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Adoption behaviour of *Bt* cotton growers in irrigated and rainfed conditions of Tamil Nadu

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ABSTRACT : The present study was conducted to analyze the adoption behaviour of *Bt* cotton growers and the various constraints faced by them with regard to *Bt* cotton cultivation under irrigated and rainfed conditions. The adoption behaviour of the respondents was measured in 3 types like specified, modified and non adoption and found that the irrigated farmers had significantly higher adoption level than their rainfed counterparts. Practice wise adoption revealed that majority of the cotton growers was not adopting the refugee technology. High seed cost of *Bt* cotton, complexity in the technology to understand, difficulties in maintaining refugee crop, inadequate knowledge on *Bt* cotton's control over all pests and non availability of *Bt* cotton varieties were the major constraints expressed. The results about adoption behavior expressed the need of educating Indian farmers about the new technology, resistance management strategies and related things through various extension programmes. The information on constraints in adoption of *Bt* cotton calls for new policy initiatives and transfer of technology strategies.

Key Words: Adoption behavior, *Bt* cotton, practice wise adoption, profile

Bt cotton was the first transgenic crop approved for commercial cultivation in India. Approval of the first Genetically Engineered (GE) cotton (*Bt* cotton) is an important development that was applauded by the scientific community both in India and outside, as it is a landmark decision paving way for more GE crops in India. International Cotton Advisory Committee stated that numerous benefits of this technology accrue to the grower. These benefits include direct benefits, such as reduced pesticide use, improved crop management effectiveness, reduced production costs, improved yield and profitability, reduction in farming risk and improved opportunity to grow cotton in areas of severe pest infestation. Indirect significant benefits of the technology include improved populations of beneficial insects in cotton fields, reduced pesticides runoff, air pollution and waste from the use of insecticides, improved farm worker and neighbor safety, reduction in labour costs and time, reduction in fuel use and improved soil quality. In fact, no other scientific decision since India's independence generated so much of heat and debate as the introduction of *Bt* cotton has. So in view of this predicament, a research idea of providing sound and impartial account of *Bt* cotton adoption in cotton based cropping systems with empirical evidences from irrigated and rainfed cotton growing districts of Tamil Nadu was undertaken.

MATERIALS AND METHODS

For this study, expost facto research design was used. A multistage random sampling was followed to select the districts, blocks, villages and farmers under both irrigated and rainfed conditions of cotton. Among the 16 *Bt* cotton growing districts in Tamil Nadu, Coimbatore and Perambalur districts were selected at random for irrigated and rainfed *Bt* cotton. 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 Avinasitaluk was selected randomly. With respect to Perambalur district, out of the 10 blocks, the block having substantial number of

rainfed *Bt* cotton growers namely Vepur of Kunnamtaluk was selected randomly. In each block, 6 villages were selected randomly and in each village 10 *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.

RESULTS AND DISCUSSION

Profile characteristics of respondents : The profile characteristics of *Bt* cotton growers in both irrigated and rainfed conditions were depicted in Table 1. The respondents in both the 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 ac of land. In their total land, 25 to 50 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 2 to 3 years of experience in *Bt* cotton cultivation. The irrigated *Bt* cotton growers were found with Rs. 15,000 to 20,000 income / annum and rainfed *Bt* cotton growers were with Rs.40, 000 to 60,000 income / annum. They had good contact with extension agency and had high economic motivation. 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. Brookes and Barfoot (2005)'s results were in contrary to this result since he reported that in relation to the nature and size of GMF technology adopters, there is clear evidence that size of farm has not been a factor affecting use of the technology.

