



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(5): 1683-1688
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www.thepharmajournal.com
Received: 26-02-2022
Accepted: 30-03-2022

Tanvi Sharma
Ph.D. Scholar, Department of
Sociology, College of Basic
Sciences and Humanities,
CCS HAU, Hisar, Haryana,
India

Jatesh Kathpalia
Assistant Scientist, Department
of Sociology, College of Basic
Sciences and Humanities, CCS
HAU, Hisar, Haryana, India

Factors affecting knowledge level of *Bt.* cotton growers: A sociological study

Tanvi Sharma and Jatesh Kathpalia

Abstract

Present study was designed to know the factors affecting the knowledge level of farmers in Jind District of Haryana State, India. A total of 120 respondents were selected by using random sampling technique. The study revealed that 60 percent of respondents were having low level of knowledge. Where, age, education, annual income, mass media exposure and social participation were found to be highly significant in relation to knowledge level. It was also found that government schemes are accessible but utilization is lesser. They tend to believe in localities sources more as comparative to cosmopolite sources and mass media for the information.

Keywords: *Bt.* cotton, cash crop, adoption level, knowledge level, local leaders, genetically modified crop

Introduction

Cotton is one of the imperative cash crop in India which is also the fount of subsistence to millions of farmers and people who are engrossed in agriculture, trades, processing and textile industries (Jeya, 2020; Randive *et al.*, 2018; Shah *et al.*, 2018) [16, 29, 34]. It is also known as “white gold” (Khan *et al.*, 2020; Ahmed *et al.*, 2018; Sun *et al.*, 2019; Prasad *et al.*, 2018) [20, 2, 44, 25]. About 80 to 90 percent of the area in India is garrisoned by hybrid cotton (Sahay, 2019; Shreedevi, *et al.*, 2017) [31, 38]. In the last few decades, *Bacillus thuringiensis* (*Bt.*) cotton is one of the India’s most closely analyzed crops in the terms of its adoption and its impact. The penchant of the professionals toward this genetically modified (GM) crop increased due to many factors such as involvement of smallholder farmers in GM crops during mid-to-late 1990’s (Stone *et al.*, 2002; Glover, 2010; Kranthi and Stone, 2020) [40, 11, 22]. Cotton has a very important role as a cash crop which also provides raw materials to the textile industries in India (Kranthi and Stone, 2020). It is cultivated in tropical and sub-tropical regions of the world which are majorly cotton producing countries such as USA, India, China, Pakistan, Brazil and Uzbekistan and also contributes more than 80 percent to the world’s cotton production (Kaur *et al.*, 2019) [19]. After the introduction of *Bt.* Cotton in India during 2002, this was tailed by a spurt of field research on farm level impacts (Bharud, 2014; Yadav *et al.*, 2018) [3, 49]. Afterwards the adoption of *Bt.* Cotton among the farmers found at greater pace (James, 2009; James, 2014). The tempo of research hanged loose since 2010’s but a tenacious heed is still prolonging (Gutierrez *et al.*, 2015) [12]. The antithetical chronicles became a topic of analysis of its own where researchers accentuated the discordant aspects regarding what should be considered as evidence (Hicks, 2015) [13] and how discrete educational system to gain knowledge gravitate to bigotry findings (Stone, 2015; Stone, 2012) [42, 41]. *Bt.* Cotton is explicitly imputed for the three times of cotton production, especially during 2002-2014 (Choudhary and Gaur, 2015; Vitale and Greenplate, 2014; Vitale *et al.*, 2008; Vitale *et al.*, 2011) [6, 45, 47]. The *Bt.* seed should be rightfully ascribed for this surge in yield and a slump in insecticide usage as well as improved profits (Qaim, 2014; Subramanian and Qaim, 2009; Dowd-Urbe, 2014) [27, 43, 10]. The meagerness of pertinent erudition ensued in farmers’ suicide. It was all over the news in 1998 when hundreds of farmers committed suicide in Andhra Pradesh (Lambrecht, 1998; Karp, 1998) [23, 18]. The dearth of knowledge among the farmers of cotton is also a topic of concern to the critics of GM crops (Renaudinet *et al.*, 2012; Vitale *et al.*, 2010; Sanouet *et al.*, 2018; Bissonet *et al.*, 1995; Steenkamp *et al.*, 1998; Constable and Rochester, 1988).

