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Evaluation of Bio-Intensive Pest Management (BIPM) module for the suppression of insect pests infesting *Bt* cotton

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ABSTRACT

A field experiment to evaluate the impact of Bio-Intensive Pest Management (BIPM) module for the suppression of insect pests infesting *Bt* cotton. The results concluded that the Bt cotton grown with BIPM practices (such as seed treatment with *Trichoderma* @ 8 g /kg seed, border row of maize crop around the cotton field, installation of bird perches @ 10 /ha, three releases of *Trichogramma chilonis* @ 1.5 lakh / ha / week, two releases of 2 to 3 days old *Chrysoperla carnea* larvae @ 14,000 /ha and need based spray of NSKE @ 5 %) significantly reduced the population of three major sucking pests (aphid, jassid and whitefly as compared to farmers practices (insecticidal spray only) as check (FP). Incidence of spotted bollworm, *Earias* spp. and pink bollworm, *Pectinophora gossypiella* (Saund.) to developing buds, green bolls and locules was found to be significantly low in BIPM module over the treatment of FP. Relatively more number of biocontrol agents *(Chrysoperla carnea,* coccinellid beetles, predatory Geocoris bug and spiders) were registered in former treatment of BIPM module than latter treatment of FP. Reduction in pest incidence due to increased number of biocontrol agents reflected on seed cotton yield. The BIPM module yielded an average of 3990 kg/ha seed cotton as against 3245 kg/ha in case of FP which found to be significantly higher (22.96 %) than the FP.

Key words : BOPM module, insect, pests, *Bt.* Cotton

Cotton is an important fibre crop which greatly contributes to the national economy. The insect pests constitute one of the major limiting factors in the production as the crop is vulnerable to attack by about 162 species of insects and mites (Sundarmurthy, 1985). Though the problem of bollworms especially *Helicoverpa armigera* (Hubner) is solved with the introduction of Bt cotton, but the problem of sucking pests remains as such. Of the various methods used to control the pests infesting cotton, the use of chemicals is most popular among the farmers, however several studies have shown its deleterious effect on natural enemies of pests infesting cotton crop (Anonymous, 1983 and Yadav *et al.*,1983). Considering the negative impact of toxic chemical, the concept of Bio-Intensive Pest Management (BIPM) practices involving the use of biocontrol agents has been evoked. Very few attempts have been made in past to evaluate the BIPM practices in large scale on farmers field. Therefore, the present study was undertaken to evaluate the BIPM module in suppression of insect pests in Bt cotton.

MATERIALS AND METHODS

A field experiment to evaluate the impact of Bio-Intensive Pest Management (BIPM) module for the suppression of insect pests infesting *Bt* cotton was conducted on farmer's field during kharif season of 2007-08 and 2008-09. During first year, the experiment was conducted at Bamania campa village of Kapadvanj taluka (Dist. Kheda) whereas during subsequent year it was conducted at Shardapura village of Savli taluka (Dist. Baroda) of middle Gujarat. *Bt* cotton cultivar (Ankur-155) was used during both the years of experimentation. The crop was sown during last week of June at a spacing of 120 x 60 cm. A module of BIPM practices consisted (1) seed treatment with *Trichoderma harzianum* @ 8 g/ kg seed (2) border row of maize crop around the cotton field (3) installation of

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bird perches @ 10/ha. (4) three releases of *Trichogramma chilonis* Ishii. @ 1.5 lakh / ha/ week (5) two releases of *Chrysoperla cornea* (Stephens) larvae (2-3 days old) @ 14,000/ha at weekly interval during later stages when aphid incidence noticed and (6) need based spray application of Neem Seed Kernel Extract (NSKE) @ 5 %. The BIPM module was accommodated in one hectare area. Similarly, one hectare area was kept as farmers practices (FP) for comparison purpose in which routine need based insecticidal sprays were made. The crop was raised following normal agronomic practices.

