

An Empirical Analysis on Cultivation Behaviour of Bt Cotton Growers

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Introduction

The decision of the Genetic Engineering Approval Committee (GEAC) of the Government of India (GOI) clearing the release of the nation's first Genetically Engineered (GE) crop "Bt cotton" for commercial cultivation during 2002-03 crop seasons is considered one of the major milestones in the history of cotton improvement in India. Incidentally, cotton happens to be the first crop to receive environment clearance as Genetically Modified Organisms (GMOs) in Indian agriculture. It has received maximum attention from planners, scientists, social workers, media, farmers and the general public both in India and outside, as it is a landmark decision paving way for more crops in India.

The commercial adoption of this technology by farmers has been one of the most rapid cases of technology diffusion in the history of agriculture in India. The area under this crop increased phenomenally from a few thousand acres in 2002 to 34.61 lakh acres in 2006 (AICCIP (2007)). More than 200 Bt cotton hybrids are commercially available in the market. On one side, this tremendous adoption rate shows the advantage of the technology and on other side, there are agitations, legal cases against the Bt cotton seed companies for compensation claims. There are certain concerns about its bio-safety, ethical, social, health, economic and environmental implications. These objections and concerns prophesize that there will be resistance against GE crops in general and Bt cotton in particular in the near future. The pertinent question today is whether our society is free to enjoy the advantages of this new technology, whether "prejudice" should be allowed to come in the way of spreading technology at the right time for the benefits of our own society. It is also of interest to determine how much information Indian cotton growers really have about Bt cotton and whether they will continue or quit Bt cotton. The mindset of the people, their awareness and knowledge level about the technology and the adopter's technology use behaviour play a major role in answering all these questions. Keeping all these in view, an empirical study was conducted to assess

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the cultivation behaviour of Bt cotton growers at farm level and the various constraints faced by them with regard to Bt cotton cultivation.

Methodology

For this study, ex post facto research design was used. A multistage random sampling technique was followed to select the sample for the study. Coimbatore and Perambalur districts were selected at random for irrigated and rainfed Bt cotton growing conditions. Two blocks viz. Annur block of Avinasi taluk in Coimbatore having substantial number of irrigated Bt cotton growers and Vepur of Kunnam taluk in Perambalur having substantial number of rainfed Bt cotton growers were selected randomly. Six villages in each block and ten Bt cotton growers in each village were selected randomly. Thus 120 Bt cotton growers from both the conditions were selected as respondents for the study. Data was collected through personal interview using a well structured pre-tested interview schedule.

In this study, the term "Cultivation behaviour" was conceptualized as the farmer's attitude, awareness level, knowledge level and adoption behaviour with respect to Bt cotton.

In order to understand the farmers' attitude towards cultivation of Bt cotton, a scale was constructed and used.

The knowledge level of the farmers about cultivation aspects of Bt cotton, was assessed on awareness, how-to-do knowledge and principles-knowledge.

The 50 items, selected for assessing the knowledge level of Bt cotton growers were used for assessing the technology use behaviour of Bt cotton growers. Then, the Adoption Index (AI) was calculated.

Results and Discussion

The results of the survey indicating the socio-economic background of the Bt cotton growers, their attitude towards cultivation of Bt cotton, their knowledge level about the cultivation aspects of Bt cotton, their technology use behaviour of Bt cotton cultivation aspects and the constraints faced by them in Bt cotton cultivation are explained below with empirical evidences.

Socio-economic Background of Bt Cotton Growers

The Bt cotton growers under both the rainfed and irrigated conditions were old aged, had primary level of education and had farming as their sole occupation. The Bt cotton growers were generally found with 2.51 to 5 acres of 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 had more than 10 years of farming experience, 5 – 10 years of experience in cotton cultivation and two to three years of experience 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 the extension agency and had high economic motivation. They had good exposure to mass media and had undergone only a few training programmes. They were risk takers, progressive farmers and innovators. They had better pest management behaviour and credit orientation. A comparison between the two categories of respondents revealed that the educational status, farm size, area under cultivation of cotton, annual income, contact with extension agency, Mass media exposure, Economic motivation, Risk orientation, Progressiveness, pest management behaviour, Credit orientation, innovativeness and marketing behaviour were significantly higher than rainfed farmers (Table 1).

