# **Globalisation and Threat to Seed Security** Case of Transgenic Cotton Trials in India

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There are high social and ecological costs linked to globalisation of non-sustainable agriculture which have been experienced in all commercially-grown and chemically-farmed crops in all regions. While the benefits of globalisation go to the seeds and chemical corporations through expanding markets, the cost and risks are exclusively born by the small farmers and landless peasants. While the commercial private seed supply system needs strong state regulation, farmer seed supply should function free of state interference with strong community control and public participation. Strong biosafety regulation with public participation is both a democratic and an ecological imperative.

The use of cotton as a source of textile extends far into the past, thousands of vears before the birth of Christ. Documentation establishes that the cotton fibre was being produced in the Indus Valley around 3000 BC. India later became the first important exporter of the finished products. Grithasamad, a vedic rishi, survived some 20,000 years ago in a village called Kalambh in the present Yavatmal district in Maharashtra state. This village has witnessed worlds' first successful researched cultivation of cotton by Grithasamad. This cotton could withstand heavy waters and people have named it as Garthasamadam. It is questioned whether this is the same Gossipium?

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# I Introduction

THE Indian seed industry is rapidly moving into a phase of 'corporate control over seeds' with the introduction of transgenic crops. The biotechnological innovations in the Indian context rely heavily on the technologies and investments of the first world. Development in these areas proceed either through transnational companies setting up their branches or through marriage of convenience between western biotechnology firms and national seed companies. Under this latter scenario, the western collaborator provides technological expertise and investment, while the national counterpart provides the Indian germplasm and a marketing base. Having developed a high level acceptance of hybrid seed, corporate strategists think acceptance of genetically engineered crops will be far easier. Therefore last year, Monsanto entered into an exclusive agreement with Maharashtra Hybrid Seeds Company (Mahyco) and formed a joint venture, to introduce genetically modified Bacillus thuringiensis (Bt) cotton in India. As Jack

Kennedy of Monsanto has stated "we propose to penetrate in the Indian agriculture sector in a big way. Mahyco is a good vehicle." This venture has been established with all hope that genetically modified cotton will account for entire sales of hybrid cotton seed within a timespan of 7-10 years. This exclusive agreement between the two would require the approval of Mahyco if Monsanto's technology were to be made available to other Indian seed companies.

However, the Indian seed industry is entering into a new phase of development without understanding and assimilating the inherent adverse impacts of genetically modified crops. Full impact of trials of genetically modified organism will only be evident in an ecological and economic study of the environment in which these trials are performed.

Evidence from the green revolution does not leave any doubt that the spread of modern varieties has been an important cause of genetic erosion. The uniformity caused by increasing areas sown to a limited number of varieties is a source of increased risk for farmers, as varieties may become vulnerable to disease and pest attack [Robinson 1996]. The trend, which is being set by the transnational companies through use of genetically engineered plants, is to create a niche for broad international market for a single product, thus creating the conditions for genetic uniformity in rural landscapes. In addition, patent protection and intellectual property rights imposed through the Trade Related Intellectual Property Rights (TRIPs) agreement of WTO will inhibit farmers from re-using, sharing and storing seeds. This increases the prospect that a few varieties will dominate the seed market. Already with monoculture development of crops, agriculture is increasingly threatened by plant diseases, insect pests

and weeds. To add to this the introduction of genetically modified crops and intensively managed farms will accelerate the erosion of rich genetic diversity that we own. There is no reason to believe that resistance to transgenic crops will not evolve among insects, weeds and pathogens as it has happened with pesticides. No matter what resistance management strategies will be used, pests will adapt and overcome the agronomic constraints.

The tragedy of farmers committing suicides for a couple of years in some states, highlights some of these high social and ecological costs which are linked to globalisation of non-sustainable agriculture and which are not restricted to the cotton growing areas of various state but have been experienced in all commerciallygrown and chemically-farmed crops in all regions. While the benefits of globalisation go to the seeds and chemical corporations through expanding markets, the cost and risks are exclusively born by the small farmers and landless peasants.

Privatisation of the seed sector has induced three major changes in agriculture. Firstly, it has led to change in cropping pattern of farmers' varieties from mixed cultivation based on internal inputs to monoculture of hybrids based on external inputs. Secondly, it has changed the culture of agriculture. Instead of growing food and maximising ecological security and food security, farmers have been induced to grow cash crops for high profits, without assessment of risks, costs and vulnerability. Thirdly, the shift from a public system approach to a private sector approach in agriculture. To add to all these, the new seed policy of the government lifted the restrictions on private sector import of foreign germplasm, enabling larger seed producers, particularly those with foreign collaborations, to access seeds from international sources [Shiva and Crompton

1998]. This has paved the way for big multinationals like Monsanto of the US, to enter our seed market, making the indigenous farmers vulnerable to the aggressive marketing onslaught of the company.

In fact, with the aim of monopolising agricultural systems in all countries, Monsanto is in the process of controlling the entire seed industry by acquiring shares in all the major national and international seed companies. By controlling seed, both through acquisitions and mergers, and through patents, Monsanto in effect is attempting to gain total control over food systems. Table 1 shows Monsanto's share in seed market.

In May 1998, Monsanto entered into a joint venture with one of India's largest seed company Mahyco and formed Mahyco-Monsanto Biotech Limited. Monsanto floated this joint venture with the intention of reaching the otherwise unreached farmers in remote villages where Mahyco has a presence. The statement of Jack Kennedy of Monsanto to penetrate the Indian agricultural sector in a big way using Mahyco as a vehicle has been proved accurate. Monsanto has acquired 26 per cent stake in Mahyco by paying nearly 24 times the paid-up value. Through this acquisition, Monsanto will get a foothold in the already established market of this company which has seed markets not only in India but also in the neighbouring countries [RFSTE 1998].

A Monsanto publication entitled Leaders in Weed Control, proudly states "Monsanto's tryst with India began over 20 years ago with Machete, the first rice herbicide in India, in 1975... Our commitment to Indian agriculture does not end with the latest herbicide. It begins." What Monsanto fails to mention is that what begins is war with Indian agriculture. What begins is the destruction of Indian agricultural diversity. What begins is the dependence of Indian farmers on industrialised, unsustainable techniques of the developed nations. What begins is the reduction of years of breeding and innovation to uniform monoculture systems. What begins is a commitment to remain the largest monopoly in agro-chemicals, a commitment to exploit third world farmers. What begins is the launch of a neo-imperialism of seed and food [RFSTE 1998].

The present study is an attempt to understand the corporate control over the genetically engineered crops heralding a new phase in the seed industry through globalisation of agriculture and to understand the threat posed to our seed security by probing into the case of trangenic cotton trials in India. In June 1998 Monsanto of the US, without any prior permission by the government of India, started field trials of its Bt cotton in 40 locations spread across nine states in India. The present paper probes into the details of the field trials of its Bt cotton at various sites across the length and breadth of India in all the important cotton growing regions. The study analyses the timing of plantation of trial crop, terms of trials of the company with the farmers, criteria for selection of the farmers and the fields, information dissemination on the transgenic crops among the farmers by the company, biosafety measures as practised by the company and by the farmers, comparison of the performance of Bt and non-Bt crop and ecological risks associated with the transgenic crops in the wake of the biosafety guidelines issued by the department of biotechnology. This paper has been organised into six sections. Section II deals with importance of cotton and a brief history on cotton hybrids. Section III deals with cotton failure and suicides by farmers. Section IV looks into the seed quarantine and biosafety rules with respect to seed production and supply. Section V deals at length with Monsanto's illegal and unscientific field trials in India and probes into the myths created by the company among the farmers and the public. Section VI looks into the need for strong biosafety regulations.

# Π

# Importance of Cotton

Cotton is one of the most ancient and important cash crops. It constitutes nearly 70 per cent of the raw material for the textile industry and directly or indirectly provides huge employment in rural as well as urban sectors.

Cotton cultivated in India can be classified broadly depending upon its cultivation in three distinctly different agroclimatic zones through four different species of *Gossypium* and F-1 hybrids (Table 2). The species composition has shifted from the predominance of diploid (*Gossypium arboreum* and *Gossypium herbaceum*) till the early 1960s, to one with dominance of *Gossypium hirsutum* and tetrapoliod hybrids beyond the 1970s.

There has been significant increase in area under cotton from 7,610 thousand hectares to 9,063 thousand hectares registering a 16 per cent increase from 1960-61 to 1995-96. During this period, the yield has been almost doubled from 125 kgs per hectare to 246 kgs per hectare [CICR 1997-98]. However for the last few years there has been failure of cotton crops in all the three zones. For the small and marginal farmers the failures have proved to be serious. The farmers apprehend that the failure of crops is due to supply of spurious seeds by various private seed companies across all the three zones.