The entire plot of one hectare area in each treatment was divided into five subplots. Five plants were randomly selected from each sub-plot and tagged for recording the various observations. Population of sucking pests viz., aphid *(Aphis gossypii* G.), Jassid *(Amrasca bigutulla bigutulla* Ishida) and whitefly *(Bemisia tabaci* Gen.) was recorded from three leaves (top, middle, bottom) of each tagged plant. Thus in all 15 leaves were examined and based on this mean population of each sucking pest per 3 leaves was worked out. The data subjected to statistical analysis following square root transformation and the mean population of sucking pests are presented in Table 1. The incidence of spotted bollworm *(Earias* spp.) and pink bollworm *(Pectinophora gossypiella*) on developing intact buds and green bolls was assessed by examining total and damaged buds as well as green bolls present on five plants from each sub-plot. Based on the observations, extent of bud and green boll damage due to bollworms in each treatment was calculated. Similarly, the extent of locules damaged by *Earias* and *P. gossypiella* was assessed at the time of harvesting. The values obtained were subjected to statistical analysis following arcsin transformed values and presented in Table 2.

To determine the impact of BIPM on natural enemies of cotton pests, their presence on five tagged plants from each sub-plot were recorded. The mean population of various biocontrol agents (chrysopa, coccinellids, Geocoris bug and spider) are presented in Table 3. Treatmentwise seed cotton yield harvested from each sub-plot was recorded during each picking and based on the data yield in ka/ha was calculated. The data on yield of seed cotton recorded in both the treatments are presented in Table 4. Economics of both the treatments under study was worked out based on the yields, its prevailing market price and cost of materials used in each treatment. The data on economics of the treatments evaluated are presented in Table 4.

RESULTS AND DISCUSSION

There was significant reduction in the population of aphid (*A. gossypii),* Jassid, *(A. bigutulla bigutulla)* and whitefly *(B. tabaci)* in the treatment of BIPM module as compared to farmers practices (Table 1). As per the report of Anonymous (2009), the incidence of sucking pest complex was comparatively lower in *Bt* cotton when grown with BIPM practices than farmers practices as it revealed from the results of various field experiments conducted on farmer's field in Andhra Pradesh and Maharashtra. They also registered lower population of leafhopper and aphid in *Bt* cotton grown with BIPM in Tamil Nadu. These reports are in

Table 1 Impact of BIPM practices in Bt cotton on incidence of sucking pests

Treatments	Sucking pests / 3 leaves								
	2007-08			2008-09			Pooled		
	Aphid	Jassid	W. fly	Aphid	Jassid	W. fly	Aphid	Jassid	W. fly
BIPM practices	9.42* (87.74)	1.71* (1.92)	1.33* (0.77)	2.82* (7.95)	1.46* (2.13)	0.99* (0.98)	6.20* (37.44)	1.74* (2.03)	1.47* (1.16)
Farmers' practices	11.40 (128.96)	1.97 (2.88)	1.87 (2.50)	4.44 (19.71)	1.89 (3.57)	1.36 (1.85)	7.98 (62.68)	2.06 (3.24)	1.73 (1.99)
S. Em. ±	0.15	0.01	0.01	0.23	0.04	0.02	0.17	0.02	0.01
C.D at 5 %	0.48	0.04	0.05	0.92	0.16	0.09	0.55	0.06	0.03
C.V. (%)	3.16	2.84	3.63	14.45	12.40	10.22	5.47	7.13	4.41

* $\sqrt{X+1}$ transformed values Figures in parentheses are retransformed values

Table 2 Impact of BIPM practices in Bt cotton on incidence of bollworms

Treatments	% Damage by bollworms											
	2007-08				2008-09				Pooled			
	Bud	Boll	Locules		Bud	Boll	Locules		Bud	Boll	Locules	
BIPM practices	7.06* (1.51)	2.60* (0.21)	4.34* (0.57)	3.72* (0.42)	9.22* (2.97)	8.85* (2.37)	9.05* (2.47)	6.70* (1.36)	8.57* (2.22)	6.15* (1.15)	6.70* (1.36)	5.21* (0.82)
Farmers' practices	10.83 (3.53)	4.60 (0.64)	5.67 (0.98)	4.80 (0.70)	13.52 (5.47)	13.00 (5.06)	11.40 (3.91)	9.15 (2.53)	12.04 (4.35)	9.37 (2.65)	8.54 (2.21)	6.97 (1.47)
S. Em ±	0.40	0.52	0.28	0.24	0.39	0.35	0.32	0.28	0.23	0.40	0.36	0.26
C.D at 5 %	1.56	1.50	0.92	0.79	1.55	1.37	1.06	0.90	0.75	1.30	0.97	0.78
C.V. (%)	22.16	7.71	12.61	12.74	16.80	14.25.	7.08	7.79	15.83	32.55	8.92	9.54

