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Evaluaton of IPM module for the management of sucking insect pests of *Bt* cotton

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ABSTRACT : Integrated Pest Management (IPM) module for the management of sucking insect pests *viz.*, aphid (*Aphis gossypii* Glover),leaf hopper (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius) and thrips (*Thrips tabaci* Lindemann) was evaluated in *Bt* cotton consecutively for three years from 2009-2010 to 2011-2012 at Anand Agricultural University, Anand, Gujarat. IPM module consisting of one spray application of *Beauveria bassiana* (2 x 10^8cfu) @ 4 g /l water, two spray applications of thiamethoxam 25 WG @ 0.01 per cent (0.4 g /l water) and one spray application of acephate 75 SP @ 0.075 per cent (1 g /l water) following threshold level (5 sucking pests /leaf) was found effective and economical (Incremental cost benefit ratio: 1:19.03) for the management of sucking insect pests without any adverse effect on the natural enemies (Spiders, *Chrysoperla* and Coccinellids) in *Bt* cotton. The application of this module also resulted higher seed cotton yield (2770 kg /ha) as compared to control (1113 kg /ha).

Key words : *Bt* cotton, IPM module, natural enemies, sucking insect pests

Cotton has played a vital role in updating Indian economy in evolution of human ethical, moral and cultural values. Cotton pest management has always been an immensely challenging task for entomologists all over the world. About 1326 species of insects have been reported on cotton worldwide.

On the introduction of Bollgard II (BG II), known bollworms including *Helicoverpa armigera* (Hubner) Hardwick are under controlled since last five years in India. *Bt* cotton does not interfere in the activity of sucking insect pests and it becoming a burning issue. Now a days, sucking insect pests' *viz.,* leaf hopper (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius), thrips (*Thrips tabaci* Lindemann) and aphid (*Aphis gossypii* Glover), which were minor and non targeted in cotton hybrids (Non *Bt*) get the favorable condition for their development and multiplication. The reduction of pyrethroids and several conventional insecticides on *Bt* cotton is also presumed to have led to an enhanced infestation of sucking pests. In past, IPM modules mostly targeted to *H. armigera* were recommended in non *Bt* and hybrid cottons. Higher dose of nitrogenous fertilizers leading to an increase in the quantum of some amino-nitrogen concentrations in the plant system makes it more conducive for the fast development and higher fertility of the sucking insect pests (Jain and Bhargava, 2007). Scanty information is available on IPM module for the management of sucking insect pests in *Bt* cotton. Therefore, present experiment was conducted to evaluate the IPM module for sucking insect pests in *Bt* cotton.

MATERIALS AND METHODS

Field experiments were conducted at Anand Agricultural University, Anand [AES-III (Middle Gujarat)] for three years from 2009-2010 to 2011-2012 on cotton crop (variety RCH II BG II) following recommended agronomical practices. IPM Module consisting of one need based (5 aphid, leafhopper and whitefly /leaf) application of *Beauveria bassiana* (2 x 10^8cfu) @ 4 g /l water followed by two need base applications of thiamethoxam 25 WG @ 0.01 per cent (0.4 g /l water) (50 g a.i. /ha) and a need based (5 thrips / leaf) application of acephate 75 SP @ 0.075 per cent (1 g /l water) (375 g a.i. /ha)], was compared with Non IPM (did not taken any of the plant protection measures) in large plot completely randomized design. The IPM and non IPM treatments were executed in two different blocks each of 30.0 m x 10.8 m by keeping 100 meter distance between two. Each block was divided into 12 equal sectors each of 2.5 m x 0.9 m and each sector were considered as one repetition.

The observations on population of sucking insect pests' *viz.*, aphid, leaf hopper, whitefly and thrips were made on three plants selected randomly in each sector. From each selected plant, three leaves were selected randomly from top, middle and bottom canopy to record the pest population. The observations were recorded at weekly interval right from the germination to last picking of the crop. Observations on population of natural enemies' *viz.*, Chrysopids (larvae), coccinellids (larvae) and spiders /plant were also recorded at weekly interval throughout the period of experimentation. Seed cotton yield was also recorded picking wise. The periodical data on population of sucking pests and predators were subjected to ANOVA and were also pooled over periods and years. The yield data were also analyzed and pooled over years. Finally, economics of the IPM module was also calculated.

