Research Paper :

Perceptions of Karnataka farmers on insect pests and pest management practices in Bt. cotton

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SUMMARY

This study was undertaken with the purpose of examining the various factors involved in the adoption of Bt. cotton, source of Bt. cotton seeds purchase and mainly to evaluate farmers' know how on Bt. technology and perception on insect pests and disease incidence and their management practices in Bt. cotton in Karnataka, India. A total of 500 Bt. cotton growing farmers were interviewed in the cotton belt of Karnataka through a questionare. Drastic reduction in damage due to bollworms, fewer pesticide interventions, reduced labour and higher yield and profit seems to be the main factors responsible for large scale adoption of Bt. cotton. Local market and seed companies found to be the major source of Bt. cotton seed while some farmers in certain locations go for illegal Bt. cotton seeds due to their availability at cheap rate and also on credit. The present study revealed that farmers were aware of the major bollworm pests and expressed low to nil incidence of bollworms (*Helicoverpa armigera*, *Earias vitella*, *Pectinophora gossypiella*,) and gradual increase in incidence of *Spodoptera litura* and sucking pests (*Thrips tabaci*, *Amrasca devastans* and *Aphis gossypii*) in Bt. cotton. Farmers also observed the incidence of new secondary pests, the cotton mealybug (*Phenacoccus* sp.), cotton mirid bug (*Creontiodes biseratense*), shoot weevil(*Alcidodes affaber*) that caused moderate to severe damage to the crop in most of the cotton-growing districts. Farmers knew little about natural enemies and diseases in their fields, but reported a high incidence of cotton leaf reddening.

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Cotton is a major crop of India grown in about 22.50 million acres, the largest cotton area in the world. But while India ranks first in total area of cotton planted, it ranks third in total cotton produced because of the low yield per acre. More than four million farmers with small and medium holdings cultivate cotton in the country. Average cotton yields in India have been 320 kg/ha, compared with a world cotton average of 580 g/ha. As a result of low yields, cotton production in India represents only 13% of the total world production. Nevertheless, India accounted for approximately 20% of the world's total cotton area. Cotton provides livelihood to over 60 million people in India and contributes 29.8% of the Indian Agricultural Gross Domestic Product. A major limiting factor for cotton production in India is the damage due to insect pests, especially bollworms. Of the over Rs. 2400 crores worth of insecticides used in Indian agriculture, more than half are used to control cotton pests and of this, about Rs. 1100 crores are used to control bollworm alone. Often excessive use of pesticides intensifies pest problems and complicates pest control strategies besides causing massive ecological disruption and endangerment of human health.Biotechnology has emerged as the most important scientific tool of the 21st century. Realizing the importance of severity of the loss of cotton crop due to insect pests, Bt. cotton (Bollgard) hybrids have been approved for commercial cultivation in India, since March 2002.The use of transgenically modified cotton that expresses an insecticidal protein toxin derived from *Bacillus thuringiensis* Berliner (Bt.) is revolutionizing global agriculture. Bt. cotton expressing the Cry1Ac protein has been available commercially in the US since 1996 and is also being grown in Mexico, Colombia, Australia, China,Argentina and South Africa

(James, 2006).

Bt. transgenic cotton may perform differently in different agro-ecological conditions and hence the need for scientists and extension workers to undertake a survey and field demonstrations to map complete insect pest management module for long term benefit from the technology. With this objective we have undertaken the study to evaluate the farmers' know how and perceptions of pests and diseases incidence in Bt. cotton and their management practices in Karnataka state.The survey aimed at understanding why farmers go for Bt. cotton, source of Bt. seed purchase, theit perception on pests and diseases, nutrient dissorders and their management in Bt. cotton.

