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Management of sucking insect pest complex of *Bt* cotton by Integrated pest management (IPM)

[1] Rita Sharma, [2] Dr. Sudha Summarwar

[1] Laboratory of Environmental Science, P.G. Department of Zoology, Govt. Dungar College, Bikaner, Rajasthan, India
[2] Department of Zoology, S.D. Govt. College, Beawar, M.D.S. University, Ajmer, Rajasthan, India

Abstract
Farmers use more and more insecticide/pesticide to control sucking insect pests and due to this, more toxic effect is found on natural enemies and so also on environment, hence attempts were made to study on Management of sucking insect pest complex of *Bt* cotton by Integrated pest management. The population of sucking pests were recorded in both IPM and Non IPM plots. Weekly data collected on population count of various insect pests for the season, were pooled and presented in table forms. The population of sucking insect pests viz. jassid, whitefly and thrips have been recorded at fortnight interval during the growing season and was presented as average population in IPM and Non-IPM plot. The perusal of observations in the present study concluded that, in case of Jassid, the minimum population of Jassid (2.05/3leaves) was recorded in in IPM plot and it was 21.76% less than non-IPM plot. In case of whitefly, minimum population of whitefly (13.22/3leaves) was recorded in in IPM plot and it was 19.66/3leaves in non-IPM plots being 32.76% less in IPM plot than non-IPM plot. Regarding thrips, the minimum population of thrips (12.46/3leaves) was recorded in IPM plot and 17.12/3leaves in non-IPM plot which was 27.22% less in IPM than non-IPM plot.

Keywords: sucking insect pests, jassid, whitefly, thrips

Introduction
Pest management using conventional pesticides can be effective but imposes significant economic and environmental costs including disruption of natural biological control agents. Integrated pest management has long been proposed as a more sustainable approach in many situations, however, the adoption of a truly integrated pest management approach has been extremely patchy. Broadly IPM can be defined as "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms." (FAO 2002).
Srivastava *et al*. (2004) conducted a field study on Integrated Pest Management comprises of deep summer ploughing, seed treatment with imidacloprid @ 7.5 g/kg seed, NSK 0.5% 30 day after germination, neem oil @ 4 ml/litre of water after 7 days, destruction of spotted bollworm infested twigs, ethion after 12 days, profenofos after 12 days, trap crop/ bird purcher maize and marigold, use of pheromone, light trap and hand collection of larvae, along with bio control. Significantly lower infestation of sucking pests i.e. aphid, jassid, thrips, whitefly and minimum per cent damage to squares, green bolls, open bolls and locules were observed in IPM block. The maximum yield 625 kg/ha and 1325 kg/ha was gained in IPM during both the cropping season. Farmers use more and more insecticide/pesticide to control sucking insect pests and due to this, more toxic effect is found on natural enemies and so also on environment, hence attempts were made to study on Management of sucking insect pest complex of *Bt* cotton by Integrated pest management.

Material & Method
For management of Bt cotton pests, different IPM modules consisting of combination of cultural, mechanical, biological and chemical control methods were used. The population of sucking pests were recorded in both IPM and Non IPM plots. Weekly data collected on population count of various insect pests for the season, were pooled and presented in table forms. The percent reduction in sucking pest population has been calculated. Percent reduction has been calculated by using the below mention formula:

$$(\%)\ \text{Reduction} = \frac{\text{Population in Non IPM plot} - \text{Population in IPM plot}}{\text{Population in Non IPM plot}} \times 100$$

Result
Different IPM treatments consisting of three sprays alternately at 10 days interval in comparison to unsprayed Non-IPM plot (control) have been evaluated for two consecutive years 2012-13 and 2013-14. The population of sucking insect pests viz. jassid, whitefly and thrips have been recorded at fortnight interval during the growing season and was presented as average population in IPM and Non-IPM plot. The data recorded on the effectiveness of different IPM strategy in terms of population of sucking insect pest, for IPM and Non-IPM plots have been presented in Table 1 & 2.

