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PARADIGM SHIFT FROM NON-BT TO BT COTTON AND FACTORS CONDUCING BT COTTON PRODUCTION IN A SOUTHERN PUNJAB'S DISTRICT OF PAKISTAN

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Abstract

Pakistan is one of the developing countries and major portion of its economy depends on agriculture. The study aim was to identify the different factors affecting the adoption of Bt cotton and analysis of paradigm shift from Non-Bt to Bt cotton in tehsil Jatoi of Muzaffargarh district, which provided a guideline for extension organizations to develop better strategies in future for effective extension work towards Bt cotton production. The data were collected from 120 Bt cotton growers through random sampling technique. The data were analyzed through Statistical Package for Social Sciences (SPSS). Descriptive statistics such as frequencies, percentages, means, standard deviations and rank order were used for interpretation of the data. The study revealed that maximum respondents were belonging to the middle age group, agriculture and livestock farming were their source of income and their maximum cultivation was under Non-Bt cotton. Cotton growers were highly dependent on pesticide companies for agricultural information. The higher crop yield was the major factor which shifted the farmers to grow Bt cotton. Unapproved Bt, high fertilizer requirement and non-availability of seed were the threatening factors being faced in Bt cotton cultivation, ranked at medium scale. Opportunities of less use of pesticides, increase in production and net annual income, reduction in health hazards, less cost of production and availability of certified seeds was generated by the cultivation of Bt cotton, was recorded at medium scale.

Key words*: cotton, Bt and Non-Bt, paradigm shift, adoption, factors.*

INTRODUCTION

Pakistan is one of the developing countries and major portion of its economy depends on agriculture. About 70.5% of the population of Pakistan are involved directly or indirectly in the agriculture industry. It contributes almost 21% to GDP of Pakistan. Cotton accounts for 8.6% of the value added in agriculture and about 1.8% to GDP. The crop was sown on the area of 3106 thousand hectares during growing season of 2012, 10.1% more than previous year (2820 thousand hectares) (Govt. of Pakistan, 2013). The main cotton growing districts in the Punjab province are Muzzaffargarh, Lodhran, Rahim Yar Khan, Vehari, Bahawlanagar, Multan, Rajanpur, Bahawalpur and Dera Ghazi Khan. Its production was 5% less than the target of 13.36 million bales mainly due to the shortage of irrigation water, less use of DAP in the cotton crop, attack of Cotton Leaf Curl Virus (CLCV), mealy bug and white fly on the crop and last picking of it was affected due to higher prices of wheat announced by the government (Govt. of Pakistan, 2013). Pakistan is the largest exporter of cotton material such as (cotton fabric, cotton yarn and other items, manufactured of cotton) to the USA and other countries of the world. The statistical analysis showed that cotton has importance in Pakistan

Economy (Shafiq-ur-Rehman, 2009).

Punjab and Sindh are two major cotton producing provinces in the country. The share of Punjab in the production is about 80% and the contribution of Sindh is about 20%. The share of other provinces like Baluchistan and Khyber Pakhtunkhwa is very low as compared to Punjab and Sindh provinces (Govt. of Pakistan, 2013). Biotechnology is playing a vital role in the cotton industry, the Bt technology is providing the varieties of high yield (Gandhi and Namboodiri, 2006). Bt cotton showed some problems in the local environment, to solve these issues government start Bt breeding programs. These breeding programs conducted various trials by sowing different varieties of Bt and non-Bt cotton on experimental basis, with different variations. Resultantly, they developed variety of seed Bt cotton, which could be survived at high temperature and low water with high yield. It has been noticed that these locally developed varieties according to local environment showed better results, and suggested to cotton growers to grow these locally developed Bt varieties (Mahmood and Farooq, 2011).