Table 1. Socio-economic Background of the Bt Cotton Growers

Variable No.	Profile characteristics	Total	Irrigated condition	Rainfed condition	't' value
X1	Age	Old	Old	Old	—
X2	Educational status	Primary level	Middle	Primary level	Highly significant
X3	Occupational status	Farming as sole occupation	Farming as sole occupation	Farming as sole occupation	Non significant
X4	Farm size	2.51-5.00 acres	>10 acres	Up to 2.5 acres	Highly significant
X5	Area under cultivation of cotton	25.01 – 50.00 %	25.01 – 50.00 %	25.01 – 50.00 %	Highly significant
X6	Area under cultivation of Bt cotton	One acre	One acre	One acre	Non significant
X7	Farming experience	>10 years	>10 years	>10 years	Non significant
X8	Experience in cultivation of cotton	5-10 years	High	Medium	Non significant

X9	Experience in cultivation of Bt cotton	2-3 years	Medium +High*	High	Highly significant
X10	Annual income	Medium	High	Medium	Highly significant
X11	Contact with extension agency	High	High	High	Highly significant
X12	Mass media exposure	High	High	High	Highly significant
X13	Training undergone	Low	Medium + high*	Low	Highly significant
X14	Economic motivation	High	High	High	Highly significant
X15	Risk orientation	High	High	Medium	Highly significant
X16	Progressiveness	High	High	High	Highly significant
X17	Pest management behaviour	High	High	Medium	Highly significant
X18	Credit orientation	High	High	High	Highly significant
X19	Innovativeness	Moderate	High	Moderate	Highly significant
X20	Marketing behaviour	Less favourable	Highly favourable	Less favourable	Highly significant

Farm size, area under cultivation of cotton, annual income and marketing behaviour are allied factors. Since, majority of the irrigated farmers operated larger farms, they cultivated more area under cotton, their annual income was higher and their marketing behaviour was better while, majority of their counterparts were small farmers and accordingly their area under cotton cultivation, annual income and marketing behaviour were found to be low. Cultivation of Bt cotton requires more initial investment on seeds, which would be possible mainly for big farmers and this was also reflected in the farm size variable, where the proportion of big farmers was high in irrigated condition than in rainfed

condition. Further it was found that majority of the respondents in both the categories had high and medium levels of economic motivation, risk orientation, progressiveness and innovativeness. These are psychological variables. These characteristics were the main driving factors for them to cultivate the novel technology Bt cotton in their fields.

Attitude towards Cultivation of Bt cotton

The results show that 26.67 per cent of the respondents had an unfavorable attitude towards cultivation of Bt cotton. They strongly agreed that cultivating conventional cotton varieties / hybrids is better than cultivating Bt cotton. They feared that in future the bollworm could develop resistance to Bt cotton and cultivating Bt cotton would affect the health of livestock and farmers. They also added that Bt cotton can benefit the prosperous and large farmers in irrigated conditions but not the small and marginal farmers in rainfed conditions. These fears may be considered as thrust areas for further research in Bt cotton. It is seen that nearly three fourths (73.33 per cent) of the respondents had a favourable attitude towards cultivation of Bt cotton (Table 2). 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 Bt toxin in Bt cotton would not affect the soil, underground water and environment in the long run. They hoped that Bt cotton would increase the opportunities to grow cotton in areas of severe pest infestation and help the cotton grower, the environment and the ultimate consumer in a big way. Their contact with the extension agency, exposure to mass media, economic motivation, risk orientation and progressiveness had resulted in their favourable attitude towards cultivation of Bt cotton. This information may pave way for researchers to develop new Bt strains, for the extension personnel to bring out strategies to popularize the Bt cotton hybrids and for the policy makers to develop policy measures for further GE crops.

