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DEVELOPMENT OF IPRM STRATEGY IN BT COTTON AND ITS IMPACT ON PRODUCTION AND ECONOMICS

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ABSTRACT

In order to manage the problems arising due to the excessive use pesticides for the control of sucking insect pests in Bt cotton, a strategy based on four window programme has been developed for disseminating among the cotton growers of Punjab. These four windows of insect pest resistance management (IPRM) strategies included cultivation of varieties/ hybrids tolerant to sucking pests, sowing of refugia around the main field, no spray from sowing to first week of July, use of endosulfan/imidacloprid from second week of July to 1st week of August, use of OPs/Carbamates/SPs during the mid to end of August, use of OPs/new chemicals during September to October. Three districts i.e. Mansa, Ferozpur and Bathinda were covered. Non–IPRM villages were also selected for calculating the impact of adopted strategies. It was observed that with the adoption of IPRM strategies, there was less incidence of sucking pests, higher number of natural enemies reduced cost of production and the net income increased. The farmers obtained an additional profit of Rs. 4724and Rs. 4267 per hectare during 2005–06 and 2006–07, respectively, due to the adoption of IPRM strategies in Bt cotton production in Punjab.

Key words: Bt Cotton, IPRM strategy, insect–pest management

Cotton is an important commercial crop in India and occupies a prime position in our agro–industrial economy. In Punjab, it is grown over 6.04 lakh hectares with the production of 23.55 lakh bales (Anonymous, 2010), but productivity is low because of insect–pest damage at all the stages of crop growth. A large number of insect–pests have been found inflicting damage (30–80%) but major ones are bollworms, jassids, whitefly, aphids and thrips (Patil, 1998). To protect the crop from the insect–pests ravage, farmers solely rely on insecticides. Due to excessive use of pesticides on cotton caused development of resistance, resurgence in insect–pests, depletion of natural enemies. The use of resistant cultivars is one of the critical components determining the success of the integrated pest management (IPM) programme in agricultural crops. *Bacillus thuringiensis* (Bt) is the most successful and widely used biological control agent for the control of lepidoptern pests (Glare and O'Callagham, 2000). The regular use of Bt cotton against insects pests especially bollworms will also help in development of resistance in susceptible strains against endotoxin. To manage these problems, a strategy based on four window programme was developed for disseminating among cotton growing farmers of Punjab.

MATERIALS AND METHODS

The IPRM strategies based on four window programmes has been developed and disseminated among the cotton growers of three districts in south–west of Punjab i.e. Mansa, Ferozpur and Bathinda. These four windows of insect pest resistance management (IPRM) strategies included cultivation of varities/ hybrids tolerant to sucking pests, sowing of refugia around the main field, no spray from sowing to first week of July, use of endosulfan/imidacloprid from second week of July to 1st week of August, use of OPs/Carbamates/SPs in the mid to end August, use of OPs/new chemicals during September to October (Singh and Dhawan, 2006). For proper implementation of these strategies, the farmers were given training about identification of insect pests, when to spray, what to spray, what to spray and how to spray, economic threshold levels etc. Non–IPRM villages were also selected for calculating the impact of strategies. This number of villages selected under IPRM project was 112 and 120, number of farmers was 2240 and 2400 and total area was 2591 and 5720 ha during 2005–06 and 2006–07, respectively (Table 1). The data on the sucking pests (jassid and whitefly), bollworm complex (American bollworm and spotted bollworm), tobacco caterpillar, grey weevil and natural

Table 1. Total number of villages, farmers and total area covered under IPRM and non–IPRM villages

District	Total no. of villages covered		Total area (ha) covered		Total no. of farmers	
	2005–06	2006–07	2005–06	2006–07	2005–06	2006–07
			IPRM			
Mansa	39	40	436	2048	780	800
Ferozpur	36	40	1585	2664	720	800
Bathinda	37	40	570	1008	740	800
Punjab	112	120	2591	5720	2240	2400
			Non–IPRM			
Mansa	3	3	88	30	60	60
Ferozpur	3	3	204	321	60	60
Bathinda	4	3	153	146	80	60
Punjab	10	9	445	497	200	180

enemies were recorded at weekly intervals upto 140 DAS. The number and cost of insecticidal spray, cost of cultivation and seed cotton yield were also recorded for calculating net profit and additional profit over non–IPRM villages.

