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Association of profile of Bt. cotton growers and adoption of recommended package of practices

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Abstract
Study entitled "Adoption of recommended cultivation practices by the Bt. cotton growers" was undertaken in Warora, Bhadrawti and Chimur talukas in Chandrapur district of Vidarbha region of Maharashtra state. Ex-post facto research design was used for the same. The farmers growing Bt. cotton since last five years consecutively were identified and from each selected village 10 Bt. cotton growers as respondents were selected randomly to constitute sample size of 120 respondents. The data from Bt. cotton growers were collected by personal interview method. Relatively higher proportion of Bt. cotton growers (36.66%) were in medium adoption level followed by (29.16%) were in low level of adoption of recommended package of practices whereas, 34.18 percent Bt. cotton growers who were in high level of adoption of recommended package of practices by Bt. cotton growers.

Keywords: Adoption, Bt., cotton, cultivation, practices

Introduction

The "King of Fiber" and "White Gold" due to its huge economic value globally, cotton stands out among all the cultivable fibre crops in its own special way. In the world's economic, political, and social affairs, cotton is one of the oldest and most important commercial crops. There are about 60 countries in the globe where cotton is grown. The oil content of cotton seeds, which are utilised in the production of soap and oil, ranges from 15 to 20%. The remaining cake is pretentious and used as animal fodder after the oil has been extracted. The world's largest producer of cotton is India. *Gossypium herbaceum*, *Gossypium hirsutum*, *Gossypium barbandense* and *Gossypium arborium* are the four varieties of cotton grown in India. *Gossypium hirsutum*, *Gossypium barbandense*, *Gossypium arborium* and *Gossypium herbaceum* are the four varieties of cotton grown in India. Bt. cotton is a genetically engineered crop hence is referred as transgenic cotton. This Bt. cotton contains a toxic protein-inducing gene from soil borne bacterium Bacillus thuringiensis (Bt.), thus enabling the crop to produce toxin resulting in decreased bollworm infestation, reduced application of insecticides, increased productivity & improved quality of 'Kapas' that provides peace to the farmers.

The Genetically Engineering Approval Committee (GEAC) permitted the release of Bt. cotton for commercial cultivation during 2002-03 crop season. Being the first and only crop that received environmental clearance as GMO (Genetically Modified Organisms) in India, it is receiving maximum attention from planners, scientists, social workers, media, farmers and general public. The area under Bt. cotton is constantly increasing in all the states of the country since its induction. In the first year itself the Bt. cotton was cultivated on 29072 hectares. It was increased to 92000 hectares in 2003. It was increased again four-fold in 2004 to reach over half a million hectares (524, 000 ha.). In 2005, the area covered by to Bt. cotton in India continued to climb reaching 1.3 million hectares that is an increase of 160 percent over 2004 (Anonymous, 2020) [1]. In 2006, the record increases in adoption in India continued with almost tripling of area under Bt. cotton that is from 1.3 million hectares to 3.8 million hectares.

Methodology

The present study was carried out in Chandrapur district of Maharashtra. From these districts three talukas were selected purposively i.e. Warora, Bhadrawati and Chimur as they cover highest area under Bt. cotton. Four villages were randomly selected from each tahsil. Total twelve villages were selected for the study. A list of Bt. cotton growers from the selected villages was prepared randomly by using simple random sampling method to constitute sample size of 120 respondents. An interview schedule was prepared in view of the objectives of the study and data were collected by personal interview of the selected respondents.

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Results and Discussion
1.1 Profile of Bt. cotton growers
1.1.1 Farming experience
Farming experience is the actual time period spent by the person in farming. Experience in farming makes farmers more oriented towards adopting new strategies and technologies and it also increases the proficiency of farmers in growing the crop.

The details regarding farming experience of Bt. cotton growers is presented in table 1.

Table 1. Distribution of the Bt. cotton growers according to their farming experience

N=120

SL. No.	Category	Frequency	Percentage
1	Low (Up to 7 years)	25	20.83
2	Medium (8 to 12 years)	74	61.66
3	High (Above 12 years)	21	17.51
	Total	120	100.00

It was observed from the table 1. that majority 61.66 percent of Bt. cotton growers had medium farming experience and 20.83 percent of the Bt. cotton growers had low farming experience whereas 17.51 percent of the Bt. cotton growers had high farming experience.