TABLE 2: INCREASE IN AREA UNDER HYBRIDS IN INDIA (1975-1998)

(1 cr cem)	
Area	
3	
11	
26	
36	
40	

Source: ICAC (1997); Singh (1998)

TABLE 3: AREA AND PRODUCTION OF SPECIES AND HYBRIDS IN INDIA

(Par cont)

		(Per ceni)
Species/Hybrids	Area	Production
Species		
G hirsutum	36	40
G barbadense	<1	<1
G arboreum	16	8
G herbaceum	8	4
Hybrids		
Intra-hirsutum	35	40
.hirsutum*barbadense	5	8
.herbaceum*arboreum	<1	<1
.arboreum*arboreum	negligible	negligible

Source: ICAC (1997).

TABLE 1: MERGERS AND ACQUISITIONS BY MONSANTO FROM 1995 TO 1998 ALL OVER THE WORLD

Year	Company	Country	Specialisation	Share (Per Cent)	Purchased at (US \$)
1998	Cargill	Central and Latin America, Europe, Asia, Africa	Seed operations		1.4 billion
1998	Delta and Pine	US	Cottonseed	85	1.82 billion
1998	Dekalb	US	Seed operations		2.3 billion
1998	Mahyco	India	Seed operations	26	24 times paid up value
1998	Unilever	Europe	Seed operation		525 million
1998	EID Parry	India	Seed operation	51	
1997	Holden	US	Seed operation	25-35	
1997	Semetes	Brazil	Seed operations	30	
1997	Millennium	US	Seed operations		118 million
1996	Agracetus	US			150 million
1996	Calgene	US	Seed operations	49.9	
1995	Kelco		Chemicals		1.06 billion
1996	Roche		Women's health care		240 million

Source: Compiled from Monsanto (1998) and The Hindu, December 21, 1998.

There has been significant increase in the private seed companies operating in these regions. These seed companies are not sincere in meeting the seed needs of the farmers. They are profit-driven and use advanced advertising methods to sell new seed varieties to ill-informed farmers. These seed companies are selling 'truthful' seeds without providing any sort of compensation in case the seeds fail. To add to this, multinational companies are trying to capture the entire seed market for major crops throughout the world by patenting their innovative technologies. These companies are making the farmer further handicapped by making them sign a pre-sale contract. Inherent to the contract is a strict prohibition on the farmers' ageold practice of producing their own seeds, storing, and replanting them.

#### HISTORY OF HYBRIDS

In India hybrid cotton has been introduced since 1970 with the release of world's first hybrid cotton H-4 from Cotton Research Station, Surat in Gujarat. This hybrid cotton by virtue of its high yield potential and adaptability became popular among the farmers initially in Gujarat and later on in the states of Andhra Pradesh, Maharashtra, Karnataka and Madhya Pradesh. Two years after the release of H-4, the world's first interspecific hybrid between Gossypium hirsutum and Gossypium barbadense called Varalakshmi was released from Dharvad in Karnataka, which crossed the state and has spread in states such as Tamil Nadu, Andhra Pradesh and Maharashtra under irrigated conditions. With the success of these two hybrids, several hybrids in tetraploid cottons and a few in diploid cotton were released for commercial cultivation in major cotton growing states.

The area under hybrid cotton in India is given in Table 2. Share of different species and hybrids is given in Table 3. At present maximum area of cotton is covered by hybrids (40 per cent), followed by G hirsutum (36 per cent), G arboreum (16 per cent), and G herbaceum (8 per cent). The area under G barbadense is negligible. Among the hybrids, maximum area is covered by intra-hirsutum hybrids, followed by interspecific hybrids between G hirsutum and G barbadense. A very little area is covered by diploid hybrids [Singh 1999].

The central and southern zones saw successful cropping of hybrids. However these hybrids have not become popular among the farmers of north zone and less than 1 per cent area is covered by hybrid cotton in this zone. Statewide area under hybrid cotton is presented in Table 4. Hybrid cotton could not become popular in northern zone due to high cost of hybrid seeds and late maturity. Table 5 gives cotton acreage, production and productivity for the zones.

#### III Cotton Failure and Farmers' Suicides

The epidemic of farmers' suicides is the real barometer of the stress under which Indian agriculture and Indian farmers have been put by globalisation of agriculture. Indebtedness and crop failure are the main reasons for farmers' suicides. Also indebtedness and crop failure are inevitable outcomes of the corporate model of industrial agriculture being introduced in India through globalisation. Agriculture driven by MNCs is capital intensive and creates heavy debt for purchase of costly internal inputs such as seeds and agrichemicals. It is also ecologically vulnerable since it is based on monoculture of introduced varieties and on non-sustainable practices of chemically intensive farming.

The focus of cotton failure has been on the excessive use of pesticides or of spurious pesticides. However, pesticide use is intimately linked to hybrid seeds. Pesticides become necessary when crop varieties and cropping patterns are vulnerable to pest attacks. Hybrid seeds offer a promise of higher yields, but they also have higher risks of crop failure since they are more prone to pest and disease attack as illustrated by the Andhra Pradesh experience. Monocultures further increase the vulnerability to pest attacks since the same crop of the same variety planted over large areas year after year encourages pest build-ups.

# ANDHRA PRADESH COTTON FAILURE

More than 300 cotton farmers have committed suicide in Andhra Pradesh in 1997-98. Cotton cultivation has been taken up in areas which were not traditionally cotton growing areas. One such region is Warangal district, which has switched over from food crops to cotton which is relatively a new crop introduced under trade liberalisation. The area under cotton in this region grew over three times in a decade. The increase in area under cotton has been due to the good returns that the farmers were getting on cotton.

However, the cotton failed due to severe pest attack. The frequent sprays and spurious quality of pesticides used made them even more ineffective. Most farmers had spent between Rs 12,000 to Rs 15,000 an acre on pesticides. The heavy investment made in purchase of agri-chemicals could not be recovered because the yield was much below the expected level and it even did not cover the input cost. The small farmers who had taken loans and material on credit were driven into debt and then to suicide.

The present agricultural season in the state of Andhra Pradesh has also seen suicides by farmers, 15 in the last two months of 1998. Bearing incessant rains and drought, working hard for the whole year and not getting a reasonable price for the produce, unable to pay back the loan obtained from private moneylenders, farmers are resorting to suicides. In the state last year around 300 farmers committed suicide. Out of these approximately 130 farmers belonged to Warangal district.

Farmers, lured by the good features of the varieties of cotton seeds of a few companies advertised in their villages, cultivated their lands with new varieties of cotton, namely, Navratan, Ajith, Parry White Gold, Bioseed. Keeping in mind the losses incurred during the past cotton crop, cotton has been cultivated with utmost care. In spite of that, the adulterated seeds have destroyed thousands of acres of cotton crop in Parakala, Regonda, Atmakuru, Geisukonda, Sangyam, Dharmasagar mandals of the district.

In the district itself, the extent of area under these varieties of cotton is around 30 thousand acres, which is spread across 200 villages in 27 mandals. It is believed that about six seed companies were successful in introducing these varieties in the villages through their field distributors.

Interestingly, the seed companies are selecting their seed distributors from the village itself. These distributors are found to be the large farmers who were well off and have a say in decision-making for a number of villagers. The films shown to the farmers have a great impact on the choice of seed. Many of the farmers were reporting that the boll size and the opened boll were very good in the films. However they could not get a single boll so far, and whatever bolls formed were shed by the plant without opening.

In Ulligedda Damera, in Atmakuru mandal of Warangal district, the whole village has planted a total of 150 acres with Navratan Ajith variety of cotton. Madarappu Ramesh, who has cultivated Navratan Ajith, informs that he has invested Rs 10,000 to Rs 11,000 per acre on his cotton crop. Of this investment nearly 70 per cent is spent on the chemicals and fertilisers. In the same village another farmer, Gudur Rajaiah has cultivated three acres of land with Navratan Ajith variety and admits that he also incurred the same cost of cultivation for the crop. His situation is worse as compared to M Ramesh as he has a debt of Rs 90,000 from the 'adti' shop at an interest rate of 36 to 48 per cent.

All of them learnt of this variety of seed from TV film (video film) shown to them in their village. And almost all the farmers have debts either at the 'adti' shops or with the landowners.

In another village Pallarigudda in Sangyam mandal of Warangal district, almost all the farmers of this village have cultivated their fields with Parry White Gold (PWG). The standing crop is very robust but without any bolls on the plants. The distributor of PWG seeds is from the village itself and he is not convinced that the yield is not there. About 150 villagers have taken their cases in the district consumer redressal forum at Warangal against the failure of PWG and demanded appropriate compensation for them by the company. Government officials visited the fields of farmers whose cotton crops have failed.