Adoption behaviour of *Bt* cotton growers : To assess the adoption behaviour of irrigated and rainfed farmers, 3 types *viz.,* specified adoption, modified adoption and non adoption were measured. The distribution of respondents under irrigated and rainfed conditions according to their adoption behaviour of *Bt* cotton practices is furnished in Table 2. From result in this table, it is seen that majority (66.67%) of the irrigated farmers were found with high level of adoption behaviour, followed by 33.33 per cent with low level. As far as rainfed farmers were concerned, more than one third (38.33%) of them were observed with high level of adoption followed by 31.67 per cent with medium and the remaining 30 per cent with low level of adoption behaviour. In total, majority (52.50%) of the respondents were found with high level of adoption behaviour. This finding is in line with the findings of Ismael *et al.*, (2002). The 't' value was significant at 1 per cent level, indicating that the adoption behaviour of irrigated farmers was significantly higher than their rainfed counterparts. Therefore, the hypothesis that, there will not be difference in the adoption behaviour of *Bt* cotton growers under irrigated and rainfed conditions, was rejected.

Practice wise adoption level of *Bt* cotton cultivation practices : The details about the distribution of respondents according to practice wise adoption behaviour of *Bt* cotton cultivation practices is provided in Table 3. While exploring the practice wise adoption behaviour of the respondents, majority (60%) of the irrigated farmers and 70 per cent of the rainfed farmers had not adopted the important technology of planting refuge crop (5 rows/ac) of non *Bt* cotton seeds surrounding the *Bt* cotton plot) as specified

Table 1. Summary of the characteristics of irrigated and rainfed *Bt* cotton growers with their respective't' value

Variable No.	Profile characteristics	Total	Irrigated condition	Rainfed condition	Differences between mean values of "I" and "R"	"t" value
X1	Age	Old	Old	Old	-	-
X2	Educational status	Primary level	Middle	Primary level	1.3833	4.874**
X3	Occupational status	Farming as sole occupation	Farming as sole occupation	Farming as sole occupation	0.0500	-0.334^{NS}
X4	Farm size	2.51-5.00 ac	>10 a	Up to 2.5 a	1.5833	11.277**
X5	Area under cultivation of cotton	25.01 – 50(%)	25.01 – 50.00(%)	25.01 – 50(%)	0.9500	-6.403**
X6	Area under cultivation of *Bt* cotton	One ac	One ac	One ac	0.3667	1.811^{NS}
X7	Farming experience	>10 years	>10 years	>10 years	0.0500	-1.036^{NS}
X8	Experience in cultivation of cotton	5-10 years	High	Medium	1.3667	1.568 ^{NS}
X9	Experience in cultivation of *Bt* cotton	2-3 years	Medium +High*	High	1.0667	9.225**
X10	Annual income	Medium	High	Medium	38.2167	10.838**
X11	Contact with extension agency	High	High	High	3.7167	8.591**
X12	Mass media exposure	High	High	High	6.7500	16.689**
X13	Training undergone	Low	Medium + high*	Low	0.8500	6.427**
X14	Economic motivation	High	High	High	7.8000	8.243**
X15	Risk orientation	High	High	Medium	7.1667	7.936**
X16	Progressiveness	High	High	High	3.8833	26.042**
X17	Pest management behaviour	High	High	Medium	3.4167	7.461**
X18	Credit orientation	High	High	High	0.7333	3.908**
X19	Innovativeness	Moderate	High	Moderate	0.9667	10.780**
X20	Marketing behaviour	Less favourable	Highly favourable	Less favourable	10.9667	14.799**

(** - Significant at 0.01 level of probability, NS- Non significant and

by the Genetic Engineering Advisory Committee (GEAC). Remaining 40 per cent among irrigated farmers and 30 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. This finding is *on par* with the results of Asha (2003). She reported that farmers in India, predominantly small and marginal landholders operating on less than 2 ha are unable to set aside land for "refugia" to prevent pests from attacking the *Bt* cotton plants and thereby developing resistance to it. 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. It could also be observed from the table that cent per cent of the respondents were not adopted the practices *viz.,* pest monitoring, pheromone spray and pest scouting and observing ETL. The lack of knowledge among farmers about *Bt* cotton's control over bollworms and other pests was found as the major reason for this non adoption. This result is in accordance with the results of Sahai and Rahman (2003).