Table 2: Distribution of Respondents according to their Attitude towards Cultivation of Bt Cotton under Irrigated and Rain fed 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)

Knowledge Level of Bt cotton growers about the Cultivation aspects of Bt cotton

The distribution of respondents under irrigated and rainfed conditions according to their awareness, how-to-do and principle knowledge about cultivation practices of Bt cotton are furnished in Table 3. From the table, it is seen that nearly half of the respondents (44.17 per cent) had a high level of awareness about the cultivation aspects of Bt cotton. More than one third of them (35.83 per cent) had known the how-to-do aspect of the various practices, and 29.16 per cent of them had known the principle behind each practice recommended. When the respondents were enquired about their practice-wise awareness, how-to-do and principle knowledge, especially about the critical practices pertaining to Bt cotton, majority of them fell under the low category. They did not know the correct Bt cotton genotypes suited for their region, spacing, seed rate, how to plant the refugee crop, ETL for various pests and need based spraying of chemical pesticides for pests other than bollworms. Inadequate training programmes, inadequate broadcast / telecast of messages through mass media and inadequate information flow about Bt cotton were the main reasons for this lacuna. This must be considered as the most important need of the hour and strategies may be developed to educate the farmers about the various aspects of Bt cotton. Failing this would lead to sheer ignorance among farmers and other stakeholders about Bt cotton and intensification of the propaganda against Bt cotton and other such GE crops.

Table 3: Distribution of Respondents according to their Knowledge level about Cultivation of Bt Cotton under Irrigated and Rain fed Conditions

Variables	Production System	Summary of Response (% total respondents)
Awareness knowledge	Irrigated (60)	Low -26.67 (16)
		Medium -20.00 (12)
		High -53.33 (32)
	Rainfed (60)	Low -28.33 (17)
		Medium -36.67 (22)
		High- 35.00 (21)
	Total (120)	Low -27.50 (33)
		Medium -28.33 (34)
		High - 44.17 (53)

How-to-do knowledge	Irrigated (60)	Low –33.33 (20)
		Medium – 33.33 (20)
		High – 33.34 (20)
	Rainfed (60)	Low –30.00 (18)
		Medium –31.67 (19)
		High –38.33 (23)
	Total (120)	Low –31.67 (38)
		Medium – 32.50 (39)
		High –35.83 (43)
Principle knowledge	Irrigated (60)	Low –16.67 (10)
		Medium – 46.67 (28)
		High- 36.66 (22)
	Rainfed (60)	Low –31.67 (19)
		Medium – 46.66 (28)
		High – 21.67 (13)
	Total (120)	Low – 24.17 (29)
		Medium – 46.67 (56)
		High – 29.16 (35)

Adoption Behaviour of Bt Cotton Cultivation Aspects

Adoption behaviour refers 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.

The distribution of respondents under irrigated and rainfed conditions according to their adoption behaviour of Bt cotton practices is furnished in Table 4. It is seen that a majority (66.67 per cent) of the irrigated farmers were found with a high level of technology use behaviour, followed by 33.33 per cent with a low level. As far as rainfed farmers were concerned, more than one third (38.33 per cent) of them were observed with high level of technology use followed by 31.67 per cent with medium and the remaining 30.00 per cent with low level of technology use behaviour. 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 pests from developing resistance to Bt toxin. The remaining 40.00 per cent among the irrigated farmers and 30.00 per cent among the rainfed growers had adopted the technology with modifications of their own.

Table 4. Distribution of Respondents according to Technology Use Behaviour

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)

Instead of planting around the Bt cotton plot, they mixed the Bt cotton and non Bt cotton seeds and had 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 a 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 1Ac protein in seeds and leaves of cotton. None of the respondents was aware of this particular technical information in the study area.