In addition to the seed failure, in many mandals yellow-insect pest of cotton has destroyed the entire standing crops. The farmers reported that the agriculture department of the state has shown total negligence in disseminating the advice of scientists and this has resulted in the havoc caused by the pest. Added to this, the farmers, persuaded by the suggestions given by the pesticide shopkeepers, have used high-cost but inferior chemicals, which could not reduce the pests attack on the cotton crop. Also the rate for cotton per quintal is not more than Rs 1,500 which is not commensurate with the investment made on the crop. The same pesticides, though, did kill the farmers. Table 6 gives details of farmers who committed suicides.

Through discussions with various seed and pesticide merchants at Warangal, it is revealed that the seed companies provide a very high margin on their products and also they do not demand immediate payment through cash. About 80 per cent of the transactions are on credit basis. They get nearly 45 to 60 days of credit. The merchants pay the seed companies through post-dated cheques. In turn the merchant sells the product on credit to the farmers. The same merchants sell the chemicals and fertilisers required for the crops. Getting everything under one roof and that too without paying cash, i e, on credit tempts the farmer and makes him receptive to suggestions given by the merchant. In this way the farmer sinks in to indebtedness.

Various seed and chemical companies that are operational in Warangal are Shaw Wallace, ICI, Rallis India, Saral India, Novratis, Nocil, Bayer with various brands. Some of these have come in after liberalisation opened the seed sector to foreign companies.

# MAHARASHTRA COTTON FAILURE

Similarly, farmers in Yavatmal district in Vidharbha, for the last few years, are facing of cotton failure despite favourable climatic conditions and uninterrupted supply of inputs. The yields have drastically decreased from a quintal to a few kilograms per acre over these years.

The plight of organic farmers is more severe and they are struggling for survival in the wake of failure of not only cotton but also other important crop seeds such as 'toor'. Till 1992, majority of farmers were cultivating basic normal hybrid (AHH 468) which was fairly consistent and provided normal yield. The problem in this region started since 1992, when a new variety of cotton (CAHH 468), was introduced to the farmers in the region. The farmers found that the new hybrid, which has not been certified by the government, failed to perform well in spite of all the care taken by them. As reported by the

farmers, the yield registered was almost negligible in subsequent years. These seeds were supplied by some of the seed companies trusted by the farmers for years. Some of these include Nath Seeds, Aurangabad, Ajith Seeds, Jalana, and Sanjay Seeds, Jalana. The government outlets for selling seeds are supplying substandard seeds to the farmers. Some farmers have brought this to the notice of the authorities of these seed companies. For instance, 'karadi' (Bhima) seed (marketed by Mahabeej, Akola) which have been duly certified by a certifying agency was found to be substandard. Cotton and toor are commonly intercropped. These farmers found that not only cotton but also seeds of toor failed to perform.

#### ISSUE OF ACCOUNTABILITY

Unaccountability and lack of democracy under any condition generates disasters. This is the message of the increasing seed failure under globalisation. When techno-

TABLE 4: STATEWISE AREA UNDER HYBRID COTTON

States	Types of Hybrid Grown	Area in Per Cent
Punjab, Haryana and Rajasthan	Intra-hirsutum and Intra-arboreum	Less than 1
Gujarat	Intra-hirsutum and Interspecific diploid	
-	hybrids	50
Maharashtra	Intra and Interspecific tetraploid hybrids	50
Andhra Pradesh	Intra and Interspecific tetraploid hybrids	65
Karnataka	Interspecific tetraploid and diploid	
	hybrids; and Intra-hirsutum hybrids	70
Madhya Pradesh	Intra-hirsutum hybrids	42
Tamil Nadu	Intra and Interspecific tetraploid hybrids	15

Source: Singh (1999).

Zone	States	Averages as (Per Cent of Total)		t of Total)
		Area	Production	Productivity (Kg/ha)
Northern zone	Punjab, Haryana, Rajasthan	23	19	238
Central zone	Gujarat, MP, Maharashtra	60	56	412
Southern zone	AP, Karanataka, Tamil Nadu	17	25	382

Source: Annual Report, CICR, 1997-98.

TABLE 6:DETAILS OF FARMERS WHO COMMITTED SUICIDE DURING NOVEMBER-DECEMBER 1998 IN WARANGAL DISTRICT

Name of Farmer	Age	Village	Mandal	Date of Suicide
Ketapalli Sambi Reddy	40	Ogalpur	Atmakur	October 22
Bhukya Sarma	35	Harischandra Nayak Tandra	Hasanparti	November 8
Kari Kumari Lingayya	49	Gidde Muttaram	Chityala	November 11
Malotu Danja	40	Mangalvaripeta	Khanapuram	November 12
Nagelli Tirupati Reddy	26	Challlagarige	Chityala	November 14
Indla Ayilayya	36	Neredupalli	Bhupalapalli	November 18
Pacchi Kalaya Someswara Rao	48	Aakinepalli	Mangapeta	November 19
Kattula Yakayya	32	Samudrala	Stn Ghanpur	November 19
Akutota Venkatayya	65	Govindapuram	Sayampeta	November 21
Bolla Hari Krishna	22	Nadikuda	Parakala	November 24
Edelli Lakshmi	45	Rauvlapalli	Regonda	November 18
Cheviti Veeranna	28	Tehsildar Banjar	Dornakal	December 03
Pentla Odelu	42	Nagurlapelli	Regonda	December 16
Ragula Devender Reddy	25	Jubilee Nagar	Regonda	December 16
Tallapalli Lakshmayya	38	Solipuram	Narmetta	December 18

Source: Prajasakhti newspaper.

logical totalitarianism converges with economic totalitarianism to make genetic engineering the basis of commercial activity by coercing farmers and consumers, the potential disasters can be unprecedented. The combination of total irresponsibility in manipulating the genetic structure of crops and totalising rights over life forms through intellectual property rights makes for absolute rights and absolute irresponsibility on the part of the biotechnology industry.

The question, which becomes very pertinent in this context, is that who is going to be accountable for what is happening to the farmers? Who is going to take care of the social and economic liabilities of the farmers? Who is accountable for meeting the biosafety norms? These are some of the basic questions, which need to be answered before anything further is done on the introduction of genetically engineered crops in India.

# IV

# **SPS Quarantine and Biosafety Rules**

The tremendous growth of research in the field of biotechnology has not been matched by the development of necessary infrastructure for education and research on biosafety, impact assessments on genetic engineering and for safety measures and regulations. There is presently no exact predictive science or exact predictive ecology capable of accurately anticipating the behaviour and effects of genetically modified organisms. Ecological dynamics display the entire range of complex behaviours typical of systems involving complicated couplings and feedbacks between different processes. This makes prediction inherently problematic and requires that utmost care be exercised in drawing even the most uncertain conclusions. Nevertheless, biotechnology regulators tend not to use the most advanced and modern sciences in making risk assessments. The precautionary principle should thus be strictly applied to activities involving genetic engineering.

There are grounds for suspecting that proponents of genetic engineering are following a policy of 'strategic ignorance', characterised by neglect of standards and safety considerations, disregard for scientific inputs and assessments, and suppression of information on adverse effects.

#### POLICY ON REGISTRATION OF SEEDS

In the present scenario there are two types of seeds available in the market for the farmers to buy. These are (i) certified seeds and (ii) truthful seeds. Certified seeds are sold on certification of purity by the government. For any company to launch certified seeds it takes at least six to seven years of undergoing trials and verifications under the supervision of government authorities. However to avoid such delays in the launch of seeds in market, seed companies sell the seeds as 'truthful' seeds, which means that the company sells seed asking the farmers to accept the company's claims as truthful. There is no regulation to prevent marketing of 'truthful' seeds. The sale and exchange of truthful seeds was prevalent among the farmers before the seed companies were functioning. The farmers used to exchange or buy seeds from other farmers and such seeds were known as truthful seeds because farmers could trust each other. The corporate seed companies replaced the farmers' seed supply but continued with the practice of using the label 'truthful' for seeds, and no public regulation was prevalent to prevent such sale.

In such a situation, the introduction of genetically engineered (GE) seeds becomes worrisome. In absence of any such regulation, the costlier GE seeds will offer no guarantee for whether they perform well or not. This will lead to complete erosion of the agricultural biodiversity and adversely affect the socio-economic status of the farmers. This will be further aggravated since GE seeds will be patented, and corporations will treat information about them as proprietary.

# INDIAN BIOSAFETY REGULATIONS

In India, compliance of requisite safeguards at various levels of research on plants including the development of transgenic plants and their growth in soil is governed by biosafety guidelines issued by the department of biotechnology from time to time. In 1989, the ministry of environment and forests empowered the review committee on genetic manipulation (RCGM) to bring out manuals of guidelines specifying procedure for regulatory process with respect to activities involving genetically engineered organisms in research use and applications including industry with a view to ensuring environmental safety.