Relationship of profile characteristics on adoption behaviour of *Bt* cotton growers : The correlation between characteristic variables of the *Bt* cotton growers and their adoption behaviour under irrigated and rainfed conditions are presented in Table 4. Out of the 22 characteristics of irrigated farmers, area under cultivation of cotton, experience in cultivation of cotton, contact with extension agency, progressiveness and marketing behaviour had positive and significant association with the dependent variable "Adoption Behaviour" at 1 per cent level. The variables *viz.,* occupational status, perception on biological performance of *Bt* cotton and perception on attributes of *Bt* cotton had positive and significant relationship at 5 per cent level. The variable training undergone had negative and significant relationship with adoption behaviour at 5 per cent level. In the case of rainfed farmers, out of 22 characteristics, perception on biological performance of *Bt* cotton and perception on attributes of *Bt* cotton had positive and significant association with impact where as farm size and pest management behaviour had negative and significant relationship with impact. Rejecting and accepting the null hypothesis for significant and non significant correlation values respectively, it is inferred that the adoption behaviour of irrigated farmers about the cultivation practices of *Bt* cotton was the function of the area under cultivation of cotton, experience in cultivation of cotton, their contact with extension agency, progressiveness, marketing behaviour, pest management behaviour, perception on biological performance of *Bt* cotton and perception on attributes of *Bt* cotton. In the case of rainfed farmers it was the function of their perception on biological performance of *Bt* cotton, perception on attributes of *Bt* cotton, economic motivation and marketing behaviour. Thus it is concluded that more the area under cultivation of cotton, more experience in cultivation of cotton, more contact with extension agency, more progressiveness, favourable marketing behaviour, positive perception on biological performance of *Bt* cotton and positive perception on attributes of *Bt* cotton will increase the adoption behaviour of *Bt* cotton growers under irrigated condition. With regard to rainfed farmers, higher the positive perception on biological performance of *Bt* cotton and positive

Table 2. Distribution of respondents according to adoption behavior of *Bt* cotton cultivation practices under irrigated and rainfed conditions

Category	Irrigated condition (n=60)		Rainfed condition (n=60)		Total (n=120)	
	No.	(%)	No.	(%)	No.	(%)
Low	20	33.33	18	30.00	38	31.67
Medium	-	-	19	31.67	19	15.83
High	40	66.67	23	38.33	63	52.50
Total	**60**	**100.00**	**60**	**100.00**	**120**	**100.00**
Mean	**39.4333**		**24.4833**			
Differences between means			14.9500			
't' value			26.441**			

** - Significant at 0.01 level of probability

Table 3. Distribution of respondents according to the practice wise adoption level of *Bt* cotton cultivation practices under irrigated and rainfed conditions

