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Appraisal of Bollworm complex damage of *Bt* cotton by Integrated pest management (IPM)

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Abstract

In cotton production, there are many factors that can reduce crop yield. One important cause is arthropod insects. Insects that cause loss to the fruit are frequently more destructive than those that damage leaves, stems, and roots. This review describes integration of pest control tactics directed against the bollworm pest complex. 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 effectiveness against bollworms complex was evaluated in term of square and boll damage in both the plots. In the result, the low incidence of bollworm complex was recorded in IPM plot over non-IPM plot. The minimum square damage, green boll damage, open boll damage and locule damage was recorded in IPM plots in comparison to non-IPM plot from July to October. The minimum square damage (5.13%), green boll damage (4.1%), open boll damage (13.45%) and locule damage (4.43%) was recorded in IPM plot, which was recorded higher in non-IPM plot.

Keywords: bollworm pest complex, pest control, IPM

Introduction

Insect pests represent a significant limitation for production of many crops. Traditional reliance on pesticides brings significant economic costs and environmental liabilities of off-target drift, chemical residues and resistance. IPM has long been proposed as an alternative. Amongst the various reasons for low productivity in the country a loss due to insect pest is one of them. Chemical insecticides are being used extensively for control of these insect pests in India. It is estimated that insecticides worth about Rs. 30 billion is used in India agriculture out of which Rs. 16 billion are spent for the control of cotton pests and of this Rs. 12 billion against bollworms alone (Manjunath, 2000) [3]. This indicates the economic importance of bollworms. Despite such huge efforts bollworm control has not been generally satisfactory, this mainly because of the fact that the bollworms developed resistance to most of the currently recommended insecticides, further these chemical insecticides bears the stigma of ecological hazards. (Kranthi *et al*. 2007) [1].

Yang *et al.* (2005) [8] conducted a comparative field research on transgenic Bt cotton and conventional cotton under different conditions (fields without pesticide inputs, fields managed by farmers with IPM education, fields managed by farmers lacking IPM education) in Hubei province of China in 2002. They reported that the amount of pesticide used on Bt cotton by non-IPM farmers was found to be around three times that used by IPM farmers. IPM farmers made significantly higher net profits from cultivating transgenic Bt cotton in comparison with non-IPM farmers. Other pest management practices had more significant influences on the population dynamics of predatory natural enemies and major insect pests than did the adoption of transgenic Bt cotton in the cotton ecosystem. They showed that IPM education, by increasing farmer capacity to critically evaluate inputs and their effects, monitor their fields and make informed decisions on pest management, enabled farmers to reduce pesticide use significantly, so resulting in improved production and profit margin. IPM farmer education thus, contributed to maximising the value of planting transgenic Bt cotton. In this paper, we will illustrate the progress that Appraisal of Bollworm complex damage of *Bt* cotton by Integrated pest management (IPM)

Material & Method

For management of Bt cotton pests, different IPM modules consisting of combination of cultural, mechanical, biological and chemical control methods were used. Weekly data collected on population count of various insect pests for the season, were pooled and presented in table forms.

The percent damage caused by bollworms were recorded in both IPM and Non IPM plots. The percent damage in square and green boll (fruiting bodies) has been calculated by using the below mention formula:

$$(\%)\ \text{Damage} = \frac{\text{Number of damaged squares / greenbolls}}{\text{Total number of squares/greenbolls (damaged + healthy)}} \times 100$$

The percent open boll damage and loculi damage was also recorded. The percent infestation was worked out on the basis of total and damaged ones and have been presented as percent open boll and loculi damage. Percent reduction in damage caused by bollworms, has been calculated using following formula:

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

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 effectiveness against bollworms complex was evaluated in term of square and boll damage in both the plots. The data recorded on the effectiveness of different IPM strategy in damage of square and boll due to bollworms, for IPM and Non-IPM plots have been presented in Table 1, 2 & 3.
In the present study, the low incidence of bollworm complex was recorded in IPM plot over Non-IPM plot.

