

Bt Cotton Vs. Non Pesticidal Management of Cotton – Findings of a study done by Centre for Sustainable Agriculture

A study was taken up by Centre for Sustainable Agriculture based on season-end interviews with cotton growing farmers in Warangal and Medak districts, to compare various aspects of Bt Cotton as a solution for pest problems in cotton crop and NPM (Non Pesticidal Management) approach as a solution¹. The following is the summary of the findings from this study.

Sample size and location:

A total of 121 NPM farmers (cotton growers who did not use any synthetic pesticides and grew NPM cotton on 193 acres) were compared with 117 Bt Cotton farmers (who grew Bt Cotton on 151 acres) for the purposes of this study. Out of the Bt Cotton farmers, 88 farmers grew MECH 12 Bt variety, 1 farmer grew MECH 184 Bt variety and 31 farmers have experienced the performance of RCH 2 Bt cotton (a few of the farmers have grown both MECH Bt and RCH 2 Bt in different plots and therefore, these numbers do not necessarily add up to 117 Bt Cotton respondents). In the case of NPM cotton, varieties used by the farmers include Brahma, Maruthi, Dasera, Gemini, Sumo, Tulasi, Bhagya, Durga, Kranthi etc.

Mandals surveyed for Bt Cotton farmers include Parvathagiri, Raghunathpalli and Sangem mandals in Warangal district (farmers drawn from 9 villages) and Thogunta mandal of Medak district (farmers drawn from 1 village). Therefore, 10 villages from 4 mandals in 2 districts.

Mandals surveyed for NPM cotton farmers include Parvathagiri, Devaruppala, Gundala, Raiparthi and Sangem mandals in Warangal district (11 villages) and Thogunta mandal of Medak district (farmers drawn from 1 village). Therefore, 12 villages from 6 mandals in 2 districts.

In Andhra Pradesh, 2004-05 saw around 182,000 acres planted with approved Bt Cotton varieties (93,374 acres with MECH 12 Bt, 1015 acres with MECH 162 Bt, 6420 acres with MECH 184 Bt and 81375 acres with RCH 2 Bt variety). There were also more than 7000 acres cultivated with NPM practices without the use of chemical pesticides in around seven districts of the state in the same season.

Scope of the study:

The study looked at the incidence of various pests and diseases as well as incidence of beneficial organisms in the Bt Cotton and NPM fields in addition to looking at the economics of pest management in Bt Cotton and NPM cotton on an average.

This study puts to question the current pest management paradigm in which Bt Cotton is being promoted as a safer and better alternative to conventional cotton cultivation, which has intensive use of pesticides. Bt Cotton is thought to be 'the' solution by the scientific establishment to the cotton pest problems and the industry likes to promote this on such 'humanitarian' grounds too (saving farmers from suicides, the industry said). However, Bt Cotton should be assessed to see if it is the best solution against safest successful approaches known right now including NPM. This study attempts such a comparison.

The study was designed and supervised by Dr S M A Ali, Entomologist; Dr G V Ramanjaneyulu, Extension Scientist and Ms Kavitha Kuruganti, development activist.

¹ More on NPM can be found in the accompanying booklet called "No Pesticides, No Pests"

Findings of the study:

The following are the findings from the study. The first set of findings is against incidence of harmful and beneficial insects in Bt Cotton and NPM fields. This is for bollworm complex as well as sucking pests. The next set of findings is for wilt. This is followed by incidence of beneficial insects in the cotton field.

Findings also include economics of pest control in Bt Cotton and NPM cotton in the case of pesticides used and pest management expenses.

Incidence of Bollworm complex: (Bt Cotton n=117; NPM n=121)

Level of incidence	Spotted Bollworm		American Bollworm		Tobacco Caterpillar		Pink Bollworm	
	Bt Cotton	NPM Cotton	Bt Cotton	NPM Cotton	Bt Cotton	NPM Cotton	Bt Cotton	NPM Cotton
High	15 (12.8)	4 (3.3)	38 (32.5)	5 (4.1)	8 (6.8)	2 (1.7)	20 (17.1)	25 (20.7)
Medium	23 (19.7)	18 (14.9)	59 (50.4)	24 (19.8)	34 (29.1)	22 (18.2)	67 (57.3)	57 (47.1)
Low	77 (65.8)	93 (76.9)	20 (17.1)	92 (76.1)	75 (64.1)	93 (76.8)	29 (24.8)	38 (31.4)
Nil	2 (1.7)	6 (4.9)	0 (0)	0 (0)	0 (0)	4 (3.3)	1 (0.8)	1 (0.8)

