

## Impact of Bt Cotton Production Technology in Haryana

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### ABSTRACT

*Cotton is a major fiber crop and used for textile purpose by about 75 percent of world's population. Cotton is attacked by several insect pests reducing the crop yield to a greater extent. The insect pests that attack cotton crop may be classified into sap sucking insects (aphids, Jassids and white fly) or chewing insects (bollworms, leaf eating caterpillars etc.) of the total pesticides used in Indian Agriculture, about 45 per cent is sprayed on cotton crop alone. To reduce pesticide usage in cotton, several strategies like use of Genetic Resistance to insect pests, Integrated Pest Management (IPM), Insecticide Resistance Management (IRM) etc. are advocated. In recent times, Bt cotton technology is found to be one of the best strategies to manage bollworms, the most important pest of cotton. The present study was conducted during 2014-2015 in Haryana. Two districts Hisar and Sirsa were purposely selected for the study because they have largest area of production under Bt cotton. The present study was conducted in purposely selected districts of Hisar and Sirsa of the native state Haryana because these districts have largest area and production under Bt-cotton. In this study, Impact of Bt cotton production technology was seen on the cotton growers in Haryana. 160 farmers constituted the sample for the purpose of the study. Majority of respondents perceive that Bt. Cotton reduces the insecticide use, increases household incomes, employment, education, standard of living and reduction in health hazard incidences due to pesticides.*

**Key words:** Impact; Bt cotton; Bt production technology; Haryana;

India, China, U.S.A, Brazil, Egypt, Mexico, Turkey and Sudan are the major cotton growing countries in the world. The U.S.A, Russia, China, India and Pakistan produce approximately 75 per cent of total production of it. Cotton popularly known as "White Gold" is a major fiber crop of the world. India alone being the major cotton producing country occupies 23 per cent area and contributes about 10 per cent of the total produce of cotton. India's cotton production for the year 2010-11 was 31.2 million bales, covering 11.16 million hectare with average yield 475.23 kg/ha. India is one of the leading producers of cotton in the world. However, its average productivity is far less than other countries. In our country before the introduction of *Bacillus thuringiensis* (Bt) cotton, nearly 50 per cent of the pesticides approximate value of (Rs. 3000 crores) were sprayed on cotton for the control of bollworms, which accounts for major damage for the crop (Anonymous, 2014).

India was estimated to have enhanced farm income

from Bt cotton by 95.14 thousand crores rupees in the 11-year period 2002 to 2012 and 14 thousand crores rupees in 2012 alone (Brookes and Barfoot, 2014). Bt-cotton was introduced in India in 2002 for commercial production in Southern states followed by that in Northern states (Haryana, Punjab and Rajasthan) in 2005. In India, biotechnology made its long-awaited entry into commercial agricultural in March, 2002 with the approval of three (MECH-12, MECH-162 and MECH-184) Bt cotton hybrids for commercial cultivation. The Genetic Engineering Approval committee, Ministry of Environment and Forest, Government of India granted the approval, at its 32<sup>nd</sup> meeting held in New Delhi. The transgenic hybrids were developed by Maharashtra Hybrid Seed Company Limited in collaboration with Monsanto. Presently, 1340 Bt cotton hybrids have been released and recommended for cultivation in India (Bharud, 2014), which has created a confusing situation for the farmers for choosing the appropriate hybrid.

In Haryana cotton is grown during *Kharif* season. Cotton accounts for an area of 610 thousand ha in Haryana with total production of 24,000 thousand bales and yield of lint is 664.50 kg/ha (*Anonymous 2014*).