The Bt cotton was adopted in Pakistan mainly due to requiring less number of sprays and high productivity. The average yield of Bt cotton is 23-28 mounds per acre as compared to conventional cotton, which is 17-20 mounds per acre (Abid, 2010). The small farmer reported the main reason of the adoption of Bt cotton was high yield. When they analyzed the data, it was revealed that the adoption of Bt cotton was due to three main reasons, one it reduced the pesticide application, second it increased the seed cost and the third main reason of the adoption of Bt cotton was its high yield (Gouse et al., 2002). Subramanian and Qaim (2008) studied the impact of Bt cotton on poor households in rural India. They focused on insect resistant *Bacillus thuringiensis* (Bt) crops, especially Bt cotton. Bt technology had been adopted by a large number of farmers in the world. Data were collected from Kanzara village which was located in Akola district of Maharashtra the state with the largest area under cotton in India. They used a microeconomic modeling approach and comprehensive household survey data. Study showed that the farmers got a number of benefits from Bt cotton in which some were insecticide savings, higher yields through reduced crop losses, and net revenue gains, in spite of higher seed prices. This study also showed that Bt cotton entails positive direct and indirect welfare effects in the rural economy. The study concluded that Bt cotton contributes to poverty reduction and rural development.

Cotton production in Pakistan faces a rising occurrence of diseases and insect's attack. In Pakistan agriculture is particularly susceptible to pest invasion and climatic extremes because of their capacity to stand any form of financial risks (Farooqi, 2010; Ahmad et al., 2016; Bakhtavar et al., 2015). While on the other side the cultivation of Bt cotton at a commercial level have gained importance, in terms of reduced pesticide use and costs and higher yields (Qaim and Matuschke, 2005). There are many extension organizations working in Pakistan for the introduction of Bt cotton among the farmers. However, despite all efforts, farmers have not been adoptedto Bt cotton as desired by the extension organizations. A conventional cotton profit is reduced because of pesticide cost and insect attack losses. While in case of Bt cotton the pesticide costs and losses by pest attack were reduced. Keeping in view all these facts, the present study was designed for analysis of paradigm shift from Non-Bt to Bt cotton in tehsil (local administrative division) Jatoi. The objective of the study was to identify the different factors affecting the adoption of Bt cotton, which provides a guideline to extension organizations to develop better strategies in future for effective extension work towards Bt cotton production.

MATERIALS AND METHODS

The district Muzzafargarh (Punjab province) is about 34 km away from Multan cross, the river Chenab on its' east. It comprises of four tehsils namely Muzaffargarh, Ali pur, Kotaddu and Jatoi. Most of the area in tehsil Jatoi is canal irrigated. The climatic conditions of this area are suitable for successful in cotton cultivation. The basic objective of this research project was to conduct an analysis of paradigm shift from Non-Bt to Bt cotton in tehsil Jatoi. All the Bt

and Non-Bt cotton farmers of this area were considered as the population of the study. The sample of the population was limited to 120 Bt cotton growers selected through random sampling technique. Four union councils (UCs) were selected randomly from the total 16 rural union councils. From each randomly selected rural union council, two villages were selected randomly. From each selected village, 15 Bt cotton growers were selected randomly. So, the total sample size of the respondents was consisted of 120 and the study was performed in the year 2014. The questionnaire formulated in Urdu language according to the requirement of the research objectives. But at the time of interview local language was used to ask the question from the respondents. The data were analyzed with the help of Statistical Package for Social Sciences (SPSS). Descriptive statistical such as frequencies, percentages, means, standard deviations and rank order were used for interpretation of the data. In order to know the relative ranking of various factors, their weighted scores were calculated by multiplying the score value allotted to each category of the scale with frequency count. Means were calculated as sum of values divided by number of observations. Then, factors were ranked taking their mean value into consideration.

RESULTS AND DISCUSSIONS

Survey results showed that less than half (47.5%) of the respondents were middle aged, followed by old (25%) and 27.5% respondents were young (Table 1). It means that nearly about half of the respondents related to the middle aged category. These results are more or less similar to those of Gangil and Dabos (2005) who reported that 44.5% of the respondents fell middle age (35-50 years) category, whereas 25% and 31.8% belonged to young and old age categories respectively. Many research studies have confirmed that education plays a vital role in the adoption process because it is easy to understand and getting acquired information by educated person than the illiterate one (Muro and Burchi, 2007; Fiaz et al., 2016). Table 1 also indicated that 30.0% of the respondents were primary to middle educated, and 26.7% of them were illiterate. Among the literate respondents, 23.3% of them who had primary level. However, 20.0% of the respondents were up to secondary and higher secondary, respectively. An analysis of the above data signified that quite a good number (30.0%) of the respondents were educated (Table 1). These results were also more or less similar to that of Arshad (2007) who found that 58% of the respondents were illiterate, 14% of them had an education level up to primary and 11% of the respondents had up to the middle level of education. While, 8% and 9% of the respondents were matriculation and above matriculation.

