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RESEARCH ARTICLE

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Analysis on impact and constraints of Bt cotton cultivation in middle Gujarat

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ABSTRACT : The performance regarding Bt technology and its impact on farming community have been assessed in Middle Gujarat based mainly on primary data using tabular analysis. The farmer's perceptions on the impact of Bt cotton technology on various dimensions were ascertained and analyzed in terms of "positive", "neutral" and "negative". 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 risk. To foster adoption, availability of quality and quantity of Bt cotton seed to farmers needs greater attention of development agencies, while researchers' attention is called for incorporating resistance/ tolerance to Spodoptera and pink bollworms. The major production, marketing and economic constraints faced by the Bt cotton growers were non-availability of agricultural labour during peak seasons, high incidence of attack from sucking insect-pests and bollworms, fluctuation in the market prices, lack of transportation facilities, high cost of quality Bt seeds and high cost of fertilizers and pesticides.

KEY WORDS : Bt cotton, Bt technology, Farmer's perception towards Bt technology, Pink bollworm, Market prices

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INTRODUCTION

In 2014, the adoption of Bt-cotton in India increased by 600,000 hectares to a record 11.6 million hectares, equivalent to a high adoption rate of 95 per cent of 12.25 million hectares total cotton area. In 2014, India planted the largest ever area of cotton – 105,000 ha more than the previous record cotton area of 12.1 million ha in 2011. Thus, in 2014, India achieved a near optimal adoption rate of 95 per cent at the national level and this was distributed evenly among the ten cotton growing States. The number of Bt cotton farmers increased to 7.7 million in 2014 from 7.3 million in 2013 (Choudhary and Gaur, 2015).

During thirteen years period, 2002 to 2014, India tripled cotton production from 13 million bales to 39 million

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bales in 2013, with a projected 40 million bales in 2014. World cotton production was estimated at 151 million bales in 2014 and impressively, India contributed one quarter of this global total. As a result of this phenomenal increase in cotton production in the recent years, India surpassed USA in 2006 to become the second largest cotton producing country and is projected to surpass China in 2014 to become the number one cotton producer in the world. Thirteen years ago, China produced twice as much as India's cotton production of 13 million bales in 2002. The phenomenal increase in cotton production in India during the period 2002 to 2014 is due to the structural transformations in the cotton value chain driven by multiple factors including: the high and broad scale adoption of Bt cotton technology; hybridization of the cotton crop, supply of good quality seeds by the private sector and last but not least the untiring efforts of millions of small resource-poor cotton farmers. The resurgence of cotton, the white gold of rural India can help resurrect the spirit of the Gandhian 'spinning wheel' and the glory of the cotton and textile sectors in the country (Chaudhary and Gaur, 2015).

Objectives of the study:

–To analyze the dimensions of impact of Bt technology through farmer's perception

–To study the constraints faced by Bt cotton growers.

EXPERIMENTAL METHODS

Ahmedabad and Vadodara districts were selected purposively, as they collectively covered about 83.42 per cent area of cotton in triennium average of the years 2010-11, 2011-12 and 2012-13 in Middle Gujarat Zone. Two talukas were selected from each district on the basis of concentration of area. Further, three villages were selected randomly from the each selected talukas. Thus, total 12 villages were selected for the study. Then, randomly 12 Bt cotton growing respondents from each of the selected villages were chosen for the study. Thus, in all 144 growers (43 marginal, 34 small, 31 medium and 36 large) were selected for the study. The farmer's perceptions on the impact of Bt cotton technology on various dimensions were ascertained and analyzed in terms of "positive", "neutral" and "negative" mainly based on primary data by personally interviewing the farmers through tabular analysis. The problems of Bt cotton growers were identified through close-ended questions. Based on the frequency and percentage of the respondents, intensity of problems was assessed and ranking was done.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Farmer's perceptions on various dimensions of impact of Bt technology:

The farmer's perceptions on the impact of *Bt*-cotton technology on various dimensions were ascertained and analyzed in terms of "positive", "neutral" and "negative" and the results have been presented in Table 1.

