# Did Bt Cotton Save Farmers in Warangal?

## A season long impact study of Bt Cotton - Kharif 2002 in Warangal District of Andhra Pradesh

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# *About this study*

When the GEAC (Genetic Engineering Approval Committee) of the Government of India permitted the commercial release of Bt cotton hybrids, a new chapter was added to Indian agriculture. On the one hand there were hopes that Bt cotton would help reduce the pesticide use, increase the yield, and make the cultivation of cotton more economical and environmental friendly. And on the other, there were serious apprehensions that this would lead to increased pest resistance, antibiotic resistance, increased genetic pollution, destruction of biodiversity, and perpetual dependence on transnational agrochemical and seed companies. Thus, this decision evoked a mixed response from the farming communities and the civil society in the country.

Warangal District in Andhra Pradesh attracted the attention of the world a few years back, when more than 200 cotton farmers, caught in the vicious cycle of pests, pesticides and debts found no way out and committed suicide. Therefore, the district naturally became an area of interest for Governmental and Non-Government Organisations. For an agro industry like Mahyco-Monsanto Biotech Ltd., this was a God-sent opportunity to promote their GE technology. In Kharif 2002 they released two Bt cotton hybrids viz., MECH Bt 12, and MECH Bt-162 in Warangal district.

It is in this context that the Andhra Pradesh Coalition in Defence of Diversity[1] [APCID], and the Deccan Development Society, decided to initiate a systematic study in order to understand the facts in the field clearly, and make it available for a transparent public debate. The study was made possible through a strong support provided by the APCID's Warangal chapter and MARI (Modern Architects for Rural India), a leading NGO in Warangal. Two scientists Dr. Abdul Qayum and Mr Kiran Sakkari led the study, and got periodical assistance from Dr Ramanjaneyaloo.

The season long study involved all the stakeholders in the district: farmers who cultivated Bt and non-Bt hybrids, scientists associated with cotton, officials of the State agricultural department and the agricultural market committee, and the manager of a ginning factory.

I sincerely thank the scientists, who did this study and swam against the mainstream trends, a number of NGOs from the Warangal Chapter of the APCID, and its District Convenor Mr Damodar. Mr Murali of MARI was a major source of inspiration and support and we thank him profusely for his role in this study. So was Mr Ch. Kishan of MARI, who took us to the homes and farms of all the Bt farmers in the two focus villages along with Mr Krishnamurthy from Santi Service Society. We gratefully thank both of them.

Of the farmers who participated in the study, sharing their dreams and realities with us, we would like to offer very special thanks to Mr Nallapu Ramulu, Mr Palle Prabhakar Rao, Mr Yadagiri, Mr Ramanaiah, Ms Laxmamma and Ms Rama Devi, belonging to Kaapula Kanaparti and Chinta Nekkonda. They never showed any irritation over our presence and our questions. We also thank more than 500 farmers who participated in the focus group discussions and the subsequent questionnaire-based study. But for them, this study would have been soulless and sterile.

The women farmers of Community Media Trust, Pastapur, in Medak District of AP, were another driving force in the study. They relentlessly returned to Warangal, month after month, both in cold winter and searing summer, sought out their focus farmers, cajoled them to share their information and opinions, and came up with a stunning film. We admire and earnestly thank them for their efforts. Particularl mention must be made of the contribution of Eedulapalle Manjula, Matoor Shakuntala, Chinna Narsamma, Ippapalle Mollamma, Zaheerabad Punyamma and Humanpur Laxmamma. Yesu, who put the film together with the women, deserves special thanks.

Dr Raghavendra Manvi, who patiently went through the text of the study and carefully edited it, my colleague Giridhar, who as usual, was a solid support throughout the task, merit sincere thanks. And finally Janiah, Network Manager of DDS,who dedicated himself to facilitating the study, deserves a big,big thanks.

We hope the results presented in the report will trigger a healthy and informed debate about the Bt cotton and use of Genetic Engineering in agriculture, particularly with reference to small holder farmers. We would be very happy if this also inspires many other independent studies, which can look at genetic engineering from people's perspectives.

We earnestly believe that such independent studies are a great necessity, in the face of the reckless propaganda by the GE industry, to decide whether GE does save small farmers in India, and whether it is worth the environmental costs that it inflicts.

P V satheesh

June 5, 2003

Convenor, AP Coalition in Defence of Diversity

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[1] *Andhra Pradesh Coalition in Defence of Diversity [APCID] is a four year old network of over 140 civil society groups in Andhra Pradesh that promotes agrobiodiversity and ecological agriculture.*

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# *Acknowledgments*

We are extremely grateful to a host of civil society groups in Warangal lead by MARI. They include SEED, Pragati Shanthi Service Society,CROPS, Sarvodaya Youth Organization, SEVA, World Vision India, Rural development Foundation, and Rudrama MACS Society Ltd. They have helped us in more ways than one in making this study possible.

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# *Executive summary*

Bt cotton sold in Andhra Pradesh as "Bollgard" was marketed by Mahyco-Monsanto, a joint venture of a Jalna based Indian Seed Company Mahyco and Monsanto, a multinational seed and agrochemical company. Bt cotton, India's first GM crop, got the nod for its commercial cultivation in south India, in the month of March 2002. It was sown approximately in 9500 acres (one acre of land ~ 2500 $m^2$) in the state of Andhra Pradesh, which stands third in cotton cultivation in the country, with an area of 8,87,000 ha under cotton. The State also stands first in pesticide-useon cotton crop.

The Warangal district of Andhra Pradesh, a major cotton district, was the centre of negative attention as over 150 farmers, unable to come out of the debt trap they had entered into by following cotton cultivation, found no better alternative to suicide. In spite of this, about 10-20% more land was brought under cotton cultivation the very next year. In the wake of this situation, the approval given in March 2002 by the Government of India's Genetic Engineering Approval Committee [GEAC], for commercial cultivation of Bt cotton naturally received very high attention in Andhra Pradesh.

Following the GEAC approval, approximately 1200 farmers of Warangal district planted Bt cotton over 1500 acres in Kharif 2002-03. Since such a commercial scale cultivation of Bt cotton was taking place for the first time in the State, the Andhra Pradesh Coalition in Defence of Diversity, a coalition of over 140 civil society groups in the State, decided to commission a scientific study on the results of Bt. Two agricultural scientists, Dr Abdul Qayum, formerly Joint Director of Agriculture, Andhra Pradesh, and Kiran Sakkari, who had worked with ICRISAT for three years, led the scientific study.