Table 1. Distribution of respondents according to their age and education

Age (Years)	Respondents %	Education	Respondents %
Up to 35	27.5	Illiterate	26.7
36-50	47.5	Up to Primary	23.3
Above 50	25.0	Primary-Middle	30.0
Total	100.0	Matriculation and above	20.0
		Total	100.0
Source of income and area under cotton crop			
Source of income	Respondents %	Area under cotton cultivation (acres)	Respondents %
Crop farming	10	Up to 12.5	51.7
Crop and livestock farming	90	13-25	28.3
Total	100	Above 25	20.0
		Total	100.0
Total	100.0		

Results also showed that 51.7% of the respondents had up to 12.5 acres area under cotton, whereas 28.3% of the respondents having 13-25 acres under cotton cultivation, and 20.0% of the respondents were cultivating more than 25 acres of cotton (Table 1). According to the source of income the results showed that a large majority of the respondents (90%) had their source of income mainly from crop and livestock farming, followed by 10% of the respondents having crop farming as their sources of income. A small number of farmers

were dependent on agriculture and service as their sources of income.

In Table 2 results showed that 42.5% of the respondents cultivated the Bt cotton and 75% were with Non-Bt cotton under the area of up to 5 acres, 30.0% of the respondent were Bt cotton growers and only 8.3% of the respondents were growing Non-Bt cotton under the area of 5 to 10 acres. Whereas, 27.5% of the respondents growing the Bt cotton and 15.8% of the respondents were growing Non-Bt cotton under the area of more than 10 acres.

Table 2. The area cultivated under Bt and on Bt cotton

Area	BT Cotton	Non-BT Cotton
(Acres)	Respondents (%)	Respondents (%)
Up to 5	42.5	75.8
5.1-10	30.0	8.3
Above 10	27.5	15.8
Total	100.0	100.0

Table 3 describes the distribution of respondent according to the source of information. Data showed that the level of dependency on pesticide companies were high (37.5%) to medium (35.8%) and ranks first with mean and standard deviation of 3.31 and 0.90, respectively. Only 10% respondents showed very high level of confidence on pesticide companies regarding source of information and 10% respondents out of 120 respondents didn't show their interest. Respondents that had got information from their neighbors or fellow farmers ranked 2nd in rank order with the mean 3.31 followed by progressive farmers, agricultural department (Extension) and pesticide dealers, that were ranked 3rd, 4th and 5th with the means 1.93, 2.72 and 2.37, respectively.

Table 3. Distribution of the respondents according to their sources of information

	Level of dependency (%)								
Source of information	Very low	Low	Medium	High	Very High	No response	Mean	Std. Deviation	Ranks order
Pesticide companies	0.0	6.7	35.8	37.5	10.0	10.0	3.31	0.90	1
Fellow farmers	3.3	10.8	39.2	32.5	6.7	7.5	3.31	0.90	2
Progressive farmers	6.7	24.2	30.0	22.5	13.3	3.3	1.93	1.07	3
Agriculture Department	6.7	10.8	25.8	3.3	3.3	50.0	2.72	1.01	4
Pesticide dealers	22.5	31.7	14.2	15.0	3.3	13.3	2.37	1.16	5
NGOs	15.0	33.3	24.2	3.3	0.0	24.2	2.21	0.81	6
Newspapers	22.5	25.0	13.3	2.5	3.3	33.3	1.59	0.70	7
Television	40.8	25.0	17.5	3.3	3.3	10.0	1.82	0.97	8
Fertilizer companies	15.0	37.5	3.3	3.3	0.0	40.8	2.72	1.01	9
Radio	35.8	30.0	9.2	2.5	2.5	20.0	1.92	0.73	10
Fertilizers dealers	19.2	40.8	0.0	3.3	0.0	36.7	2.37	1.16	11
Internet	14.2	23.3	1.7	1.7	0.0	59.2	1.78	0.71	12
Mobile	44.2	28.3	10.0	0.0	0.0	17.5	1.80	0.69	13