MATERIALS AND METHODS

A survey was conducted from May to Janaury 2008 in the major cotton-growing districts (Dharwad, Haveri, Belgaum, Raichur, Bellary, Shivmoga, Mysore and Gulbarga) of the Karnataka state in India where Bt. cotton has been grown for 6–7 years. It included 500 Bt. cotton growers. Within each district Bt. cotton growing farmers were chosen with the advice of the Subject Matter Specialists of Krishi Vigyan Kendras and Agriculture Department of the district. To evaluate farmers' pest perceptions through a developed questionare, farmers were first asked to rank pests, diseases and natural enemy incidence in Bt. cotton, based on a four-level scale (low, medium, high, no response), and to indicate from where they obtained information on protection measures. The questionnaire was completed during face-to-face interviews in the field, each questionnaire taking 30–60 min. Survey data were summarised and analysed to know the farmers perception.

RESULTS AND DISCUSSION

Many of the 500 farmers surveyed (49.6%) were in the middle age category (31–45 years), while 31.2% were up to 30 years old, and 19.20% of the respondents were over 45 years of age (Table 1).Seventy one per cent of the farmers were literate and 28.8% illiterate. Among the literate, 34.8% had undergone Primary to Middle School education (class 1–8), while 36.4% of the respondents had matriculation and above education (class 9–10 and above) (Table 1).The surveyed farmers started to grow Bt. cotton in 2002 and adoption increased so that 30.4% of 500 farmers had adopted it in 2004, 66.2% in 2005, 99.6% in 2006 and all of them in 2007 (Table 2). When the farmers were asked why they adopted Bt. cotton, 28.40% responded that they grew it on a trial basis to evaluate its effectiveness against bollworms. Other reasons given by the farmers were reduced bollworm damage (29.80%), reduced pesticide usage (15.8%), higher yield (9.8%), reduced labour (5.4%), greater profit (5.4%), less sucking pest incidence (2.8%) and greater boll size (2.6%).Most of the literate farmers (middle, matriculation and above) mentioned that Bt. cotton required less use of pesticides and produced a high yield whereas illiterate farmers did not have the same opinions (Table 3).

Table 1 : Socio-economic characteristics of the respondents (n=500)

Categories of farmers	No.(%) respondents
Age	
Young (up to 30 years)	156 (31.2)
Middle (31-45 years)	248 (49.6)
Old (Above 45 years)	96 (19.20)
Education	
Illiterarte	144 (28.8)
Up to Middle School (8 years)	174 (34.8)
Matriculation and above (above 8 years)	182 (36.4)

Table 2 : Farmers' adoption of Bt. cotton in Karnataka (n=500)

Year when first grew Bt. cotton	Number of respondents	Aggregated percentages of respondents
2002	17	3.4
2003	51	13.6
2004	84	30.4
2005	179	66.2
2006	167	99.6
2007	2	100

Farmers indicated different sources of Bt. seed acquisition. Majority of the farmers obtained Bt. cotton seed from the local market (70%) and also used loose/ illegal Bt. seeds (18.0%), only 2% of the farmers approach research stations for seed aquisation,while a few obtained it from other farmers (10%).

A major aim of this survey was to understand farmers' perceptions of the incidence of the bollworm complex, as well as sucking pests and also beneficial insects in Bt. cotton. Farmers were generally aware of major insect pests and disease incidence in Bt. cotton.In response to the question concerning the major insect pests and diseases, farmers mentioned different species of insects and diseases according to observed symptoms. Farmers' estimates of insect pests and disease incidence

Table 3 : Factors revealed by cotton growers for adoption of Bt. cotton

Categories of farmers	Higher yield	Less use of pesticides	Less requirement of labour	Less sucking pests incidence	Greater boll size	Less bollworm damage	More profit	On trial basis
Age								
Young-30	18	21	12	9	3	64	12	40
Middle 31-45	15	40	9	0	6	64	9	70
old >45	16	18	6	5	4	21	6	32
Education								
Illiterate	12	12	3	5	7	54	12	51
Middle	10	36	18	5	6	51	6	59
Matriculation and above	27	31	6	4	0	44	9	32
Total (n=500)	49	79	27	14	13	149	27	142
%	9.8	15.8	5.4	2.8	2.6	29.8	5.4	28.4