**METHODOLOGY**

The present study was conducted in the native state Haryana. Two districts Sirsa and Hisar have largest area of production under Bt cotton among all the district of Haryana state. Multistage sampling technique was adopted for the selection of district, block, village .There are nine blocks in Hisar district and six blocks in Sirsa district out of these two blocks from each district were selected randomly. A list of all the village of the two selected blocks was prepared and two villages from each block were again selected randomly. Thus the eight villages were selected for the study. The Bt cotton growing farm families in the selected villages constituted the population for the study. A village-wise list of Bt cotton growers, was prepared and from that list of 20 farmers were selected randomly. Therefore, 160 Bt cotton respondents from 8 villages were selected for the present study. The data were collected through pre-tested structured interview schedule from the respondents to find out the impact of Bt cotton. A list of statements was prepared and the farmers were asked to speak out their responses against each statements. Whether it was ‘increased’, ‘no change’ and ‘decreased’ weightage given to these response categories were 3, 2, and 1 respectively, for negative statement weightage should be given reverse.

**RESULTS AND DISCUSSION**

*Perceived social impact of Bt cotton production technology:* In order to access social impact of Bt cotton, the respondents were asked about their perception on various aspect of Bt cotton production technology. The Table 1 shows that majority of the respondents (81.88%) perceived that contact with fellow farmer increased whereas 1.87 per cent perceived that it has decreased.

The contact with scientists was perceived to be increased by majority (68.13%) of the respondents whereas 5 per cent perceived is to be decreased. Similarly 65 per cent of respondents perceived that contact with input agencies has increased and 10.62 per cent viewed that it has decreased. Socio-economic

**Table 1. Perceived social impact of Bt cotton production technology**

Social impact	Category	No.	%	WMS	Mean
Contact with fellow farmers	Increased (3)	131	81.88	393	2.80
	No change (2)	26	16.25	52	
	Decreased (1)	3	1.87	3	
With scientists	Increased (3)	109	68.13	327	2.63
	No change (2)	43	26.87	86	
	Decreased (1)	8	5.00	8	
With input agencies	Increased (3)	104	65.00	312	2.54
	No change (2)	39	24.38	78	
	Decreased (1)	17	10.62	17	
Socio-eco. status	Increased (3)	123	76.88	369	2.70
	No change (2)	26	16.25	52	
	Decreased (1)	11	6.87	11	
Income generation	Increased (3)	141	88.13	423	2.82
	No change (2)	10	6.25	20	
	Decreased (1)	9	5.62	9	
Farmer’s awareness	Increased (3)	126	78.75	378	2.69
	No change (2)	19	11.88	38	
	Decreased (1)	15	9.37	15	
Change in social sphere	Increased (3)	101	63.13	303	2.52
	No change (2)	41	25.62	82	
	Decreased (1)	18	11.25	18	
Quality of life	Increased (3)	106	66.25	318	2.60
	No change (2)	45	28.13	90	
	Decreased (1)	9	5.62	9	
Farm mechanization	Increased (3)	115	71.88	345	2.63
	No change (2)	32	20.00	64	
	Decreased (1)	13	8.12	13	
Irrigation facilities	Increased (3)	107	66.88	321	2.89
	No change (2)	49	30.62	98	
	Decreased (1)	4	2.50	4	
Agronomic practices	Increased (3)	101	63.13	303	2.54
	No change (2)	45	28.12	90	
	Decreased (1)	14	8.75	14	
Family education	Increased (3)	87	54.38	261	2.40
	No change (2)	50	31.25	100	
	Decreased (1)	23	14.37	23	
Family welfare	Increased (3)	123	76.88	369	2.71
	No change (2)	29	18.12	58	
	Decreased (1)	8	5.00	8	
Average of weighted mean score			2.63		

status was perceived increased by majority of the respondents (76.88%) whereas 6.87 per cent viewed that it has decreased. A washed majority (88.13%) of respondents perceived that Bt cotton production is income generating technology but 5.62 per cent did not favour it. Similarly the farmers’ awareness was