Respondents did not fully dependent on a single source of information regarding Bt cotton technology, but they got it from multiple sources. High (32.5%) to medium (39.2%) level of dependency has been found in fellow farmers, but in case of progressive farmers medium (30.0%) to low (24.2%) dependency level was found. This might be due to unavailability of approach for progressive farmers to small or poor farmers. Agricultural department (Extension) showed very poor performance in delivering Bt cotton technology information. Only 25.8% respondents were showed a medium level of dependency on agriculture department and 50% respondents were refused to answer the question. This might be due to poor or lack of knowledge about Bt cotton technology information delivered by the extension agents. The need is to give the training on Bt cotton technology to extension agents that should help the farmers. Respondents also showed low (31.7%) to very low (22.5%) dependency levels on pesticide dealers for Bt cotton technological information and ranked at 5th on rank order with 2.37 mean and 1.16 standard deviation values. While electronic and print media received lowest number on rank order that indicates respondents did not had access to these technologies. This might be due to the poor

financial situation of the respondents that kept them away from source of advanced information (Muddassir et al., 2016).

Table 4 described the respondent's reason for shifting from Non-Bt cotton to Bt cotton. The maximum respondents shifted from Non-Bt to Bt cotton variety for their higher yields. High yields ranked 1st on rank order. The dependency level was found high (49.2%) and tends toward medium (27.5%) with 3.43 as mean and 0.92 as standard deviation, respectively. The optimum pesticide use was ranked 2nd and respondents showed high (45.8%) level of dependency with mean and standard deviation of 3.39 and 0.92, respectively, followed by insect/pest control and resistivity against bollworm in Bt cotton than Non-Bt. Respondents also showed medium (58.3%) level dependency on plant height and it ranked 5th with mean and standard deviation of 3.20 and 0.88, respectively. Other factors such as less irrigation, multiple harvest, growth rate and high potential ranked 15th, 14th,13th and 12th with means 2.84, 2.89, 2.90 and 2.99, respectively. The level of dependency was also in medium categories, indicated that these factors did not seriously contribute to shift from Non-Bt to Bt cotton.

Table 4. The distribution of the respondents according to factors which shifted them to grow Bt cotton instead of non Bt cotton

Factors	Level of dependency (%)								
	Very low	Low	Medium	High	Very High	No response	Mean	Std. Deviation	Rank Oder
High yields	3.3	13.3	27.5	49.2	6.7	0.0	3.43	.92	1
Optimum pesticide use	3.3	13.3	30.8	45.8	6.7	0.0	3.39	.92	2
Insect/ pests control	3.3	16.7	32.5	37.5	10.0	0.0	3.34	.98	3
Resistance variety	3.3	16.7	35.0	35.0	10.0	0.0	3.32	.98	4
Plant height	3.3	10.8	58.3	17.5	10.0	0.0	3.20	.88	5
Good quality of seed	5.0	9.2	56.7	25.0	4.2	0.0	3.17	.78	6
Low cost of inputs	4.2	16.7	40.8	34.2	4.2	0.0	3.17	.88	7
Farm income raise	6.7	17.5	35.8	36.7	3.3	0.0	3.13	.97	8
Number of boll	3.3	10.0	54.2	25.8	3.3	3.3	3.12	.81	9
Production increase	4.2	22.5	40.0	28.3	5.0	0.0	3.07	.90	10
More profit	7.5	20.0	39.2	30.0	3.3	0.0	3.02	.97	11
High potential	3.3	25.0	47.5	17.5	6.7	0.0	2.99	.91	12
Growth rates	7.5	20.0	50.8	18.3	3.3	0.0	2.90	.90	13
Multiple harvesting	6.7	20.8	55.8	10.0	6.7	0.0	2.89	.91	14
Less irrigation requirement	3.3	20.0	62.5	7.5	3.3	3.3	2.84	.74	15

