Pest Hot Spots and Impact of IPM in Bt Cotton in Belgaum District of Karnataka

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ABSTRACT

Cotton (Gossypium spp.) is a major cash crop, being the world's leading natural fibre for the manufacture of textiles and edible oil. Climate has changed many times in response to a variety of natural causes. Increasing temperature can have both positive and negative effects on cotton growth depending on the location of the region. Pests are a threat to the cotton production worldwide. Water availability is another important factor in cotton cultivation. The work was carried out in five taluk of Belgaum district in Karnataka state covering 42 villages for five consecutive years from 2008 to 2013. The data anlysed clearly showed that the number of sprays, quantity of pesticides usage and cost of production increased from 2008-09 to 2012-13 only due to reduced rainfall. The study also revealed the impact of IPM measure over non IPM and spread of the IPM measures to adjacent non project area. This paper elaborate the hot spots as a result of changing rainfall, temperature and related factors of production and recommendations of alternate measures of monitoring and control of pests and natural enemies as an impact of advisory at regular intervals of cotton production period.

Key words : *Hot Spots, Impact, IPM, Bt Cotton.*

Cotton is one of the most important commercial crops playing a key role in economic and social affairs of the world. It is an important fibre crop, which is cultivated in more than 80 countries of the world but ten countries viz USA, CIS, China, India, Brazil, Pakistan, Turkey, Mexico, Egypt and Sudan account for nearly 85 per cent of the total production.

Of late cultivation of cotton in irrigated ecosystem has become uneconomical due to increase in protection cost. Transgenic Bt cotton has become an important IPM tool which needs to be evaluated with regard to occurrence of insect pests, natural enemies, monitoring resistance and working out its economic sustainability.

India is one of the largest producer of cotton in the world with the largest area. Bollworms have been the key pest regularly causing decrease in cotton production. Historically pest management has relied largely on synthetic pesticides. This resulted in several environmental and economic liabilities. Recently development of biotechnological tools facilitated the introduction of genes into crop plants of economic importance as one of the potential way to combat insect pests and becomes a major tool in Integrated Pest Management (IPM).

Among various transgenic crops, cotton hybrids that express gene derived from the bacterium, Bacillus thuringiensis (Bt) has been deployed for combating cotton bollworms since 2002 in India. Bt cotton cultivation has expanded rapidly to three million hectare of the total cotton area of 8.9 m. ha in 2006-07 (Anonymous, 2006). Initial filed studies showed that Bt cotton yielded more than the non Bt hybrid and was found to be safe for beneficial fauna and reduces the cost of cotton production (Bambawale et al., 2004 and Patil et al., 2005). However, many farmers, consumers and environmentalists adamantly opposed to the transgenic cotton with the intention that Bt cotton causes harmful effects on beneficial organisms, susceptibility to insect pest and non profitable to farmers (Abdul Qayuam and Kiran Sakkhari 2003). This was leading to a state of confusion. Keeping all these points in view present study was undertaken in irrigated ecosystem for three seasons to understand the insect pest status on Bt cotton, effect on natural enemies population, monitoring of Helicoverpa resistance to Bt cotton, development of IPM schedule and lastly working out economics of its cultivation and impact of advisory.

METHODOLOGY

Out of 10 taluk of Belgaum district 5 taluk have been purposively selected which have more cotton growing area compared to other taluk of the district. From each taluk five villages have been selected based on the more area covered under Bt cotton. Based on the situation every year 10-25 per cent villages were replaced to understand the pest hot spot and also to spread the cotton technology to new area. In Bailhongal, Saundatti and Hukkeri taluk increase in cotton growing area was noticed from 2008-09 to 2011-12, however due to less rainfall during 2012-13 in all taluk cotton cultivation area decreased. Totally 42 villages covered in the project period of five years and all details were collected from the ten field scouts recruited for the purpose from the selected fields of 42 villages. The formatted booklet was kept with the field scouts to regularly monitor and note the data in the data sheet. The completed data book was consolidated and results are tabulated and interpreted.