**Table 2. Perceived economic impact of Bt cotton production technology**

Eco. impact	Category	No.	%	WMS	Mean
Yield enhancement	Increased (3)	142	88.75	426	2.85
	No change (2)	13	8.13	26	
	Decreased (1)	5	3.12	5	
Crop profitability	Increased (3)	128	80.00	384	2.73
	No change (2)	21	13.13	42	
	Decreased (1)	11	6.87	11	
Labour requirement	Increased (3)	25	15.63	75	1.52
	No change (2)	34	21.25	68	
	Decreased (1)	101	63.12	101	
Human labour	Increased (3)	43	26.88	129	1.72
	No change (2)	30	18.75	60	
	Decreased (1)	87	54.37	87	
Bullock labour	Increased (3)	36	22.50	108	1.63
	No change (2)	29	18.13	58	
	Decreased (1)	95	59.37	95	
Quality of produce	Increased (3)	113	70.63	339	2.61
	No change (2)	32	20.00	64	
	Decreased (1)	15	9.37	15	
Marketing of produce	Increased (3)	137	85.63	411	2.81
	No change (2)	17	10.62	34	
	Decreased (1)	6	3.75	6	
Reduction of insecticide	Increased (3)	128	80.00	384	2.78
	No change (2)	30	18.75	60	
	Decreased (1)	2	1.25	2	
Control of harmful insect	Increased (3)	135	84.38	405	2.77
	No change (2)	14	8.75	28	
	Decreased (1)	11	6.87	11	
Net income of farmer	Increased (3)	138	86.25	414	2.83
	No change (2)	18	11.25	36	
	Decreased (1)	4	2.50	4	
Cash in hand	Increased (3)	114	71.25	342	2.63
	No change (2)	34	21.25	68	
	Decreased (1)	12	7.50	12	
Farm power	Increased (3)	123	76.88	369	2.73
	No change (2)	31	19.37	62	
	Decreased (1)	6	3.75	6	
Farmer's purchasing power	Increased (3)	136	85.00	408	2.80
	No change (2)	16	10.00	32	
	Decreased (1)	8	5.00	8	
Family expenditure	Increased (3)	101	63.13	303	2.48
	No change (2)	36	22.50	72	
	Decreased (1)	23	14.37	23	
Expenditure on health	Increased (3)	110	68.75	330	2.57
	No change (2)	32	20.00	64	
	Decreased (1)	18	11.25	18	
Expenditure on education	Increased (3)	128	80.00	384	2.73
	No change (2)	21	13.13	42	

Expenditure on social ceremony	Decreased (1)	11	6.87	11			
	Increased (3)	113	70.63	339			
	No change (2)	39	24.37	78			
Expenditure on farm renovation	Decreased (1)	8	5.00	8			
	Increased (3)	135	84.38	405			
	No change (2)	21	13.12	42			
Expenditure on house renovation	Decreased (1)	4	2.50	4			
	Increased (3)	108	67.50	324			
	No change (2)	45	28.13	90			
Miscellaneous expenditure	Decreased (1)	7	4.37	7			
	Increased (3)	119	74.38	357			
	No change (2)	29	18.12	58			
				Decreased (1)	12	7.50	12
Average of weighted mean score				2.54			

perceived to be increased by 78.75 per cent whereas 9.37 per cent viewed that it has decreased. A total of 66.25 per cent respondents perceived that quality of life increased but 5.62 per cent viewed that it has decreased. Nearly half of the respondents (54.38%) perceived that family education has increased whereas 14.37 per cent did not favour it. Family welfare was perceived increased by 76.88 per cent respondents but 5.00 per cent viewed that it has decreased. According to weighted mean scores perceived income generation (2.82), contact with fellow farmer (2.80), family welfare (2.71), socio-economic status (2.70), farmer awareness (2.69), contact with scientist as well as farm mechanization (2.63) and quality of life (2.60) were in decreasing order. The average of weighted mean scores was calculated to be 2.63 which show that the farmer perceived Bt cotton production technology have highly positive social impact.