were categorised as low, medium, high and no response (Table 4). The majority of farmers (88.4%) mentioned a low incidence of American bollworm (*Helicoverpa armigera*), while 2.4% reported medium and nobody expressed high incidence of this pest (Table 4). Only 9.2% of the farmers gave no response when asked about the American bollworm, this was attributable to confusion over its identity. Most farmers were also aware of the incidence of the spotted bollworm (*Earias vitella*) one of the bollworm pests of cotton in India. Most of the farmers (93.4%) reported a low incidence of this pest in Bt. cotton, 1.6% reported a medium, and nobody reported a high incidence (Table 4). Another important pest of cotton is the monophagous pink bollworm (*Pectinophora gossypiella*), which farmers recognise by the formation of rosette flowers. They reported a low (90%), medium (3.6%) and high (2.8%) incidences, while only 3.6% gave no response (Table 4). Leaf eating caterpillar (*Spodoptera litura*) is a sporadic pest but in 2008–2009 cotton seasons it caused a major loss to the cotton crop and has become a major pest of cotton in certain cotton growing districts. Many farmers (26.8%) reported a low incidence in Bt. cotton, while 37.4 and 22% reported medium and high incidences, respectively (Table 4).

Another important group of pests causing problems in cotton is the sucking pest complex against which Bt. cotton is ineffective. Whitefly (*Bemisia tabaci*) a vector of cotton leaf curl virus (CLCV) for which farmers (5%) reported a high incidence,while 23.8% reported a medium and only 58% of respondents reported a low incidence of this pest (Table 4). The second most important sucking pest is the cotton jassid (*Amrasca devastans*). Many

Table 5 : Perceptions of cotton growers on the incidence of pest and diseases and disorders in Bt. cotton (n=500)

Pests/disease/natural enemies	Low to very low	Medium	High	No response
ABW (*Helicoverpa armigera*)	442 (88.4)	12 (2.4)	0 (0)	46(9.2)
SBW (*Earias* spp.)	467(93.4)	8(1.6)	0(0)	25(5)
PBW (*Pectinophora gossypiella*)	450(90)	18(3.6)	14(2.8)	18(3.6)
Leaf eating caterpillar (*Spodoptera litura*)	134(26.8)	187(37.4)	110(22)	69(13.8)
Whitefly	290(58)	119(23.8)	25(5)	66(13.2)
Leaf hopper	80(16)	209(41.8)	190(38)	21(4.2)
Thrips	35(7)	110(22)	348(69.6)	7(1.4)
Aphid	40(8)	168(33.6)	287(57.4)	5(1)
Cotton mealybug	315(63)	65(13)	2(0.4)	118(23.6)
Mirid bug	95(19)	210(42)	193(38.6)	2(0.4)
Shoot weevil	370(74)	80(16)	30(6)	20(4)
Wilt	239(47.8)	187(37.4)	26(5.2)	48(9.6)
Grey mildew	290(58)	152(30.4)	35(7)	23(4.6)
Leaf reddening	35(7)	104(20.8)	354(70.8)	7(1.4)
Para wilt	310(62)	79(15.8)	36(7.2)	75(15)

farmers (38%) reported a high incidence of this pest while 41.8% reported a medium and only 16.0% mentioned a low incidence (Table 4). The fore most important sucking pest is the cotton thrips (*Thrips tabaci*). Many farmers (69.6%) reported a high incidence of this pest while 20.8% reported a medium and only 7.0% mentioned a low incidence (Table 4).