RESULTS AND DISCUSSION

The data on population of sucking pests presented in Table 1 and 2 revealed that though IPM and non IPM did not differed significantly in the first year, but IPM recorded significantly lower population of aphid than non IPM in the second and third year. The data pooled over periods and years showed significantly lower aphid population in IPM (4.21 aphids /leaf) than in non IPM (6.21 aphids /leaf). The data pooled over periods revealed that IPM recorded significantly lower population of leaf hoppers, whitefly and thrips than non IPM. The data pooled over periods and years showed significantly lower leaf hopper population in IPM (1.93 leaf hoppers /leaf) than in non IPM (3.91 leaf hoppers /leaf), significantly lower whitefly population in IPM (2.06 whiteflies /leaf) than in non IPM (4.43 whiteflies /leaf) and significantly lower thrips population in IPM (3.26 thrips /leaf) than in non IPM (4.84 thrips /leaf).

The data on population of major natural enemies' *viz.*, spider, chrysopids and coccinellids pooled over periods as well as pooled over periods and years (Table 3) revealed that there was non significant difference between IPM and non IPM. Thus, there was no negative impact of IPM module on the population of natural enemies. The seed cotton yield was *viz.,*2499, 2777. A higher insecticidal cost benefit ratio (1: 19.03) was also recorded in IPM module (Table 4).

Thus, IPM strategy kept the population of sucking insect pests *viz.*, aphid, leaf hopper, whitefly, and thrips, below their threshold level (5 /leaf) without any adverse effect on the natural enemies (Spiders, *Chrysoperla* and Coccinellids) in *Bt* cotton.

Jat and Jeyakumar (2006) reported that bio-agent *Beauveria bassiana* reduced the whitefly and leaf hopper population up to 39.7-72.6 and 10-14 per cent, respectively in cotton. Saleem *et al.,* (2001) and Srinivasan *et al.,* (2004) have reported higher effectiveness of thiamethoxam for the control of sucking peats in cotton. During present study also, *Beauveria bassiana*, a fungal bio-agent and thiamethoxam, a neonicotinoid are also found effective in management of sucking pests in cotton.

It is concluded that IPM strategy can be recommended to the farmers for management of sucking pests effectively and economically without any adverse effect on natural enemies *viz.*, spiders, *Chrysoperla* and coccinellids in cotton.

Table 1. Impact of IPM module on population of aphid and leaf hopper (Pooled over periods and years)