On the yield front, farmers perceived that the Bt cotton technology had a very high positive impact on the yield of main product (95.83%). They were also confident that the technology provided cost reduction (74.31%). Amongst all the environmental factors, use of insecticides and bollworm incidence were greatly influenced by the Bt cotton technology as 90.97 per cent of the respondents reported that the quantity of insecticide usage on Bt cotton had reduced over the years. As regards the role of Bt cotton in minimizing the attack of bollworm, 89.58 per cent farmers opined that Bt cotton had reduced the attack of bollworms. While on the issue of impact of beneficial insects, farmers were observed indecisive.

Under the category of socio-economic factors, farmers opined that there was a positive and significant impact of Bt technology on their farm income (77.08%), employment (76.39%), standard of living (75.69%), educational level (74.31%), saving of time (70.14) per cent and equity (52.08%). Shelton *et al*. (2002) have reported that environmental and health risks need to be considered in a comprehensive impact assessment and that Bt crops pose no significant risks to the environment or to human health and that their positive externalities exceed the potential negative ones.

Amongst several other dimensions of impact, the sustainability of resource use and quality of output on the main product as well as by-product were reported to be positively influenced by the introduction of Bt cotton technology.

The overall impact of Bt cotton, as perceived by the farmers, is found to be positive and quite significant in terms of enhanced yield, reduced pest and disease incidence, increased income, employment, education and standard of living and reduced health risk while research attention is called for incorporating resistance/tolerance to *Spodoptera* and pink bollworms. The results of this study are close in line with the findings of Shah (2007), Anonymous (2011); Kiresur and Ichangi (2011) and Haque *et al.* (2015).

Constraints faced by Bt cotton growers:

The developments of new agricultural technologies do not yield benefits by itself. The new technologies are required to be transferred to the farmer's field. In the past, improved technologies were developed at a fast pace. But, the adoption of technologies occurred at desired pace was only in case of some specific regions and crops. There have been some constraints in the adoption of technology in Bt cotton. Though some farmers are able to achieve high yields with the help of new technologies, they have hardly reached near the success attained at experimental level.

The problems of Bt cotton growers were identified through close-ended questions. Based on the frequency and percentage of the respondents, intensity of problems was assessed and ranking was done as shown in Table 2.

In the process of agricultural development, the Bt gene is considered to be the new farming technology. The benefit of such technology is actually derived only when individual farmers in his local situation efficiently

Table 1: Farmer's perceptions about Impact of Bt technology **(% of sample respondents)**

Impact indicators	Positive	Neutral	Negative
Yield enhancement			
Main product	95.83	4.17	0.00
By-product	27.08	72.22	0.69
Cost reduction	74.31	11.11	14.58
Improvement in environmental factors			
Soil texture	56.94	40.97	2.08
Soil moisture/water demand	22.22	75.69	2.08
Soil/water quality	56.94	40.97	2.08
Soil micro flora	12.50	85.42	2.08
Bollworm	89.58	10.42	0.00
Sucking pests	61.81	16.67	21.53
Diseases	61.81	29.86	8.33
Use of insecticides	90.97	9.03	0.00
Impact on beneficial insects	51.39	48.61	0.00
Improvement in farm level social-economic factors			
Standard of living	75.69	16.67	7.64
Farm income	77.08	15.97	6.94
Educational level	74.31	18.06	7.64
Employment	76.39	16.67	6.94
Equity	52.08	46.53	1.39
Enhanced sustainability in resource use	51.39	47.12	1.39
Saving of time/season	70.14	13.19	16.67
Improvement in quality of output			
Main product	97.22	2.08	0.69
By-product	69.44	29.17	1.39
Complementary enterprise/resource use	56.25	43.75	0.00
Eco-friendliness	70.14	29.17	0.69

utilize it. A large number of constraints are faced by the farmers, which are ultimately responsible for the low yield particularly in case of cotton production. The constraints were studied for production and marketing.