The aphid (*Aphis gossypii*) was noted by many farmers, with 33.6% reporting a medium incidence,while 8.0% reported high incidence and 57.4% low incidence, while only one per cent gave no response (Table 4). During the last two cotton growing seasons, few new pests, cotton mealybug (*Phenacoccus* sp.),cotton mirid bug (*Creontiades biseratense*) and cotton shoot weevil (*Alcidodes affaber*) caused noticeable damage to both the Bt. and non-Bt. cotton crops in most of the cotton-growing areas. Many farmers were still not very much aware of these new pests but heavy losses occurred. Mites (*Tetranychus* spp.) are also serious pest of cotton crop and cause significant loss under favourable conditions.However, farmers were unaware of mites due to their small size and lack of skills identifying them.When farmers were asked about natural enemies in Bt. cotton, they showed a moderate level of awareness. Farmers mentioned only the main predators e.g. lacewings (*Chrysoperla* sp.), ladybird beetles (*Coccinella* sp.), dragon, spiders and birds but were unaware of the parasitoids and pathogens. Most farmers were aware of two main natural predators (spiders and ladybird beetle) and reported a high incidence of these two predators in Bt. cotton fields. The survey indicated that farmers' knowledge of disease identification was very poor. They were only aware of cotton leaf reddening which is due to multinutrient deficiency but farmers perceive it as disease. This is very common in every Bt. cotton growing districts of Karnataka. Few respondents (64.6%) were aware of wilt caused by *Fusarium* sp.and *Verticillum* sp. and some other diseases of cotton.

The survey indicated that farmers used several methods for controlling pests in Bt. cotton. Almost all farmers sprayed the crop with pesticides and used cultural practices such as weeding and hoeing, while none of them used light-trapping or biological control. Bt. cotton has resistance against cotton bollworms, but most of the farmers were still extremely conscious of their incidence in Bt. cotton and took some action. Few farmers (17%) were not aware that the Bt. technology will take care of bollworms only. They feel no need to spray any kind of insecticides on Bt. cotton. While majority (83%) sprayed insecticides immediately (or soon after) the appearance of sucking pests. Most of the farmers (47%) seek the advice of pesticide salespersons for plant protection measures,and 11% of the farmers listen to the advise of extension personell, 28% of them follow the pesticide dealers suggestion and and 14% followed the advice of their neighbouring farmers.

When farmers were asked about the safety of Bt. cotton for humans, animals and beneficial insects,multiple responses were obtained. Many (84.0%) reported that it is safe for humans, while 16% gave no response. Most of the farmers (70.0%) mentioned that it is safe for domesticated animals, while 30% gave no response Many of the respondents (60.0%) had no knowledge of its effects on beneficial insects, while 32% of respondents reported that it is safe and 8% cited that Bt. cotton was harmful to the beneficial insect fauna. The majority of the literate farmers were aware of the effectiveness of Bt. toxin against the target insect pests and mentioned no harmful impact on non-target species, but most of the illiterate farmers were unaware of the effectiveness of Bt. cotton toxin and mentioned that it is also harmful to humans, animals and beneficial insects.Transgenic Bt. cotton has been grown over the last 6-7 years in Karnataka, India, and farmers are satisfied about adopting this new technology. Seed companies are promoting Bt. cotton through research trials conducted in farmers' fields. Results from our study are largely consistent with other farmer surveys conducted in Shandong and Hebei Provinces, China (Yang *et al*., 2005), in South Africa (Ismael *et al*., 2001) and in Sindh Province, Pakistan (Hayee ,2005). We found that farmers have some awareness of the major insect pests and reported a low incidence of bollworms in Bt. cotton. Previous studies have shown that Bt. cotton is highly effective against the cotton bollworms, Helicoverpa armigera (Olsen and Daly 2000), Pectinophora gossypiella (Flint and Parks, 1999; Nava-Camberos *et al*., 1999) and Earias spp. (Abro *et al*., 2004).

Farmers reported a high incidence of leaf eating caterpillar in Bt. cotton, as compared to other bollworms in recent days. Armyworm *Spodoptera* spp. in Bt. cotton fields, as armyworm shows tolerance to Bt. cotton producing Cry1Ac (Ashfaq *et al*., 1999; Adamczyk and Sumerford, 2001). No Bt. cotton seed developer has ever claimed that it would also control sucking pests but some farmers believe that no pesticide spray is required on Bt. cotton due to the lack of awareness and also confusion created by seed companies through advertisements. Our results have shown that Bt. cotton-growers reported a high incidence of sucking pests namely, thrips, jassid, aphid

and whitefly, cotton mealybug, as Bt. cotton hybrids are not effective against sucking insect pests (Sharma and Pampapathy, 2006). Cotton mealybug incidence was severe in certain locations of the Bt. cotton fields. Farmers' knowledge of natural enemies and diseases was inadequate. In our current study, farmers mentioned appearance of predators *viz.*, spiders and ladybird beetle in Bt. cotton fields. Farmers mentioned a high incidence of cotton leaf reddening in Bt. cotton. This is a very common nutrient disorder caused by multi nutrient deficiency. Some farmers mentioned wilting of Bt. cotton plants, but actually the wilting was due to excessive use of fertilizer and irrigation applications, which increased the buildup of Verticillum and Fusarium wilts.

