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## Validation of IPM module for pink bollworm, *Pectinophora gossypiella* on *Bt* cotton

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#### Abstract

Validation of IPM module and farmer practices revealed that the range of percent rosette flower by pink bollworm during 2020-21 was 0.79 to 2.32 percent and 5.45 to 6.50 percent recorded from 50 to 65 DAS in IPM module and farmer practices, respectively. The percent green boll damage was 2.18 to 2.60 percent and 11.24 to 15.9 percent record from 120 to 150 DAS in IPM module and farmer practices, respectively. During 2021-22 percent of the rosette flowers by pink bollworm was 0.67 to 1.97 percent and 5.37 to 6.13 percent recorded from 50 to 65 DAS in IPM module and farmer practices, respectively. The percent green boll damage was 1.98 to 2.23 percent and 10.83 to 16.20 percent recorded from 120 to 150 DAS in IPM module and farmer practices, respectively. Also seed cotton yields during 2020-21 & 2021-22 were recorded at 3321kg/ha and 3455 kg/ha in the IPM module, respectively.

**Keywords:** Cotton, pink bollworm, management, validation, IPM practices, farmer practices

#### Introduction

Cotton (*Gossypium* spp.) (Family: Malvaceae) is one of the most important commercial crop and is popularly known as the "White Gold". It is the most precious gift of nature to mankind, contributed by the genus "*Gossypium*" to cloth people all over the world. Cotton is one of the most important commercial crops playing a key role in the economic, political and social affairs of the world chiefly as a fiber crop. Cotton is cultivated in about 60 countries of the world but 10 countries viz., China, India, Russia, USA, Brazil, Pakistan, Turkey, Egypt, Mexico and Sudan account for about 85% of the total production. Out of this India commands the highest share (36%) in terms of area under cotton cultivation in the world. Around 67% of India's cotton is grown in rain-fed areas and 33% in irrigated areas. India is the largest producer of cotton in the world accounting for about 25 percent of the world's cotton production.

In India, approximately 160 species of insect pests have been reported to attack the cotton crop right from germination until the final harvesting of the cotton crop. Among these pests, pink bollworms have heavy incidence and one of the most damaging pests for cotton, resulting in 20-30 percent loss of bolls (Khuhro *et al.*, 2015) [3]. Also it assumed as major pest status in the recent past (Ghosh, 2001) [2]. Moth of *P. gossypiella* has become a commercial problem because its larval stage frequently enters diapause in seed capsules, which enables the pest to become widespread (Bellows and Fisher, 1999) [1]. Affected flowers may dry and fall off. Later the larva bore into the bolls and penetrates immature seeds. The larva keeps on feeding the seeds by tunneling across the locules.

Information on validation of pink bollworm management practices helps to take up effective control measure against pink bollworm, hence, the present studies was taken up to correlate the management of pink bollworm, *P. gossypiella* on *Bt* cotton.

#### Materials and Methods

A field experiment for the management of pink bollworm, *Pectinophora gossypiella* on *Bt* cotton was conducted at Cotton Research Station, Junagadh Agricultural University, Junagadh during *kharif*, 2020-21 and 2021-22. The variety of G. Cot. Hy-8 BG II was sown with a spacing of 120 x 45 cm in an area of 2722 m<sup>2</sup>. Cotton crop was grown as per recommended agronomical practices and the following observation were recorded.

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## Treatment details

Sr. No.	Treatments	IPM module
1	IPM module	<ol style="list-style-type: none"> <li>Timely sowing</li> <li>Installation of pheromone traps at 45 DAS @ 5-10/ha</li> <li>Neem-based formulation @ 1500 ppm after 45 DAS</li> <li>Release of <i>Trichogramma</i> spp. @ 1.5 lakh/ha (thrice at weekly intervals) starting 50 DAS (at least one week after)</li> <li>ETL (10% fruiting body damage) based application of recommended insecticides (Lambda-cyhalothrin 2.5% EC @ 0.0025% (10 ml/10 lit. of water) and Deltamethrin 2.8% EC) @ 0.0028% (10 ml/10 lit. of water)</li> <li>Timely termination of crop</li> </ol>
2	Farmers' practices	<p><b>As per Farmers' practices (5 sprays were carried out at 15 days intervals as per need based on when the pest initiated and crossed ETL.) (Only Insecticidal Spray)</b></p> <ol style="list-style-type: none"> <li>Profenophos 50% EC @ 0.10% (20 ml/10 lit. of water)</li> <li>Cypermethrin 10% EC @ 0.01% (10 ml/10 lit. of water)</li> <li>Quinalphos 25% EC @ 0.05% (20 ml/10 lit. of water)</li> <li>Profenophos 40% + Cypermethrin 4% EC @ 0.044% (10 ml/10 lit. of water)</li> <li>Spinosad 48% SC @ 0.014% (3 ml/10 lit. of water)</li> </ol>

**Method of observation**

The following observations were recorded for *P. gossypiella*.