The finding result are similar to Katke (2011) [17], Prashanth (2011) [26], Khupse (2012) [18], Mane (2012) [21], Lad (2013) [20], Meena (2014) [23] and Dhaigude (2021) [10].

1.1.2 Education
The level of formal education gained by a personal gravitates to the degree of that they're unveiled to new concepts and knowledge. It plays a momentous role in finding potentiality of Bt. cotton growers. The details pertaining to the education of the Bt. cotton growers was collected, tabulated and analysed. The results are presented in table 2.

Table 2: Distribution of the Bt. cotton growers according to their level of education

Sl. No.	Category	Frequency	Percentage
1.	Illiterate	3	02.51
2.	Primary Education (1st to 7th Standard)	24	20.00
3.	Secondary Education (7th to 10th Standard)	28	23.33
4.	Higher Secondary Education (11th to 12th Std.)	40	33.33
5.	Graduate/Post graduate	25	20.83
	Total	120	100.00

The data from table 2 showed that 23.33 percent of the Bt. cotton growers were educated up to secondary school and 33.33 percent of Bt. cotton growers were educated up to higher secondary school level, whereas 20.00 percent Bt. cotton growers were educated up to primary school followed by 20.83 percent of Bt. cotton growers were educated up to graduation level and only 02.51 percent of Bt. cotton growers were illiterate.

Thus it concludes that more than half of the Bt. cotton growers had received secondary and higher secondary education. The potential reason might be that availability of higher education facilities in rural areas and problems regarding transportation and finance to go to urban areas for higher education is reduced.

These findings are in line with the findings of Bhatt (2011) [5], Borman (2011) [7], Chahande (2012) [8], Bhangare (2014) [4] and Godbharle (2021) [12].

1.1.3 Annual income
Annual financial gain is that the major determinant of the economic well-being of a personal. He can afford to pay additional on things needed in reference to improved farming techniques and this influences him to use new agricultural techniques. The particulars concerned to the annual income of the Bt. cotton growers were collected, tabulated and analysed. The results are presented in table 3.

Table 3: Distribution of the Bt. cotton growers according to their annual income

N=120

SL. No.	Category	Frequency	Percentage
1.	Low (Up to 69,500)	18	15.00
2.	Medium (69,501-1,21520)	78	65.00
3.	High (Above 1,21,520)	24	20.00
	Total	120	100.00

Table 3 revealed that Slightly more than half 65.00 percent of Bt. cotton growers had medium annual income, whereas 15.00 percent Bt. cotton growers had low level of annual income and 20.00 percent had high level of annul income.

Thus, it is seen form the data that majority of cotton growers had medium annual income. The potential cause behind that must be semi-medium and medium land holding.

The findings are in line with the findings of Nichal (2010) [25], Katke (2011) [17], Kumar *et al.* (2013) [19], Dhaigude (2021) [10], Godbharle (2021) [12] and Sou (2021) [31].

1.1.4 Land holding
It refers to the number of hectare of land owned and operated by the Bt. cotton growers. Land use life is considered as one of the most critical factors in finding the competence of Bt. cotton growers to adopt new agricultural technologies approch-making factor that determines the socio-economic status of the family and the source of livelihood. Therefore, it is accounted in the present investigation. The data of the present investigation in this regard is presented in table 4.

Table 4: Distribution of the Bt. cotton growers according to their size of land holding

N=120

SL. No.	Category	Frequency	Percentage
1.	Marginal farmer (Up to 1.00 ha)	2	01.66
2.	Small farmer (1.01 to 2 ha)	16	13.33
3.	Semi-medium farmer (2.01 to 4.00 ha)	26	21.66
4.	Medium farmer (4.01 to 10 ha)	55	45.83
5.	Large farmer (above 10.01 ha)	21	17.52
	Total	120	100.00

The data from the table 4 reveals that 21.66 percent of the Bt. cotton growers had semi-medium size of land holding (02.01 to 04.00 ha), 45.83 percent of the Bt. cotton growers had medium size of land holding followed by small size 13.33 percent and marginal size 1.66 percent of land holding and only 17.52 percent Bt. cotton growers had large land holding. Thus it is seen from the findings that majority 67.49 percent of the Bt. cotton growers had semi-medium and medium size of land holding. The plausible reason behind this could be the lineal transfer of lands from parents to their descendent which leads to the land fragmentation.