Simultaneously, the Community Media Trust, a remarkable media group of rural women farmers, based in Village Pastapur of Medak District, were entrusted with the responsibility of a systematic documentation of the experiences of a few selected Bt farmers at regular monthly intervals, from August-2002 till the end of the crop season i.e., March 2003.

The results of the study indicate that the cost of cultivation for Bt cotton was Rs.1092 more than that for non-Bt cotton because there was only a meager reduction

in the pesticides consumption on Bt crop. On an average, there was a significant reduction (35%) in the total yield of Bt cotton, while there was a net loss of Rs 1295/ in Bt cultivation in comparison with non-Bt cotton, where the net profit was Rs 5368/-. Around 78 per cent of the farmers, who had cultivated Bollgard this year, said they would not go for Bt the next year. The survey also reveals that 71 per cent of the Bt farmers incurred loss at the end of the season, whereas only 18 per cent of the non-Bt farmers had to face this unfortunate situation.

The study also points to the deep disappointment of farmers over the performance of Bt cotton, and that too in the very first year of its commercial cultivation. Many farmers who have grown this crop are angry about its paltry performance and express their great anguish over the hype created among the farming community, by way of overt propaganda, that Bt is a miracle seed that can resist the pest, and thereby improve the yield. It has not only shattered the hopes of scores of farmers, but has also thrown them deeper into a biological trap.

## Objectives

The study was planned to serve the following objectives.

1. To document the experiences of Bt cotton farmers in the Warangal district of Andhra Pradesh.
2. To map the economics of Bt cotton cultivation vis à vis popular cotton hybrids.
3. To document the perceptions and future plans of multiple stakeholders with regard to Bt vis a vis popular hybrids.

## Methodology

The study has been conducted in three different patterns. The details are as follows;

1. A season-long research was initiated in two villages of the District where 22 farmers had planted Bt. Two farmers were selected randomly from each village, and throughout the crop season, these farmers were interviewed every month. Simultaneously, their experiences about the performance of the crop were captured on video by the Community Media Trust of Pastapur village. The video documentation started in the month of August-2002 and continued till the end of the crop season i.e., till April-2003.
2. A mid-season exploratory study involving 21 farmers spread across 11 villages in the district was conducted to assess the performance of the crop across the district (in November 2002).
   - The midseason exploratory study selected and visited 21 farmers cultivating Bt cotton in Kharif 2002 from 11 villages, and representing a variety of ecosystems in the district. The study team visited the fields and interviewed

the farmers (individually and in groups). While these 21 farmers remained primary respondents, focus group discussions were also held in their villages on their experiences with Bt cotton cultivation. In each of these focus groups there were approximately 15-20 farmers. Thus the total number offarmers who were consulted on the issue of Bt through the Exploratory Study, was more than 200.

- The study team had discussions with different stakeholders in the district involving farmers, scientists, the market committee Secretary, and the Manager of a Ginning Mill, on the performance of the crop till mid November 2002, during the midseason study.

3. In April 2003, at the end of the cropping season, an extensive survey was conducted by randomly selecting 225 farmers out of around 1200 farmers who had taken up the cultivation of Bt cotton in Warangal district. They constituted about 20% of all Bt farmers in the District.

Of the 225 farmers surveyed, 86 farmers [38.2%], had land holdings up to 5 acres, 84 [37.4%] had 5-10 acres, and the remaining 55 [24.4%] had more than 10 acres of land.

Key Findings

**1. Pest intensity**

- The initial sucking pests like aphids and jassids were absent in both the Bt and non-Bt during the first 30 to 35 days after germination, since all the hybrid seed sold in the market is pre-treated with Imidachloprid. However, from early October, when the crop was about 80 to 90 days old, moderate to heavy infestation of aphids and white flies was reported throughout the area, more prominently on Bt than on non Bt crop.
- Even the dreaded pest Helicoverpa armigera was at the lowest level till early to late October. From November 2003 onwards, the bollworm infestation increased. Later, from December onwards, pink bollworm infestation was more predominant both in Bt and in non-Bt crops.

**2. Comparative performance of Bt and Non-Bt**

**a.** Bt flowered earlier than non-Bt

**b.** Bt plant was shorter, had lesser branches, thereby reducing its yield.

**c.** Bt had smaller boll size

**d.** Bt showed higher characteristics of premature drying and boll shedding

**e.** Bt was less tolerant to abiotic stress

**f.** Bt had 10% less of American bollworm infestation compared to non-Bt and 10% more sucking pest attacks compared to non-Bt

**g.** Bt had less number of cotton pickings compared to Non-Bt.

**h.** Bt had twice as many seeds as non Bt, thus reducing the quantity of lint

### 3. Economics of Bt & Non Bt

- Cultivation costs of Bt cotton was Rs.1092 more than that of Non Bt cotton.
- Seeds of Bt cotton were nearly Rs.1100 more expensive than Non Bt.
- Bt farmers had to spend just a shade less, Rs.70 per acre in comparison with Non Bt farmers on plant protection, the raison d'etre for Bt cotton cultivation
- The average yield for Bt farmers was 4.5 quintals per acre, which was 2.4 quintals less than that of Non Bt farmers who got a yield of nearly 7 quintals per acre.
- The market price for Bt cotton was around Rs.2080 a quintal, which was roughly Rs.100 less than the price fetched by non-Bt hybrids.

- All these factors together resulted in Bt farmers netting a return that was nearly Rs.6663/- less than that of Non-Bt farmers. While Bt farmers had a net loss of Rs.1295/- per acre, non-Bt farmers earned a profit of Rs.5368/- per acre.
- While 71% of Bt farmers reported losses, only 18% of non-Bt farmers reported losses.
- In terms of profits, while 29% of Bt farmers reported profits, 82% of non-Bt farmers had gained profit.