	Treatments No. of insects /leaf															
	Aphid				Leafhopper				Whitefly				Thrips			
	2009-2010	2010-2011	2011-2012	**Pooled**	2009-2010	2010-2011	2011-2012	**Pooled**	2009-2010	2010-2011	2011-2012	**Pooled**	2009-2010	2010-2011	2011-2012	**Pooled**
IPM	3.37	1.66	1.46	**2.17**	1.60	1.51	1.56	**1.56**	1.58	1.57	1.60	**1.58**	2.16	1.96	1.69	**1.94**
	(10.86)	(2.25)	(1.63)	**(4.21)**	(2.06)	(1.78)	(1.93)	**(1.93)**	(2.00)	(2.00)	(2.06)	**(2.00)**	(4.17)	(3.34)	(2.36)	**(3.26)**
Non IPM (Control)	3.47	2.24	2.07	**2.59**	1.89	2.17	2.23	**2.10**	1.82	2.14	2.22	**2.06**	2.45	2.19	2.30	**2.31**
	(11.54)	(4.52)	(3.78)	**(6.21)**	(3.07)	(4.21)	(4.47)	**(3.91)**	(2.81)	4.08)	(4.43)	**(3.74)**	(5.50)	(4.30)	4.79)	**4.84)**
Mean	3.42	1.9	1.77	**2.38**	1.74	1.84	1.90	**1.83**	1.70	1.86	1.91	**1.82**	2.31	2.08	1.99	**2.12**
	(11.20)	(3.30)	(2.63)	**(5.16)**	(2.53)	(2.89)	(3.11)	**(2.85)**	(2.39)	(2.96)	(3.15)	**(2.81)**	(4.84)	(3.83)	(3.46)	**(3.99)**
ANOVA																
S. Em ± Treatments (T)	0.05	0.02	0.02	**0.02**	0.07	0.01	0.01	**0.01**	0.05	0.01	0.01	**0.01**	0.04	0.02	0.01	**0.01**
Periods (P)	0.08	0.04	0.04	**0.03**	0.05	0.04	0.04	**0.02**	0.05	0.04	0.05	**0.07**	0.05	0.04	0.04	**0.03**
Year (Y)	-	-	-	**0.02**	-	-	-	**0.01**	-	-	-	**0.03**	-	-	-	**0.02**
T x P	0.12	0.06	0.05	**0.06**	0.07	0.06	0.05	**0.04**	0.07	0.05	0.04	**0.03**	0.08	0.05	0.03	**0.04**
T x Y	-	-	-	**0.03**	-	-	-	**0.02**	-	-	-	**0.01**	-	-	-	**0.02**
P x Y	-	-	-	**0.06**	-	-	-	**0.04**	-	-	-	**0.04**	-	-	-	**0.05**
T x P x Y	-	-	-	**0.06**	-	-	-	**0.06**	-	-	-	**0.06**	-	-	-	**0.07**
C. D. (p=0.05) T	NS	0.05	0.04	**0.04**	0.20	0.12	0.03	**0.02**	0.14	0.03	0.03	**0.02**	0.11	0.04	0.03	**0.03**
P	0.24	0.10	0.11	**0.09**	0.14	0.04	0.11	**0.07**	0.14	0.10	0.12	**0.07**	0.14	0.11	0.11	**0.08**
Y	-	-	-	**0.05**	-	-	-	**0.03**	-	-	-	**0.03**	-	-	-	**0.04**
T x P	NS	NS	0.13	**NS**	0.19	0.16	0.13	**0.10**	0.20	0.14	0.12	**0.09**	0.22	NS	0.10	**0.10**
T x Y	-	-	-	**0.08**	-	-	-	**0.04**	-	-	-	**0.04**	-	-	-	**0.06**
P x Y	-	-	-	**0.16**	-	-	-	**0.12**	-	-	-	**0.12**	-	-	-	**0.14**
T x P x Y	-	-	-	**NS**	-	-	-	**0.17**	-	-	-	**0.16**	-	-	-	**0.18**
C. V. (%)	12.13	9.85	9.18	**12.35**	13.86	10.77	8.74	**11.60**	14.47	9.40	7.60	**10.89**	12.78	8.08	9.58	**10.64**

Note: Figures in parentheses are retransformed values, those outside are $\sqrt{x+0.5}$ transformed values.

Table 2. Impact of IPM module on population of natural enemies (Pooled over periods and years)