1) Jassid
The pooled data for the two years under study presented in Table 1 revealed that the incidence of jassid from July to October in IPM plot was in decreasing order as compared to

Non-IPM plot. The minimum population of jassid (0.90/3leaves) was recorded in IPM plot during the month of October. The mean of jassid population which was recorded from July to October, present in Table 2 revealed that the minimum population of jassid (2.05/3leaves) was recorded in IPM plot and it was 21.76% less than Non-IPM plot.

2) Whitefly

In the present study, the low incidence of whitefly population was recorded in IPM plot in comparison to Non IPM plot (Table 1). The lowest population of whitefly (7.0/3leaves) was recorded in IPM plot during the month of July. The mean population of whitefly, as depicted in Table 2 revealed that the minimum population of whitefly (13.22/3leaves) was recorded in IPM plot and it was 19.66/3leaves in Non-IPM plot being 32.76% less in IPM plots than Non-IPM plot.

3) Thrips

A very low incidence of thrips was recorded in IPM plot over Non IPM plot (Table 1). The lowest population of thrips (4.5/3leaves) was recorded in IPM plot during the month of October. The mean data of thrips population presented in 2 revealed that the minimum population of thrips (12.46/3leaves) was recorded in IPM plot and 17.12/3leaves in Non-IPM plot which was 27.22% less in IPM than Non-IPM plot.

Table 1: Sucking pest population in IPM and Non-IPM plots during Kharif 2012-13 & 2013-14 (pooled data of two years).

Month	Jassid/3leaves		Whitefly/3leaves		Thrips/3leaves	
	IPM	Non-IPM	IPM	Non-IPM	IPM	Non-IPM
July	2.6*	3.66*	7*	8.5*	12.45*	17.2*
August	2.75	3.4	15.8	25.4	22.6	30.5
September	1.95	2.46	17.6	28.5	10.3	14.6
October	0.9	0.96	12.5	16.25	4.5	6.2

* Mean of two observations in each month recorded at fortnight interval in IPM and Non-IPM plots

Table 2: Mean population of sucking pests Cotton in IPM and Non-IPM plots during Kharif 2012-13 & 2013-14 (Pooled data of two years)

Sucking pests (July to October)	IPM	Non-IPM	(%) Reduction over non-IPM
Jassid/3leaves	2.05*	2.62*	21.76
Whitefly/3leaves	13.22	19.66	32.76
Thrips/3leaves	12.46	17.12	27.22

* Mean of four weeks

Discussion

The perusal of observations in the present study concluded that the incidence of sucking pests from July to October in IPM plot was in decreasing order as compared to non-IPM plot. In case of Jassid, the minimum population of Jassid (2.05/3leaves) was recorded in in IPM plot and it was 21.76% less than non-IPM plot. In case of whitefly, minimum population of whitefly (13.22/3leaves) was recorded in in IPM plot and it was 19.66/3leaves in non-IPM plots being 32.76% less in IPM plot than non-IPM plot. Regarding thrips, the minimum population of thrips (12.46/3leaves) was recorded in IPM plot and 17.12/3leaves in non-IPM plot which was 27.22% less in IPM than non-IPM plot.

The present results are in agreement with the observation of Patel *et al*. (2003) and Thulasiram *et al.* (2003) who reported low incidence of sucking pests in IPM fields as compared to non-IPM fields. Similarly, Balakrishnan *et al.* (2004) and Vadodaria *et al.* (2004) also reported effectiveness of IPM modules in reducing the sucking pest's population over non-IPM module.

The lowest population of Jassid found in IPM plot over non-IPM plot in present investigation gets support from the observation of Rao *et al.* (2001), Srivastava *et al.* (2004) and Kumar *et al*. (2011) who found significantly lower infestation of Jassid in IPM block as compared to non-IPM block.

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