Biosafety Concerns

- The refugia followed by farmers were not monitored by any regulatory authority. Mahyco Monsanto had completely abdicated their responsibility for this. This raises serious concerns about the possibility of genetic pollution since the Bt cotton pollens can transfer themselves to cotton in adjacent fields.
- Similarly the regulatory authority totally failed to monitor or control the mixing of Bt and non Bt cotton at the market yard. To offset their loss due to reduction in the price of the seed Bt cotton, almost all farmers resorted to mixing of Bt and non-Bt seed cotton before marketing. This has raised severe anxieties about the entrance of GM crops into the food chain, since cottonseed is used as feed for cattle [which can enter the human food chain through milk]. Further, cotton oil is used in cooking.

■

# *1. Introduction*

Cotton, popularly known as "white gold", is an important commercial crop not only in India but also in all the countries where it is under cultivation. India ranks second among the cotton countries with around 8.9 mha of land under cotton cultivation. Cotton is a big market for the hybrid seed companies, pesticides companies and non-formal credit suppliers, many a time bundled together and labeled as 'input dealer'. In India, the input dealers play a major role in the promotion of the products/ agri-inputs.

Cotton cultivation has been rapidly extended in Warangal District in Andhra Pradesh during the past two decades. This extension has coincided with the frequency and intensity of insect pest incidence. The use of a variety of toxic pesticides on Helicoverpa and other pests has led to the development of pest resistance even to the latest 3rd or 4th generation insecticides. The two recent epidemics of Helicoverpa in 1997 and 2001 broke the backbone of the whole farming community in the district. Similar hardships are also reported from other districts in AP. The increasing need for expensive insecticides and resulting resistance have forced the indebted and frustrated farmers to commit suicide.

This was perhaps the overriding factor that prompted Mahyco Monsanto Biotech Ltd. to get the approval for release of genetically engineered Bt cotton hybrids MECH Bt-12, MECH Bt-162 and MECH Bt-184 from the GEAC (Ministry of Environment and Forest, Government of India), for 3 years, i.e., from April 2002 to March 2005. Monsanto developed these cotton hybrids by inserting genes responsible for the production of Delta-endotoxin from a soil bacterium Bacillus thuringiensis. This had earlier been released for commercial cultivation in 1996 as "Bollgard" in the US and "Ingard" in Australia. ■

# 2. Need for the study

With the approval for growing Genetically Engineered cotton, the company promoted Bt cotton as environmentally safe and economically beneficial for the following reasons:

- It would reduce pesticide use
- It would reduce cost of cultivation and
- It would result in increased yields.

A lot of propaganda was made regarding the excellent performance of the Bt cotton in America and Australia, both in print and visual media. This encouragedmany enthusiastic farmers to take up Bt cotton cultivation in the district. Most farmers who purchased the seed were very hopeful that they would save a lot of money on the pesticides, and thereby would reap a good crop. So they came forward to pay more for Bt cottonseed.

At the same time, civil society groups and environmental organisations were very much concerned over the reports of likely contamination of neighboring cotton fields by the transmitted pollen from Bt plants, the development of cross resistance in insects, and anti-biotic resistant genes escaping into the environment— the problems associated with CaMV 35 S promoter and reports of large scale failures of Bt cotton in Gujarat, Maharashtra and Madhya Pradesh. In the midst of this huge concern, the Andhra Pradesh Coalition in Defence of Diversity[1] in general, and NGOs of Warangal district in particular, decided to initiate a systematic study on the performance of the Bt cotton in Warangal district.

## 2.1 Objectives

The study was planned so as to serve the following objectives.

1. To document the experiences of Bt cotton farmers in Warangal district of Andhra Pradesh.
2. To map the economics of Bt cotton cultivation vis à vis popular cotton hybrids.

[1] Andhra Pradesh Coalition in Defence of Diversity [APCDD] is a four year old network of over 140 civil society groups in Andhra Pradesh that promotes agrobiodiversity and ecological agriculture.

3. To document the perceptions and future plans of multiple stakeholders with regard to Bt vis à vis popular hybrids.

## 2.2 Methodology

A season -long research in two villages in the district was initiated. In the first village, Chintanekonda, more that 20 farmers had planted Bt while in the second, Kaapula Kanaparthi, only two farmers had planted Bt. Two farmers were selected randomly from each village and throughout the crop season, these farmers were interviewed every month, and their experiences were documented.

- Simultaneously their experiences were captured on video by the Community Media Trust[2] of Pastapur village. The video documentation started in the month of August-2002 and continued till the end of the crop season i.e., till April-2003.
- A mid-season exploratory study involving 21 farmers spread across 11 villages in the district was conducted in the month of November-2002 to assess the performance of the crop across the district.
- The study team had discussions with different stakeholders in the district involving farmers, scientists, the market committee manager, and the ginning mill manager during the midseason study, on the performance of the crop till mid November 2002.

Later, in the month of April-2003, an extensive survey, using an interview schedule was organised with a sample of 225 farmers, (approximately 19% of the total Bt cotton farmers in the District) covering a variety of ecosystems representing the different agro-climatic regions across the Warangal district.

## 2.3 Selection of respondents

During the midseason exploratory study, 21 farmers from 11 villages cultivating Bt cotton during the current season (Kharif, 2002) were selected in a way that covered a variety of ecosystems, all representing the different agro-climatic regions of Warangal district.

The group also provided a forum for general discussion on weather and soil moisture conditions, other popular cotton hybrid varieties, sowing dates, intensity of pests anddiseases in cotton, measures taken by farmers, harvest and market situations besides the specific objectives.

[2] Community Media Trust is a remarkable six year old media group of rural women, all of them farmers themselves. The group operates from Pastapur village in Medak District of Andhra Pradesh.

While these 21 farmers remained primary respondents, focus group discussions were also held in their villages on the experiences of the Bt cotton cultivation. In each of these groups there were approximately 15-20 farmers. Therefore, the total number of farmers who were consulted on the issue of Bt through the exploratory study was more than 200, which is approximately 18% of the total Bt farmers in the District.

In April 2003, i.e., at the end of the cropping season, a large survey was conducted by randomly selecting 225 farmers out of around 1200 farmers who have taken up the cultivation of Bt cotton in Warangal district. They constituted about 20% of all Bt farmers in the District. The survey was carried out in 69 villages covering 17 mandals of the district. In order to elicit unbiased responses, the selected farmers were individually interviewed with the help of a pre-tested interview schedule.