Treatments		Number of indicated predator /plant during the indicated year											
		Spiders				*Chrysoperla carnea*(Grubs)				Coccinellids (Grubs)			
		2009-2010	2010-2011	2011-2012	**Pooled**	2009-2010	2010-2011	2011-2012	**Pooled**	2009-2010	2010-2011	2011-2012	**Pooled**
IPM		0.96	0.79	1.01	0.92	0.98	0.69	0.97	0.88	1.06	0.68	0.95	0.90
		(0.42)	(0.12)	(0.52)	(0.35)	(0.46)	-	(0.44)	(0.27)	(0.62)	-	(0.40)	(0.31)
Non IPM (Control)		0.95	0.77	1.09	0.94	0.92	0.74	0.99	0.88	1.04	0.71	0.98	0.91
		(0.40)	(0.09)	(0.69)	(0.38)	(0.35)	(0.05)	(0.48)	(0.27)	(0.58)	-	(0.46)	(0.33)
Mean		**0.96**	**0.78**	**1.05**	**0.93**	**0.95**	**0.71**	**0.98**	**0.88**	**1.05**	**0.70**	**0.96**	**0.90**
		(0.42)	**(0.11)**	**(0.60)**	**(0.36)**	**(0.40)**	**-**	**(0.46)**	**(0.27)**	**(0.60)**	**-**	**(0.42)**	**(0.31)**
ANOVA													
S. Em ± Treatments (T)		0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Periods (P)		0.03	0.02	0.03	0.02	0.04	0.02	0.02	0.02	0.04	0.02	0.02	0.02
Year (Y)		-	-	-	0.01	-	-	-	0.01	-	-	-	0.01
T x P		0.05	0.03	0.03	0.03	0.05	0.03	0.03	0.02	0.06	0.04	0.03	0.02
T x Y		-	-	-	0.02	-	-	-	0.01	-	-	-	0.01
P x Y		-	-	-	0.04	-	-	-	0.03	-	-	-	0.03
T x P x Y		-	-	-	0.05	-	-	-	0.04	-	-	-	0.04
C. D. (p=0.05)	T	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
P		0.08	0.07	0.08	0.07	0.11	0.06	0.07	0.05	0.11	0.08	0.06	0.05
Y		-	-	-	0.04	-	-	-	0.03	-	-	-	0.03
T x P		NS	0.09	0.08	0.08	NS	0.09	NS	0.06	NS	0.11	0.08	NS
T x Y		-	-	-	0.05	-	-	-	0.03	-	-	-	NS
P x Y		-	-	-	0.11	-	-	-	0.09	-	-	-	0.09
T x P x Y		-	-	-	NS	-	-	-	NS	-	-	-	NS
C. V. (%)		17.03	15.69	9.09	19.43	18.48	17.09	10.44	14.37	18.23	20.39	10.52	15.60

Note: Figures in parentheses are retransformed values, those outside aretransformed values

Table 5. Economics of the IPM module for the control of sucking insect pests in *Bt* cotton

Treatments	Quantity of insecticides for spray (l or kg/ ha)	Price of insecticide (Rs/l or kg)	Cost of insecticide (Rs/l or kg)	Labour charges (Rs/ha)	Total cost of treatments (Rs/ha)	Yield (Q/ha)	Net gain over control (q/ha)	Realization over control (Rs/ ha)	ICBR
IPM module									
Beauveria bassiana (2 x 10^8 cfu) 4 g/ l water	2.00 (1 spray)	200	400	344	744	-	-	-	-
Thiamethoxam 25 WG (0.01%) (0.4 g/l water)	0.40 (2 spray)	3,580	1432	688	2120	-	-	-	-
Acephate 75 SP (0.075%) (1 g/l water	0.50 (1 spray)	550	275	344	619	-	-	-	-
Total	**3,483**	**27.70**	**16.57**	**66,280**	**1: 19.03**				
Non IPM (Control)	**-**	**-**	**-**	**—**	**-**	**11.13**	**-**	**-**	**-**

Market price of seed cotton: Rs: 4,000 /q
Labour charges: For one spray Rs. 172 /labour /day (two labours per hectare required for each spray).

REFERENCES

Jain, P. C. and Bhargava, M. C. 2007. *Entomology Novel Approaches.* Publ, New India Publishing Agency. New Delhi. 294 p.

Jat, M. C. and Jeyakumar, P. 2006. Bio-efficacy of botanicals and bio-agents on sucking pests of cotton. *Annals of Plant Protection Science,* **14** : 8-10.

Saleem, M. A., Khalid, M. and Riaz, H. 2001. Comparative efficacy of some insecticides against some sucking insect pests of CIM-443, cotton. *Pakistan Entomologist,* **23** : 91-92.

Srinivasan, M. R., Sheeba, J. R. and Palaniswamy, S. 2004. Evaluation of thiamethoxam 70 WS and thiamethoxam 25 WG against cotton sucking insects. *Pestology,* **28** : 37-40.

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