The figure gives the organogram for the presently existing guidelines for research, field trials and commercial application of transgenic plants. The committee which approves field tests and environmental release of GMOs is the Genetic Engineering Approval Committee (GEAC).

However, it is not clear whether the Monsanto trials were cleared by GEAC or by the Review Committee on Genetic

TABLE 7: COMPARISON OF ACTUAL DATES OF PLANTING AND DATE OF PERMISSION, 1998

Location	Sites in the Respective State Visited by Research Foundation	Actual Date of Planting on Individual Fields
Date of Permission by L	DBT July 27	
Total $= 25$	Mehboobnagar, Andhra Pradesh	End of June 98
AP = 7	Kurnool, Andhra Pradesh	June 20, 98
Maharashtra = 6	Warangal, Andhra Pradesh	June 26, 98
Gujrat = 2	Rangareddy, Andhra Pradesh	End of June 98
Karnataka = 2	Yavatmal, Maharashtra	June 24, 98
MP = 2	Raichur, Karnataka	Mid June 98
Haryana = 1	Bellary, Karnataka	June 17, 98
Punjab = 1	Khargoan, Madhya Pradesh	First week of July 98
Rajasthan = 1	Hissar, Haryana	June 19, 98
Tamil Nadu $= 2$	·	
Date of Permission by L	OBT August 5	
Total $= 15$	Haveri, Kanataka	June 26, 98
AP = 3	Sirsa, Haryana	June 28, 98
Maharashtra = 4	Gurgoan, Haryana	Mid June 98
Gujarat = 1	Firozpur, Punjab	June 29, 98
Karnataka = 2	<b>x v</b>	
Haryana = 2		
Punjab = 1		
Tamil Nadu $= 1$		

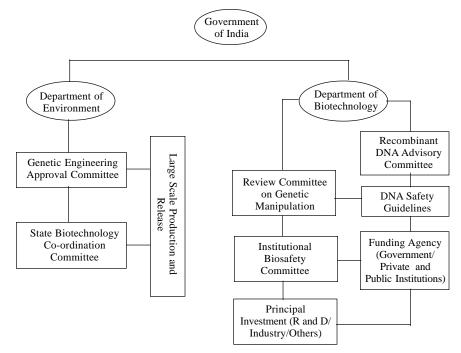
Source: Compiled from Primary Survey of Trial Sites.

TABLE 8: YIELD REPORTED BY THE FARMERS IN THE TRIAL PLOTS FOR BT COTTON

		(Kg/acre)
Name of the Farmer and Location	Bt Yield/Acre	Non-Bt Yield/Acre
Lehri Singh, Hissar, Haryana	745 Kg	880 Kg
Harpal Singh, Sirsa, Haryana	5 Kg	200 Kg
Surendra Singh Hayer, Punjab	Poor yield	250 Kg
Mahalingappa Shankarikopp, Haveri, Karnataka	700 Kg	700 Kg
B V Nunjundappa, HBHalli, Karnataka	Poor yield	Not performed well
Karelli Bakka Reddi, Rangareddy, Andhra Pradesh	50 Kg	150-200 Kg
Bansi lal Lakhmi, Khargoan, Mahdya Prsedh	12 Kg	300 to 400 Kg

Source: Compiled from Primary Survey of Trial Sites.

FIGURE 1: INSTITUTIONAL, MECHANISM FOR IMPLEMENTATION OF GUIDELINES



Manipulation (RCGM). Since the state governments were not consulted and Mahyco has only shown a letter of approval from the department of biotechnology under which the RCGM functions, rather than the ministry of environment, under which the GEAC functions, it is possible that the trials only had a RCGM clearance, and not a clearance through GEAC which would have required consultation with state biotechnology co-ordination committees (SBCC).

However, RCGM is only supposed to clear contained lab experiments, not field experiments in open farmers' fields of the kind that are being undertaken in various locations in India. Field experiments need to be cleared by the GEAC since they take place in the open environment and their risks are not contained. The full ecological impact of such trials needs to take into account interaction with diverse species, impact on soil, impact on biodiversity and impact on public health.

According to Article 4.1 (i) and (ii) of Recombinant DNA Safety Guidelines, 1990, GEAC is supposed to regulate experimental field trials and research developmental activity. To quote Article 4.1 (i) and (ii):

4.1 GEAC will have the Biotechnology Coordination Committee under it which will function as legal and statuary body with judicial powers to inspect, investigate and take punitive action in case of violations of statutory provisions under EPA.

(i) Review and control of safety measures adopted while handling large-scale use of genetically engineered organisms/ classified organisms in research, developmental and industrial production activities.

(ii) Monitoring of large-scale release of engineered organisms/products into environment, oversee field applications and experimental field trials.

Since neither were the state governments involved, nor have the trials proceeded on a case by case and step by step basis from laboratory, to contained environment, to open environment and have been rushed to the stage of trials in open fields of farmers as the first step, Monsanto trials are clearly illegal and illegitimate even under the presently existing weak guidelines for regulation of GE crops.

Under Article 16 of the Environment (Protection) Act, 1986, these trials are an environmental offence and should be treated as such in law.

Offence by companies

(1) Where any offence under this Act has been committed by a company, every person who, at the time the offence was committed, was directly in charge of, and was responsible to, the company for the conduct of the business of the company, as well as the company, shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this sub-section shall render any such person liable to any punishment provided in this Act, if he proves that the offence was committed without his knowledge or that he exercised all due diligence to prevent the commission of such offence.

(2) Notwithstanding anything contained

in sub-section (1), where an offence under this Act has been committed by a company and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any director, manager, secretary or other officer of the company, such director, manager, secretary or other officer shall also be deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

Explanation – For the purposes of this section,

- (a) "company" means any body corporate, and includes a firm or other association of individuals; and
- (b) "director", in relation to a firm, means a partner in the firm.

Under the above Article, Monsanto has committed an offence and should be deemed guilty and should be liable to be proceeded against and punished accordingly.

The produce from the trial plots of the *Bt* cotton has been directly sold in the open market mixing it with normal cotton. This has been serious lapse on the part of the permitting authority and the company as well. The produce from trials is to be fully contained and should have been destroyed by burning.

# V Monsanto's Trials in India

Even from the viewpoint of a totally inadequate biosafety regulation framework in this country, the Monsanto trials are illegal and unscientific. As long as the genetic engineering is taking place in labs or in farms that are totally contained, the RCGM of the department of biotechnology governs the approval. The moment trials are conducted on the open environment, as the case is with these trials, the GEAC governed by the ministry of environment and forests becomes active under the Environment Protection Act 1986. The list of all the trial sites is given in Table A. In what follows, we present how these trials are illegal, unscientific and fraudulent.

TABLE 9: NUMBER OF CHEMICAL SPRAYS ON BT COTTON PLOT

Name and Location of Farmer	Number of Sprays on <i>Bt</i> -Crop
Surinder Singh Hayer,	
Sirsa, Haryana	5 to 6
Lejri Singh, Firozpur,	
Punjab	3
Mahyco R D Centre,	
Gurgoan, Haryana	3
B V Nanjundappa, Bellary,	
Karnataka	4
V Thirupalliah, Kurnool, AF	<b>2</b> 4

Source: Compilation from Primary Survey, December 1998.

# PLANTING OF *BT* COTTON BEFORE PERMISSION GRANTED

The stamp of clearances for all the trials of genetically modified cotton came through P K Ghosh, who is the advisor to RCGM through its letter dated July 27, 1998 and August 5, 1998 to Maharashtra Hybrid Seeds Company (Mahyco) to carry out multicentric trials on transgenic cotton (Bacillus thuringiensis) initially at 25 locations by permission dated July 27, 1998 and thereafter 15 locations by permission dated August 5, 1998 making 40 locations in nine states. The date of sowing obtained from individual farmers show that the crop had been sown before the trial permissions were obtained in June 1998. Table 7 complied on the basis of actual field observation shows that the dates of actual sowing of Bt on the trial plots were much earlier to the permission granted by the wrong committee.