Corresponding Author
Tanvi Sharma
Ph.D. Scholar, Department of
Sociology, College of Basic
Sciences and Humanities, CCS
HAU, Hisar, Haryana, India

Materials and Method

Jind District of Haryana State is situated at Lat. 29° 19' N and Long. 78° 26' E. According to Agriculture Contingency Plan District, Jind 2011 had 2,35,000 ha net sowing area. Agriculture and allied activities is the major occupation of the rural people in Jind. Descriptive research design was utilized during this study. This study was designed to know the knowledge level among the farmers who were growing *Bt.* Cotton in Jind District of Haryana. This study was conducted in Jind district of Haryana state, India which was chosen purposively. From the Jind district, two blocks i.e.

(i) Jind and

(ii) Alewa was selected randomly and from these blocks two villages from each i.e. (i) Roopgarh, (ii) Nidan and (iii) Pegan, (iv) Alewa were selected randomly respectively. And from each of the village a sample of 30 respondents was selected randomly to make a total sample of 120 respondents. The analysis of data was done by using simple percentages and cross tabulations for the association of variables.

Results and Discussion

Knowledge statements regarding *Bt.* cotton of the respondents

In table 1, it was revealed that 60 percent of the respondents

were having full knowledge about the agronomic practice which includes field preparation followed by removal and burning of debris of the previous crop, 3-4 number of irrigation given depend on rainfall, 2-3 times hoeing should be done, stopped irrigation after the opening of one-third of bolls, 4-5 cm depth of *Bt.* cotton sowing and first spray at the appearance of sucking pest with 38.34 percent, 28.33 percent, 27.50 percent, 24.16 percent, 18.33 percent and 5.83 percent respectively. Regarding sowing methods 35 percent were having full knowledge about sowing time should be after fortnight of April to end of May whereas 43.33 percent were not having any knowledge about line to line spacing should be minimum 100 cm. 58.34 percent of the respondents were having full knowledge regarding white flies were the most serious pest in the area and 46.66 percent were unaware of that the Neem oil and Ragor should be used to control the pest. More than one-third i.e. 35.84 percent of the respondents were fully known to the fact that only cotton should be picked not bracts. Approximately half of the respondents i.e. 49.17 percent were not known to the fact that harvesting should be done the time interval of 1 week. During the post-harvest techniques 63.33 percent did not have any idea about the process of drying over dry sand.

Table 1: Knowledge statements regarding *Bt.* cotton of the respondents

(N=120)

S. No.	Statements	Full Knowledge	Partial Knowledge	No Knowledge
Agronomic practices				
a.	Field preparation (1 time mould ploughing and two times harrowing)	72(60.00)	30(25.00)	18(15.00)
b.	Removal and burning of debris of the previous crop	46(38.34)	42(35.00)	32(26.66)
c.	3-4 number of irrigation given depend on rainfall	34(28.33)	38(31.67)	48(40.00)
d.	2-3 times hoeing should be done	33(27.50)	40(33.33)	47(39.17)
e.	Stopped irrigation after the opening of one-third of bolls	29(24.16)	31(25.84)	60(50.00)
f.	4-5 cm depth of <i>Bt.</i> cotton sowing	22(18.33)	43(35.83)	55(45.84)
g.	First spray at the appearance of sucking pest	7(5.83)	38(31.67)	75(62.50)
Sowing method				
a.	Sowing time should be after fortnight of April to end of May	42(35.00)	54(45.00)	24(20.00)
b.	Recommended seed rate for 850g (Rs.730)	37(30.84)	52(43.33)	31(25.83)
c.	Method used for seed selection (disease resistance or high yielding)	35(29.16)	41(34.17)	44(36.67)
d.	Plant to plant spacing should be 45 cm	23(19.17)	46(38.33)	51(42.50)
e.	Line to line spacing should be minimum 100 cm	20(16.67)	48(40.00)	52(43.33)
Pest and disease management				
a.	Whitefly is the most serious pest in the area	70(58.34)	40(33.33)	10(8.33)
b.	Chemical treatment should be adopted to control pest	48(40.00)	28(23.33)	44(36.67)
c.	Neem oil and Ragor should be used to control the pest	26(21.67)	38(31.67)	56(46.66)
Picking of cotton				
a.	Only cotton should be picked not bracts	43(35.84)	31(25.83)	46(38.33)
b.	165-175 days is the appropriate time for picking	42(35.00)	37(30.83)	41(34.17)
c.	Cotton should be picked from well burst bolls	22(18.33)	42(35.00)	56(46.67)
d.	Harvesting should be done at the interval of more than 1 week	18(15.00)	43(35.83)	59(49.17)
Post-harvest techniques				
a.	Shade drying procedure	72(60.00)	30(25.00)	18(15.00)
b.	Grading procedure	28(23.33)	41(34.17)	51(42.50)
c.	Drying over dry sand	20(16.67)	24(20.00)	76(63.33)