Table 1: Bollworm complex damage (%) in square and green boll basis in IPM and Non-IPM plots (pooled data of two years)**.**

Month	Square damage (%)		Green boll damage (%)	
	IPM	Non-IPM	IPM	Non-IPM
July	1.1*	1.2*	0*	0*
August	2.4	3.2	1.6	2.3
September	7.4	10.4	4.6	7.2
October	9.62	11.3	10.2	12.1
***** Mean of two years.				

Table 2: Mean of square damage (%) and green boll damage (%) in IPM and Non-IPM plots during Kharif 2012-13 & 2013-14 (Pooled data of two years).

(%) Damage (July to October)	IPM	Non-IPM	(%) Reduction over non-IPM
Square damage (%)	5.13*****	6.52*	21.32
Green boll damage (%)	4.1	5.4	24.07
* Mean of four months			

Table 3: Bollworm complex damage (%) in open boll basis in IPM and Non-IPM plots during Kharif 2012-13 & 2013-14 (Pooled data of two years)

Open boll damage (%)	IPM	Non-IPM	(%) Reduction over non-IPM
Boll damage (%)	13.45*	18.4*	26.90
Locule damage (%)	4.43*	7.21*	38.55
* Mean of two years			

1. Square damage (%)
The data presented in Table 1 revealed that the minimum square damage was recorded in IPM plot in comparison to Non-IPM plot from July to October. The mean of square damage which was recorded from July to October, presented in Table 2 revealed that the minimum square damage 5.13% was recorded in IPM plot and it was 21.32% less than Non-IPM plot, whereas 6.52% square damage was recorded in Non-IPM plot.

2. Green boll damage (%)
According to data presented in Table 1, minimum green boll damage was recorded in IPM plot over Non-IPM plot. According to mean, which was presented in Table 2, minimum green boll damage 4.1% was recorded in IPM plot and it was 24.07% less than Non-IPM plot. The maximum green boll damage 5.4% was recorded in Non-IPM plot.

3. Open boll damage (%)
The data presented in Table 3 revealed that the IPM plot showed minimum boll damage and locule damage in comparison to Non-IPM plot. The minimum boll damage 13.45% and locule damage 4.43% was recorded in IPM plot which was 26.90% and 38.55% less than Non-IPM plot, respectively, whereas 18.4% boll damage and 7.21% locule damage was recorded in Non-IPM plot.

Discussion
In the present study, the low incidence of bollworm complex was recorded in IPM plot over non-IPM plot. The minimum square damage, green boll damage, open boll damage and locule damage was recorded in IPM plots in comparison to non-IPM plot from July to October. The minimum square damage (5.13%), green boll damage (4.1%), open boll damage (13.45%) and locule damage (4.43%) was recorded in IPM plot, which was recorded higher in non-IPM plot.
The present findings are in agreement with the findings of earlier workers, who had undertaken the studies to evaluate the performance of IPM practices against bollworm complex, over non-IPM practices. The minimum incidence of bollworm complex was recorded in IPM plot over non-IPM plot in present investigation gets support from the observation of Vadodaria *et al.* (1998) [7], Murthy *et al.* (1998) [4], Rote *et al.* (2001) [5] and Thulasiram *et al.* (2003) [6], who reported minimum bollworm damage and higher seed cotton yield in IPM block as compare to non IPM block. This observation is also in conformity with the observation of Yang *et al.* (2005) [8] and Kumhar *et al.* (2009) [2] who reported superiority of IPM technology over the non-IPM.
The minimum square damage (%) and green boll damage (%) was recorded in IPM plot over non-IPM plot in present investigation gets support from the observation of Srivastava *et al.* (2004) and Tanwar *et al.* (2004), who reported minimum square damage and green boll damage due to *Helicoverpa armigera* in IPM block, compared to non-IPM block. Similarly, Bambawale *et al.* (2004) also recorded significant reduction in bollworm incidence and the damage caused by them to the square and green boll basis in IPM practices.

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