(Figures in parentheses indicate the percentage number of respondents)

As can be seen above, a majority of NPM farmers have reported Low incidence of Spotted Bollworm (76.9% of them, as opposed to 65.9% of Bt growers), American Bollworm (76.1% of NPM growers against 17% of Bt growers) and Tobacco Caterpillar (76.8% instead of 64.1% of the Bt Cotton growers) on their cotton crop. In the case of Bt Cotton, however, it is interesting to note the number of respondents who have reported High incidence of American Bollworm (32.5%), an important pest that the Bt Cotton is ostensibly designed to control through its endotoxin mechanism. In the case of Spotted Bollworm, 6 of the NPM farmers reported Nil incidence, as against 2 Bt Cotton farmers.

It is only in the case of Pink Bollworm that NPM farmers reported differently. Here, most of the respondents reported Medium incidence (47.1% of NPM farmers), as in the case of Bt Cotton growers too (57.3% of these farmers). However, more number of NPM farmers also reported Low incidence of this pest too (31.4%), compared to number of Bt Cotton farmers who reported Low incidence (24.8%).

Incidence of sucking pests:

Level of incidence	Jassids		Thrips		Whitefly		Aphids		Mites	
	Bt.	NPM	Bt.	NPM	Bt.	NPM	Bt.	NPM	Bt.	NPM
High	52 (44.5)	7 (5.8)	1 (0.8)	0 (0)	39 (33.4)	2 (1.6)	35 (29.9)	1 (0.8)	21 (17.9)	3 (2.5)
Medium	42 (35.9)	20 (16.5)	21 (17.9)	8 (6.6)	35 (29.9)	15 (12.4)	43 (36.8)	20 (16.6)	45 (38.6)	10 (8.3)
Low	22 (18.8)	94 (77.7)	92 (78.7)	107 (91.5)	41 (35.0)	90 (74.4)	39 (33.3)	95 (78.5)	50 (42.7)	101 (83.5)
Nil	1 (0.8)	0 (0)	3 (2.6)	6 (4.9)	2 (1.7)	14 (11.6)	0 (0)	5 (4.1)	1 (0.8)	7 (5.7)

(Figures in parentheses indicate the percentage number of respondents)

In the case of sucking pests too, majority of NPM farmers have reported Low incidence while several of them have reported Nil incidence for pests like Whitefly, Aphids and Mites. In contrast, there were many Bt Cotton farmers who reported High incidence of Jassids, Mites and Aphids in their Bt fields. Most of the Bt Cotton farmers reported Low incidence in the case of Thrips.

In terms of **Wilt**, only about 17 of the Bt Cotton farmers said that their crop did not suffer any wilt during the season (14.5%). In comparison, around 50 NPM farmers said that they had not experienced any wilt problems with their crop (41.3%). The degree of wilt on the crop ranged from 30% to 70% in the case of Bt. while it was reported to be around 10-15% in the case of NPM approach to cotton.

Incidence of Beneficial Insects:

An important aspect of the current study is the incidence of beneficial insects in Bt cotton fields and NPM fields. Farmers surveyed were asked to report the level of incidence of a variety of beneficial insects. The findings reiterate a fear expressed by many environmentalists on the effect of Bt Cotton and its endotoxin on beneficial insects.

Level of Incidence reported of beneficial insects	Bt Cotton fields	NPM fields
High	0 (0)	85 (70.2)
Medium	7 (5.9)	26 (21.5)
Low	97 (82.9)	8 (6.6)
Nil	13 (11.2)	2 (1.7)

The main mechanism by which NPM farmers control pests in their fields is through predators or beneficial insects. As the above table shows, there is a High incidence of such insects reported in NPM fields (70.2% of the NPM farmers reported High incidence). The contrast with Bt Cotton fields and the reported incidence of beneficial insects there is telling (only 0%). Not a single farmer reported High incidence of beneficial insects. In contrast, about 13 of the Bt Cotton farmers (11.2% of farmers) actually reported Nil incidence of beneficial organisms on their crops.