The field trials of *Bt*-cotton on 40 locations in nine states are totally unscientific and illegal. The permission granted to Mahyco-Monsanto for the open

field trials is in category of organisms with potential ecological risks and these environmental risks need to be assessed and regulated in accordance with the rules called the 'Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms Genetically Engineered Organisms or Cells, 1989' framed under the Environment (Protection) Act, 1986 (hereafter referred to as 'Rules'). The permission has been granted for carrying out multicentric field trials without assessing ecological impact on biodiversity, protection of environment, danger to agriculture and health hazards to human beings and animals. The said permission has not only been granted in violation of the provisions of the above mentioned Rules which clearly stipulate that any such permission can be granted only by the GEAC under the ministry of environment and forests, but also of the guidelines of department of biotechnology which have been framed under these Rules. Rules are totally inadequate to deal with the present state of genetic engineering. The permission is further vitiated by reason

of the concerned nine states not being consulted before granting such permission when 'agriculture' is a state subject and such experimentation has direct impact on the agriculture of a particular state. In fact, the two committees, viz, state biotechnology co-ordination committee (SBCC) and the district level committee (DLC) were not informed in advance before the grant of permission as these committees are concerned with biosafety of such genetically engineered trials in the state as well as in a particular district. Therefore the permission which has been granted is violative of Articles 14, 19 and 21 of the Constitution; it is also violative of the provisions of Environment (Protection) Act, 1986 and the Rules framed under section 6, 8 and 25 of the said Act.

# MYTH OF HIGH YIELD

The yields in all the trial plots were found to be low as compared to what the company promised. A comparison of the local hybrid variety cultivated and Bt shows that the yield from both the crops was more or less same. The failure of Bt to

# TABLE A: SITES FOR FIELD TRIALS CUM DEMONSTRATIONS

Sl	State	Sl	District	Tehsils/Mandals	Village	Survey No	Farmer's Name	Area
No		No						
1	Andhra Pradesh	1	Guntur	Rentanchitala	Rentachintala	44	Thumma Fatima Reddy	1 acre
	"	2	Mahboobnagar	Bijnepally	Manganur	268	Indla Mallikarjun Rao	1 acro
	"	3	Khammam	Madira	Dendukur	581 and 582	K Ranga Rao	1 acr
	"	4	Kurnool	Pagadiala	Nagatur	228	O Tirupalliah	1 acr
	"	5	Warangal	Atmakur	Vururgondo	121	Bollu Sami Reddy	1 acr
	"	6	Rengareddy	Vikarabad	Kothagadh	130	Karella Bakku Reddy	1 acr
	"	7	Adilabad	Adilabad	Ponnari	12/43	Meghraj Sharma	1 acr
	"	8	Prakasham	Addanki	Gopalpuram	71/1	Yerra Hanumanth Rao	1 acr
	"	9	Karimnagar	Vemulawada	Pushpanagar	428	Kalakam Show Reddy	1 acro
	"	10	Rengareddy	Rengareddy	Medchal	93 RU/93 LU	Kailash Charan	1 acro
	"	11	Rengareddy	Shamshabad	Kavaguoa	467	Mahyco Seeds Company	1 acre
2	Maharashtra	12	Yavatmal	Kelapur	Both	32	Arunbhau S Thakre	1 acre
	"	13	Jalna	Bhokardan	Viregoan	5	Baburao T Pise Patil	1 acro
	"	14	Parbhani	Sailu	Kolha	45	Ganpatrao B Bhise	1 acro
	"	15	Nanded	Nanded	Barad	338/1	Kerbaji P Bhimewar	1 acro
	"	16	Buldana	Malkapur	Lonwadi	7	Narhari G Patil	1 acro
	"	17	Jalgaon	Chalisgaon	Umberkhede	63-1-A	Dhanraj A Patil	1 acre
	"	18	Latur	Udgir	Lohara	434	Chandrarao H Sontake	1 acre
	"	19	Amravati	Warud	Warud	2	Rambhau N Hole	1 acro
	"	20	Jalna	Jalna	Jamwadi	198	Mahyco Seeds Company	1 acre
	"	21	Akola	Telhara	Chittalwadi	29	Vijay A Ingle	1 acro
3	Gujarat	22	Vadodara	Karjan	Pingarwada	455	Kishore Bhan T Shah	1 acre
	"	23	Rajkot	Gondal	Bhuvna	66	Naganbhai Tejabhai	1 acro
	"	24	Mehsana	Gozaria	Parsa	82	Harshadbhai Bhailal Patil	1 acro
4	Karnataka	25	Raichur	Sindhanur	Maladagudda	238/A	Basanna J Kunsala	1 acro
	"	26	Bellary	Hagari Bommanhalli	Ranikkar	291/B	B V Nanjundappa	1 acre
	"	27	Dharwad (Haveri)	Hangal	Adur	141	Mahalingappa S Sankarikoppa	1 acre
	"	28	Chittradurga	Harihar	Duggavathi	115	B Chandrappa and S Ramappa	1 acro
	"	29	Haveri	Ranebennur	Kunbev	98	Mahyco Seeds Company	1 acro
5	Madhya Pradesh	30	Khargone	Barwah	Keeduh	250	Bansi Lal	1 acro
	"	31	Khandwa	Burhanpur	Mohammadpura	204	Chaganlal C Mahajan	1 acro
6	Haryana	32	Hissar	Hissar	Mayar	82/16 Murabba	Lehri Singh	1 acr
	"	33	Sirsa	Mandi Dabwali	Allika	_	Harpal Singh	1 acr
	"	34	Gurgoan	Farrukhnagar	Sewari	76	Mahyco Seeds Company	1 acr
7	Punjab	35	Bhatinda	Talwandi	Maiserkhana	124	Tej Singh	1 acro
	"	36	Firozpur	Abohar	Rajanwalli	6/21	Surinder Singh	1 acro
8	Rajasthan	37	Sriganganagar	Kesri Singhpur	Chak 22F	54	Ram Das Jain	1 acr
9	Tamil Nadu	38	Theni	Theni	Verrapandi	102/IF	Narayanswamy	1 acro
	"	39	Dharmapuri	Uttamkarai	Kannanoor	10/1	A Jaychandran	1 acre
	"	40	Coimbatore	Valampalayam	Kondayampalaya	m 119	Mahyco Seeds Company	1 acre

yield has been reported from all over the world. The Mississippi Seed Arbitration Council has ruled that Monsanto's Roundup Ready Cotton failed to perform as advertised last year (1997) and recommended payments of nearly \$2 million to three cotton farmers who suffered severe crop losses.

The performance of Bt with respect to other non-Bt cotton in some of the trial sites is given in Table 8. It has been observed that in almost all the sites, farmers reported that except for the protection from bollworm nothing much has benefited them. The cost of cultivation has also worked out to be same for all the farmers.

#### MYTH OF REDUCTION IN PESTICIDE USE

According to industry, the promise of transgenic crops inserted with Bt-genes is the replacement of synthetic insecticides now used to control insect pests. Since most crops have a diversity of insect pests, insecticides will still have to be applied to control pests other than Lepidoptera not susceptible to the endotoxin expressed by the crop [Gould 1994]. On the other hand, several Lepidoptera species have been reported to develop resistance to Bt toxin both in field and laboratory tests, suggesting major resistance problems are likely to develop in Bt-crops which through continuous expression of the toxin create a strong selection pressure [Tabashnik 1994]. Monsanto company admits that bollworm larvae greater than, 1/4 inch long or 2 to 4 days old are difficult to control with Bollgard alone (see promotional material of Monsanto). It recommends applying supplemented insecticide treatment and further recommends to the farmers that "if sufficient larvae of this size are present you may need to apply supplemental treatment at intervals" [Monsanto Company 1996].

The company suggests maintaining a refuge to Bollgard cotton for pest/insect resistance management. These refuge acress must be planted in close proximity of Bollgard cotton and recommends that four acress of non-Bollgard cotton refuge for every 100 acress of Bollgard cotton should be planted. In India, most of the farmers in the cotton growing zones are small-scale farmers with small and marginal landholdings. For such farmers it is very difficult to maintain such refuges [Monsanto Company 1996].

In another instance, the pesticide effect of the engineered Bt was not sufficient to kill off all pests throughout the season as Monsanto promised. Mae-Wan Ho, of the UK's Open University, attributes this failure to unpredicted changes in the behaviour of the Bt-gene. In 1997, 20 per cent of the first commercial crop of Roundup Ready cotton suffered deformed bolls and bolls dropping off early.

An analysis by the Pesticides Trust on behalf of Greenpeace argues that the introduction of herbicide resistant varieties will alter the pattern of herbicide use but will not change the overall amounts used. If it leads to greater use of glyphosate this will damage other crops and have potential adverse effects on wildlife, including beneficial insects such as ladybirds. The analysis further shows that the compounds can remain active in the soil for long periods and can contaminate water [International Agricultural Development 1998].