Knowledge level of respondents regarding *Bt.* Cotton

In Table 2, it can be clearly seen that majority of the respondents were having low level of knowledge, 30 percent were having medium level of knowledge whereas only 10 percent of them belong to high level of knowledge. Similar results can be seen in a study conducted by Sharma *et al.*, 2021^[36-37] where majority of the respondents disclosed that

inadequate knowledge regarding pest control and lack of marketing guidance as constraints among the *Bt.* Cotton growers of Haryana. Dissimilitude results were found in various studies by Bishnoi, *et al.*, 2017; Rajeshwar, *et al.*, 2019; Khodake, *et al.*, 2019; Yadav, *et al.*, 2019; Sarada, 2019 and Deepika, *et al.* 2020[□]. Where majority of the farmers were having medium level of knowledge.

Table 2: Knowledge level of respondents regarding *Bt.* Cotton

(N=120)

S. No.	Knowledge level	Frequency	Percentage
1.	Low (23-38)	72	60.00
2.	Medium (39-53)	36	30.00
3.	High (54-69)	12	10.00

Association between Socio-economic variables and Knowledge level of *Bt.* Cotton growers

Knowledge refers to the known facts to the respondents regarding *Bt.* cotton production such as agronomic practices, sowing methods, pest and disease management, picking of cotton and post-harvest techniques. Majority of the respondents were fully known to the field preparation, white fly is the most serious pest in the area and about the shade drying procedure whereas maximum number of the respondents were unaware of the facts like there should be 3-4 number of irrigation given depend on rainfall, should stopped irrigation after opening of one-third bolls, there should be 4-5 cm depth of *Bt.* cotton sowing, first spray should be at the appearance of sucking pest, plant to plant spacing should be 45 cm, line to line spacing should be 100 cm, cotton should be picked from well burst bolls, harvesting should be done at the interval of 1 week, about the grading procedure and drying over dry sand. Majority of the respondents were having low level of knowledge. In the present study it was found that there were various socio-economic factors which influence the knowledge level of the respondents such as age education,

annual income, mass-media exposure, size of land, subsidiary occupation, social participation and socio-economic status. Similar findings were also reported by Duhan & Singh (2017) [9] regarding knowledge level among farmers that it was affected by the socio-economic variables. We have found that there is positive and highly significant correlation of knowledge level with age, education, annual income, mass-media exposure and social participation whereas subsidiary occupation and size of land holding were also positive but simply significant in relation to knowledge level. Sharma *et al.*, 2021 [36-37] disclosed in their study that socio-economic factors such as mass-media exposure and social participation in any organization were having significant relationship with adoption level among *Bt.* Cotton growers of Haryana. So we can say low level of knowledge lead to low level of adoption of *Bt.* Cotton. Caste and socio-economic status were not found to be significant with knowledge level. Closely related results were revealed by the Shakyat. *al.* (2016) [35] who stated that correlation analysis indicated that all socio-economic factors had the positive correlation with knowledge level.

