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Farmers Experiences on Evaluation Bt Cotton in Tamil Nadu

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ABSTRACT

Bt cotton is an attractive alternative technology to protect cotton from bollworms and to make cotton farming more sustainable, economical and eco-friendly. It has the inbuilt resistance to bolloworms and is very effective in controlling the yield losses caused by bolloworms to a considerable extent. It results in improvement of yield levels and also improves margin of profit to the farmers. Though the technology crowns the credits of various benefits, it's end users have certain concerns about it's bio-safety, ethical, social, health, economic and environmental implications. These concerns prophesize that there will be resistance against GE crops in general and Bt cotton in particular in near future. The attitude of the people, their awareness about the technology and their adoption behaviour play a major role in sustaining any technology. Keeping this in mind, an empirical study was conducted among 120 randomly selected Bt cotton growers at Coimbatore and Perambalur districts of Tamil Nadu to evaluate the experiences they had in Bt cotton cultivation. Majority of the growers had favourable attitude towards cultivation of Bt cotton and would like to grow Bt cotton in future too. Their primary sources of information about Bt cotton were the local input dealers. Majority of them had not adopted the refugee technology prescribed by the Government of India to avoid the development of resistance by bollworms to Bt cotton. They perceived that major social, economic, environmental, ethical and bio-safety implications would occur in near future due to intensive of Bt cotton.

Biotechnology is currently a hot topic in both academic and political circles for its implications on food security, economic growth and income distribution, human health, the environment, and agricultural trade. Genetic modification techniques are at the center of this focus and have spurred worldwide debate on bio-safety issues (Zhong et al., 2002).

Commercial release of nation's first transgenic crop "Bt cotton" in 2002 marks the beginning of transgenic era in India. The technology has numerous benefits accrue to the grower, the global cotton, industry and society on many levels viz., economic, environmental and social (Ismael *et al* (2002), James (2002), Pray *et al* (2002) and Purcell *et al* (2004)). Global adoption of Bt cotton has risen dramatically from 800,000 hectares in its year of introduction in 1996 to 5.7 million hectares in 2003 (Purcell and Perlak, 2004). The tremendous adoption rate of Bt cotton in India, from a few thousand acres in 2002 to more than 38 lakh hectares in 2006 shows the relative advantage of the technology. Within a span of five years (2002-2006), the technology facilitated the country to gain a net farm income of US $ 1294 million and produce 310 lakh bales of cotton with productivity touching 550kg/ha (2007-08).

However, based on recent trends, it is expected that there will be resistance against Bt cotton and other biotech crops by farming community and other stakeholders in near future. This resistance is due to the belief on negative implications of the technology despite it has been proved of its safety through bio-safety experiments beyond doubt. These objections and concerns prophesize that there will be resistance against GE crops in general and Bt cotton in particular in near future. The attitude of the people, their awareness and knowledge

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level about the technology and their adoption behaviour play a major role in sustaining the technology. Keeping this in mind. This study was conducted to evaluate the experiences of Bt cotton growers at farm level and the various implications perceived by them about cultivation of Bt cotton.

METHODOLOGY

For this study, *expost facto* research design was used. A multi-stage random sampling was followed to select the districts, blocks, villages and farmers under both irrigated and rainfed conditions of cotton. To select the districts, secondary data pertaining to the Bt cotton cultivated districts both in irrigated and rainfed conditions were perused. Among the 16 Bt cotton growing districts in Tamil Nadu, Coimbatore and Perambalur districts were selected at random for irrigated and rainfed Bt cotton growing conditions. Taking into consideration the need for adequacy of representation of the universe, time availability and data requirement, it was decided to select two blocks at random from the selected districts. Out of the 19 blocks in Coimbatore district, the block having substantial number of irrigated Bt cotton growers namely Annur block of A vinasi taluk was selected randomly. With respect to Perambalur district, out of the ten blocks, the block having substantial number of rainfed Bt cotton growers namely Vepur of Kunnam taluk was selected randomly. In each block, six villages were selected randomly and in each village ten Bt cotton growers were selected randomly. Thus 120 Bt cotton growers from both the conditions were selected as respondents for the study. Taking into consideration, the scope and objectives of the study, a well-structured interview schedule was prepared after perusal of literature and in consultation with cotton scientists. A pre-testing in the form of pilot survey was done in the non-sampling area to probe into the relevancy of the schedule. Suitable modifications were made based on the pre- testing and the final interview schedule was prepared. The respondents were personally contacted for collection of data by undertaking tours to Perambular and Coimbatore districts.