TABLE 10: COMPARISON OF THE FIELD TRIAL DESIGN WITH ACTUAL FIELD PRACTICE AND ECOLOGICAL TRIAL PARAMETERS AS SPECIFIED BY BIOSAFETY REGULATIONS

PARAMET	TERS AS SPECIFIED BY BIOSAFETY REGU	LATIONS
Trial Design	Actual Field Practice	Ecological Trial Parameters
• Experimental design for the quadruplicate trials of <i>Bt</i> -cotton would be in field space of about 1,394 sq meters.	• 1,800 sq meters of plots were used.	<ul> <li>Impact of leaf fall on soil organisms.</li> <li>Impact on non target species.</li> <li>Emergence of resistance.</li> </ul>
• Experimental plots contain- ing transgenic <i>Bt</i> -cotton plants should be surrounded by an isolation distance of 5 meters with no plantations.	<ul> <li>No isolation distance. Instead crops were planted in between the plots.</li> </ul>	<ul> <li>Experimental plots in total isolation. Series of experiments to be conducted in contained environment.</li> <li>Assessment of the impact on other crop and plant species dominant in the region.</li> </ul>
• Comparative assessment of lepidopteran pest load in randomised <i>Bt</i> , non- <i>Bt</i> field along with non- <i>Bt</i> foeld plantations due to host preference.	• No data available.	<ul> <li>Integrated analysis of flora and fauna in soil and agro- ecosystem within a distance covered by pollination potential.</li> </ul>
• Performance of the <i>Bt</i> and non- <i>Bt</i> hybrids for yield and fiber quality.	<ul> <li>Manipulation in comparing the yield of <i>Bt</i> and non-<i>Bt</i> cotton by opting for its own inferior variety and not taking the most common variety cultivated by the farmers in the region.</li> </ul>	• Local cultural practices should not be manipulated and comparison should be made with the most commonly grown variety of the crop.
• Keep full account of the transgenic materials and seeds in the transgenic plots and use all transgenic material in a contained environment.	<ul> <li>Free sale of the <i>Bt</i>-cotton produced mixed with normal cotton produce in the market by the farmers. No precaution of containment.</li> </ul>	• Complete destruction of the material/produce obtained from the trials.
• All materials, like quantities of transgenic <i>Bt</i> -cotton seeds produced, transgenic cotton produce, etc, after experimentation be reported to the government.	• Taluk level concerned government departments unaware of the experiment- ation and did not receive any material or produce of the trangenic <i>Bt</i> -cotton.	• All concerned committees at all levels of institutional hierarchy should be well informed about any trials with the genetically modi- fied organisms in the field.
• Ensure company authorised personnel permitted to visit experimental sites.	<ul> <li>Mahyco organised 'kshetra utsav' for publicity of the <i>Bt</i>-cotton among other farmers of the region surrounding the trial fields.</li> </ul>	• While in research conditions all the results should be open and accessible to the interested citizens of the country.
• Ensure adherence to Recombinant DNA guidelines of the government of India.	• No adherence to the guide- lines laid by the government of India.	<ul><li>Strong biosafety regulations needed.</li><li>More public participation needed.</li></ul>

Source: Compiled from Primary Survey, Biosafety Guidelines and Rissler and Mellon (1996).

TABLE	11:	GENETIC	ENGINEERING
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	Genetic Engineering Assumptions	Reality of Scientific Findings		
1	Genes determine characters in linear casual chain: one gene gives one function.	Genes function in complex network; cau- sation is multidimensional, non-linea and circular.		
2	Genes and genomes are not subject to environ- mental influence.	Genes and genomes are subject to feed- back regulation.		
3	Genes and genomes are stable and unchanging.	Genes and genomes are dynamic and fluid and can change directly in response		
to		the environment and give adaptive mutations to order.		
4	Genes stay where they are put	Genes can jump horizontally between unrelated species and recombine.		

The actual pesticide sprays by the farmers at various trial sites in India reveal that the use of pesticides has not at all stopped for Bt crop. Pesticide sprays ranging from as high as 12 to 15 in one of the trial fields in Haryana to a minimum of three in most of the trial fields have been observed. According to Basavanappa in Hagari Bommanahalli taluk, Bellary district, the number of sprays in all the three test plots of Bt and non-Bt has been almost the same. He incurred an expense of around Rs 6,700 for chemicals sprays and fertilisers. This amount is almost the same as that spent by all other conventional/hybrid cotton growers on purchase of chemicals and fertilisers in that part of the state. Table 9 gives the number of sprays farmers used on the Bt plots. Contrary to the claim of Monsanto about the reduction of chemical sprays, farmers had to revert to chemical spraying in spite of built-in insecticidal properties in the Bt-cotton.

#### NO ENVIRONMENTAL ASSESSMENT

The wrong committee asked Mahyco-Monsanto to generate data on pest load, performance in terms of yield and fibre quality, to compare the insect damage on the boll shedding and retention for *Bt*cotton. There has been no concern to monitor the impact of transgenic crops on the surrounding flora and other relevant ecological aspects. A comparison of the field trial design with actual field practice and required ecological trial parameters as specified by biosafety regulations is presented in Table 10.

# POTENTIAL ENVIRONMENTAL IMPACTS

Transgenic plants are the crops that have been genetically engineered to contain traits from unrelated organisms. The spread of transgenic crops threatens crop genetic diversity by simplifying cropping systems and promoting genetic erosion. The potential transfer of genes from pesticide resistant crops to wild or semi-domesticated relatives may create new super weeds.

There is serious mismatch between the mindset of genetic engineering biotechnology and the reality of the new genetics (Table 11).

Insects were found to develop resistance rapidly to the transgenic plants with builtin biopesticide, when exposed to the toxin. This has been the problem with the *Bt*cotton crop at Texas. The widespread use of *Bt* containing crops could accelerate the development of insect pest resistance to *Bt*, which is used for organic pest control. Already eight species of insects have developed resistance to *Bt*-toxins including diamond black moth, Indian meal moth, tobacco budworm, colorado potato beetle and two species of mosquitoes [Altieri 1998].

Due to potential risks associated with genetic engineering, article 19.3 of the Convention on Biological Diversity called for a biosafety protocol, which is currently being developed through international negotiations. This is also the reason France has banned all genetically engineered crops and the UK has responded to the call of citizens by having a 1-year moratorium on release of genetically engineered crops. Most recently, IFOAM, the world's largest body for organic agriculture called for a ban on genetic engineering from agriculture because it poses unnecessary hazards with little benefit for the development of agriculture.

#### RISKS OF MONSANTO'S TOXIC PLANTS

Monsanto's genetically engineered 'Bollgard' cotton or *Bt*-cotton has genes from a bacteria engineered into it so that the plant produces its own pesticide. Contrary to Monsanto's claim, Bt-cotton is not 'pest-resistant' but a pesticide producing plant. The severe ecological risks of crops genetically engineered to produce toxics include the threat posed to beneficial species such as birds, bees, butterflies, beetles which are necessary for pollination and for pest-control though prey-predator balance. Nothing is yet known of the impact on human health when toxic producing Bt. crops such as potato and corn are eaten or on animal health when oilcake from Btcotton or fodder from *Bt*-corn is consumed as cattle feed.

Further, while pesticide producing plants are being offered as an alternative to spraying pesticides, they will in fact create the need for more pesticides since pests are rapidly evolving resistance to genetically engineered *Bt*-crops. The widespread use of Bt containing crops could accelerate the development of insect pest resistance to Bt, which is used for organic pest control. The genetically engineered Bt-crops continuously express the Bt-toxin throughout the growing season. Long-term exposure to Bt-toxins promotes development of resistance in insect populations, this kind of exposure could lead to selection for resistance in all stages of the insect pest on all parts of the plant for the entire season. Due to this risk of pest resistance, the US Environment Protection Agency (EPA) offers only conditional and temporary registration of varieties producing Bt.

Monsanto's technology will therefore destroy beneficial biodiversity and create superpests both through wiping out pest predators and by creating pests which are resistant to pesticides. Monsanto's pesticide producing *Bt*-crops are not based on the terminator technology, which terminates germination of seed so that farmers cannot save it. However, they are in an ecological sense terminator, which terminates biodiveristy and the possibilities of ecological and sustainable agriculture based on the conservation of biodiversity.

The ecological impact of *Bt*-cotton cannot be assessed on the basis of a 3-month trial. The trial needs to be carried out over 2-3 seasons and impact needs to be assessed on all organisms, including soil microorganisms which have been known to be killed by the toxics in *Bt*-crops. To get the full ecological impact of biodiversity destruction and genetic pollution caused by genetically engineered crops, the following steps are necessary.

 a full biodiversity assessment of the ecosystem in which the GMO is to be introduced;

 impact of genetically engineered crop on diverse species including pollinators and soil micro-organism; and

 risks of transfer of genetically engineered traits to non-engineered crops through horizontal gene transfer and pollination.

None of these essential steps for ecological risks of GMOs has been carried out in Monsanto's present trials with Bollgard cotton.