## 2.4 Data Collection

Data was collected from each individual farmer on the following aspects. (Detailed interview schedule is enclosed in the Annexure)

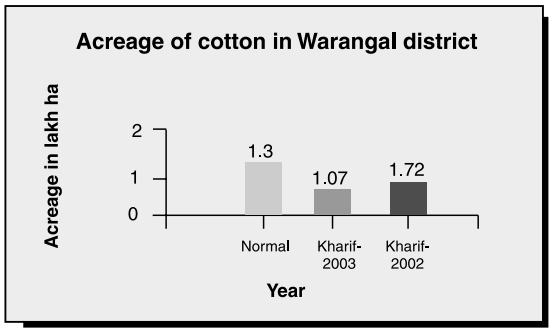
- Area under cotton cultivation in her/his field
- Performance of both Bt and non Bt cotton on her/his field
- Intensity of pests & diseases in cotton (both Bt and non Bt) in their field at different stages
- Control measures taken up by her/him (in both Bt and non Bt) on her/his field
- Economics of cultivation of both Bt and non-Bt cotton on her/his field
- Her/his perceptions and future plans with regard to cultivation of Bt cotton

## 2.5 Season and sowing

Although the average rainfall of Warangal District is almost 900 mm, there are wide variations across the district, deficit rain in the southern parts to moderate in the central part and high in the north and northeastern parts of the district. Kharif 2002 was a season of extremely erratic rainfall marked by long dry spells and high day temperatures. As against the normal practice of starting sowings in the second week of June, the sowings this time were delayed and staggered, and were taken up from mid June to late July, in some places extending even up to the first week of August.

## 2.6 Weather situation

Farmers were worried over inadequate rains and consequent delayed sowing. Due to the severe pest outbreak, witnessed during the preceding cotton season (Kharif



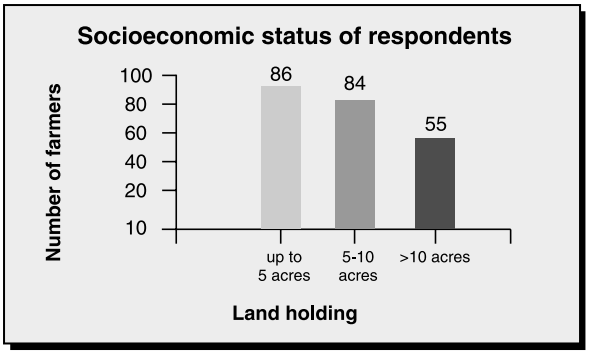

2001), many of the cotton farmers individually reduced their area of cultivation in the current Kharif season by about 25%. This was confirmed by the Joint Director of Agriculture, Warangal, who said that coverage under cotton during Kharif 2002 was only 1.07 lakh ha as against the normal area of 1.30 lakh ha and the high of about 1.72 lakh ha witnessed in Kharif 2001. ■

# 3. Data Analysis and Results

The data collected from the farmers, institutions, market committee and processing industry are summarised and presented below.

## 3.1 Socio-economic Profiles of the respondents

Of the 225 farmers surveyed, 86 farmers [38.2%] had land holdings up to 5 acres and 84 [37.4%] had 5-10 acres and the remaining 55 [24.4%] had more than 10 acres of land. They have been cultivating all the important crops including cotton for the last 15 to 20 years. They were well aware of popular varieties and hybrids of



cotton, its pests and diseases, and had access to print and electronic media, either directly or through their family members. One can conclude that these were aware farmers and clearly knew why they were venturing into Bt apart from knowing how to grow it.

### 3.2 Distribution of seed of Bt cotton hybrids

In Warangal district, Mahyco-Monsanto company distributed to farmers 1550 packets of Bt MECH-162 and 28 packets of Bt MECH-12. The cost of seed was Rs.1600 per packet of seed, sufficient for sowing in an acre (each seed packet contains 450g of Bt hybrid seed and 120g of non-Bt, but same hybrid seed for use as refugia). Farmers had signed an agreement at the time of the purchase of seed, with the company agreeing to follow all the conditions imposed by GEAC, which were printed and distributed by the company along with the seed packets.

**Table 1. Distribution of seed of Bt varieties in Warangal District for Kharif- 2002**

| No. | Hybrids | No. of packets |
|---|---|---|
| 1. | MECH-162 | 1550 |
| 2. | MECH-12 | 28 |
| | Total | 1578 |

**Source: Personal discussion with JDA, Warangal on 21st November 2002*

### 3.3 Pest intensity

The initial sucking pests like aphids and jassids were absent in both the Bt and non-Bt during the first 30 to 35 days after germination, as all the hybrid seed sold in the market is pretreated with Imidachloprid. However, from early October, when the crop was about 80 to 90 days old, moderate to heavy infestation of aphids and white flies was reported throughout the area, more prominently on Bt than on non Bt crop.

By and large there were unanimous reports in all the group meetings and individual interviews, that there was much less pest load till the end of September. Even the much dreaded pest "Sanaga pacha purugu" (Helicoverpa armigera) was at the lowest level till that time. (Scientists opined that, dry and hot season has a suppressing effect on this pest). From the month of November, the bollworm infestation increased. Later in the same month, pink bollworm infestation was more predominant both in Bt as well as non-Bt crops.

**Table 2. Comparative performance of both Bt and non-Bt cotton crops**

| S no | Characteristic | Comparative results | |
|---|---|---|---|
| | | Bt | Non Bt |
| 1 | Flowering | 15-20 days early | 15-20 days late |
| 2 | Height of the plant | About 90-110 cm | 115-130 cm |
| 3 | Boll size | Smaller | Larger |
| 4 | No of bolls / plant | 40-45 more than non Bt | 40-45 less than Bt |
| 5 | Premature drying and shedding of bolls | More | Less |
| 6 | Tolerance to abiotic stress conditions | Less | Moderate |
| 7 | Staple length | Short | Long |
| 8 | No of seeds per boll | 30-35 | 16-20 |
| 9 | Pest incidence<br>• Bollworm<br>• Sucking pests | <br>71 %<br>29 % | <br>81 %<br>19 % |
| 10 | No of pickings | Less | More |

The above table gives the comparative expression of different qualitative characteristics of the Bt crop in the field in 2002-2003 vis-à-vis popular non-Bt cotton hybrids. As can be seen from the table, the Bt hybrid was most affected by the prevailing weather conditions. It was also evident that though the number of bolls per plant was more on Bt hybrid, they suffered from heavy premature drying as well as boll shedding. Small boll size, and short staple length which appear to be the genetic character of MECH Bt 162, affected the market preference as well as the price of seed cotton.