The results revealed that on an average, non-availability of agricultural labour during peak seasons was the most severe problem felt by the majority of the growers (77.08%). It could be attributed to the reason that majority of the labourers were not willing to work at the prevailing wage rate as they were much interested to work in non-agricultural sector as they received good amount of wages comparatively. Problems like lack of availability and high cost of recommended fertilizers and high incidence of sucking insect-pests were faced by 70.14 per cent of farmers as farmers claimed that with the introduction of Bt cotton, though bollworm damaged had declined, there was an increased damage of sucking pests such as Aphids, Jassids, Thrips, Whiteflies and Mealy

Table 2: Constraints faced by Bt cotton growers

Rank	Problems/ constraints	Marginal (43)	Small (34)	Medium (31)	Large (36)	Overall (144)
Production constraints						
1	Non-availability of agricultural labour during peak seasons	31 (72.09)	27 (79.41)	25 (80.65)	28 (77.78)	111(77.08)
2	Lack of availability and high cost of recommended fertilizers	37 (86.05)	24 (70.59)	18 (58.06)	22 (61.11)	101 (70.14)
3	High incidence of sucking insects-pests	37 (86.05)	26 (76.47)	22 (70.97)	16 (44.44)	101 (70.14)
4	Lack of knowledge about recommended package of practices or of technical guidance	38 (88.37)	28 (82.35)	20 (64.52)	13 (36.11)	99 (68.75)
5	High incidence of attack from bollworms	30 (69.77)	24 (70.59)	20 (64.52)	16 (44.44)	90 (62.50)
6	Growth of weeds	22 (51.16)	20 (58.82)	18 (58.06)	16 (44.44)	76 (52.78)
7	Lack of availability of recommended plant protection chemicals	25 (58.14)	18 (52.94)	13 (41.94)	12 (33.33)	68 (47.22)
8	High incidence of disease attack	18 (41.86)	14 (41.18)	11(35.48)	9 (25.00)	52 (36.11)
9	Lack of irrigation facilities	11 (25.58)	5 (14.71)	3 (9.68)	3 (8.33)	22 (15.28)
10	Non-availability of quality seeds of Bt cotton in time	2 (4.65)	1 (2.94)	0 (0.00)	3 (8.33)	6 (4.17)
Marketing constraints						
1	Fluctuation in market prices	43 (100.00)	34 (100.00)	31 (100.00)	36 (100.00)	144 (100.00)
2	Lack of cheap and efficient transportation facilities	20 (46.51)	17 (50.00)	15 (48.39)	12 (33.33)	64 (44.44)
3	Lack of storage facilities	27 (62.79)	19 (55.88)	9 (29.03)	3 (8.33)	58 (40.28)
4	Long distance of market	8 (18.60)	7 (20.59)	11 (35.48)	7 (19.44)	33 (22.92)
5	Lack of marketing facilities at village level	4 (9.30)	3 (8.82)	5 (16.13)	1 (2.78)	13 (9.03)
6	Lack of grading and standardization	6 (13.95)	2 (5.88)	4 (12.90)	1 (2.78)	13 (9.03)
7	Irregular payment for sale	1 (2.33)	1 (2.94)	0 (0.00)	0 (0.00)	2 (1.39)
Economic constraints						
1	High cost of quality Bt seeds	43 (100.00)	30 (88.24)	25 (80.65)	29 (80.56)	127 (88.19)
2	High cost of fertilizers	38 (88.37)	24 (70.59)	22 (70.97)	20 (55.56)	104 (72.22)
3	High cost of pesticides	37 (86.05)	23 (67.65)	22 (70.97)	19 (52.78)	101 (70.14)
4	High cost of labour	28 (65.12)	26 (76.47)	21 (67.74)	19 (52.78)	94 (65.28)
6	High cost of credit	43 100.00)	22 (64.71)	16 (51.61)	10 (27.78)	91 (63.19)
5	High cost of irrigation	19 (44.19)	8 (23.53)	7 (22.58)	4 (11.11)	38 (26.39)
7	Non-availability of credit in time	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