To disseminate IPM technologies various extension activities were conducted. The farmers and field scouts training were conducted in order to upgrade their knowledge on pest habit, habitat and management strategies. In the project period 55 farmers trainings were conducted and trained 1951 farmers on cotton production technologies and pest management. The field scouts trainings conducted to train them on different pests, natural enemies' production, technologies of cotton, pest habitat, methods of pest counting and related aspects. Totally 18 such trainings organized and trained 204 scouts to build knowledge and refresh on pest data base management, cotton pest and production technology.

The impact of the project was studied with survey and schedule interview. The information on pesticide usage pattern, number of sprays with chemical and bio pesticide, quantity of pesticide used, cost of pesticide, horizontal spread of IPM, yield and B:C ratio was collected and dealt in detail in results and discussion.

RESULTS AND DISCUSSION

Pests hot spots during project period

In the project study, in a field the pest crossing ETL was called as hot spot for that particular pest. Based on pest data recorded in each field hot spot data presented in Table 1. During 2010-11 hot spots of different pest were less because of more rainfall occurred between 2nd fortnight of August to first fortnight of October.

Hot spot of Jassids were observed in all the five years. During 2009-10, 2011-12 and 2012-13 eight, six and nine hot spots were observed, respectively. Only in 2012-13 hot spots for whitefly was observed.

Table 1
Number of hot spots of pests between 2008-09 and 2012-13

Name of pest	Number of hot spots					
	2008-09	2009-10	2010-11	2011-12	2012-13	Total
Jassids	2	8	2	6	9	**27**
Whitefly	-	-	-	-	3	**3**
Aphid	12	20	16	19	31	**98**
Thrips	2	4	16	18	27	**67**
Mirid Bug	1	8	3	11	18	**41**
Mealy Bug	-	-	1	1	2	**4**
Red leaf	5	8	12	17	62	**104**
Leaf rust	-	4	-	-	-	**4**
Grey mildew	-	4	-	-	5	**9**

Hot spots of aphid have been recorded in all the five seasons. In 2009-10 (20), 2011-12 (18), 2010-11 (16) and 2012-13 (31) hot spot of aphid was recorded. These data showed that aphid pest problem was found increased over the years. All these hot spots were observed between the crop age of 40-50 days and it was found as regular pest in cotton fields of Belgaum district.

Data in the Table 1 showed that thrips pest problem increased and more number of hot spots recorded during 2010-11 (16), 2011-12 (18) and 2012-13 (27). In the fields where thrips hot spots noticed in that place long (15-25 days) dry spell was observed.

To manage Jassids, aphid and thrips it was suggested to spray 5 per cent Neem pesticide or 0.075 g/lit Clothianidian 50WDG or 1.5 ml/lit Oxydemeton methyl 25EC or 0.2 g/lit Acetamiprid 20SP or 0.2 g/lit Thiamethoxam 25WG or Fipronil 5 SC @ 1 ml/lit.

Mirid bug hot spots were found increased in the all the five years. In 2008-09 only one hot spot was recorded whereas in 2012-13 the hot spot number of this pest rose to 18. This indicates that problem of this pest increased year by year. During 2008-09 Mirid bug incidence noticed more in few villages of northern part of Belgaum district and these villages are near or adjacent to Dharwad district where mirid bug incidence was more. In later years in the district incidence slowly increased or spread to other taluk. Application of Fipronil 5SC @ 1 ml/lit or Monocrotophos 36SL @ 2 ml/lit of water was suggested as a short term emergency measure. But the early mirid management intervention may disrupt the natural enemy and may result in outbreak of whiteflies, aphids or mites in the later season. Thus there was a need for predator complex, such as damsel bugs, big eyed bugs, assassin bugs, predatory shield bugs, spiders and ants. Acephate 70SP @ 1.0g/lit or Imidachloprid 17.8SL @ 0.2 lm/lit or NSKE @ 5 % or Fipronil 5SC @ 1 ml/lit are best options for the management.

Mealy bug hot spot recorded in both 2010-11 and 2011-12 and one hot spot was observed in each year and during 2012-13 two hot spots were recorded. It showed that pest was slowly spreading and necessitated for keen observation on the pest. It was suggested to manage parthenium weed. Don't allow movement of human, animal and water in infested field. Spray of Verticillium lecanii @ 2 g/lit, drenching of acephate 75SP along the border to prevent spread of mealy bugs was suggested. Crop rotation was promoted to break the infestation cycle.