Aggressive advertisements by pesticide companies often influence the adoption of any IPM approach to the extent that farmers rely only on pesticide use (Pray *et al*., 2002).Our study has shown that most of the farmers consulted pesticide sellers about pest problems. Very few approached research station and extension units. Finally we would like to conclude that education to farmers regarding effectiveness of Bt. cotton, including risks and benefits is very much needed. And also we feel the need of strict regulatory body in local area to protect the farmers from illegal lots. Training farmers on importance of nutrient management especially micronutrients is urgent need of the hours as many farmers are ignorant about the right dose of fertilizers in Bt. cotton

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REFERENCES

Abro, G.H., Syed, T.S., Tnuio, G.M. and Khuro, M.A. (2004). Performance of transgenic Bt. cotton against insect pest infestation. *J. Biotechnol*., **3**(1) : 75–81.

Ashfaq, M., Young, S.Y. and Dugger, P. (1999). Effect of transgenic Bt. cotton on larval mortality and developement of beet armyworm, *Spodoptera exigua* (Lepidoptera: Noctuidae). Proc. of the Beltwide Cotton Conferences, National Cotton Council; 1999 January 3–7, 1999, Orlando,FL, USA. **2**:1232–1234.

Adamczyk, J.J. and Sumerford, D.V. (2001). Increased tolerance of fall armyworms (Lepidoptera: Noctuidae) to Cry1Ac delta-endotoxin when fed transgenic *Bacillus thuringiensis* cotton: impact on the developement of subsequent generations. *Fla Entomol*., **84**:1–6.

Flint,H.M. and Parks, N.J. (1999). Seasonal infestation by pink bollworm, *Pectinophora gossypiella* (Saunders) of transgenic and non-transgenic cultivars of cotton Gossypium hirsutum L., in central Arizona. *Southwest Entomol*., **24**:13–20.

Hayee, A. (2005). Cultivation of Bt. cotton : Pakistans' experience.Available from: www.actionaid.org/pakistan

Ismael, Y., Bennett, R. and Morse, S. (2001). Farm level impact of Bt. cotton in South Africa. *Biotechnol Dev Monit*., **48**:15–19.

James, C. (2006). Preview: global status of commercialized biotech/GM crops: 2006. Ithaca, (NY): ISAAA.

Nava-Camberos, U., Berdegue, M., Sanchez-Galven, H., Guerrero-Rodriguez, E.R. and Dugger, P. (1999). Monitoring of pink bollworm susceptibility to the Bt. endotoxin Cry1Ac in the Cameara laqunera, Mexico. Proc. of the Beltwide Cotton Conferences, National Cotton Council; January 3–7, 1999 Orlando, FL, USA. **2**:1246–1248.

Olsen, K.M. and Daly, J.C. (2000). Plant toxin interactions in transgenic Bt. cotton and their e.ect on mortality of *Helicoverpa armigera* (Lepidoptera: Noctuidae). *J. Econ.Entomol*., **93** : 1293–1299.

Pray, C., Huang, J. and Rozelle, S. (2002). Five years of Bt. cotton in China – the benefits continue. *Plant J*., **31** (4):423–430.

Sharma,H.C. and Pampapathy, G. (2006). Influence of transgenic cotton on the relative abundance and damage by target and non-target insect pests under different protection regimes in India. *Crop Prot*., **25**(8):800–813.

Yang, P., Iles, M., Yan, S.and Jolli,E.F. (2005). Farmers' knowledge, perceptions and practices in transgenic Bt. cotton in small producer systems in Northern China.*Crop Prot*., **24**:229–239.

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