When Monsanto states that they have had 93 per cent success they are referring to agronomic performance, not to ecological safety. Further, since the *Bt*technology is aimed at pesticide production, not yield increases, Monsanto is deliberately distorting facts when it refers to yield increasing characteristics of Bollgard cotton.

Monsanto is also misinforming the public when it states that pesticide producing plants mean no pesticide needs to be sprayed. The primary justification for the genetic engineering of Bt into crops is that this will reduce the use of insecticides. One of the Monsanto brochures had a picture of a few worms and states, 'You will see these in your cotton and that's OK. Don't spray.' However, in Texas, Monsanto faces a law suit filed by 25 farmers over Bt-cotton planted on 18,000 acres which suffered cotton bollworm damage and on which farmers had to use pesticides in spite of corporate propaganda that genetic engineering meant an end to the pesticide era. Cotton bollworms were found to have infested thousands of acres planted with the new variety of cotton in Texas.

# TRIAL FARMERS AND MAHYCO-MONSANTO

Unscientific sampling of the farmers and sites: The selection of the farmers for the illegal trials was based on totally unscientific sampling techniques. The company as well the government hurried up for trials without determining the sample size for the trials. Most of the selected farmers for the trials were either seed distributors or had long-term association with the company. In this selection process it seems there has been some vested interest of the dealer-farmer in terms of getting favour for the dealership of the GE seeds in future from the company.

Based on prior acquaintances, Mahyco contacted the individual farmers. In all these zones Mahyco used to supply the farmers with new hybrid seeds for initial trials. Based on the performance of these new seeds, farmers patronised Mahyco and established good rapport. Most of the trials were based on this mutual trust which the farmers have developed with Mahyco.

At most of the trial sites, farmers selected were the exemplary farmers who were singled out on the basis of their past performance in the yield of major crop in the previous cropping season. Those farmers were presented with trophies and other awards so as to maintain their faith in the company. For instance, Sri Bassanna at Sindhanur district in Karnataka, was selected for the trial based on performance for best yield in paddy.

All the trial sites were on the main approach road. This has been purposefully done so that the visit of the supervisory staff is easier. These trial plots were not isolated, as is mandatory from the biosafety point of view and were amidst other surrounding fields.

In some of the trial sites, Mahyco's own dealers were given seed to test *Bt* on their fields and for recommendation to other farmers. Mahyco agreed to meet the expenditures incurred on the cultivation of the *Bt*-crop on their fields.

No independent scrutiny of trials: There has been no appointment of independent group comprising of outside scientists/ citizens other than company personnel, to closely monitor the data and results generated by the joint venture and the government. This has been done to produce suitable data to get approval of the concerned ministry of the government. At the field level, none of the village/taluk level government organisations have been contacted prior to taking up trials in open fields. The Research Foundation has intervened to ensure public assessment of the trials.

*Enticing the farmers:* In order to attract other farmers, the company organised 'khestra utsav' to show the crop performance to other villagers from neighbouring villages. This has been the strategy of many companies on market expansion through concentrating upon development of market *per se*, rather than pushing their own particular brand. Farmers are invited to the fields of another exhibiting uncommonly high yields of branded seed. However, during shows organised by the Monsanto-Mahyco, the cost of technology has not been revealed to the farmers which is associated with sale of genetically engineered seeds. Thus, cost of such technology becomes important in the context where farmers have had the options of exchange of saved seeds and purchase of hybrid seeds at much lower price than the *Bt*.

# Cost of the BT Technology

Bt technology is not free of cost to the farmers. These farmers have to pay for the non-cotton gene inserted into the cotton genome. The fees that are charged to farmers are related to the benefits or saving made in planting the transgenic cotton varieties. It is generally presumed that Bt-cotton if planted would significantly reduce the need for spraying insecticides and accordingly the technology fee has been related to the insecticide use.

Each farmer interested to plant *Bt* variety has to sign an agreement with Monsanto. One of the important conditions of the contract is that the seeds can neither be saved for next year nor passed on to other cotton growers. The company apparently intends to reap technology benefits for years to come by extending the duration of agreement.

It has been observed that the performance of Bt-cotton is not always profitable. According to a study by Sutton (1998) it was not profitable to grow Bt-cotton in Arkansas during 1997. The study involved two similar fields on the same farm at seven locations for comparing cost of production and net returns from Bt verus non-Bt cotton varieties. The study noted that the differences between the Bt and non-Bt fields were in the area of technology fees, cost of insecticides and their application, growth regulators and second harvest costs. In most Bt fields, the additional cost of seed, the necessity of using plant growth regulators, the technology fee and the need to make second pick were responsible for higher cost of production. It is very clear through various studies [like Sutton 1998; Bryant et al 1997] that wherever the bollworm pressure is not high, *Bt*-cotton might not be economically suitable.

Gibson et al (1997) compared the costs and returns associated with growing Btcotton and non-Bt in Mississippi for two years. The study reveals that there was no difference in the total cost of production but better yields were reported in case of Bt-cotton. However, Bt-cotton required more expenses in the form of fertilisers, fungicide treatments and the technology fees. The Table 12 provides the performance of Bt to that of non-Bt cotton in Mississippi in 1995-97. It is observed from the table that the amount spent on insect control together with the technology fee exceeds for Bt-cotton in all the years and made it more expensive for the farmers. Thus the total cost for *Bt*-crop is on an average 50 per cent more than that of non-Bt-crop.

The Andhra Pradesh government initiated steps to prevent the introduction of *Bt* by asking M K Sharma, managing director, Mahyco-Monsanto Biotech (I) to stop the field trials in its seven districts. However, the government has made it clear that if the company still wants to continue with the trials, it will be permitted to carry them out in the research stations of N G Ranga Agricultural Research University.

For the trials, the company has not charged any technology fees. However, for commercial sale of the seeds the company is certainly going to impose technology fees. In such situation, there will be tremendous pressure on the farmers and ultimately the very survival of farmers will be threatened. There is absolutely no difference in terms of total returns for *Bt* and non-*Bt* crops of cotton.

# THREAT TO ORGANIC FARMERS

With the introduction of genetically modified crops, per acre cost of cultivation will increase with increase in added costs in terms of seed cost, technology fees, and use of chemicals. In the present situation with internal inputs used by organic agriculture, the added costs are almost negligible except for the cost of seeds. Most of the farmers save their seeds and use them for cultivating in the following season. Other inputs are also provided on

TABLE 12: PERFORMANCE OF BT VS NON-BT COTTON IN MISSISSIPPI 1995-1997

		1995		1996		1997	
		Bt	Non-Bt	Bt	Non-Bt	Bt	Non-Bt
Lint yield	kg/ha	1086	983	1002	950	1103	1009
Insect control	US\$/ha	176	232	157	144	209	204
Bollgard fee	US\$/ha	204		61		133	
Total cost	US\$/ha	380	232	218	144	342	204
Total return	US\$/ha	1176	1176	1218	1218	1239	1239

Source: ICAC, June 1998.

farm. Once *Bt*-cotton is cultivated, all these costs will appear and the farmer will get into serious financial troubles.

The additional burden on the farmer switching over to *Bt*-cotton from conventional variety is nearly nine times more in terms of seed cost, technology fee of nearly US\$ 80 per hectare and more spending on pesticides and chemicals. Most calculations used by Monsanto compare the costs incurred by the farmers of developed countries. The estimates for Indian farmers are totally different and have profound impact when the comparisons are made in Indian context between cultivation with genetically engineered seeds and cultivation under organic conditions.

Socio-economic costs of GE seeds for Indian farmers: The genetic engineering option is projected as leading to lower chemical use and hence economic benefits by comparing it to chemical intensive, large-scale industrial monocultures. GE is not compared to ecological organic agriculture which is perhaps the only real alternative. However the comparison of genetically engineered crops that should be made is not with chemical intensive agriculture but with ecological regenerative agriculture. In addition to the increased cost of chemicals, the shift from ecological agriculture to genetic engineering also leads to increased costs of seed, including technology costs, which are never mentioned when the economic benefits of transgenic crops are assessed. Field survey indicates per acre seed cost of Rs 550, technology cost of Rs 2,000 and pesticide cost of Rs 7,500. Ecological farming has no expenditure in terms of seed cost, technology fee imposed on the seed and the cost of pesticide. Once there is shift in the farming system, from ecological to that of genetically engineered farming, the farmer has to bear Rs 10,500 per acre additional cost apart from other input costs such as labour costs.

As per 1997-98 figures the total area under cotton in India is 214 lakh acres. Therefore, if whole of the cropping shifts to genetically engineered cotton then nearly Rs 16,050 crore on pesticides and Rs 22,470 crore on entire cotton cultivation will be the added costs compared to the ecological option of internal input agriculture. The false comparison with chemical/industrial agriculture rather than with ecological organic agriculture is used to create the illusion of sustainability of genetically engineered crops.