Raising refugee crop was the only way recommended by the GEAC to manage pests from developing resistance to Bt toxin. If this trend of non-adoption of this technology goes on, the pest would certainly develop resistance to Bt cotton as it developed for pyrethroids. Similarly, selling small quantity of Bt cotton seeds in unsealed packets would lead to mushrooming of illegal Bt seeds in the market. This should be considered as the most important need of this hour and strategies should be developed to educate the farmers about its importance and consequences.

Constraints encountered in Bt Cotton Cultivation

The Bt cotton seed was initially sold @ Rs.1400/- for 450 g of Bt cotton seed and 120 g of non-Bt seed. After the intervention of Government of India, the companies have reduced the cost to Rs. 750/- for 450 g of Bt cotton seed and 120 g of non-Bt seed, which is recommended for half an acre only. As can be seen in Table 5, almost all the farmers under both irrigated and rainfed conditions felt that the cost of seed is high and is a major

constraint for cultivating Bt cotton. They added that no input subsidy was given for Bt cotton cultivation either by the Government or by the Private agencies. Added to this they opined that the given seed rate is not sufficient for one acre of land since majority of them were not using the non-Bt seeds.

Table 5. Distribution of Respondents according to the Constraints Encountered by them under Irrigated and Rainfed Conditions

S. No	Constraints	Irrigated N=60 Per cent	Rainfed N=60 Per cent
1.	High seed cost	100.00	100.00
2.	Lack of input subsidy	93.00	100.00
3.	Complexity in the technology to understand	100.00	85.00
4.	Difficulties in maintaining refugee crop	100.00	100.00
5.	Inadequate knowledge on Bt cotton's control over all pests	100.00	98.33
6.	Inadequate knowledge on ETL of different cotton pests	100.00	98.33
7.	Inadequate training in cultivation of Bt cotton	100.00	100.00
8.	Inadequate technical guidance from extension workers	100.00	100.00
9.	Controversial information about Bt cotton through various mass media	100.00	98.33
10.	No special price for kapas of Bt cotton	100.00	100.00
11.	Propaganda of NGO about the implications of Bt cotton	70.00	100.00
12.	Non-availability of Public Bt cotton varieties	100.00	100.00

More than 90 per cent of them felt that the technology refugia is a new practice for cotton growers and very complex to understand. Cent per cent of them felt that the technology refugia need separate attention of pesticides monitoring and management. Inadequate knowledge on Bt cotton's control over all pests, inadequate knowledge on ETL of different cotton pests, inadequate training in cultivation of Bt cotton, inadequate technical guidance from extension workers, controversial information about Bt cotton through various mass media, no special price for kapas of Bt cotton, propaganda of NGOs about the implications of Bt cotton and Non-availability of Public Bt cotton varieties were the other constraints expressed by the Bt cotton growers in Bt cotton cultivation.

Conclusion

Bt cotton is an attractive alternative technology to protect cotton from bollworms and to make cotton farming more sustainable, economical and eco-friendly. Evaluation

of farmers' attitude, knowledge and technology use behaviour on the use of this new technology is essential for development of strategies to sustain the new technology. This kind of study on Bt cotton is also especially important for the development of practical strategies for Bt cotton (Yang et al., 2005). The salient findings of this study might help the researchers, extension personnel and policy makers to draw suitable strategies for the existing Bt cotton as well as forthcoming biotech crops. The study reveals that the farmers had favourable attitude towards Bt cotton and it may pave way for researchers to develop further Bt strains and other biotech crops and for the extension personnel to develop strategies for popularizing the Bt cotton hybrids. The information about their knowledge revealed the need for educating Indian farmers about the new technology, resistance management strategies and related issues through various training programmes. The information on cultivators' concerns would facilitate the policy makers to plan effective research and development programmes.

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