The hot spots data of red leaf showed that over the five years period, red leaf problem found increased. More number (62) of hot spots of red leaf in 2012-13 was recorded whereas in 2008-09 only 5 hot spots were recorded. This problem was managed with foliar spray of 1 per cent MgSO4 or 2 per cent urea or 2 per cent KNO3 or 2 per cent DAP with weekly interval prior to onset of winter or from last week of September.

Leaf rust and grey mildew hot spots (4) were recorded during 2009-10 only because during 2nd fortnight of September and first fort night of October heavy rainfall was received in two villages which led for the development of more relative humidity. At this period these two diseases developed severely. In 2012-13, five hot spots of grey mildew were observed. It was advised to spray hexaconazole @ 1 ml/lit or carbandazim @ 1g/lit.

Impact of the project

Pesticides usage, yield and cost of production

were calculated and presented in Table 2. This shows the average data of number of sprays, quantity of pesticide applied, yield and cost of production for Bt cotton in IPM and non IPM fields for five years. The information in the Table shows that number of sprays, quantity of pesticides usage and cost of production increased from 2008-09 to 2012-13. But seed cotton yield level decreased over the years because of reduced rainfall and increased pest population.

The data of number of sprays (Table 4) and the cost of spray incurred by IPM and non IPM farmers were recorded and the five years average data are given. The data shows number of sprays and cost of spray (Rs/ha) was comparatively more in non IPM farmers than IPM farmers. Up to 20.59 per cent reduction in number of sprays and 22.63 per cent in cost of spray was noticed during project period.

GM seeds, first adopted in developed countries, are expensive. Nonetheless, the use of the Bt cotton seed, in particular, has spread widely in developing countries in recent years. The main reason for this is the many identified Other benefits of Bt cotton. Studies by Huang, et al. (2002, 2005), Qaim and Zilberman (2003), Bennett, et al. (2003), Pray et al. (2002), Bennett, et al. (2006), and Qaim, et al. (2006) suggest that Bt cotton use reduces pesticide sprays and increases seed cost and yields. Wu et al. (2008) provide evidence that the planting Bt cotton not only significantly decreases spraying against the pest cotton bollworm, but it also reduces the pest cotton bollworm on other crops.

Study of Pray et al. (2002), report that a larger percent of non-Bt growing farmers (around 22 percent) identified various health problems related to pesticide use compared to farmers planting only Bt

Table 2

Pesticide application, yield and benefit/cost ratio in IPM and FP during 2008-13

Year	No. of chemical pesticide spray		Quantity of chemical pesticide applied (kg/ha)		Application of bio-pesticide (%)		Seed cotton yield (Kg/ha)		Cost of cotton production* (Rs/ha.)	
	IPM	FP	IPM	FP	IPM	FP	IPM	FP	IPM	FP
2008-09	3.41	4.37	0.68	4.68	43.29	09.21	20.37	19.15	13284	14547
2009-10	3.33	4.71	0.71	5.19	56.28	10.19	21.78	20.56	15958	16854
2010-11	3.19	3.90	0.63	3.95	62.81	10.25	19.53	19.21	17614	18985
2011-12	4.06	5.21	1.25	6.85	83.26	12.15	18.69	17.05	21541	23257
2012 13	4.57	5.16	1.63	7.57	81.69	09.84	16.57	15.34	27200	31300
Average	**3.71**	**4.69**	**0.98**	**5.64**	**65.46**	**10.32**	**19.38**	**18.26**	**19119.4**	**20988.6**

Table 3

Horizontal spread of IPM (farmer to farmer) under NISPM during 2008-13

Sl. No.	Crop season	No. of villages	No. of IPM farmers	Area under IPM (ha)	No. of motivated farmers	Area increased by motivated farmers (ha)
1	2008-09	20	200	88.9	57	25.3
2	2009-10	20	100	75.3	294	280.1
3	2010-11	20	100	60.6	329	273.5
4	2011-12	20	100	81.2	311	292.8
5	2012-13	20	100	103.6	318	308.3
Total		100	600	409.6	1309	1180