To offset the reduction in the price of Bt seed cotton, almost all farmers resorted to mixing of both Bt and non-Bt seed cotton before marketing, thus paving way for

GM crops to enter the food chain, since cotton seed oil is used in cooking in India, and the seed is a feed for milch cattle. *THIS IS AN EXTREMELY CRITICAL BIOSAFETY CONCERN, AND IT INDICATES THE TOTAL FAILURE OF REGULATORY MECHANISMS.*

Another important finding of the study was that the number of seeds per boll in Bt cotton was more compared to non-Bt hybrids, which affected the lint to seed proportion as well as its price. The number of pickings from Bt crop were at least two times less than non-Bt hybrids, as pickings from non-Bt crop extended till March, where as pickings from Bt crop closed by late December /early January, in most of the areas.

When asked about their perception on the damage caused by different pests, while 81 percent of non-Bt farmers blamed the bollworm the most, 71 per cent of Bt farmers too had similar things to say about the pest. Therefore, the crop damage caused by the bollworm (which the Bt primarily claims to fight) was almost equal both in Bt and non-Bt.

On the other hand, most farmers expressed the view, that sucking pests attacked their crop more in Bt than in non Bt. This implies that even though there was some reduction in the incidence of Bollworm in Bt cotton, there was, however, a simultaneous increase in the incidence of sucking pests on Bt crop. This fact has almost leveled farmers' expenses on the use of pesticides. The results of the extensive survey are presented below.

### 3.4 Economics of Bt cultivation

**Table 3. Economics of cultivation of Bt and Non Bt cotton**

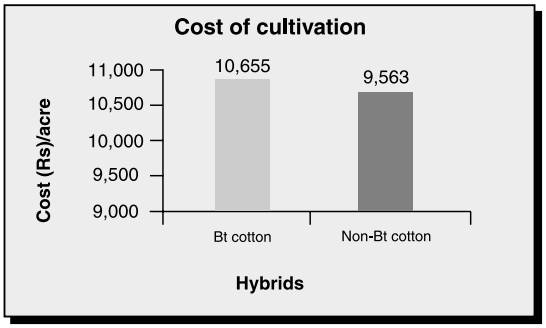
| S no | Characteristic | Comparative results | |
|---|---|---|---|
| | | Bt | Popular hybrids |
| | Total cost of cultivation/acre | Rs10,655/- | Rs 9563/- |
| 1 | Cost of seed / acre | Rs 1600/- | Rs 450-500/- |
| 2 | Expenditure on plant protection per acre | Rs. 2909/- | Rs. 2971/- |

| | | | |
|---|---|---|---|
| 3 | % of expenditure on plant protection chemicals to total cost of cultivation | 27 % | 31 % |
| 4 | Average yields per acre | 4.5q | 6.9q |
| 5 | Market price per quintal of seed cotton | Rs 2080/- | Rs 2164/- |
| 6 | Net returns/acre at the end of cropping season | (-) Rs 1295/- | Rs 5368/- |
| 7 | No of farmers who incurred loss | 160 (71%) | 40 (18%) |
| | • > Rs 10,000/- | 3 (1.3%) | 1 (0.4%) |
| | • Rs 7501- 10,000 | 15 (6.7%) | 2 (1%) |
| | • Rs 5001-7500 | 33 (14.6%) | 0 (-) |
| | • Rs < 5000 | 109 (48.4) | 37 (16.6%) |
| 8 | No of farmers who gained profit | 65 (29%) | 185 (82 %) |
| | • Upto Rs 5000/- | 39 (17.4%) | 67 (29.7%) |
| | • Rs 5001-7500/- | 4 (1.8%) | 28 (12.4%) |
| | • Rs 7501-10,000/- | 9 (4%) | 20 (8.9%) |
| | • Rs >10,000/- | 13 (5.8%) | 70 (31%) |

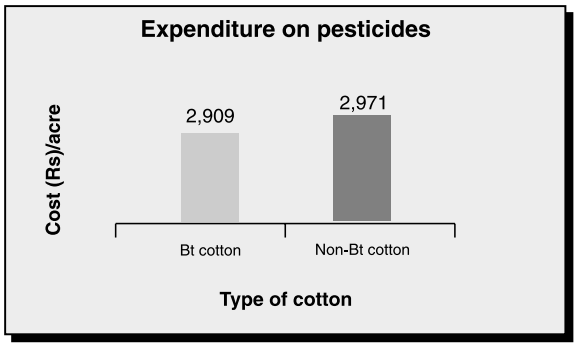
From the above table, one can very easily infer that of the total number of Bt farmers who were sampled for assessing losses due to cotton cultivation, 48% suffered losses up to Rs 5000/- per acre, while 22.6 per cent suffered losses above Rs.5000/- per acre. On the other hand, 16 per cent of the non-Bt farmers suffered losses up to Rs. 5000/- and only a meager percentage, 1.4% suffered losses more than Rs.5000/-. Further, while a sizeable 31% of the non-Bt farmers gained a net profit of more than Rs.10,000/- per acre, only 5.8 per cent of Bt farmers could manage to gain more than Rs.10,000 per acre.

### 3.6 Salient observations made during the study

The table shows that, on an average, cost of cultivation of Bt crop was Rs 10,655/- where as for non-Bt it was Rs9563/-. It clearly reveals that cultivation of Bt costs Rs1092/- more than the cost of cultivation of non-Bt cotton.