S. No.	Practices	Irrigated(n=60)			Rainfed(n=60)		
		SA	MA	NA	SA	MA	NA
I.	**Land preparation**						
1	Removing and burning debris of previous crop	45.00	35.00	20.00	33.33	41.67	25.00
2	Two deep summer ploughings	93.33	6.67	-	35.00	58.33	6.67
3	Repeated harrowing	1.67	68.33	30.00	5.00	13.33	81.67
II.	**Suitable *Bt* cotton hybrids**						
4	Commercialized *Bt* cotton hybrids	100.00	-	-	100.00	-	-
III.	**Application of manures and fertilizers**						
5	Application of organic manure	21.67	71.67	6.66	11.67	73.33	15.00
6	Application of inorganic fertilizers based on soil test	63.33	36.67	-	6.67	86.67	6.66
7	Application of basal dose of NPK	26.67	73.33	-	13.33	83.33	3.34
8	1st top dressing of NPK	11.67	88.33	-	11.67	61.67	26.66
9	2nd top dressing of NPK	8.33	91.67	-	6.67	28.33	65.00
10	Application of micronutrients	-	100.00	-	3.33	6.67	90.00
11	Foliar spray of NPK	-	90.00	10.00	1.67	6.67	91.66
12	Foliar spray of growth regulators	-	96.67	3.33	1.67	5.00	93.33
13	Arresting terminal growth	-	43.33	56.67	1.67	3.33	95.00
IV.	**Spacing**						
14	Recommended spacing	70.00	30.00	-	65.00	35.00	-
V.	**Planting methods**						
15	Seed rate and sowing 1 seed/hill	63.33	31.67	5.00	68.33	28.33	3.34
16	Planting under ridges and furrows system	65.00	30.00	5.00	15.00	36.67	48.33
17	Planting 5 rows/ac of non *Bt* cotton seeds as refuge crop surrounding the *Bt* cotton plot	-	40.00	60.00	-	30.00	70.00
18	Planting seeds 4–5 cm deep and covering with soil	11.67	88.33	-	3.33	83.33	13.34
19	Gap filling in the *Bt* and non *Bt* areas a week after germination	16.67	83.33	-	5.00	71.67	23.33
VI.	**Inter cultivation and weed management**						
20	Pre emergence application of weedicides	-	16.67	83.33	3.33	16.67	80.00
21	Hand weeding	40.00	45.00	15.00	15.00	81.67	3.33
VII.	**Irrigation management**						
22	During germination	76.67	23.33	-	-	-	-
23	During seedling growth	76.67	23.33	-	-	-	-
24	During flowering	66.67	33.33	-	-	-	-
25	During boll formation and development	66.67	33.33	-	-	-	-
VIII.	**Disease management**						
26	Field sanitation	13.33	56.67	30.00	8.33	73.33	18.34
27	Seed treatment	3.33	96.67	-	3.33	3.33	93.34
28	Maintaining correct population	73.33	23.33	3.34	-	5.00	95.00
29	Soil drenching	3.33	91.67	5.00	1.67	6.67	91.66
30	Application of fungicides	-	70.00	30.00	-	15.00	85.00
IX.	**Pest Management**						
31	Crop rotation	76.67	23.33	-	11.67	71.66	16.67
32	Summer ploughing and field sanitation	66.67	33.33	-	15.00	58.33	26.67
33	Seed treatment	100.00	-	-	96.67	-	3.33
34	Intercropping	-	100.00	-	10.00	60.00	30.00
35	Trap cropping	16.67	66.66	16.67	6.67	10.00	83.33
36	Use of bio control agents	-	16.67	83.33	1.67	5.00	93.33
37	Monitoring	-	-	100.00	-	-	100.00
38	Pheromone spray	-	-	100.00	-	-	100.00
39	Pest scouting and observing ETL	-	-	100.00	-	-	100.00

Table 3 contd...

Table 3 contd...

S. No.	Practices	Irrigated(n=60)			Rainfed(n=60)		
		SA	MA	NA	SA	MA	NA
40	Botanical insecticides	-	6.67	93.33	-	-	100.00
41	Mechanical control	-	3.33	96.67	-	-	100.00
42	Chemical control	-	100.00	-	1.67	98.33	-
X.	**Harvesting**						
43	Harvesting at frequent intervals (<7 days)	33.33	66.67	-	6.67	90.00	3.33
44	Harvesting in the morning h upto 10-11 AM	80.00	20.00	-	10.00	85.00	5.00
45	Picking *kapas* from well burst bolls	80.00	20.00	-	80.00	18.33	1.67
46	Removing only the *kapas* not the bracts	80.00	20.00	-	88.33	6.67	5.00
47	Separating the stained, discoloured and insect damaged *kapas* from good *kapas*	80.00	20.00	-	86.67	8.33	5.00
XI.	**Post harvest techniques**						
48	Shade drying the *kapas*	90.00	10.00	-	91.67	6.67	1.66
49	Grading the *kapas*	73.33	18.33	8.34	3.33	8.33	88.34
50	Drying over dry sand	6.67	3.33	90.00	3.33	5.00	91.67

* - Applicable for irrigated conditions, SA - Specified adoption, MA - Modified adoption, NA - Non adoption

perception on attributes of *Bt* cotton, higher will be their extent of adoption of *Bt* cotton technologies, irrespective of their all other characteristics.