Note: Figures in the parentheses indicate the percentages to total number of respondents in each category of farm

bugs. Problems of lack of technical guidance were faced by 68.75 per cent of farmers. 62.50 per cent of the farmers felt the problem of high incidence of attack from bollworms. Mainly it is attributed to the reason that Bt gene has started showing resistance against pink bollworm as a natural factor since last three years. Attack from pink bollworms was found in all the regions of the study area except Dhandhuka taluka in Ahmedabad district. Other major production problems faced by the Bt cotton growers were weed infestation (52.78%) and lack of availability of recommended plant protection chemicals (47.22%). Only 4.17 per cent respondents found the problem of non-availability of quality seeds of Bt cotton in time as farmers were able to get Bt cotton seeds in time from nearby agro centers. Interestingly, few farmers in Anjesar village purchased Bt cotton seeds online from the website *www.agrostar.in.*

As far as the marketing constraints were concerned, fluctuation in market prices was the most severe problem felt by all the Bt cotton growers (100.00%). As farmers observed low and fluctuating cotton prices over the years, it could make the cotton crop production risky and non-remunerative in some years. Lack of cheap and efficient transportation facilities was the second major problem faced by 44.44 per cent of the farmers followed by lack of storage facilities (40.28%) and long distance of market (22.92%). Further, only 9.03 per cent of the farmer's faced the problem of lack of marketing facilities at village level and lack of grading and standardization. Only 1.39 per cent of the Bt growers were observed facing the problem of irregular payment for sale. This could be because farmers received immediate cash while selling the cotton to village merchant or marketing yard.

As for the economic constraints, the high cost of quality Bt seeds was observed as the most important constraints (88.19%) followed by high cost of fertilizers (72.22%), high cost of pesticides (70.14%) and high cost of labour (65.28%). Farmers also opined that labour costs had been increasing over the years due to shortage of labour. Steep hike was found in labour charges. On an average, wage rate was observed about 120-180 per day. Analysis further revealed that some 63.19 per cent farmers faced a problem of high cost of credit. The results of this study are in line with the findings of Visawadia *et al.* (2006); Darandale *et al.* (2011); Kotwal and Leua (2014) and Haque *et al.* (2015).

Conclusion:

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 risk. To foster adoption, availability of quality and quantity of Bt cotton seed to farmers needs greater attention of development agencies, while researchers' attention is called for incorporating resistance/ tolerance to *Spodoptera* and pink bollworms.

The major production, marketing and economic constraints faced by the Bt cotton growers were non-availability of agricultural labour during peak seasons, high incidence of attack from sucking insect-pests and bollworms, fluctuation in the market prices, lack of transportation facilities, high cost of quality Bt seeds and high cost of fertilizers and pesticides.

As a salient observation, the study has brought to the fore that pink bollworm has started showing resistance against Bt technology. Hence, there is need for more innovative, high-yielding technologies and resistant varieties so that cotton crop can be protected from a broad spectrum of bollworm complex and spodoptera and eventually making Bt cotton more remunerative and sustainable.

The major parts of the state fall under semi tropics. Thus the sensible use of scarce water resource is to boost up the Bt cotton production. Shrinking labour force and non-availability of manpower particularly during peak crop season is a growing problem. To address these issues, promoting mechanization in Bt cotton cultivation seems a logical choice given the larger focus on improving yields, quality of fibre, profitability and addressing the labour problem.The agricultural extension agencies operating in the study area also need to be strengthened to educate the farming community regarding judicious use of agricultural inputs as per the recommended practices.

Significance of quality seeds in Bt cotton cannot be overemphasized. Nearly 90 per cent farmers surveyed faced the problem of high cost of quality Bt seeds. Hence, Bt seeds need to be made available to the farmers timely and at reasonable prices. The high cost of institutional credit was also observed as a major problem faced by the farmers to boost the Bt cotton cultivation. This becomes even more important in the face of growing resistance of pink bollworm against Bt technology.

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