Table 3: Association between socio-economic variables and Knowledge level of *Bt.* Cotton Adopters

(N=120)

Socio-economic variables		Knowledge level			
Age	Low	Medium	High	Total	
20-35 years of age group	19(46.34)	21(51.23)	1(2.43)	41(34.17)	
35-50 years of age group	30(65.22)	11(23.92)	5(10.86)	46(38.33)	
50-65 years of age group	23(69.67)	4(12.15)	6(18.18)	33(27.50)	
Total	72(60.00)	36(30.00)	12(10.00)	120(100.00)	
χ^2 Cal= 16.82**					

Caste				
Scheduled	3(50.00)	2(33.33)	1(16.67)	6(5.00)
Backward	9(75.00)	2(16.67)	1(8.33)	12(10.00)
General	60(58.82)	32(31.38)	10(9.80)	102(85.00)
χ^2 Cal=1.40				

Education				
Illiterate	7(87.50)	1(12.50)	0(0.00)	8(6.67)
Middle School Level	29(78.39)	7(18.91)	1(2.70)	37(30.83)
Secondary Level	27(67.50)	10(25.00)	3(7.50)	40(33.33)
Senior Secondary and above	9(25.73)	18(51.42)	8(22.85)	35(29.17)
χ^2 Cal= 26.35**				

Size of land holdings				
Marginal farmers (<1 ha)	32(84.22)	4(10.52)	2(5.26)	38(31.66)
Small farmers (1-2 ha)	15(62.50)	7(29.17)	2(8.33)	24(20.00)
Semi-medium farmers (2-4 ha)	12(46.15)	11(42.30)	3(11.55)	26(21.67)
Medium farmers (4-10 ha)	13(40.63)	14(43.75)	5(15.62)	32(26.67)
χ^2 Cal=16.70*				

Annual income				
Low (Upto Rs. 1,50,000/-)	42(72.41)	15(25.86)	1(1.73)	58(48.33)
Medium (Between Rs. 1,50,001 - 3,00,000/-)	20(62.50)	10(31.25)	2(6.25)	32(26.67)
High (Above Rs. 3,00,001/-)	10(33.33)	11(36.67)	9(30.00)	30(25.00)
χ^2 Cal= 22.29**				

Subsidiary occupation of the family				
Nil	40(76.93)	10(19.23)	2(3.84)	52(43.33)
Small scale enterprise	16(53.33)	11(36.67)	3(10.00)	30(25.00)
Business and services	16(42.11)	15(39.47)	7(18.42)	38(31.67)
$\chi^2 Cal= 12.98^*$				

Mass media exposure				
Low (6-12)	43(64.17)	22(32.85)	2(2.98)	67(55.83)
Medium (13-18)	17(60.71)	9(32.14)	2(7.15)	28(23.33)
High (19-24)	12(48.00)	5(20.00)	8(32.00)	25(20.84)
$\chi^2 Cal= 17.47^{**}$				

Social Participation in any organization				
Not member of any organization	34(62.97)	19(35.18)	1(1.85)	54(45.00)
Member of 1 organization	24(75.00)	7(21.87)	1(3.13)	32(26.67)
More than 1 organization	14(41.18)	10(29.41)	10(29.41)	34(28.33)
$\chi^2 Cal= 22.38^{**}$				

Socio-economic Status				
Low (5-10)	12(50.00)	11(45.83)	1(4.17)	24(20.00)
Medium (11-14)	23(60.54)	12(31.57)	3(7.89)	38(31.67)
High (15-17)	37(63.79)	13(22.42)	8(13.79)	58(48.33)
$\chi^2 Cal= 5.51$				

Figures in parentheses indicate percentage
 **Significant at 1percent level of significance
 *Significant at 5percent level of significance

Access and utilization of government schemes and services
 Ntale (2013) [24] stated that social capital was important and had a direct impact on other capitals, as it improved the effectiveness of economic affairs or it reduced the difficulties related to the public goods using the common trust and responsibilities put on the community. For the present study social capital was accessed in terms of access and utilization of government schemes and services where it was revealed that more than half of the respondents somewhat accessed the government schemes and services like panchayat, anganwadi and government hospitals and majority of the respondents were fully/ highly aware about the government schemes and services but due to lack of quality services majority of them never used them and one fourth of them oftenly used them.