Influence of independent variables on adoption of *Bt* cotton growers : It could be seen from the Table 5, that for irrigated *Bt* cotton growers the coefficient of multiple determination (R^2) was positive with a value of 0.848 and found significant at 0.01 level of probability as explained by the "F" value. The 22 profile characteristics of irrigated *Bt* cotton growers included in the function explained 84.80 per cent of variation in their adoption behaviour. The regression constant was positive with a value of 2.645. The independent variable annual income was found significant at one per cent level and the variables *viz.,* farming experience, experience in cultivation of cotton, experience in cultivation of *Bt* cotton, risk orientation, marketing behaviour and perception on attributes of *Bt* cotton were found significant at 5 per cent level. This means that an increase of one unit in those significant variables from existing mean level *"ceteris paribus"* will increase the attitude by their respective 't' value units. The variable contact with extension agency was negatively significant at 5 per cent level. This indicates that with every decrease in one unit of contact with extension agency from the existing mean level ceteris paribus, the attitude will increase by 2.200 units. The table also showed that in the case of rainfed farmers, the coefficient of multiple determinations (R^2) was positive with a value of 0.650 and found significant at one per cent level as indicated by the "F" value. The 22 characteristics of rainfed farmers included in the function explained 65.00 per cent of variation in the adoption. The independent variable perception on performance of *Bt* cotton was found significant at 1 per cent level. This means that an increase of one unit in perception on performance of *Bt* cotton from existing mean level *"ceteris paribus"* will increase the adoption by 2.830 units. The variables *viz.,* experience in cultivation of cotton, risk orientation and pest management behaviour were found significant at 5 per cent level. The variables age, economic motivation and marketing behaviour were negatively significant with adoption behaviour. This indicated that with every decrease in one unit of these variables from the existing mean level *ceteris paribus*, the knowledge level will increase by their respective 't' value units.

Constraints encountered and suggestions offered by *Bt* cotton growers : The distribution of respondent according to the constraints encountered under irrigated and

rainfed conditions are presented in Table 6. High seed cost of *Bt* cotton, high labour cost, non availability of crop insurance, lack of input subsidy, high rate of interest for credit, inadequate credit to purchase inputs and high rate of interest for credit were the major economic constraints in adoption of *Bt* cotton. Reducing the seed cost of *Bt* cotton, providing crop insurance for *Bt* cotton cultivation, providing subsidies for *Bt* cotton seeds and providing credit facilities for growing *Bt* cotton were the major suggestions offered to overcome the economic constraints. With regard to the technical constraints, complexity in the technology to understand, difficulties in maintaining refugee crop, inadequate knowledge on *Bt* cotton's control over all pests, inadequate knowledge on Economic Threshold Level (ETL) of different cotton pests and inadequate training in cultivation of *Bt* cotton were the main technical constraints in adoption of *Bt* cotton technology. Finding out alternate technology for refugee crop, providing knowledge on ETL of different cotton pests, providing knowledge on *Bt* cotton's inability to control the pests other than boll worms and imparting adequate training in cultivation aspects of *Bt* cotton were the suggestions recommended to overcome technical constraints.

Inadequate technical guidance from extension workers, inaccessibility of *Bt* related information through mass media and inability to contact extension agency at times of emergency were the major extension constraints in *Bt* cotton adoption. Majority of the respondents recommended to disseminate *Bt* related information through mass media and to empower the extension workers to be competent in cultivation aspects of *Bt* cotton as suggestions to overcome the extension constraints.With regard to marketing constraints, absence of quality based price policy for *kapas*, exploitation by middlemen, no special price for *kapas* of *Bt* cotton and inadequate agencies for contract farming were the major ones. Cent per cent of the

Table 4. Correlation analysis of profile characteristics with respect to adoption behaviour of *Bt* cotton growers under irrigated and rainfed conditions (n=120)