Table 4
Details of number of spray, cost of spray and reduction in cost of spray

Year	No. of spray			Cost of spray (Rs/ha)			Reduction in cost of spray by IPM farmers compared to non IPM farmer (Rs)
	IPM farmers	Non-IPM farmers	% reduction in IPM	IPM farmers	Non-IPM farmers	% reduction in IPM	
2008-09	3.41	4.37	21.96	1924	2621	26.59	697
2009-10	3.33	4.71	29.29	1716	2460	30.24	744
2010-11	3.19	3.90	18.20	1445	1954	26.04	509
2011-12	4.06	5.21	22.09	2457	2938	16.37	481
2012-13	4.57	5.16	11.43	3169	3681	13.90	512
Average	**3.72**	**4.67**	**20.59**	**2142**	**2730**	**22.63**	**588**

cotton (5-8 percent). Kousar and Qaim (2011) also argue that Bt cotton has led to a notable decline in acute pesticide poisoning cases among cotton growers in India.

Farmers around the world both large and smallholders benefit from this technology through increased productivity, convenience, and time savings. The vast majority of farmers using Bt cotton globally are smallholder farmers. The economic, environmental, and social benefits derived from adoption of this important tool have very positive implications for the farmers, their surrounding communities, and the future of agriculture. (Purcell, J.P.,& Perlak, F.J., 2004) It was concluded that if the profitability status of Bt cotton cultivation in the area could be enhanced, the sustainability status of Bt cotton could be increased (Nithy et al. 2009)

CONCLUSION

Commercial cultivation of Bt cotton hybrids in irrigated ecosystem showed significant reduction in pesticide application against bollworms with increased net profit to cotton farmers and has become economically sustainable crop.

The education of the farmers has certainly a role to play in cultivation of Bt cotton specially with reference to refuge management, insecticide spray, and integrated pest management as well as other agricultural practices. It is necessary that a concerted effort by the extension programs in collaboration with State Dept. of Agriculture and Agricultural Universities in the State would go in long way in managing Bt cotton cultivation economically and environmentally sound manner.

The number of hot spots of sucking pests initially were found due to the weather congenial for their habitat and further perpetuation. This was very well forecast with the weather forecast data and suitable monitoring and at times the control measures to save natural enemies were propagated under integrated pest management strategy.

Though the project covered only 409.6 ha cotton area the spread of the technologies was noticed in 1180 ha and in most of the non IPM farmers fields.

It was concluded that the number of sprays and cost of spray (Rs/ha) was comparatively more in non IPM farmers than IPM farmers. Up to 20.59% reduction in number of sprays and 22.63% in cost of spray was noticed during project period. The project concept is very ideal to forecast pest spread hence the project may also be extended for other crops.

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REFERENCES

1. Abdul. Qayum. & Kiran, Sakkhari, 2003. Did Bt cotton save farmers in Warangal ? A season long impact study of Bt cotton-Kharif 2002 in Warangal district of Andra Pradesh. ***AP Coalition in Defence of Diversity and the Deccan Development Society, Hyderabad.***
2. Anonymous., 2006, Project Co-ordinator's report, All India Co-ordinated Cotton Improvement Project. ***CICR, Coimbatore.***
3. Bambawale, O.M., Amerika Singh, O.P. Sharma, & B.B. Nhasle, 2004. Performance of Bt cotton (MECH-162) under integrated pest management in farmers participatory field trails in Nanded district, ***Central India. Curr. Science. 86 (12): 1628-1633.***
4. Hegde, M., J. M., Nidagundi, D. P., Biradar, S.S. Udikeri, and B.M., Khadi, 2004, Performance of Bt and non-Bt cotton hybrids against insect pests under irrigated condition. In: International symposium on "Strategies for Sustainable Cotton Production – A Global Vision". ***Crop Protection, 23-25 November 2004, UAS, Dharwad, Karnataka (india): 143-145.***