*Perceived impact of Bt cotton production technology on economy* : In order to assess social impact of Bt cotton, the respondents were asked about their perception on varied aspect of Bt cotton production technology. The Table 2 showed that majority of the respondents (88.75%) perceived yield increase whereas 3.12 per cent perceived that it has decreased. The labour requirement perceived to be decreased by majority (63.12%) of the respondents whereas 15.63 per cent perceived is to be increased. Similarly 54.37 percent of respondents perceived that human labour decreased and 26.88 per cent views that it has increased. Quality of produce perceived to be increased by majority of the respondents (70.63%) whereas 9.37 per cent did not favour it. A majority (80%) of respondents perceived

that reduction in pesticide use but remaining 1.25 per cent did not favour it. Similarly the net income of farmers was perceived to be increased by 86.25 per cent of the respondents whereas 2.50 per cent viewed that it has decreased. Majority 85 per cent respondents perceived that purchasing power increased but 5.00 per cent viewed that it has decreased. Expenditure on education perceived to be increased by 80.00 per cent of respondents whereas 6.87 per cent viewed to be decreased. Expenditure on farm renovation was perceived to be increased by 84.38 per cent respondents whereas 2.50 per cent unfavour it.

According to weighted mean score perceived yield enhancement (2.85), net income of farmer (2.83), marketing of produce (2.81), expenditure on farm renovation (2.81), farmer’s purchasing power (2.80), reduction of insecticide (2.78), control of harmful insect (2.77), expenditure on education (2.73), farm power (2.73), crop profitability (2.73), miscellaneous expenditure (2.66), expenditure on social ceremony (2.65), cash in hand (2.63), expenditure on house renovation (2.63), quality of produce (2.61), expenditure on health (2.57), family expenditure (2.48), human labour (1.72), bullock labour (1.63) and labour requirement (1.52) received scores in decreasing order. The average of weighted mean score was calculated as to be 2.54 which show that the farmer perceived Bt cotton production technology have highly positive impact on the economy.

*Perceived impact of Bt cotton production technology on health:* Perceived impact of Bt cotton production technology was studied on six sub parameter namely live stock health, farmer health, non farmer health, residual effect in food and water and pesticide poisoning incidences and presented in Table 3. The table showed that majority of the (71.88%) respondents perceived that negative effect on livestock health as decreased whereas 8.13 per cent perceived that it has increased. The positive effect on non farmer health was perceived to be increased by majority (79.38%) of the respondents whereas 5.00 per cent perceived is to be decreased. Similarly 86.25 per cent of respondents perceived that positive effect on farmer health increased and 1.88 per cent views that it has decreased. Pesticide poisoning incidences were perceived decreased by majority of the respondents (83.13%) whereas 5.63 per cent were viewed that it has increased. Decreasing residual effect of pesticide in food a washed majority (91.88%)

**Table 3. Perceived impact of Bt production technology on health**

Health impact	Category	No.	%	WMS	Mean
Effect on livestock health	Increased (1)	13	8.13	13	2.64
	No change (2)	32	20.00	64	
	Decreased (3)	115	71.87	345	
Positive effect on non human health	Increased (3)	127	79.38	381	2.74
	No change (2)	25	15.62	50	
	Decreased (1)	8	5.00	8	
Positive effect on farmers health	Increased (3)	138	86.25	414	2.84
	No change (2)	19	11.88	38	
	Decreased (1)	3	1.87	3	
Pesticide poisoning incidences	Increased (1)	9	5.63	18	2.78
	No change (2)	18	11.25	36	
	Decreased (3)	133	83.12	399	
Perceived residual effect of pesticide in food	Increased (1)	2	1.25	2	2.91
	No change (2)	11	6.88	22	
	Decreased (3)	147	91.87	441	
Perceived residual effect of pesticide in water	Increased (1)	3	1.88	3	2.88
	No change (2)	14	8.75	28	
	Decreased (3)	143	89.37	429	
Average of weighted mean score				2.79	

perceived that it has decreased and 1.25 per cent perceived that it has increased. Similarly the residual effect of pesticide in water was perceived decreased by 89.38 per cent whereas 1.88 per cent viewed that it has increased. According to weighted mean score the perceived residual effect in food (2.91), water (2.88), farmer health (2.84), pesticide poisoning incidences (2.78), non farmer health (2.74) and effect on livestock health (2.64) were in decreasing order. The average of weighted mean score was calculated as to 2.79 which shows that the farmer perceived Bt cotton production technology have highly positive impact on the health.