V.No.	Variables	Irrigated condition(n=60) "r" value	Rainfed condition(n=60) "r" value
X1	Age	0.224 NS	-0145 NS
X2	Educational status	0.122 NS	0.118 NS
X3	Occupational status	0.284*	-0.077 NS
X4	Farm size	0.068 NS	-0.06 NS
X5	Area under cultivation of cotton	-0.003 NS	-0.106 NS
X6	Area under cultivation of *Bt* cotton	0.602**	0.045 NS
X7	Farming experience	0.014 NS	0.116 NS
X8	Experience in cultivation of cotton	0.434**	0.142 NS
X9	Experience in cultivation of *Bt* cotton	0.232 NS	0.127 NS
X10	Annual income	0.177 NS	0.252 NS
X11	Contact with extension agency	0.346**	-0.172 NS
X12	Mass media exposure	0.001 NS	-0.064 NS
X13	Training undergone	-0.313*	-0.054 NS
X14	Economic motivation	0.047 NS	-0.315*
X15	Risk orientation	0.036 NS	0.037 NS
X16	Progressiveness	0.466**	-0.145 NS
X17	Pest management behavior	0.312*	-0.109 NS
X18	Credit orientation	-0.237 NS	-0.161 NS
X19	Innovativeness	0.032 NS	-0.012 NS
X20	Marketing behavior	0.496**	-0.387**
X21	Perception on biological performance of *Bt* cotton	0.290*	0.476**
X22	Perception on non biological performance of *Bt* cotton / attributes of *Bt* cotton	0.724**	0.384**

** - Significant at (1%) level, * - Significant at (5%) level, NS – Non significant

Table 5. Multiple regression analysis of profile characteristics with respect to adoption behaviour of *Bt* cotton growers under irrigated and rainfed conditions (n=120)

V. No.	Profile Characteristics	Variables		Irrigated condition(n=60)		Rainfed condition(n=60)	
		'b' value	Standard error	't' value	'b' value	Standard error	't' value
X1	Age	-0.135	0.107	-0.810 NS	-0.467	-2.853	-2.853**
X2	Educational status	-0.061	0.383	-0.540 NS	0.080	0.554	0.554 NS
X3	Occupational status	0.076	0.391	0.891 NS	0.137	0.980	0.980 NS
X4	Farm size	-0.032	0.869	-0.210 NS	0.009	0.079	0.079 NS
X5	Area under cultivation of cotton	0.153	1.077	1.115 NS	-0.151	-1.024	-1.024 NS
X6	Area under cultivation of *Bt* cotton	0.193	0.471	1.728 NS	0.102	0.816	0.816 NS
X7	Farming experience	0.356	2.285	2.556*	0.161	1.172	1.172 NS
X8	Experience in cultivation of cotton	0.447	0.162	2.342*	0.324	2.402	2.402*
X9	Experience in cultivation of *Bt* cotton	0.233	0.732	2.198*	-0.027	-0.191	-0.191 NS
X10	Annual income	0.521	0.034	2.895**	-0.097	-0.609	-0.609 NS
X11	Contact with extension agency	-0.506	0.399	-2.200*	-0.050	-0.253	-0.253 NS
X12	Mass media exposure	0.001	0.208	0.011 NS	0.093	0.542	0.542 NS
X13	Training undergone	0.243	0.305	1.944 NS	0.006	0.046	0.046 NS
X14	Economic motivation	-0.169	0.083	-1.530 NS	-0.404	-2.540	-2.540*
X15	Risk orientation	0.392	0.076	2.015*	0.277	2.145	2.145*
X16	Progressiveness	0.221	0.379	1.488 NS	0.181	1.338	1.338 NS
X17	Pest management behaviour	0.013	0.251	0.110 NS	0.420	2.515	2.515*
X18	Credit orientation	0.131	0.58	1.383 NS	-0.210	-1.180	-1.180 NS
X19	Innovativeness	-0.201	0.331	-1.720 NS	-0.091	-0.634	-0.634 NS
X20	Marketing behaviour	0.298	0.112	2.576*	-0.325	-2.018	-2.018*
X21	Perception on biological performance of *Bt* cotton	0.144	0.034	1.579 NS	0.525	2.830	2.830**
X22	Perception on attributes of *Bt* cotton	0.771	0.265	6.901**	0.126	0.980	0.980 NS
	"R" square	0.848	0.650				
	:F"	11.459**	2.995**				