#### INADEQUACIES OF BIOSAFETY REGULATIONS

The clearance of Monsanto's trials with toxic plants without the democratic consent of concerned governments, from state to local level and democratic participation of the public in biosafety decisions reveals the loopholes and inadequacies in the present biosafety regulations both from the democratic perspective and the ecological perspective. The trial produce has been freely marketed without adhering to any containment process.

The clearance for trials of genetically engineered crops and their release needs to be given not just by the central government but by all levels of government, from the state to the local level. Further, before any clearance is granted for trials of a particular genetically engineered crop the application for trials should be notified to the public as part of the citizen's right to know. Public hearings need to be organised in the specific villages and districts and states where the trials and introductions are planned.

The scientific framework for assessing the ecological impact of genetically engineered crops on biosafety, ecosystem health and public health also needs to be upgraded for dealing with the impact of field trials and deliberate releases under diverse ecological contexts existing in India.

If Monsanto and the Indian government fail to fulfil these ecological and democratic criteria for field trials of genetically engineered crops, we will have further evidence that the promotion of genetic engineering by corporations like Monsanto can only be based on dictatorial, distorted and coercive methods. In such context, genetic engineering in agriculture must necessarily be anti-nature and antipeople.

#### VI

# Need for Biosafety Regulations

The Monsanto trials with genetically engineered crops have clearly shown that there are many gaps and many weaknesses in the regulation of genetically engineered (GE) crops and there is an urgent need for strengthening the biosafety regulations in India.

#### REGULATORY ANARCHY IN GENETIC ENGINEERING

The trials have shown that under the present regulations it is possible for a company to perform GE trials secretly without prior informed consent of either the state government or the local community or gram sabha. The agriculture minister of Karnataka, Byre Gowda, learnt about the trials in his state through the newspapers. The agriculture minister of Andhra Pradesh said that the department of biotechnology had given the clearance for trials to Mahyco without informing the state government. The fact that it was Mahyco which got the clearance but Monsanto which carriedout the trials shows how much anarchy exists in approval for GE experiments and commercialisation.

The approval of trials should include prior informed consent of state governments or local communities or gram sabhas. The states should be included because agriculture is a state subject. People should be included because decentralised democracy and panchayati raj are commitments which have been made through the Constitution. The present regulations have no respect for the decentralised democracy required by panchayati raj. Nor do they have any room for public participation in decisions about genetic engineering either at the experimental stage or at the commercialisation stage. These lacunae must be filled to ensure democratic participation and decision-making.

The anarchy, chaos and confusion in the regulatory system needs to be stopped. This requires that all trials are stopped till biosafety regulation is made strong, coherent, scientifically sound and transparent through public participation.

#### PUBLIC MONITORING OF PRIVATE CORPORATIONS

The Monsanto trials have also revealed that the corporations pushing genetically engineered crops are simultaneously the judge and accused.

When Trade Related Intellectual Property Rights (TRIPs) Agreement of WTO was signed, a Monsanto representative had claimed that Monsanto with other corporations had shaped and designed the agreement. As they stated, "We were the physician, the diagnostician, the patient – all in one". In the area of biosafety too, Monsanto seems to be functioning as the diagnostician, physician and patient – all in one.

They are the source of information on biosafety, they carry out the trials without government and public monitoring and they themselves declare their activities as safe and causing no risks. The information on risks and status of the GMO are provided to GEAC by the company, not the government, ensuring that biosafety information is biased, not neutral.

The Andhra Pradesh government's order to Mahyco-Monsanto to stop trials and to only carry them out in the research stations of N G Ranga Agricultural University under the direct supervision of government scientists is a precedence that should be applied nationwide. Genuine biosafety requires that experiments with GMOs prior to commercialisation be carried out in the public system and not by the private firm that stands to gain through commercialisation and has nothing to lose if there is 'genetic pollution' and risks posed to the environment and public health.

The public system science and technology capacity in India is high. Our scientists have wider knowledge of plants and ecosystems than Monsanto's scientists or narrowly trained biotechnologists whose expertise is restricted to petridishes and does not cover ecological and ecosystem expertise. Public scientists with ecological expertise will therefore do a much more comprehensive job of assessing the ecological risks of transgenic crops than corporate scientists with biotechnology expertise. This will also ensure better monitoring and control over the trials.

In addition to experiments being carried out in public system institutes, public participation in the monitoring of trials is also essential.

# 'SUBSTANTIAL EQUIVALENCE'

The entire genetic engineering guidelines is based on the false assumption that GMOs behave like their naturally occurring counterparts. The guidelines are also based on the totally incorrect assumption that "G Eorganisms have greater predictability compared to species evolved by traditional techniques". Neither of these assumptions is true. GMOs do not behave like their naturally occurring counterparts and the behaviour of GMOs is highly unpredictable and unstable.

Naturally occurring *Klepsiella planticola* does not kill plants, but as research at the University of Oregon has shown, the genetically engineered Klepsiella was lethal to crops [Report of the Independent Group 1996].

The naturally occurring *Bacillus thuringiensis* (*Bt*) has not contributed to the evolution of resistance in pests, but the genetically engineered *Bt*-crops create rapid resistance evolution because the *Bt*. toxin is expressed in *every* cell of the plant, *all* the time [Shiva 1998]. The assumption of 'substantial equivalence' does not hold, and biosafety regulation is undermined because of this false assumption of substantial equivalence.

The assumption of 'predictability' is also totally false. While genetic engineering makes the *identification* of the gene to be transferred into another organism more predictable, the ecological behaviour of the transferred gene in the host genome is totally unpredictable. A transgenic yeast engineered for increased rate of fermentation with multiple copies of one of its own genes, resulted in the accumulation of the metabolite, mythylglyoxal, at toxic mutagenic levels. Intransgenic tobacco, 64 to 92 per cent of the first generation of transgenic plants become unstable. Petunias do not have unstable colouring, but genetically engineered petunias changed their colour unpredictability due to 'gene silencing' [Report of Independent Group of Scientific and Legal Experts on Biosafety 1996].

Monsanto's Round up Ready Cotton engineered to resist Monsanto's herbicide Round up, had its bolls falling off, an instability which does not occur in the naturally occurring cotton and was induced unpredictability due to genetic engineering of herbicide resistance. Monsanto has been sued for millions of dollars because of the losses incurred by farmers.

GMOs do not have greater predictability compared to species evolved through traditional techniques. Since the very assumptions underlying our genetic engineering guidelines are false, we need to evolve new biosafety regulations on the basis of honest and good science, after assessing all the independent scientific evidence available across the world. Guidelines based on anti-democratic structures and unscientific assumptions provide no safeguards for the public or the environment. Strong biosafety regulation with strong public participation is both a democratic and an ecological imperative. The public and the government needs to act immediately to prevent private corporations from unleashing irreversible genetic pollution through the release of G E organisms in the agriculture and the environment.

 A five-year moratorium should be introduced on all commercialisation of genetically engineered crops both through imports and through seed production and distribution in India while full and adequate ecological and regulatory frameworks for assessing the ecological impact of genetically engineered crops and public participation is evolved.

- The regulatory framework for genetic engineering is not just inadequate in India. It is inadequate worldwide. In the US, trials for such crops do not have any ecological dimensions. They only assess agronomic performance. The data from the hundreds of US trials is basically 'nondata from non-trials' in the ecological context.

- The large-scale seed failure pushing farmers to suicides create the need for strict certification and liability for the commercial seed sector. This issue of liability becomes urgent in the context of genetically engineered seeds which in addition to normal risks of seed failure have the potential of leading to genetic pollution and high ecological risks.

- The farmers' seed supply and direct exchange network must be strengthened through community control and local participation. Farmer's seed supply system must be treated totally distinct from the commercial seed supply system. While the commercial private seed supply system needs strong state regulation, farmer seed supply should function free of state interference with strong community control and public participation.

Biotechnology and genetic engineering in agriculture is evolving in a total regulatory vacuum as it is clear from the US situation. Monsanto itself states, "Monsanto should not have to vouchsafe the safety of biotech food"; "Our interest is in selling as much of it as possible. Assuring its safety is the FDA's job". FDA does not look at the safety of *Bt*-crops since such crops are treated as a pesticide. EPA which is supposed to look at safety of pesticides treats genetically engineered crops which produce pesticide as conventional crops and hence does not look at the safety either. There is, therefore, no agency guaranteeing the safety of genetically engineered crops. It is to fill this policy vacuum for environmental safeguards that citizens worldwide are calling for a five -year moratorium on genetic engineering in agriculture.

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