*Perceived ecological impact of Bt cotton production:* Perceived impact of Bt cotton production technology was studied on twelve sub parameter namely soil fertility, ecofriendly, herbicide use, cropping pattern, farm life, sustainability of life, risk bearing capacity, biofertilizer use, manure use, pollution of air, pollution of water and pollution of land. The Table 4 shows that a washed majority of the (91.88%) respondents perceived that Bt cotton production is ecofriendly whereas minority (3.12%) unfavour it. The positive effect on soil fertility was perceived to be increased by majority (82.50%) of the respondents whereas 1.87 per cent perceived is to be decreased.

**Table 4. Perceived ecological impact of Bt cotton production technology**

Ecological	Category	No.	%	WMS	Mean
Soil fertility	Increased (3)	132	82.50	396	2.80
	No change (2)	25	15.63	50	
	Decreased (1)	3	1.87	3	
Ecofriendly	Increased (3)	147	91.88	441	2.88
	No change (2)	8	5.00	16	
	Decreased (1)	5	3.12	5	
Herbicide use	Increased (3)	5	3.12	15	1.98
	No change (2)	148	92.50	296	
	Decreased (1)	7	4.38	7	
Cropping pattern	Increased (3)	141	88.13	423	2.83
	No change (2)	11	6.87	22	
	Decreased (1)	8	5.00	8	
Farm life	Increased (3)	130	81.25	390	2.79
	No change (2)	27	16.87	54	
	Decreased (1)	3	1.88	3	
Sustainability of life	Increased (3)	143	89.38	429	2.86
	No change (2)	13	8.12	26	
	Decreased (1)	4	2.50	4	
Risk bearing capacity	Increased (3)	125	78.13	375	2.66
	No change (2)	16	10.00	32	
	Decreased (1)	19	11.87	19	
Bio-fertilizer use	Increased (3)	11	6.88	33	1.96
	No change (2)	133	83.12	266	
	Decreased (1)	16	10.00	16	
Manure use	Increased (3)	71	44.38	213	2.38
	No change (2)	79	49.37	158	
	Decreased (1)	10	6.25	10	
Pollution in air	Increased (3)	5	3.13	15	1.16
	No change (2)	16	10.00	32	
	Decreased (1)	139	86.87	139	
Pollution in water	Increased (3)	3	1.88	9	1.12
	No change (2)	14	8.75	28	
	Decreased (1)	143	89.37	143	
Pollution in land	Increased (3)	5	3.13	15	1.11
	No change (2)	8	5.00	16	
	Decreased (1)	147	91.87	147	
Average of weighted mean score					2.21

Similarly 78.13 per cent of respondents perceived that risk bearing capacity of farmer increased and 11.87 per cent views that it has decreased. Pollution of air was perceived decreased by majority of the respondents (86.87%) whereas 3.13 percent were viewed that it has increased. Decreasing in pollution of water perceived by a majority (89.37%) of respondents and minority 1.88

**Table 5. Correlation of socio economic variables with impact of Bt cotton on growers.**

Socio-economic variables	'r' value
Age	0.120
Education	0.625*
Socio-economic status	0.135
Irrigation facilities	0.085
Mass media exposure	0.218*
Risk orientation	0.343*
Extension contact	0.434*
Economic motivation	0.145
Scientific orientation	0.156