RESULTS AND DISCUSSION

Socio-economic Background of Bt cotton growers of the farmers interviewed for the study, 50 per cent were irrigated farmers and 50 per cent were rainfed farmers (Table 1). The average age was 52 years, with most of the farmers (64.17%) were above 45 years old. Most of them (90.00 %) had some formal education: either to middle school level (VIII standard) or above. Only 5 % of them were illiterates. Majority of them (85.00%) had farming as their sole occupation. Most (60.00%) of them had 1 to 5 acres of farm land. In their total land, 25.00 to 50.00 per cent was allotted to cultivation of cotton and one to two acres to cultivation of Bt cotton. Almost all of them (95.00%) had more than 10 years of farming experience, 5 - 10 years of experience in cotton cultivation and two to three years of experience

Attitude towards cultivation of Bt cotton

A scale to measure the attitude of cotton growers towards cultivation of Bt cotton was constructed using Turnstone's (1969) Equal Appearing Interval Method. The scale was administered to all the respondents with two point continuum favourable and unfavourable. The details with respect to the distribution of the respondents under the two categories are presented in table 2: It is seen that nearly three fourth (73.33 per cent) of the respondents had favourable attitude towards cultivation of Bt cotton. They strongly agreed that cultivation of Bt cotton is a solution for sustainable cotton farming and is compatible with the current farming system. They believed that the

Table 1. Socio- economic background of the Bt cotton growers

Variables Production system	Summary of responses (%)
Irrigated	50.00
Rainfed	50.00
Age	
Up to 35 years	10.00
36-45 years	25.83
Above 45 years	64.17
Educational status	
Illiterate	5.00

Can read only	2.50
Can read and write	1.67
Primary level	23.33
Middle level	31.67
High school level	14.17
Higher secondary level	10.83
Collegiate level	10.83
Occupational Status	
Farming as sole occupation	85.83
Farming + Agricultural labour	5.83
Farming + Business	5.00
Farming + Service	3.34
Farm size	
Up to 2.5 acres	27.50
2.51 to 5 acres	32.50
5.01 to 10 acres	17.50
Above 10 acres	22.50
Area under cotton (% to total land holdings)	
< 25.00	15.00
25.01 to 50.00	45.83
50.01 to 75.00	22.50
75.01 to 100.00	16.67
Area under Bt cotton	
One acre	47.50
Two acres	27.50
Three acres	13.33
Four acres	8.33
Five acres	3.34

Bt toxin in Bt cotton will not affect the soil, underground water and environment in long run. They hoped that Bt cotton increases the opportunities to grow cotton in areas of severe pest infestation and will help the cotton grower, environment and the ultimate consumer in a big way. Their contact with extension agency, exposure to mass media, economic motivation, risk orientation and progressiveness liad resulted in their favourable attitude towards cultivation of Bt cotton. This finding is consistent with previous observations in Taiwan and with the study conducted at China by Zhong et al., in 2002 and may pave way to researchers to develop new Bt strains, to the extension personnel to bring out strategies to popularize the Bt cotton hybrids and to the policy makers to develop policy measures for further GE crops.

Awareness about Cultivation of Bt cotton

Six questions were included in the interview schedule to assess their awareness about cultivation of Bt cotton. They were, where the interviewee bought Bt cotton seed; what factors he or she was concerned with when buying it; if, and how well, he or she was aware of Bt cotton; where such information was obtained; if aware, whether he or she thought that Bt cotton are safe and will he or she continue to grow Bt cotton in next season. From the table 3, it is evident that 91.66 per cent of the Bt cotton growers bought the Bt cotton seeds from the local input dealers and only a few (8.34 %) of them acquired it from their relatives and friends. The major invigorating factor opined by majority of the

respondents was the slogan used by the input dealers as "Cotton hybrid which needs no pesticides". Majority of them (68.33 %) were just heard about the technology and few of them (31.67%) opined that they knew something about the technology. More than 85 per cent of them stated that their local input dealers were the primary information source for knowing about the technology. More than 50.00 per cent of them were not sure about the safety of the technology in near future. Majority of them (80.83%) were willing to grow Bt cotton in next year too..