It is evident from the data given in Table 5, that high seed rate, non-availability of seed and high requirements of fertilizer were ranked 1st, 2nd and 3rd on the basis of threats. They fell between high and very high category but inclined towards high category with mean values of 2.99, 2.98 and 2.97, respectively on the basis of threats. Un-approved Bt cotton variety, save anti-law methods and lack of knowledge about Bt technology were in between low and medium category but inclined towards low category having mean values of 2.92 and 2.76 and 2.57, respectively. Climatic variations (temperature, humidity and wind) inclined towards low category with mean values of 2.35, respectively.

Table 5. Distribution of the respondents according to the threats which they are facing in Bt cotton cultivation

Threats	Very low	Low	Medium	High	Very High	No response	Mean	Std. Deviation	Rank order
High seed rate	3.3	15.0	33.3	14.2	3.3	30.8	2.99	0.90	1
Non availability of seed	0.0	21.7	46.7	13.3	3.3	15.0	2.98	0.76	2
High fertilizer requirements	5.0	20.8	50.8	20.0	3.3	0.0	2.97	0.83	3
Un-approved Bt verities	4.2	17.5	54.2	10.8	3.3	10.0	2.92	0.79	4
Save anti-law methods	14.2	20.8	43.3	18.3	3.3	0.0	2.76	1.02	5
Lack of Bt technology	6.7	10.0	15.0	6.7	0.0	61.7	2.57	0.98	6
Climatic variations	14.2	35.8	40.0	3.3	0.0	6.7	2.35	0.78	7

As Bt cotton comprises of endogenous insecticidal protein to kill insect, so it reduced the number of sprays and cost of production, that ultimately alleviating the poverty of the rural people. It is evident from the data given in Table 6 that reduction in pest infestation and increase in production were ranked 1st and 2nd on the basis of opportunities and fell between high and very high category but inclined towards high category with mean values of 3.34 and 3.20, respectively on the basis of opportunities, reduction in health hazards and increase in net annual income were in between low and medium category, but inclined towards low category having mean values of 3.08 and 3.00, respectively. Reduction in pesticide applications and less cost of production inclined towards low category with mean values of 2.99 and 2.98, respectively. On the basis of opportunities, availability of certified seeds' mean value of 2.24 showed that it inclined towards very low category.

Table 6. Distribution of the respondents according to the opportunities in Bt cotton cultivation

Opportunities	Very low	Low	Medium	High	Very High	No response	Mean	Std. Deviation	Rank order
Reduced pesticides applications	0.0	27.5	42.5	26.7	0.0	3.3	3.34	0.92	1
Increase in production	5.0	10.0	53.3	23.3	8.3	0.0	3.20	0.86	2
Reduction in health hazards	4.2	23.3	40.8	25.0	6.7	0.0	3.08	0.95	3
Increase in net annual income	0.0	16.7	70.0	9.2	4.2	0.0	3.00	0.64	4
Less cost of production	3.3	16.7	61.7	15.0	3.3	0.0	2.98	0.77	6
Availability of certified seed	3.3	14.2	22.5	11.7	6.7	50.0	2.24	0.96	7

CONCLUSIONS

The study aim was to identify the different factors affecting the adoption of Bt cotton and analysis of Paradigm shift from Non Bt to Bt cotton in Tehsil Jatoi. It was concluded that cotton growers were highly dependent on pesticide companies for obtaining agricultural information. The higher crop yield was the major factor which shifted the farmers to grow Bt cotton. Unapproved Bt, high fertilizer requirement and non-availability of seed were the threatening factors facing in Bt cotton cultivation. Opportunities of less use of pesticides, increase in production and net annual income, reduction in health hazards, less cost of production and availability of certified seeds were found to be the main shifting drivers of Bt cotton. Results suggested that extension organizations should develop better strategies in future for effective extension services towards the Bt cotton production.

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