These findings are in conformity with the findings of Nagtilak (2017) [24] and Godbharle (2021) [12].

1.1.5 Area under Bt. cotton
This was operationalized as the total area in hectares under the Bt. cotton crop. The area under particular crop is influential factor for determining the potentiality of the grower to adopt new technology. The data of the present investigation in this regard are presented in table 5.

Table 5: Distribution of Bt. cotton growers according to their area under Bt. cotton

N=120

SL. No.	Category	Frequency	Percentage
1	Small area under the Bt. cotton (Up to 1.35 ha)	23	19.66
2	Medium area under Bt. cotton (From 1.36 to 3.50ha)	84	70.00
3	Large area under Bt. cotton (Above 3.50 ha)	13	10.34
	Total	120	100.00

The data presented in table 5 shows that more than half 70.00 percent of the Bt. cotton growers had medium area under Bt. cotton, whereas 10.34 percent and 19.66 percent Bt. cotton growers possessed high and small area under Bt. cotton, respectively.

The result delineates that 80.34 percent of the Bt. cotton growers had medium to high area under Bt. cotton. The credible reason behind this could be the suitable climatic conditions and suitable soil type for growing Bt. cotton in locale of study.

The results are similar to the results of Bondarwad *et.al* (2010) [6], Jakkawad and Patange (2019) [14], Waghmare (2020) [32].

1.1.6 Extension contact
Extension contact is operationalized as the frequency of contacts of the respondent with extension personnel of development departments during one year, with the purpose of seeking guidance on the issue relevant to agriculture in general.

The data concerning to extension contact of Bt. cotton growers was collected, tabulated and analysed. The results are presented in table 6.

Table 6: Distribution of the respondent Bt. cotton growers according to their extension contact

N=120

SL. No.	Category	Frequency	Percentage
1	Low (Up to 16)	29	24.16
2	Medium (17 to 29)	78	65.00
3	High (Above 29)	13	10.84
	Total	120	100.00

The data from table 6 indicates that more than half 65.00 percent of the Bt. cotton growers had medium level of extension contact followed by 24.16 percent had high, while 10.84 percent had low level of extension contact.

More than three fourth 75.84 percent of the Bt. cotton growers belonged to medium and high extension contact and the most reliable reason behind that must be the continuous endeavours of extension workers or officers to get to the bottom of problems of the farmers. Farmers who have noteworthy extension contact have better chance to be acquainted with improved cultivation practices of Bt. cotton and adopt improved cultivation practices of Bt. cotton.

The findings are same as findings of Sasane (2010) [29], Devde (2012) [9], Bhangare (2014) [4], Meena (2014) [23], Sarade (2015) [28] and Kadu (2016) [16].

1.1.7 Sources of information
It refers to sources through which Bt. cotton growers obtained the information about the Bt. cotton production technology through recommended cultivation practices. The data concerning to source of information of Bt. cotton growers was collected, tabulated and analysed. The results are presented in table 7.

Table 7: Distribution of respondents according to their sources of information

N=120

SL. No.	Category	Frequency	Percentage
1.	Low (Up to 7)	20	16.66
2.	Medium (8 to 15)	81	67.50
3.	High (Above 15)	19	15.84
	Total	120	100.00

Sources of information plays important role in adoption of new technology. Sources of information in present study refers to outside contact made by the growers for acquiring themselves with the latest technology. Method and result demonstration, agriculture officer, television, radio, field tour and newspaper are the important sources of information for utilization of information regarding Bt. cotton.

It is revealed from table 7 that, 67.50 percent of the respondents used medium sources of information while, 16.66 percent and 15.84 percent of them were in low and high use

of sources of information respectively.

The finding are same as finding of Sawale (2011) [30], Mane (2012) [21], Devde (2012) [9], Bhangare (2014) [4], Jadhav (2013) [13], Meena (2014) [23], Sarade (2015) [28] and Bankar (2017) [3].

1.1.8 Irrigation facilities

The availability of irrigation is directly linked with the assembly and productivity of crops grown by the Bt. cotton growers. Most of the agriculture pivots on monsoon precipitation. Irrigation is the method of applying a controlled quantity of water to plants at required intervals Irrigation helps to grow agricultural crops.