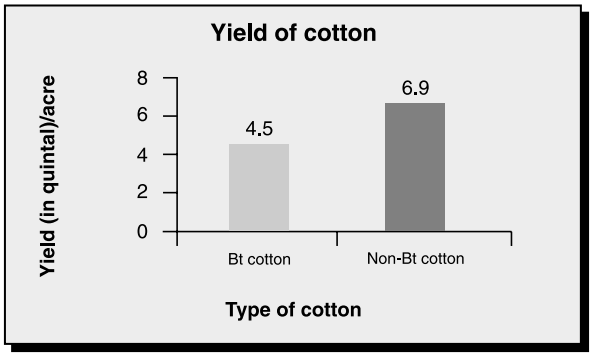



Farmers who cultivated Bt cotton spent 15 per cent of the total cost of cultivation on the seed as against 5 per cent in case of non Bt farmers, with the hope that it would reduce their spending on the pesticide sprays and improve their yields substantially. Bt farmers had to pay Rs 1600/- towards the seed cost where as non Bt farmers spent Rs 450-500/- per acre, which means they had spent almost Rs 1100/- more just on the seed cost.



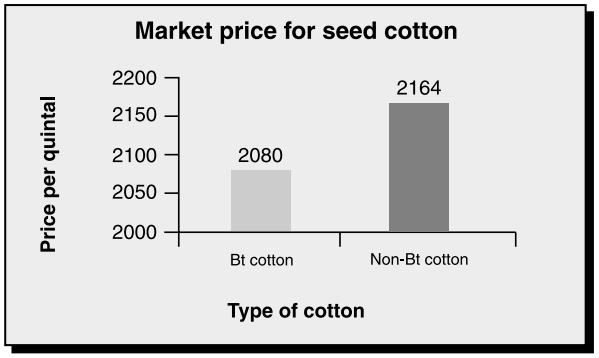

The survey revealed that, on an average, the expenditure on plant protection per acre was Rs 2909/- on Bt while it was Rs 2971/- for non Bt. This shows only a marginal decrease (Rs 62/- per acre) in the use of pesticides on Bt crop. On an average, a Bt farmer had to spend 27% of the total cost of cultivation on plant protection, where as a non Bt farmer spent a marginally higher amount on plant protection i.e. 31% of the total cost of cultivation of the crop.

In terms of final yields, the duration of Bt crop in the field was less compared to non-Bt hybrids. Bt cotton was completely harvested by January [seven months after its sowing] while Non Bt stayed on the field until March, giving it a two-month advantage. The number of pickings was therefore reduced in Bt Cotton, affecting its total yields. On an average, a non-Bt farmer reaped a harvest of 6.9 Q per acre whereas a Bt farmer had to be satisfied with just 4.5 Q per acre, suffering a net 35 per cent decrease in the yield per acre.




To deduce, in spite of spending more on seed, a Bt farmer had only a marginal reduction (4%) in pesticide costs, only to end up with a substantial, 35 % loss in the final yields.

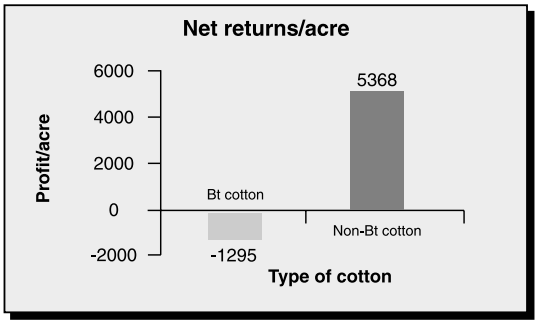
### 3.7 Market Rejection

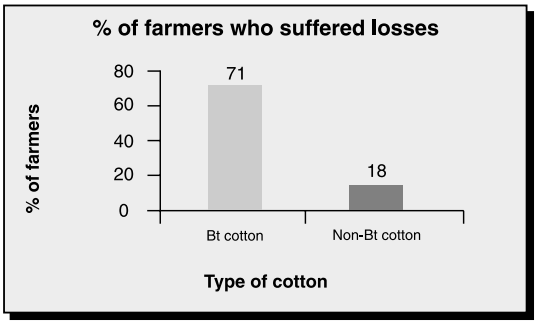


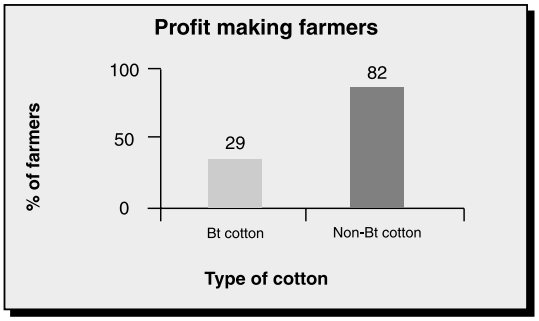

In addition, Bt. cotton fetched Rs 2080/- per quintal (even after mixing both Bt and non Bt seed cottons to offset the risk of f lower price for the Bt seed cotton) where as a pure non-Bt seed cotton fetched an amount of Rs. 2164 per q. The farmers said that there was a reduction of Rs 200 to Rs 300 per quintal of Bt seed cotton compared to non-Bt seed cotton in the market.

To a question in the study, whether there was any improvement in the yields with the cultivation of Bt, 64.5% of the farmers categorically said that there was no yield improvement, while 2.2% said that the yield was same as that of other hybrids. Only 7.5 per cent of farmers said there was an improvement in the yield. Interestingly, 25.8 per cent of the farmers asserted that the yields had gone down with the cultivation of Bt crop. This may be due to early maturity of the crop compared to non-Bt hybrids. In most cases, Bt had completed yielding by late December or early January where as non-Bt hybrids continued to yield until March. Therefore, Non Bt hybrids had a two month longer yielding period compared to Bt.

When the net returns were taken into consideration, a non-Bt farmer obtained Rs 6663/-more than the Bt farmer per acre, a five times bigger net. The study further revealed that, 71 % of the Bt. farmers experienced losses due to Bt. cultivation, where as only 18 per cent of non-Bt farmers incurred losses.




## *4. Use of pesticides on Bt and non-Bt crops*

With regard to the use of pesticides on Bt crop, 66 per cent of the farmers opined that there was no reduction in the overall pesticide use on the Bt crop compared to non-Bt.

Data from 50 farmers were analyzed on the use of pesticides on Bt and non-Bt crops both before 90 days of the crop duration and after 90 days of crop duration. This was important to test the claim of the Mahyco-Monsanto that the Bt effect lasts on the crop until 90 days and after that period it wears off. To what extent this effect works was an important determinant in the study.

While this data could not be collected for all the farmers, since many of the farmers do not have either recorded data or could not specifically recall the timing of the pesticide sprays, with at least fifty farmers, about 20% of the sample size,

this data was available. This data was separately analysed in order to understand the pattern of pesticide consumption in two spells i.e., before 90 days and after 90 days.