RESULTS AND DISCUSSION

A perusal of data (Table 2) on the incidence of insect–pests of cotton revealed that the mean numbers of jassid nymphs per 3 leaves in Mansa, Ferozpur and Bathinda districts were 0.1, 0.3 and 0.4; and 0.3, 0.4 and 0.8, respectively, during 2005–06 and 2006–07 in IPRM villages, whereas in Non–IPRM villages, the mean numbers of jassid nymphs per 3 leaves were 0.1, 0.4 and 0.4; and 1.2, 0.5 and 0.8, respectively. Similarly, in case of whitefly adults per 3 leaves, the incidence was 0.1, 0.4 and 0.3 numbers of adult whiteflies in Mansa, Ferozpur and Bathinda districts during 2005–06 and the values for 2006–07 crop season were 0.8, 0.5 and 0.9 adults, respectively, in IPRM villages. While in Non–IPRM villages, the values were 0.1, 0.6 and 0.4 for 2005–06 and 1.4, 0.7 and 0.8 adults for 2006–07 respectively. On the basis of overall means for 2005–06 and 2006–07 in Punjab, the mean numbers of jassid nymphs and whiteflies adults in IPRM were 0.3 and 0.5; and 0.3 and 0.7 per 3 leaves, respectively. Whereas in Non–IPRM, these values were 0.3 and 0.8; and 0.4 and 1.0 per 3 leaves, for 2005–06 and 2006–07, respectively. The mean bollworm damage due to American and spotted bollworm in intact as well as shed fruiting bodies in IPRM and non IPRM villages was found to be in traces for both the years under study. The number of tobacco caterpillar, grey weevil and natural enemies during 2005–06 and 2006–07 in IPRM villages was 0.2, 0.3 and 0.4; and 0.2, 0.5 and 0.4, respectively, while in non–IPRM, it was 0.3, 0.3 and 0.4; and 0.1, 0.4 and 0.3 respectively. The overall data of Punjab presented in Table 3 revealed that the number of insecticidal spray was 3.1 and 2.4 in IPRM villages as compared to 4.2 and 3.7 in non–IPRM villages during 2005–06 and 2006–07, respectively. These values indicate 26.2 and 35.1 per cent reduction in insecticidal spray in IPRM villages during 2005–06 and 2006–07 respectively. The reduction in cost of spray, cost of cultivation and increase in yield and net–profit in IPRM villages was 30.4, 9.2, 8.4 and 16.6 per cent in 2005–06 and during 2006–07, as against 34.3, 9.2, 5.0 and 12.1 per cent, respectively for non–IPRM villages. There was 77 and 80.7 per cent farmer's participation in IPRM villages during 2005–06 and 2006–07, respectively. The farmers obtained the additional profit of Rs. 4724 and Rs. 4267 per hectare during 2005–06 and 2006–07, respectively due to the adoption of IPRM strategies in Bt cotton production in Punjab (Table 3).

The results of the present studies are in agreement with those of Kranthi *et al.* (2000) who conducted similar kind of studies on non–Bt cotton. It was reported that the number of sprays for the control of sucking pests and bollworm complex varied from 2 to 20 in North India, and there was 90 per cent reduction in IRM–selected villages, the square and boll damage reduction was 15 to 52 per cent, seed cotton yield increased in some cases up to 59 per cent and plant protection cost was reduced by 2.5 – 60 per cent. On the same lines, Suruli Velu *et al.* (2004) also reported 63.0 per cent reduction in number of sprays at Coimbatore and Theni districts, with mean of 2.7 in project village as compared to 7.3 in control villages. Dhawan *et al.* (2006) also reported reduction in plant protection cost, number of sprays, bollworm damage to pickable bolls and loculi, and increased cotton–seed yield was 25.6, 24.4, 32.6 and 37.5, and 19.2; and 25.8, 42.0, 45.7 and 34.8 and 15.5 per cent respectively during 2002 and 2003 in Punjab. Similar results were also reported by Rajak *et al.* (1997) with 30 to 50 per cent reduction in pesticide consumption in IRM–adopted fields and 21–27 per cent increase in