The distribution of Bt. cotton growers on the basis of irrigation facilities are given in table 8.

Table 8: Distribution of the farmers according to their irrigation facilities

N=120

SL. No.	Irrigation facilities	Frequency	Percent
1	River	12	10.00
2	Pond	15	12.50
3	Well	32	26.66
4	Bore Well	26	21.66
5	Farm Pond	21	17.50
6	Lake	12	10.00
7	Canal	2	01.68
	Total	120	100.00

The data in table 8 disclosed that nearly 21.66 percent of the Bt. cotton growers had bore well and 26.66 percent of the Bt. cotton growers had well an irrigation source, 10.00 percent of the Bt. cotton growers had river as irrigation source followed by 10.00 percent Bt. cotton growers depended on lake for irrigation, only 01.68 percent Bt. cotton growers had canal as an irrigation source and at last 12.5 percent Bt. cotton growers had farm pond as an irrigation source.

The result concluded that the nearly half 48.32 percent of Bt. cotton growers had bore well and well as an irrigation source. The justifiable reason could be that Bt. cotton growers prefer easily available irrigation resources or prefer bore well and well rather than constructing farm pond as construction cost may be unaffordable for medium and semi-medium Bt. cotton growers.

The findings are supported by the findings of Ghube (2014) [11] and Waghmare (2020) [32].

1.1.9 Risk orientation

Risk orientation means that the capability of the farmer to espouse any new innovation while ignoring the success or failure. It is the propensity of farmer to settle for the risk. It is the degree to which a farmer is oriented towards risk and uncertainty and has courage to face the problems in farming. The data pertaining to the risk orientation of Bt. cotton growers was collected, tabulated and analysed. The results are presented in table 9.

Table 9: Distribution of Bt. cotton growers according to their risk orientation

N=120

SL. No.	Category	Frequency	Percentage
1	Low (Up to 17)	21	17.50
2	Medium (from 18 to 23)	92	76.66
3	High (Above 23)	07	05.84
	Total	120	100.00

It was observed from table 9 that most 76.66 percent of the Bt. cotton growers belonged to medium risk orientation category followed by 17.50 and 05.84 percent belonged to low and high risk orientation category, respectively.

The result indicates that 94.16 percent Bt. cotton growers belonged to low to medium risk orientation category. The legitimate reason might be that the Bt. cotton growers had medium land holding due to fragmentation and lack of resources.

The findings are in line with the findings of Jamdhade (2015) [15], Kadu (2016) [16].

1.2 Level of adoption

Adoption is a decision to make full use of innovation as the best course of action available. It thus involves a decision and an overt action. It was operationally defined as the actual use of the Bt. cotton cultivation practices by the cotton growers for last five years.

The distribution of respondents as per the adoption of Bt. cotton cultivation practices is presented in Table 10.

Table 10: Distribution of respondents according to the extent of adoption of cultivation practices of Bt. cotton

Sr. No.	Adoption level	Frequency	Percent
1.	Low	35	29.16
2.	Medium	44	36.66
3.	High	41	34.18
	Total	120	100.00

The result from the table 10 show that majority 36.66 percent of the respondents had medium level of adoption, followed by 29.16 percent of them had low level of adoption and 34.18 percent of respondents had high level of adoption regarding recommended Bt. cotton production technology.

The finding result is similar to the result of Sasane (2010) [29], Chahande (2012) [8], Sabale (2012) [27], Manoj et al. (2013) [22] and Meena (2014) [23].

Table 11: Distribution of the respondents according to their practice wise adoption about recommended cultivation practices of Bt. Cotton