**Table 4. Use of pesticides before and after 90 days of crop duration**

| S no | Pest on which chemical spray was taken up | Cost of plant protection on Bt | | Cost of plant protection on Non Bt | |
|---|---|---|---|---|---|
| | | Before 90 days (RS) | After 90 days (Rs) | Before 90 days (RS) | After 90 days (Rs) |
| 1 | Sucking pests | 955/-(30%) | 86/-(3%) | 998/-(29%) | 102/-(3%) |
| 2 | Bollworms | 432/-(13%) | 1713/-(54%) | 439/-(13%) | 1871/-(55%) |
| 3 | Total | 1387/-(43%) | 1799/-(57%) | 1437/-(42%) | 1973/-(58%) |

**As can be seen from the above table, the total cost involved in fighting different pests was as follows**

| Type of pest attack | Expenditure incurred Bt | Total and as % of cost of cultivation Non-Bt |
|---|---|---|
| • Bollworm | Rs 2145/- (67%) | Rs 2310/- (68%) |
| • Sucking pests | Rs 1041/- (33%) | Rs 1100/- (32%) |
| • Total | Rs 3186/- (100%) | Rs 3410/- (100%) |

From the above table it is very clear that, there was no significant difference in the use of pesticides both on sucking pests as well as on bollworms in either case (before 90days and after 90days).

This completely belied the Monsanto claim that Bt will eliminate Bollworm attack in the first 90 days.

It was also evident from the table that use of pesticides was more after 90 days of sowing of the cotton crop, that too mostly for the control of bollworms, both on Bt and non-Bt crops. This clearly shows that, consumption of pesticides was higher on bollworms after 90days of the sowing of the crop. Bt does not offer any protection for this phenomenon. If it tries to do that it significantly increases the chances of development of early resistance in pests, thereby making Bt even more ineffective. ■

# 5. *Farmers' preferences and perceptions*

With regard to their future preference for Bt crop there was a variety of answers:

- 50.7% farmers categorically said that they would not plant Bt crop again.
- 12.5 % said that they will not grow Bt again as the yields were less compared to other non-Bt hybrids.
- 11.1 per cent said they would not grow Bt in the next year, as cost of cultivation was higher than non-Bt crop.
- 4.4 per cent showed interest in growing the Bt crop again without any hesitations,
- 8 per cent opined that they would try again to have a full understanding of the crop to see as to how it performs in the normal season.
- 8.9 per cent said that they would go for Bt again if a better hybrid with good boll size is available.
- Only 0.4 per cent of the farmers were undecided about their future plan.

In addition to the above responses, farmers in general have the following opinions regarding Bt cotton.

- Premature drying of bolls and their shedding.
- It was very much susceptible to moisture stress and drought situations compared to non-Bt hybrids.
- Bt plants were more brittle leading to breaking of the branches / plant making interculture operations difficult.
- There was around 10 per cent reduction in the bollworm in the first 90 days compared to non-Bt hybrids. But Bt crop was more susceptible to sucking pests compared to non-Bt hybrids.
- Staple length of cotton lint of Bt hybrid was shorter than the conventional hybrids that are under cultivation.
- Picking from a Bt cotton crop was more time consuming, requiring more number of labour to harvest the crop, making the investments on the picking higher, compared to non-Bt hybrids.
- Market price for Bt. was less by 10%. Therefore, in order to offset the difference, farmers mixed both the Bt and non-Bt before marketing. ■

# 6. Biosafety issues

## 6.1 Planting of refuge

All farmers have admitted compliance with the advice of Mahyco-Monsanto to planting border rows of non-Bt hybrids in 3 to 5 lines as refuge. This was conveyed to them through audiocassettes and product-literature supplied along with the seed packets. All other treatments like spacing, manure and fertilizers application were the same for Bt, refuge, and non-Bt cotton hybrids.

When asked about the purpose of the refuge, no clear information was available.Most farmers said that it was to serve as a barrier or trap crop for the migrating moths and caterpillars, or to prevent transfer of pollen to other plants and varieties. The scientific literature however, says that refuge is to serve as a host for the susceptible bollworms, to be available for mating with surviving resistant insects in order to delay the development of resistance.

There was no proper mechanism to monitor whether or not refuge was planted in the farmers' fields. In addition, the technicalities pertaining to planting the refuge were also not clearly mentioned in the approval given to Mahyco-Monsanto by GEAC. The study team also could not find remarkable difference between the refuge crop and the main crop in the field.

## 6.2 Mixing of seed cotton

In Warangal, all the farmers who had grown Bt crop witnessed a drop in the price for their produce as well as less preference by the traders. So they had resorted to mixing of the both Bt and non-Bt seed cotton to offset the drop in the price as well as to push their Bt produce under the cover of non-Bt seed cotton.

Another important reason for mixing Bt and non-Bt was the shorter staple length of the Bt seed cotton. As Bt seed lint was attracting less price and preference from the market, they had mixed the two before taking their produce to the market.

## 6.3 Fear of GM contamination in the food chain

GEAC was silent on these issues as there are so many fears from different groups that oil from these seeds (GM seeds) would find its presence in the food chain,

which might lead to unknown diseases. There was no monitoring and regulation at any level to check the mixing of Bt crops with non-Bt crops. Cottonseed oil is normally used in cooking and vanaspati in India. In addition, GM contamination might enter into the food chain through the use of cotton seed cake for fodder purposes. ■

# *7. Perceptions and opinions of non farmers*

## 7.1 Agricultural Research Station, Warangal

The Senior Scientist and the head of the institute suggested that a better host type among cotton strains could have been selected to suit various agro-climatic situations of the state of A.P. The Bt-162 hybrid did not seem to withstand moisture stress situations. For better price, long staple superfine cotton is needed for Warangal district.

## 7.2 Agricultural Market Committee

The special grade secretary of market Committee said that

a. The farmers are mixing the seed cotton of indigenous hybrids and Bt cotton hybrid. The mixture of the long stapled non Bt hybrids with short stapled Mech Bt-162 stands to lose by 10% of the value compared to pure local hybrids of better staple length.

b. At present, neither do they have the capacity to handle the stocks of two types separately nor could they provide separate yards.

c. This year arrivals of seed cotton for sale are only 25% of the last year's, due to delayed rains and reduction of area under cotton (till November 2002).

d. According to the procedures involved, the purchasers offer secret tenders for purchase price based on whiteness, presence of moisture, full exposure of bolls, staple length, presence of foreign material, insects and mutilated bolls. He advised that farmers should be apprised of these standards.