5. Kengegowda, N. 2003. Studies on the population dynamics and screening of Bt cotton hybrids against insect pests. ***M.Sc. (Agri.) Thesis, U.A.S., Dharwad, India. : 127.***
6. Kranthi, K.R., S. Kranthi and R.R. Wanjori,. 2001. Baseline toxicity of Cry 1Ac toxins to Helicoverpa armigera. ***International of Pest Management, 47: 141-145.***
7. Patil, B.V., M. Bheemanna., A.C. Hosamani., S.G., Hanchinal, N. Kengegowda and R. Rajanikantha. 2005. Bt cotton vis – a – vis conventional hybrid cotton cultivation economics under irrigated ecosystem. In Advance in Indian Entomology : Productivity and health. ***Uttar Pradesh Zoological Society (Supplement-3): pp 125-135.***
8. Patil, B.V. and R. Rajanikanth, 2005. Dusky cotton bug – A future threat for Bt cotton cultivation. ***Insect Environment, 11 (2): 77-79.***
9. Patil, B.V., M. Bheemanna., S.B. Patil., S.S. Udikeri and A.C. Hosamani, 2006. Record of mirid bug Crentiodes biseratense (Distant) on cotton from Karnataka, India. ***Insect Environment, 11 (4): 176-177.***
10. Udikeri, S.S., S.B. Patil., R.N.Hegde., V.N.Kulkarni, & S.S. Patil, 2002. Performance of Bt cotton genotypes under unprotected condition. ***National seminar on Bt-cotton Scenario with Special reference to India. U.A.S., Dharwad Karnataka, 23 May, 2002, pp. 90.***
11. Bennett, R; Buthelezi, TJ; Ismael, Y; Morse, S, 2003, Bt cotton, pesticides labor and health: a case study of smallholder farmers in the Makhathini Flats, Republic of South Africa'. ***Outlook Agriculture, 32: 123–128***
12. Bennett, R; Kambhampati, U; Morse, S; Ismael, B (2006) 'Farm-level economic performance of genetically modified cotton in Maharashtra, India'. ***Review of Agricultural Economics, 28: 59–71***
13. Kousar, S; Qaim, M (2011) 'Impact of Bt cotton on pesticide poisoning in smallholder agriculture: A panel data analysis'. ***Ecological Economics, 11: 2105–2113***
14. Pray, CE; Huang, J; Hu, R; Rozelle, S (2002)' Five years of Bt cotton in China—the benefits continue'. ***Plant Journal, 31:423–430***
15. Qaim, M; Zilberman, D, 2003, 'Yield effects of genetically modified crops in developing countries'. ***Science, 299: 900–902.***
16. Qaim, M; Subramanian, A; Gopal, N; Zilberman, D (2006) 'Adoption of Bt cotton and impact variability: insights from India'. ***Review of Agricultural Economics, 28: 48–58***
17. Qaim, M; Matuschke, I (2005) 'Impacts of Genetically Modified crops in developing countries: a survey'. ***Quarterly of International Agriculture, 44, 207–227***
18. Wu, K; Lu, Y; Feng, H; Jiang, Y; Zhao, J, 2008, 'Suppression of cotton bollworm in multiple crops in China in areas with Bt cotton toxin-containing cotton'. ***Science, 321: 1676-1678***
19. International Service for the Acquisition of Agri-biotech Applications, 2002. Bt cotton in India. Bt cotton in South Africa. Bt cotton in Mexico. Bt cotton in Indonesia. Bt cotton in China. Available on the World Wide Web: http://www.isaaa.org.
20. Nithya, V., Arunkumar, Y.S. and Saikumar, B.C., 2009, Sustainability of Bt Cotton in Karnataka – An Economic Analysis, ***International Conference on Applied Economics – ICOAE 2009. 799-804***
21. Purcell, J.P and Perlak, F.J. 2004. Global Impact of Insect-Resistant (Bt) Cotton, ***AgBio Forum, 7(1-2), 5***
22. Xia, J.Y., Cui, J.J., Ma, L.H., Dong, S.X., & Cui, X.F. 1999. The role of transgenic Bt cotton in integrated insect pest management. ***Acta Gossypii Sim, 11, 57-64.***