Farm Level Adoption Behaviour of Bt cotton Growers

Adoption behaviour referred to the extent of adoption of selected improved cultivation practices recommended for Bt cotton, by the Bt cotton growers either as specified or with modifications. A total of 50 items were selected for evaluating the adoption behaviour of Bt cotton growers. For Full or modified adoption of a recommended practice, score one was given and for non-adoption of a recommended practice no score was given. Then, the Adoption Index (AI) was calculated. The distribution of respondents under irrigated and rainfed conditions according to their adoption behaviour of Bt cotton practices is furnished in Table 4.

In total, majority (52.50 per cent) of the respondents were found with high level of technology use behaviour. Majority (60.00 per cent) of the irrigated farmers and 70.00 per cent of the rainfed farmers had not adopted the technology of planting refuge crop (five rows (per acre) of non-Bt cotton seeds surrounding the Bt cotton plot) as specified by the Genetic Engineering Advisory Committee (GEAC) to manage pest from developing resistance to Bt toxin. Remaining 40.00 per cent among irrigated farmers and 30.00 per cent among rainfed growers had adopted the technology with modifications of their own. Instead of planting around the Bt cotton plot, they mixed the Bt cotton and non Bt cotton seeds and sown in their fields. Majority of the non-adopters and modified adopters of this technology stated that the troublesome work of spraying separately for non-Bt cotton and the fear of spread of pests from non-Bt cotton to Bt cotton were the major reasons for non-adoption of the technology. Added to this, they stated that due to the non-adoption of this technology as specified, they faced shortage of seed per acre but somehow they could manage to get the seeds from input dealers in small quantity too. Further they stated that the dealers used to sell the seeds in small quantity for gap filling and nobody was certain about the nature of seeds i.e., whether it was Bt cotton or not. The Central Institute for Cotton Research, Nagpur had developed a kit to test the presence of Cry 1 Ac protein in seeds and leaves of cotton. None of the respondents was aware of this particular technical information in the study area in Bt cotton cultivation. The irrigated Bt cotton growers were found with Rs. 15,000 to 20,000 income per annum and rainfed Bt cotton growers were with Rs.40, 000 to 60,000 income per annum. They had good contact with extension agency and had high economic motivation. They had good exposure to mass media and had only less number of training programmes. They were risk takers, progressive farmers and innovators. They had better pest management behaviour and credit orientation.

Table 2. Distribution of respondents according to their attitude towards cultivation of Bt cotton under irrigated and rainfed conditions.

Variables	Production System	Summary of response (% total respondents)
Unfavourable attitude	Irrigated (60)	20.00 (12)
	Rainfed (60)	33.33 (20)
	Total (120)	26.67 (32)
Favourable attitude	Irrigated (60)	80.00 (48)
	Rainfed (60)	66.67 (40)
	Total (120)	73.33 (88)

Socio-Economic, Bio-Safety, Environmental and Ethical Implications of Adoption of Bt Cotton as Perceived by Bt Cotton Adopters

From the table 5, it is evident that, more than half of the irrigated Bt cotton growers perceived that the socio economic implications of Bt cotton in future would be widening the gap between those who can afford the technology and those who cannot (58.00%), development

of institutional contact (90.00 %), dependence on multinational companies for seeds (86.50 %), adverse effect on conventional seed companies (66.0 %) and increase of healthy competition between cotton growers (60.00%). With regard to psychological implications, revival of interest towards cultivation of cotton in pest endemic area (85.00 per cent), reduced tension (84.00 per cent), reduction in pesticide poisoning (85.00 per cent), revival of interest towards cultivation of cotton in non traditional area (77.50 per cent) and freed from death wish (suicide) due to indebtedness (80.00 per cent) were the implications opined by them. Less than half of them perceived that the implications viz., possibility of minor pest becoming major, inadequacy of Bt toxin in all parts of the plant, development of resistance to Bt toxin, time frame of Bt toxin and movement of Bt toxin to closely related crops would occur in near future due to intensive cultivation of Bt cotton.

With regard to environmental implications, more than 90.00 per cent of Bt cotton growers in both irrigated and rainfed conditions perceived that reduced risks for farm workers, reduced risk for beneficial insects and wild lives, reduced runoff of broad spectrum pesticides, reduced air pollution and water pollution and leaving a better environment for future generation would be the possible implications of Bt cotton cultivation.

As far as ethical implications of cultivation of Bt cotton are concerned, majority of the irrigated farmers perceived that illegal sale of banned / unapproved products/ F l/F2 seeds (98.50 per cent), ownership of technologies by few private companies (98.50 per cent), availability of more numbers of Bt cotton hybrids and little information to enable the layperson to make decisions (92.50 per cent), conventional cotton varieties / hybrids will vanish in long run (92.00 per cent) and robbing the rights of farmers to save seeds for future use (92.00 per cent) would be the major ethical implications due to the introduction of Bt cotton in the subsequent years.