7.3 Joint Director of Agriculture, Warangal

According to the Joint Director of Agriculture, Warangal, the area under cotton in Warangal District in Kharif 2002 had fallen to 1.07 lakh ha from 1.72 lakh ha in 2001. This was a reduction of 25% in the normal area.

He felt that Bt should have been field tested for two more years to arrive at a valid and precise opinion.

He observed that a variety of adverse reports on the crop were being received, which might be due to very adverse and erratic weather, especially drought.

7.4 Manager of Kakatiya Ginning Mill

1. Ginning is done lot- wise which contains more than one variety
2. The lint is mostly sold in Tamil Nadu firms for manufacturing yarn.
3. Oil mill owners of Gujarat and Haryana states (where it is milled for oil and cake) mostly purchase the cottonseed.
4. He was aware of the claim that Bt cotton is specifically cultivated to protect the crop from Helicoverpa. He was not aware of the percentage of toxin in the seed. ■

# *8. Observations of the study team*

After exhaustive discussions with farmers at village level, officials of the Department of Agriculture, Market Committee, Ginning Mill and the scientists of the Research Station at Warangal, the study team has arrived at the following observations:

1. High price of the seed is a strong deterrent and some farmers may resort to resale under stress conditions which is an offence under "Intellectual Property Rights".
2. MECH Bt 162 appears to mature 15-20 days earlier than non-Bt hybrids.
3. The bolls of Bt-162 contain about 30 to 35 seeds, thereby reducing the proportion of lint, fetching lower price to farmers.
4. Picking of cotton from smaller bolls of Bt-162 consumes more time and cost under this head.
5. The performance of Bt under moisture and plant nutrient stress is not satisfactory compared to popular non-Bt hybrids.

6. The toxin content of seed may become a health hazard to cooking oil and cattle feed. This needs to be tested.
7. The faltering toxin content of the plant and seed during the crop period may encourage the development of resistance among Helicoverpa and other Lepidopteran pests. This would be a more serious problem than the pesticides. In future, finding a substitute of stronger toxin will lead to an unavoidable war between G.M. hybrids and the pest complex. It is already reported in some of the countries that the toxin has not been effective on the very 3rd or 4th generation of Helicoverpa. This should be a warning signal.
8. Farmers may retain the Bt cotton crop in the field even after 120 days, as in other hybrids of this area, by which time the toxin levels of the plant will be much less. Under these situations, the possibility of bollworm complex attaining resistance to Bt toxin would be much faster than expected.

In so far as GM hybrids are concerned, we feel that at present it is not a desirable proposition to replace the available hybrids and local varieties because of the following reasons.

1. The quest for developing plants, which have greater and greater resistance against dreaded insect pests, may prove to be unsustainable in the long run with the pest developing resistance. As in the case of toxic pesticides, wherein pests have been successful in developing resistance to the most toxic of pesticides, they may also succeed in overcoming the toxins produced by the genes. This situation may warrant more aggressive toxins to achieve the kill. This is a dangerous trend fraught with dreadful environmental consequences.
2. The farmer will have no security of seed and will also lose control over her/his own seed as per the laws made under Intellectual Property Rights.
3. Indebtedness of farmers will increase with greater dependence on external resources needed for the cultivation of the genetically modified crop.
4. Aggressive trade strategies will wipe out biodiversity, and endotoxins will devastate natural parasites, predators and soil borne pest pathogens. This will be an appalling holocaust for safe agriculture.
5. There is implicit and immediate need to critically examine the remnants of toxins in crop residues and the Bt cottonseed under storage and oil extraction process.

We once again emphasise that the policy of encouraging genetically modified cotton needs a wholesome review and critical examination from the point of view of environment, diversity and health. ■

# *Appendix*

## QUESTIONNAIRE

1. Name of the Farmer.....……S/o…… Date: ...……...

2. Village:….....…….Mandla:…….Caste:……

3. Land under cultivation
   a) Rainfed b) Irrigated

4.Crops cultivated by Farmer….....…….....

….....…….....…….....…….....

5. Extent of cotton under cultivation (give names of hybrids also)
   a) Bt cotton b) Non Bt cotton

6. Seeds purchased from?

7. Have you seen the Bt trial plot?

8. Management cost of cultivation

| S.No. | Description | Bt cotton | Refuge | Non-Bt cotton |
|---|---|---|---|---|
| 1 | Soil type | | | |
| 2 | Date of sowing | | | |
| 3 | Seed cost | | | |
| 4 | Ploughing cost | | | |
| 5 | Area under irrigation | | | |
| 6 | Area under Rainfed culitvaiton | | | |
| 7 | FYM others | | | |
| 8 | DAP (no. of bags) | | | |
| 9 | 17-17-17 ,, | | | |
| 10 | 19-19-19 ,, | | | |

| | | | | |
|---|---|---|---|---|
| 11 | Urea ,, | | | |
| 12 | Mop/Sop ,, | | | |
| 13 | Cost of water management | | | |
| 14 | Insects/disinfects That affected cotton (specify stage at which the crop was affected) | | | |
| 15 | Plant protection Chemical used (specify for which pest/ disease is was spray to<br><br>Total cost for pest management | | | |
| 16 | Affected which pest cotton crop mostly this year | | | |
| 17 | How many pickings did you get | | | |
| 18 | When was the last picking done? | | | |
| 19 | Labour cost for picking | | | |
| 20 | Total yield (no. Quintals) | | | |
| 21 | Rate/Quintal | | | |
| 22 | Total cost of cultivation | | | |
| 23 | Returns (yield x rate) | | | |
| 24 | Any others | | | |

9. Was there any reduction in Bolloworms & usages of pesticides with Bt cultivation?

10. Was there any yield benefit with Bt cotton (compared other non-Bt hybrid)?

11. Would you like to go for Bt again? If yes give reasons. If no give reasons?

Signagure of the Investigator Singature of the farmer