Table 4: Access and utilization of government schemes and services (N=120)

S. No.	Level of access	Frequency	Percentage
1.	Easily accessible	58	48.33
	Somewhat accessible	62	51.67
	Not accessible	0	0.00
2.	Awareness about the government schemes		
	Fully awared	77	64.16
	Somewhat awared	22	18.34
3.	Level of utilization		
	Never	73	60.83
	Often	31	25.84
	Most often	16	13.33

WMS of access and utilization of government schemes and services

Table 5 clearly show that intensity of the aspects regarding access and utilization of government schemes and services were level of access was at first rank followed by awareness about the government schemes and level of utilization respectively.

Table 5: WMS of access and utilization of government schemes and services

Aspect	WMS	(N=120)	
		Mean score	Rank
Level of access	298	2.48	I
Awareness about the government schemes	296	2.46	II
Level of utilization	183	1.52	III

Utilization of Information sources

This study divulged that most of the respondents got information from the localite sources as comparative to cosmopolite and mass media. Much of a muchness findings were arrived by Preeti (2014) and Jodha *et al.*, (2018) [26, 17] who found that 65 percent of the respondents had low cosmopolite source of information utilization.

Table 6: Utilization of Information sources

S. No.	Information sources	Frequency	Percentage
Locality sources			
1.	Low	0	0.00
2.	Medium	32	26.67
3.	High	88	73.33
Cosmopolite sources			
1.	Low	72	60.00
2.	Medium	38	31.66
3.	High	10	8.34
Mass media			
1.	Low	67	55.83
2.	Medium	28	23.33
3.	High	25	20.83

WMS of information source utilization

In Table 7 it is clearly revealed that first and foremost source of information for the respondents was localite sources followed by mass media and then cosmopolite sources.

Table 7: WMS of information source utilization

Information source	WMS	Mean score	Rank
Localite sources	328	2.73	I
Mass media	198	1.65	II
Cosmopolite sources	178	1.48	III

(N=120)

Conclusion

The study can be concluded that the most of the respondents belonged to lower knowledge level. Variables such as age, education, annual income, mass media exposure and participation in any organizations were found to be highly significant with the knowledge level of the respondents. Whereas, socio-economic status and caste of the respondents were not having any relation with knowledge level. Respondents got the information from localite sources mostly and most of the respondents' level of utilization of government schemes and services was found to be nil.

Suggestions

Bt. cotton cultivation can be improved by integrating the knowledge among the farmers. Farmers should be motivated to consult authorized agencies/ organizations/ SAU as an information source by the extension workers. More local leaders should be motivated and trained to create awareness as people rely on them easily.