Economics of Pest Control:

As is obvious, the economics of Bt Cotton start becoming adverse with the cost of the seed itself – while the NPM farmers used seed worth around Rs. 450/- per acre of land, Bt Cotton farmers used seed that costs Rs. 1600/- per acre. This is a difference of 355% more in the case of Bt cotton.

Let us look at the findings with regard to Pest Management Costs in Bt Cotton and NPM fields, as reported through the current survey. In the case of Bt Cotton, pesticides like Monocrotophos, Confidor, Tracer, Avaunt, Endosulfan, acephate, demethoate, imidacloprid, quinalphos, chlorpyrifos, cypermethrin etc., have been used by the farmers. This includes low-value as well as expensive pesticides.

The average number of sprays used on Bt Cotton crop per acre is 3.5 times. While two farmers reported that they did not spray any pesticides at all on their Bt Cotton crop, in the other fields, the number of sprays ranged from 2 to 7 sprays. In the case of NPM farmers, there are no synthetic pesticides used. Material like Neem Seed Kernel extract, trichoderma, panchakavya etc. have been used here. The difference in costs is reflected in the following table:

	Cost of Pest Management in Rupees, per Acre
Bt Cotton	Rs. 2632/-
NPM Cotton	Rs. 382/-

This is a difference of Rs. 2250/- per acre between Bt Cotton and NPM cotton fields. This is a 690% higher cost in Bt Cotton than in NPM cotton. This is the edge that NPM cotton has over Bt Cotton. **Yields and Net incomes** were not calculated in the study since cotton picking was still going on at the time of data collection. This data would be presented in the final report.

The above study clearly proves that restoring the natural ecological balance in the cotton fields by removing both synthetic chemicals and endotoxins (through GE) from the scene is an important step towards farmers benefiting in the short and long term.

Based on the above data and earlier fact finding visits made by Centre for Sustainable Agriculture, the organisation demands that:

- The government admits that Bt Cotton is not the best or safest technology available to solve the pest problem on cotton in the state
- the government admits that Bt Cotton has been a failure given its extremely uneven performance in all the three years of its approved commercial cultivation and that the AP government presents the same picture to GEAC which would review the first approval in the month of March 2005
- that the government cancels the approval of Bt Cotton commercial cultivation in Andhra Pradesh
- that the government makes arrangements to pay compensation to all farmers who have incurred losses in the past three years with Bt Cotton cultivation by taking up a comprehensive survey as well as by taking independent studies on board
- that the government fixes liability on the company for the failure and all negative impacts seen so far

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Annexure : **NPM Approach to Crop Cultivation**

Non-Pesticidal Management of crops believes in removing synthetic chemicals from agriculture. For this, a complete recasting of the current pest management paradigm is needed, which at present incorporates a lot of myths and false notions.

First, the myths in current pest management paradigm:

- **“Pests can be controlled only by killing them”**: this is the gravest mistake that the current pest management paradigm makes – it believes that pests can be controlled only by killing them. The pesticides and pesticide incorporated plants (for eg. Bt cotton) are based on this wrong premise. They all act only on larval stage when the damage already starts happening. A pest outbreak is waited for, after which powerful pesticides are brought in. This is only a “curative” attempt rather than a “preventive success”.
- **“All insects in the field are pests”**: there is an indiscriminate outlook towards the various insects that are present in an agricultural field and around it. Even though the modern science is talking about the natural enemies the pesticides they produce and promote kills all the insects indiscriminately. This obviously destroys the natural predators of the pests also. When the ecological balance is thus destroyed, the pesticide-resistant pests take over.
- **“No relationship exists between mono-culture and pest incidence”**: the current pest management paradigm either does not appreciate or chooses to ignore the relationship between monocultures and pest incidence. It is well-established that such mono-cropping over large contiguous areas, reduced genetic base with mono-culturing germplasm results in an unobstructed proliferation of the pest. Now with the Pesticide incorporated plants have made these monocultures to gene level, trying to put ‘Cry genes’ against all pests across crops.
- **“Chemical fertilisers and pest incidence are not related”**: though it is scientifically known that a plant’s vulnerability to pest incidence is higher with the use of chemical fertilisers (due to increased ‘succulence’ in the plant), the connection is not made in real life. Pests are sought to be dealt with in isolation to the land fertility management issues. This is a classic example of the reductionist views that modern science can take
- **“Pest resistance is a genotypic issue rather than an environmental one”**: there is much research going on to develop varieties of plants that are pest-resistant by playing around with the genes. The game plan is obvious here – genes will go hand and in hand with intellectual property rights, which in turn ensure secure markets and profits for the industry. Pest resistance therefore is made a genotypic issue rather than one that involves broad ecological management in the farm. That is where Genetic Engineering in agriculture also finds its space. In this narrow perspective, what is not understood is that the problem only gets accentuated especially in pest-resistant GE crops when other environmental factors related to the pest’s life cycle etc., are not managed.
- **“Resistance management is about using newer and newer generation pesticides” [as per the industry], and “about using more pesticides, including mixtures of upto five pesticides” [as per the farmers]**: The way to get around the problem of resistance is usually seen in inventing newer and newer molecules by the industry. In a patent regime, such newly developed pesticides mean more profits through secure markets. First came the OCs [organochlorines], followed by the OPs [organophosphates] and Carbamates, followed by the much-touted Synthetic Pyrethroids. Each generation’s problems were sought to be solved by the next generation, only to end up by creating more problems.

The cost went on increasing for the farmers. A 100 ml. pesticide of the newest generation can cost upto Rs 1000/ per container. The industry continues to grow at 4-5% per annum. However, the older molecules which were found to be problem-causing or ineffective were not removed from the scene. For some farmers, the way out is to mix four to five different pesticides and spraying them together – no one knows the ecological and health disaster that such desperate measures might be causing!

- **“Prevention of pest/disease incidence is about spraying pesticides even when the pest is not present”**: Farmers in many parts of the country have made pesticide spraying a part of their daily routine – they take a tanker on their back to go and spray pesticides in their fields...“just in case”. Pesticide use is no longer related to a pest and its manifestation in the field. Prevention is understood as spraying regularly, as per a schedule drawn up by the farmer or his industry-advisor irrespective of whether such treatment is needed or not
- **“The benefits from the use of synthetic pesticides outweigh the risks”**: Finally, it is genuinely believed by many in the scientific establishment and the industry that the benefits from the use of synthetic pesticides outweigh the risks and problems associated with it. However, this is simply not true. It might appear to have an advantageous cost-benefit ratio given their simplistic and reductionistic economic calculations. In fact, the suicides in the cotton belts of the country prove that even the economics has turned adverse with pesticides. However, complete calculations of the entire social, economic and ecological disaster that pesticides have created, especially in the face of safer alternatives, instructs us that the risks and hazards far outweigh any probable benefits.

The message is clear - ‘Nature makes insects, humankind makes pests’.

The approach that needs to be taken towards pest management, to ensure economic, ecological and social benefits to farmers is completely different from the above, of course.

Such an alternative non-pesticidal approach recognises the importance of the following:

- that natural insect balances in a farm are important to control what we consider as ‘pests’. For this to happen, the fields cannot be in a toxic-contaminated state
- that pest life cycles have to be understood and pest management has to begin right from the beginning – before the eggs are laid. Several steps along the way at each stage are needed. This understanding includes close pest surveillance and decisions based on the incidence
- that crop diversity plays an important role in pest management; in that sense, seeds play an important role and therefore, control over seeds by the farm communities. Trap crops and repellent crops have a role to play too
- that local and naturally-occurring materials can be used for pest control; this will also have its own political-economy dimensions which are of benefit to the farmers
- that since many of the pests are polyphagous, these pest management principles have to be applied across different crops and at a particular scale, for maximum benefits
- that soil nutrient management in organic ways plays a crucial role in the plant’s ability to withstand pest and disease incidence
- that a new paradigm of pest management can not only benefit the farmers economically and ecologically but can also address certain developmental and social issues including gender
- that such pest management need not result in decreased yields, as it is usually made out to be
- that such pest management principles and practices are pretty often drawn from farmers’ experiential knowledge