Table 2. Impact of the adoption of IPRM strategies on the incidence of insect–pests in Punjab

Insect/ pest	2005–06								2006–07							
	Mansa		Ferozpur		Bathinda		Punjab		Mansa		Ferozpur		Bathinda		Punjab	
	IPRM	Non–IPRM	IPRM	Non–IPRM	IPRM	Non–IPRM	IPRM	Non–IPRM	IPRM	Non–IPRM	IPRM	Non–IPRM	IPRM	Non–IPRM	IPRM	Non–IPRM
Jassid/3 leaves	0.1	0.1	0.3	0.4	0.4	0.4	0.3	0.3	0.3	1.2	0.4	0.5	0.8	0.8	0.5	0.8
Whitefly/3 leaves	0.1	0.1	0.4	0.6	0.3	0.4	0.3	0.4	0.8	1.4	0.5	0.7	0.9	0.8	0.7	1.0
Bollworms*	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces
TC/ Plant	0.1	0.1	0.3	0.6	0.1	0.2	0.2	0.3	0.0	0.0	0.2	0.1	0.3	0.3	0.2	0.1
GW/ Plant	0.1	0.1	0.4	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.6	0.5	0.5	0.4
NE/ Plant	0.2	0.2	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.4	0.3	0.5	0.4	0.4	0.3

TC – Tobacco caterpillar, GW – Grey weevil, NE – Natural Enemies; *percent bollworm damage in intact and shed fruiting bodies

Table 3. Impact of IPRM strategies on Bt cotton in insecticidal spray, seed–cotton yield, cost of cultivation and net profit in Punjab

Input/Output	IPRM		Non–IPRM	
	2005–06	2006–07	2005–06	2006–07
Jassids/ 3 leaves	0.3	0.5	0.3	0.8
Whitefly/ 3 leaves	0.3	0.7	0.4	1.0
Tobacco caterpillar/ plant	0.2	0.2	0.3	0.1
Grey weevil/ plant	0.3	0.5	0.3	0.4
Predators/ plant	0.4	0.4	0.4	0.3
Mean number of insecticide spray	3.1 (26.2)*	2.4 (35.1)*	4.2	3.7
Cost of spray (Rs./ha)	1713 (30.4)*	1469 (34.3)*	2463	2565
Cost of cultivation (Rs/ha)	15537 (9.2)*	17112 (9.2)*	17112	19093
Seed cotton yield (Kg/ha)	2566 (8.4)**	2716 (5.0)**	2366	2586
Net Profit (Rs/ha)	33165 (16.6)**	39480 (12.1)**	28441	35213
Farmers participation (%)	77	80.7		
Additional profit (Rs/ha)	4724	4267		

MSP for 2005–06 and 2006–07 was Rs. 1885/– and Rs. 2100/– for 100 kg seed cotton; * Figures in parenthesis are per cent reduction over Non–IPRM; ** Figures in parenthesis are per cent increase over Non–IPRM.

seed–cotton yield. In the present studies, the overall increase in yield and net–income in IPRM over Non–IPRM in Punjab was found to be 8.4, 16.6 and 5.0, 12.1 per cent for the year 2005–2006 and 2006–2007, respectively. In IPRM villages, the overall additional profit of Rs. 4724 and 4267 per hectare for the year 2005–2006 and 2006–2007, respectively was obtained (Table 3).

It is thus, concluded that with the adoption of IPRM strategies, there was less incidence of sucking pests, higher number of natural enemies, less number of insecticidal sprays, lower cost of production and increase in net income. Due to less number of sprays, the population of natural enemies during early season remained high in cotton crop and thus helped in reducing the pest population and ultimately the damage done by these pests. So, it is concluded from the above results that the adoption of IPRM strategies will help the farmers to sustain the crop productivity and their prosperity.

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