Table 3. Distribution of respondents according to their awareness level about cultivation of Bt cotton under irrigated and rainfed conditions.

Questions	Variables	Summary of response (% total respondents)
Where from the respondents bought the Bt cotton seeds	Local Input Dealers	91.66 (110)
	Relatives and Friends	8.34 (10)
What factors he or she was concerned with when buying it*	High yield	57.50 (67)
	No need to spray for pests	90.00 (108)
	Reduction in cost of production	65.00 (78)
	For the sake of dealers	16.66 (20)
If, and how well, he or she was aware of Bt cotton	Just heard	68.33 (82)
	Know something	26.67 (28)
Where such information was obtained	Local Input Dealers	87.50 (105)
	Neighbouring farmers	8.33 (10)
	Agents from Private Companies	4.17 (5)
Whether he or she thought that Bt cotton are safe	Safe	46.66 (56)
	Not known	53.37 (64)
Will he or she continue to grow Bt cotton in next year	Yes	80.83 (97)
	Undecided	19.17 (23)

**Due to mutiple responses*

Table 4. Distribution of respondents according to adoption behaviour of Bt cotton cultivation practices under irrigated and rainfed conditions.

Variables	Production System	Summary of response (% total respondents)
Technology use behaviour	Irrigated	Low- 33.33 (20) High – 66.67 (40)
	Rainfed	Low – 30.00 (18) Medium – 31.67 (19) High - 38.33 (23)
	Total	Low – 31.67 (38) Medium- 15.83 (19) High – 52.50 (63)

Table 5. Distribution of respondents according to their perception on socio-economic, bio-safety, environmental and ethical implications of adoption of Bt cotton under irrigated and rainfed conditions

Sl. No.	Perceived Issues	Response	
		Irrigated (N=60)%	Rainfed (N=60)%
I. Perceived Socio-economic Implications			
1.	Widening the gap between those who can afford the technology and those who cannot	43.00	73.00
2.	Development of institutional contact100.00	90.00	
3.	Dependence on multinational companies for seeds	83.00	90.00
4.	Adverse effects on other seed and pesticides companies	40.00	92.00
5.	Increase of healthy competition between cotton growers	43.00	93.00
II. Perceived Psychological Implications			
6.	Revival of interest towards cultivation of cotton in non traditional area	63.00	92.00
7.	Revival of interest towards cultivation of cotton in pest endemic area	70.00	100
8.	Freed from death wish (suicide) due to indebtedness	60.00	100
9.	Reduced tension in life regarding pest attack	70.00	98.00
10.	Reduction in pesticide poisoning 70.00	100.00	
III. Perceived Bio-Safety Implications			
11.	Development of resistance to Bt toxin in long run	48.00	48.00
12.	Inadequacy of Bt toxin in all parts of the plant	43.00	45.00
13.	Time frame of Bt toxin	40.00	47.00
14.	Movement of Bt toxin to closely related crops	40.00	45.00
15.	Possibility of minor pest becoming major	47.00	47.00
IV. Perceived Environmental Implications			
16.	Reduced risks for farm workers	93.00	98.00
17.	Reduced risk for beneficial insects and wild lives	97.00	98.00
18.	Reduced runoff of broad spectrum pesticides	100	97.00
19.	Reduced air pollution and water pollution	100	97.00
20.	Leaving a better environment for future generation	100	97.00

V. Perceived Ethical Implications		
21. Ownership of technologies by few private companies	100	97.00
22. Illegal sale of banned/unapproved products/F1/F2 seeds	10.00	97.00
23. Availability of more numbers of Bt cotton hybrids and title information to enable the layperson to make decisions	90.00	95.00
24. Conventional cotton varieties will vanish in long run	87.00	97.00
25. Robbing the rights of farmers to save seeds for future use	87.00	97.00

CONCLUSION

Majority of the growers had favourable attitude towards cultivation of Bt cotton and would like to grow Bt cotton in future too. Their primary sources of information about Bt cotton were the local input dealers. Majority of them had not adopted the refugee technology prescribed by the government of India to avoid the development of resistance by bollworms to Bt cotton. They perceived that major social, economic, environmental, ethical and bio-safety implications would occur in near future due to intensive cultivation of Bt cotton.

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