\* Significant at 0.05 level of probability

per cent perceived that it has increased. Similarly the pollution of land was perceived decreased by a washed majority (91.87%) whereas 3.13 per cent viewed that it has increased. According to weighted mean score the perceived ecofriendly (2.88), sustainability of life (2.86), cropping pattern (2.83), soil fertility (2.80), farm life (2.79), risk bearing capacity (2.66), manure use (2.38), herbicide use (1.98), biofertilizer use (1.96), pollution of air (1.16), pollution of water (1.12) and pollution of land (1.11) were in decreasing order. The average of weighted mean score was calculated as to 2.21 which shows that the farmer perceived Bt cotton production technology have highly positive impact on the ecology ( Table 4 ).

*Correlation of socio economic variables with impact of Bt cotton on growers:* Table 5 indicated that age and socio-economic status of Bt cotton farmers were not significantly correlated but showed positive relation with the impact of Bt Cotton production technology. The table shows that education played significant role in Bt cotton production technology as it was found significant and positively correlated with a value of 0.625. Further, it was found that extension contact, risk orientation and mass media exposure were having a positive and significant correlation with the impact with their respective 'r' values of 0.434, 0.343, and 0.218, respectively. This means that Bt Cotton growers having higher level of education, extension contact and mass media exposure possessed higher level of impact of the Bt Cotton production technology.

*Discussion:* It is apparent from the result of the study the majority of the respondents perceived that Bt cotton help in increasing the household income. The Bt cotton production reduces the insecticide use which help in protecting underground water and environment from

contamination. Moreover, most of the respondents perceived that it's adoption helps in increasing employment for men and women in agriculture. The reduction in health hazard incidences due to less use of the pesticide perceived by the Bt cotton growers. It was also reported that Bt cotton raise the living standard of the farmer and it recovers the farmer from ineptness. Respondents perceived that net income of the farmers increased due to adoption of Bt cotton production technology. *Qaim et al. (2006)* reported reduction in the use of pesticides and *Subramanian and Qaim (2010)* found increased labour for picking of cotton. It was also perceived that the Bt cotton production increased purchasing power of the farmers it's adoption lead to easy availing of health services for the family, easy to spent on children education and improve economic condition of the farmers. *Godara et al. (2012)* also reported that Bt production leads to easy to spent on children education and improve the economic condition of the farmer. The Bt cotton production improved the contact of respondents with scientist, fellow farmers and input agencies. Respondents were of the view that Bt cotton production improve quality of life and quality of produce. Respondents perceived that negative effect on livestock health has decreased, similarly, negative effect on human health also decreased. Respondents also perceived that Bt cotton production technology is ecofriendly and it increase the risk bearing capacity of the farmers. Favourable and positive impact of Bt cotton on social, economical, health and ecological aspects was perceived by the respondents. *Stone, (2011), Kiresur*

*et al. (2011), and Reddy et al. (2011)* also reported similar finding in their studies.

## CONCLUSION

The study concluded that farmers had perceived positive impact of Bt cotton production technology on health, social, economical and ecological aspects on farmers status. The impact of Bt cotton, as perceived by the farmers has been in terms of enhanced yield, reduced pest and disease incidence, increased income, employment, education and standard of living and reduced health hazards of human as well as animal. The incidence of pests was reported to be considerably lower in Bt cotton. The yield of Bt cotton was found to be higher and the yield increase. Good market acceptance of the product, the value of output per hectare was higher in all the states and conditions. The profit was found to be higher in all the states when the effect of the associated inputs was included. Age and socio-economic status of Bt cotton farmers were not significantly correlated but showed positive relation with the impact of Bt cotton production technology. The education played significant role in Bt cotton production technology as it was found significant and positively correlated. Further, it was found that extension contact, risk orientation and mass media exposure were having a positive and significant correlation with the impact of Bt cotton production technology. This means that Bt cotton growers having higher level of education, extension contact and mass media exposure possessed higher level of impact of the Bt cotton production technology.

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