* Arc sin transformed values Figures in parentheses are retransformed values

accordance with the present finding. However, contradicting to above, Anonymous (2008) recorded relatively more number of leafhopper and whitefly population in the treatment of BIPM practices over the treatment of FP in Ludhiana, Punjab. Bollworm incidence to developing buds and green bolls as well as locules damaged by *Earias* spp. and *P. gossypiella* recorded at harvest also found to be reduced significantly in *Bt* cotton raised by following BIPM practices. These results are supported by the reports of Anonymous (2008) and Anonymous (2009). Reduction in pest population following the adoption of BIPM practices in *Bt* cotton reflected on seed cotton yield as it revealed that treatment of BIPM practices yielded significantly higher yield over the treatment of farmers practices. The former treatment produced an average of 3990 kg / ha seed cotton as against 3245 kg / ha in case of FP indicating 22.96 % higher yield due to adopting of BIPM practices. Increase in yield following BIPM practices in *Bt* cotton noticed in present study is in agreement with the earlier reports of Godhani *et al.* (2005) and Anonymous (2007). Relatively greater number of various indigenous biocontrol agents (coccinellids, Chrysopa, *Geocoris* and spiders) were registered in *Bt* cotton with BIPM than the plots treated with insecticides (FP). Anonymous (2008) recorded higher egg-parasitism, higher predators (coccinellids and spiders) in BIPM package compared to FP in Andhra Pradesh. Anonymous (2009) also recorded higher population of coccinellids in BIPM block as against FP in Maharashtra and Punjab. Further, they reported that the aphid population was significantly reduced in BIPM field in Tamilnadu due to the activity of *C. carnea*. These reports are corroborated with the above findings.

Table 3 Population of indigenous natural enemies in both the treatments under study

Treatments	Mean population of natural enemies / 25 plants											
	2007-08				2008-09				Pooled			
	C. carnea (E+L+A)	Coccinellids (E+L+P+A)	Geocoris bug (N+A)	Spiders (N+A)	C. carnea (E+L+A)	Coccinellids (E+L+P+A)	Geocoris bug (N+A)	Spiders (N+A)	C. carnea (E+L+A)	Coccinellids (E+L+P+A)	Geocoris (N+A)	Spiders (Adults)
BIPM practices	12.20	47.10	6.00	12.70	17.25	54.75	12.00	16.00	14.73	50.93	9.0	14.35
Farmers' practices	6.60	21.40	3.50	7.60	11.00	37.75	4.00	9.25	8.8	29.58	3.75	8.43

E= Eggs L= Larva P= Pupa A=Adult

Table 4 Impact of BIPM in Bt cotton on seed cotton yield and economics

Treatments	Yield (kg/ha)			Additional yield over FP (kg/ha)	Additional income over FP (₹ /ha)	Cost of BIPM (₹ /ha)	Net return (₹/ha)
	2007-08	2008-09	Pooled				
BIPM practices	4868	3114	3990	745	20488	10575	9913
Farmers' practices	4078	2356	3245	-	-	-	-
S. Em. ±	118	158	132	-	-	-	-
C.D at 5 %	335	446	373	-	-	-	-
C.V. (%)	13.16	28.81	18.41	-	-	-	-

The cost: benefit ratio was worked out as 1:1.71 and 1:1.81 in BIPM package compared to 1: 1.03 and 1:1.27 in case of field experiments conducted in Andhra Pradesh during *Kharif* 2007 (Anonymous, 2008) and 2008 (Anonymous, 2009). These reports are in agreement with the economics worked out in present study in which the BIPM module registered ₹ 9913 net return (₹ /ha) with CBR of 1: 1.07.

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