Sr. No.	Recommended Cultivation practices	Adoption					
		Complete		Partial		Nill.	
		Fr.	Percent	Fr.	Percent	Fr.	Percent
1.	**Sowing time**						
	a) Irrigated:- Last week of May	79	65.83	39	32.5	2	1.66
2.	**Spacing**						
	a) Irrigated:- 90 x 45	80	66.66	38	31.66	2	1.66
3.	**Sowing method**						
	a) Dibbling	83	69.16	33	27.5	4	3.33
4.	**Recommended variety**						
	PKV Hy. BG-II	71	59.16	47	39.16	2	1.66
5.	**Refugee rows**						
	Sowing of Non Bt. Cotton around Bt. Cotton	73	60.83	45	37.5	2	1.66
6.	**Seed rate**						
	2.5 to 3 kg/ha	70	58.33	48	40	2	1.66
7.	**Seed Treatment**						
	a) Thiram @ 3 gm/kg for fungal diseases	55	45.83	54	45	11	9.16
	b) Azatobacter @ 6 ml/kg for biological nitrogen fixation	41	34.16	50	41.66	29	24.16
8.	**Fertilizer management**						
	a) Irrigated:- 120:60:60 kg/ha (NPK)	74	61.66	39	32.5	7	5.83
	b) Spraying of DAP @ 2percent at square formation stage.	73	60.83	43	35.83	4	3.33
	c) Spraying of urea @ 2percent at boll formation stage.	73	60.83	43	35.83	4	3.33
	d) Micronutrient:- Mg, Zn, B deficiency-Sulphur 20 kg, Magnesium sulphate 20 kg, Zinc sulphate 25 kg, Boron 5 kg	66	55.00	47	39.16	7	5.83
9.	**Weed management**						
	a) First hand weeding after three weeks of sowing followed by hoeing.	55	45.83	55	45.83	10	8.33
	b) Second hand weeding six weeks after sowing followed by hoeing.	64	53.33	47	39.16	9	7.5
	c) Dicot weeds:- Pyrithiobac sodium @ 20ml/10lit water.	64	53.33	48	40	8	6.66
	d) Monocot weeds:- Quizolphop ethyl @ 10ml/10lit water	70	58.33	44	36.66	6	5
10.	**Irrigation management**						
	a) Critical growth stages						
	i. Vegetative growth	62	51.66	48	40	10	8.33
	ii. Square formation	51	42.5	59	49.16	10	8.33
	iii. Flowering	53	44.16	54	45	13	10.83
	iv. Boll formation	59	49.16	55	45.83	6	5
	b) Irrigated:- From sowing to first rain irrigation is given at 8-12 days interval.	56	46.66	52	43.33	12	10
11.	**Square dropping**						
	Spraying of NAA @ 3ml/10lit of water at 2-3 weeks interval.	78	65	30	25	12	10
12.	**Pest management**						
	a) Aphid and Thrips						
	i. Thiamithaxim 25 WG @ 2gm/lit water	75	62.5	35	29.16	10	8.33
	ii. Astapymid 20 SP @ 2gm/lit water	70	58.33	37	30.83	13	10.83
	b) White fly and Jassid						
	i. Fipronil 5percent EC @ 10ml/10lit of water	92	76.66	23	19.16	5	4.16
	c) Bollworm						
	i. Thiodicarb 75 WP @ 20gm/10lit of water	72	60	35	29.16	11	9.16
	ii. Lambdacylothrin 5percent EC @ 10ml/10lit	69	57.5	41	34.16	10	8.33
13.	**Disorder**						
	a) Redding						
	i. Micronutrient spray Mg @ 20kg/ha	82	68.33	28	23.33	10	8.33
	ii. Nitrogen management	78	65	29	24.16	13	10.83
14.	**Harvesting**						
	a) First picking at 40percent boll popping.	79	65.83	29	24.16	12	10
	b) Further pickings at 15 to 20 days interval.	73	60.83	37	30.83	10	8.33

Conclusion

It was found that the majority of Bt. cotton growers had a medium level of farming experience, a medium yearly income, a medium to large amount of land under cultivation, and a medium to high Bt. cotton coverage rate. Nearly half of Bt. cotton growers used bore wells and wells as a source of irrigation. The majority of Bt. cotton farmers reported moderate to high extension contact, information sources, and

risk orientation. It was also plainly shown that two thirds of Bt. cotton growers use the suggested methods for growing the crop. It is discovered that annual income and extension contact have a positive and significant link with knowledge and adoption with regard to the relationship between the personality trait chosen and the knowledge and adoption of Bt. cotton growers.

It can be concluded from the above results that majority of the Bt. cotton growers had medium level of adoption of Bt. cotton cultivation practices. The relational analysis of selected characteristics showed that, farming experience, education, annual income, land holding, area under Bt. cotton, extension contact, source of information, irrigation facilities, risk orientation influenced the adoption of Bt. cotton technology by the growers.

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