticides and now with a crop like Bt Cotton needs to be recast. Similar safer and better alternatives exist for many of the problems for which the GM research is in pipeline.

Given the scenario, it is high time to rethink about the whole issue of Genetically modified crops and their implications to Indian agriculture. There is a need to put a moratorium on the release of the GM crops till the issues are settled and the regulatory systems are in place. Other wise these technologies would ruin the future of Indian farming.

## VII. Implications of KIA on Indian Agriculture

KIA proposes to bring a paradigm shift in Indian Agriculture in terms of human resource development, research, technology generation, technology dissemination and commercialization. In the short run, the KIA would concentrate on the four themes namely, (i) education, learning resources, curriculum development and training, (ii) food processing, use of byproducts, and biofuels, (iii) biotechnology and (iv) water management. Biotechnology is the main thrust of the deal with 61% of the financial resources (Rs. 350 crores) going into this theme. This means 'Biotechnology' would also be cross cutting across the themes getting major focus in education and training, to address the issues of food processing, drought management etc.

Under the theme 'Biotechnology' major thrust areas proposed include Genomic studies and Molecular Breeding in crops and animals (including fishes), developing transgenics in crops and animals, Molecular approaches for plant and health protection and Quality assurance, value addition and safety of food products.



The lessons from publicly-funded biotechnology initiatives to date suggest that much of the research under way has been proposed by scientists from the perspective of what science/technology might have to offer in solving a particular problem affecting plant production or in terms of securing markets for more agri-products by big corporations. Certainly it has not been undertaken from the perspective of actual demand in an economic sense, or of a clearly-defined need in a social sense or understanding of the ecological implications.

The proposed areas of work under KIA would intensify this process of alienation. The transgenic research in rice, wheat, mustard, pigeonpea, banana and other main food crops would seriously affect the food sovereignty of the nation. While the technological/ecological and social problems are already discussed above, critical issue is the shift in the public sector's research focus. Till now the public sector which used to provide the basic technology for the small and poor farmers would become a mere outsourcing centre to channel public money and germplasm to the private industry. The industry will gain public acceptance by donning the public sector avataar through public-private partnerships. The industry will also force the public sector to shift more towards basic and strategic research. The mad rush of developing transgenics seems to be driven more by the exclusive monopoly it gives in the form of patents while conventionally bred varieties/hybrids can only give a weaker version of IPRs as 'Plant Breeders' Rights'.

While the technologies and processes like Marker Assisted Selection do not seem to have serious problems unlike transgenic crops and may indeed help the conventional breeding methods in selecting good material, the flip side is that these selections would only be used to develop more and more transgenics and to secure exclusive markets through IPRs. "Trait selling" will be the market strategy. In fact, such a division is already seen in the seed industry where the multi-national companies make a killing through 'trait selling' and the local companies are supposed to make their money through 'seed selling'.

All the approaches mentioned in this initiative carry intellectual property rights. There is no clarity on what is the agreement on the IPRs on the products developed. Indian government in some of the earlier legislations tried to introduce clauses to safe guard the interests of the farmers. This agreement may bypass these safeguards as the laws in US would also be applicable (?). Further, such agreements will be used as a lever to bring about legislative and policy reforms at the national level – for example, when the USA approached the WTO Committee on Technical Barriers on Trade in May 2006, expressing its reservations on the Indian regulatory regime on transgenics, it invoked the KIA is a major rationalizing instrument for its arguments.

There are also many fears about bio-piracy acquiring a new route and legitimacy through the KIA.

While what would emerge from KIA and how they impact Indian agriculture is not yet completely clear, the processes adopted in developing the KIA proposal and its implementation show that it would clearly mark the end of public sector working for public good.

The KIA would certainly help the US industry to gain control over the improved germplasm and get the legal provisions changed to fully exploit their proprietary rights.