References

1. Agriculture Contingency Plan District, Jind, 2011. <http://agricoop.gov.in/sites/default/files/HAR8-Jind-30-06-2011.pdf>
2. Ahmed M, Shahid AA, Din SU, Akhtar S, Ahad A, Rao AQ, Husnain T. An overview of genetic and hormonal control of cotton fiber development. *Pak J Bot.* 2018;50(1):433-43.
3. Bharud RW. Cotton developments in India. AICCIP, Mahatma Phule Agricultural University, Rahuri, Maharashtra, India. 2014.
4. Bishnoi M, Sisodiya SS, Sharma FL, Kumar V. Knowledge of Farmers about Improved Bt Cotton Production Technology. *Indian Journal of Extension Education.* 2017;53(4):121-123.
5. Bisson P, Crétenet M, Jallas E. Nitrogen, phosphorus and potassium availability in the soil: physiology of the assimilation and use of these nutrients by the plant. 1995.
6. Choudhary B, Gaur K. Biotech cotton in India, 2002 to 2014. ISAAA Series of Biotech Crop Profiles. ISAAA: Ithaca, NY, 2015, 1-34.
7. Constable GA, Rochester IJ. Nitrogen application to cotton on clay soil: Timing and soil testing. *Agronomy Journal.* 1988;80(3):498-502.
8. Deepika M, Asokhan M, Rani SU. Knowledge level of ELS cotton growers in Vellore district—An analysis. *Journal of Cotton Research and Development.* 2020;34(1):129-134.
9. Duhan A, Singh S. Factor's affecting awareness level of farmers about crop insurance: A case study of Haryana. *Asian Journal of Agricultural Extension, Economics & Sociology.* 2017;21(4):1-7.
10. Dowd-Urbe B. Engineering yields and inequality? How institutions and agro-ecology shape Bt cotton outcomes in Burkina Faso. *Geoforum.* 2014;53:161-171.
11. Glover D. The corporate shaping of GM crops as a technology for the poor. *The Journal of Peasant Studies.* 2010;37(1):67-90.
12. Gutierrez AP, Ponti L, Herren HR, Baumgärtner J, Kenmore PE. Deconstructing Indian cotton: weather, yields, and suicides. *Environmental Sciences Europe.* 2015;27(1):1-17.
13. Hicks DJ. Epistemological depth in a GM crops controversy. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences.* 2015;50:1-12.
14. James C. ISAAA Brief, 2009, 39-2008.
15. James C. ISAAA Briefs brief 49 Global Status of Commercialized Biotech/GM Crops, 2014.
16. Jeya R. Knowledge level of hybrid cotton growers on cotton cultivation practices. *Plant Archives.* 2020;20(1):503-505.
17. Jodha R, Dahiya M. Livelihood Problems of small and marginal farm families in rural areas of Haryana State, India. *International Journal of Current Microbiology and Applied Sciences.* 2018;7(1):1624-1629.
18. Karp J. Deadly crop: difficult times drive India's cotton farmers to desperate actions. *Wall Street Journal,* 1998, 18.
19. Kaur P, Bhagria T, Mutti NK, Rinwa A, Mahajan G, Chauhan BS. Cotton Production in Australia. *Cotton Production,* 2019, 341.
20. Khan MA, Wahid A, Ahmad M, Tahir MT, Ahmed M, Ahmad S, *et al.* World cotton production and consumption: An overview. *Cotton production and uses,* 2020, 1-7.
21. Khodake SB, Deshmukh AN, Khodake VB, Deshmukh SA. Knowledge of Bt. cotton growers about management practices for control of pink bollworm. *Agriculture Update.* 2019;14(3):224-227.
22. Kranthi KR, Stone GD. Long-term impacts of Bt cotton in India. *Nature plants.* 2020;6(3):188-196.
23. Lambrecht B. India gives Monsanto an unstable lab for genetics in farming. *St. Louis Post-Dispatch.* 1998;22:A1.
24. Ntale. Forcing the dumb to sing? Rejuvenating farmer cooperatives in Uganda amidst waning social capital. *Journal of African Studies and Development.* 2013;5(8):224-235.
25. Prasad BMVS, Bhattiprolu SL, Kumari VP, Kumar PA. *In vitro* evaluation of fungicides against *Alternaria macrospora* causing leaf spot in cotton. *Int. J. Curr. Microbiol. App. Sci.* 2018;7(1):2551-2557.
26. Press Information Bureau Government of India, Ministry of Agriculture & Farmers Welfare (2018).-Preeti (2014). Feasibility of value added products of pearl millet as an enterprise for rural women. M.Sc. Thesis, CCS Haryana Agricultural University, Hisar.
27. Qaim M. Agricultural biotechnology in India: Impacts and controversies. In *Handbook on agriculture, biotechnology and development.* Edward Elgar Publishing, 2014.
28. Rajeshwar JS, Patange N, Manvar V. Extent of Farmers Knowledge on Improved Cultivation of Bt Cotton. *Young (up to 37).* 2019;18:22-50.
29. Randive PU, Deshmukh RR, Janse PV, Gupta RS. Discrimination between Healthy and Diseased Cotton Plant by Using Hyperspectral Reflectance Data. In *International Conference on Recent Trends in Image Processing and Pattern Recognition.* Springer, Singapore, 2018, 342-351.