(* = Significant at (5%) level, ** = Significant at (1%) level and NS- Non significant)

respondents in both the conditions suggested to permit adequate agencies for contract farming on *Bt* cotton and to provide special price for *Bt* cotton *kapas*. Labour scarcity was the foremost situational constraint faced by the respondents followed by dependence on monsoon, lack of assured irrigation and unsuitable soils. Non-cooperation among cotton growers, traditional beliefs existing in the society, lack of innovativeness, lack of leadership to motivate cotton growers, propaganda of NGO about the implications of *Bt* cotton and lack of organized groups such as FEG, SHG etc., were the major social constraints for the adoption of *Bt* cotton. Cent per cent of them in both the conditions recommended to establish *Bt* cotton growers' associations and to regularize the seed companies to supply good quality seeds of *Bt* cotton and compensation in failure cases. Majority of them suggested controlling the NGOs from diffusing false information about the implications of *Bt* cotton.

The findings of this study on adoption behavior of *Bt* cotton growers and the constraints faced by them in adopting the technology would facilitate the researchers, extension personnel and policy makers to draw suitable strategies to sustain the technology. The information about their adoption beahaviour expresses the need of educating farmers about the new technology, resistance management strategies and related things through various training programmes. The information on constraints in adoption of *Bt* cotton calls for new policy initiatives and transfer of technology strategies.

Table 6. Distribution of respondents according to the constraints encountered by them under irrigated and rainfed conditions (n=120)

S. No.	Constraints	IrrigatedN=60 Per cent	RainfedN=60 Per cent
I.	**Economic constraints**		
1.	High seed cost	100.00	100.00
2.	Lack of input subsidy	93.00	100.00
3.	Inadequate credit to purchase inputs	70.00	100.00
4.	High labour cost	100.00	83.33
5.	High rate of interest for credit	73.00	100.00
6.	Non availability of crop insurance	97.00	85.00
II.	**Technical constraints**		
7.	Complexity in the technology to understand	100.00	85.00
8.	Difficulties in maintaining refugee crop	100.00	100.00
9.	Inadequate knowledge on *Bt* cotton's control over pests	100.00	98.33
10.	Inadequate knowledge on ETL of different cotton pests	100.00	98.33
11.	Inadequate training in cultivation of *Bt* cotton	100.00	100.00
III.	**Extension constraints**		
12.	Inability to contact extension agency at times of emergency	93.00	100.00
13.	Inadequate technical guidance from extension workers	100.00	100.00
14.	Inaccessibility of *Bt* related information through mass media	100.00	98.33
IV.	**Marketing constraints**		
15.	Absence of quality based price policy for *kapas*	100.00	100.00
16.	Inadequate agencies for contract farming	97.00	96.67
17.	Exploitation by middlemen	100.00	100.00
18.	Lack of remunerative price for *kapas*	97.00	100.00
19.	No special price for *kapas* of *Bt* cotton	100.00	100.00
V.	**Situational constraints**		
20.	Dependence on monsoon	87.00	100.00
21.	Lack of assured irrigation	60.00	36.67
22.	Unsuitable soils	97.00	87.00
23.	Labour scarcity	100.00	100.00
VI.	**Social constraints**		
24.	Non cooperation among cotton growers	100.00	100.00
25.	Traditional beliefs existing in the society	100.00	100.00
26.	Propaganda of NGO about the implications of *Bt* cotton	70.00	100.00
27.	Lack of innovativeness	100.00	98.33
28.	Lack of leadership to motivate cotton growers	100.00	100.00
29.	Lack of organized groups such as FEG, SHG etc.,	100.00	100.00

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