30. Renaudin C, Pelc H, Opois J. Cotonniergénétiquement modifié: l'expérience d'une campagne agricole au Burkina Faso. *Cahiers Agricultures*. 2012;21(6):387-394.
31. Sahay A. Cotton Plantations in India: The Environmental and Social Challenges. *Yuridika*. 2019;34(3):429-442.
32. Sanou EI, Gheysen G, Koulibaly B, Roelofs C, Speelman S. Farmers' knowledge and opinions towards bollgard II® implementation in cotton production in western Burkina Faso. *New Biotechnology*. 2018;42:33-41.
33. Sarada O. Technological gap in adaptation of recommended Bt Cotton production technology in Prakasam district of Andhra Pradesh. *Andhra Pradesh J Agril. Sci*. 2019;5(1):40-46.
34. Shah P, Bansal A, Singh RK. Life cycle assessment of organic, BCI and conventional cotton: a comparative study of cotton cultivation practices in India. In *Designing Sustainable Technologies, Products and Policies*. Springer, Cham. 2018, 67-77.
35. Shakya MS, Patel MM, Singh VB. Knowledge level of chickpea growers about chickpea production technology. *Indian Research Journal of Extension Education*. 2016;8(3):65-68.
36. Sharma T, Kathpalia J, Kumari V. Constraints in adoption of growing Bt. Cotton among Bt. growers in Haryana. *The Journal of Rural and Agricultural Research*. 2021;21(1):57-60.
37. Sharma T, Kathpalia J, Kumari V, Tyagi R. Cropping Pattern and Adoption of Bt. Cotton among Bt. Cotton Growing Farmers in Haryana-A Sociological Study. *Journal of Global Communication*. 2021;14(1):53-59.
38. Shreedevi BC, Patil NA, Naik S. An economic analysis of augmentational trends in production and productivity in Karnataka: A case of cotton. *Agricultural Science Digest*, 2017, 37(4).
39. Steenkamp CJ, Jansen A, Boshoff H. Nitrogen fertilization of cotton based on inorganic nitrogen analysis of the soil. In *Proceedings of the World Cotton Research Conference-2*. Athens, Greece, 1998 September, 6-12.
40. Stone GD, Altieri MA, Pental D, Richards P, Suryanarayana MH, Tripp R, *et al*. Both sides now: Fallacies in the genetic-modification wars, implications for developing countries, and anthropological perspectives. *Current Anthropology*. 2002;43(4):611-630.
41. Stone GD. Constructing Facts: By Cotton Narratives in India. *Economic and Political Weekly*. 2012;62:70.
42. Stone GD. Biotechnology, schismogenesis, and the demise of uncertainty. *Wash. UJL & Pol'y*. 2015;47:29.
43. Subramanian A, Qaim M. Village-wide effects of agricultural biotechnology: the case of Bt cotton in India. *World Development*. 2009;37(1):256-267.
44. Sun W, Gao Z, Wang J, Huang Y, Chen Y, Li J, Zuo K. Cotton fiber elongation requires the transcription factor Gh MYB 212 to regulate sucrose transportation into expanding fibers. *New Phytologist*. 2019;222(2):864-881.
45. Vitale J, Glick H, Greenplate J, Abdennadher M, Traoré O. Second-Generation Bt Cotton Field Trials in Burkina Faso: Analyzing the Potential Benefits to West African Farmers. *Crop Science*. 2008;48(5):1958-1966.
46. Vitale J, Greenplate J. The role of biotechnology in sustainable agriculture of the twenty-first century: the commercial introduction of Bollgard II in Burkina Faso. In *Convergence of food security, energy security and sustainable agriculture*. Springer, Berlin, Heidelberg, 2014, 239-293.
47. Vitale J, Ouattarra M, Vognan G. Enhancing sustainability of cotton production systems in West Africa: A summary of empirical evidence from Burkina Faso. *Sustainability*. 2011;3(8):1136-1169.
48. Vitale J, Vognan G, Ouattarra M, Traore O. The commercial application of GMO crops in Africa: Burkina Faso's decade of experience with Bt cotton, 2010.
49. Yadav S, Godara AK, Nain MS, Singh R. Perceived Constraints in Production of Bt cotton by the Growers in Haryana. *Journal of Community Mobilization and Sustainable Development*. 2018;13(1):133-136.
50. Yadav VK, Kumar N, Singh AK, Chakrabarti A, Bhadana VP, Sarkar PK. Knowledge level of farmers and scientists about agricultural biotechnology in Jharkhand. *Intl. J of Chemical Studies, SP*. 2019;6:703-706.