**Rosette flower**

At the time of flowering, the number of healthy and rosette flowers was counted from five randomly selected plants from each quadrat. Based on this, percent rosette flower per plant was worked out by

$$\text{Rosette flower damage (\%)} = \frac{\text{Number of rosette flowers} \times 100}{\text{Total healthy flowers}}$$

**Green boll damage**

Five plants were randomly selected from each quadrat, and the number of healthy and damaged green bolls by pink bollworm was counted and expressed in terms of percent green boll damage as it was worked out by using the following formula.

$$\text{Green boll damage (\%)} = \frac{\text{Number of damaged green bolls} \times 100}{\text{Total no of green bolls observed}}$$

**Open boll damage**

At the time of each picking, numbers of healthy and damaged open bolls were recorded from five randomly selected plants from each quadrat. Based on this, percent open boll damage was worked out by using the following formula.

$$\text{Open boll damage (\%)} = \frac{\text{Number of damaged open bolls} \times 100}{\text{Total no of open bolls observed}}$$

**Locule damage**

At the time of each picking, the number of healthy and

damaged locules was counted from five randomly selected plants from each quadrat. Based on this, percent locules, the damage was worked out by using the following formula.

$$\text{Locule damage (\%)} = \frac{\text{Number of damaged locules} \times 100}{\text{Total no of green locules observed}}$$

**Seed cotton yield**

From the treated and untreated plots, the weight of seed cotton kg/ha during each picking was recorded.

**Results and Discussions**

The impact of the IPM module in managing pink boll worms was studied for two consecutive years by comparing the incidence and damage of pink bollworms in IPM and farmers' practices through paired 't' test and validated. The observation was recorded for the pink bollworm (*P. gossypiella*) on rosette flower, green boll damage, open boll damage and locule damage in cotton crop.

**Incidence of pink boll worm on rosette flower, green boll, open boll and locule damage in cotton during 2020-21**

The result indicated that the range of percent rosette flower by pink bollworm in the IPM module was 0.79 to 2.32 percent recorded from 50 to 65 DAS. In the case of farmer practices the percent rosette flower ranged from 5.45 to 6.50 percent which was significantly higher than the IPM module (Table 1). The percent green boll damage was 2.18 to 2.60 recorded from 120 to 150 DAS in the IPM module during 2020-21 whereas in farmer practice percent green boll damage was 11.24 to 15.9 recorded from 120 to 150 DAS which was significantly higher than IPM module (Table 2).

**Table 1:** Effect of IPM module on % rosette flower damage by pink boll worm in cotton

Treatment	Rosette flower (%)						Pooled
	50 DAS		65 DAS		Mean		
	2020	2021	2020	2021	2020	2021	
IPM module	0.79	0.67	2.32	1.97	1.56	1.32	1.44
Farmer practices	5.45	5.37	6.50	6.13	5.98	5.75	5.86
SD	3.30	3.32	2.96	2.94	3.13	3.13	3.13
S. Em.±	0.49	0.51	0.87	0.87	0.49	0.50	0.03
Cal t**	9.46	9.25	4.82	4.78	8.99	8.90	87.59
Tab t	2.14	2.14	2.14	2.14	2.05	2.05	2.00

DAS- Days after Sowing

\*\*Significance at 5%

The data (Table 3) revealed that the open boll damage of pink bollworm (*P. gossypiella*) in the IPM module was 2.87 to 3.40 percent during 1<sup>st</sup> and 2<sup>nd</sup> picking. In the case of farmer practices percent open boll damage was 18.37 to 19.07 which was significantly higher than the IPM module. Also the percent open boll damage was higher in 2<sup>nd</sup> picking as

compared to the 1<sup>st</sup> picking in both the IPM module and farmer practices. The percent locule damage was 2.52 to 3.11 in the IPM module whereas in farmer practice percent locule damage was 16.83 to 15.47 which was significantly higher than the IPM module (Table 4).

**Table 2:** Effect of IPM module on % green boll damage by pink boll worm in cotton

Treatment	Green boll damage (%)								Pooled
	120 DAS		135 DAS		150 DAS		Mean		
	2020	2021	2020	2021	2020	2021	2020	2021	
IPM module	2.18	1.98	2.37	2.21	2.60	2.23	2.38	2.14	2.26
Farmer practices	11.24	10.83	12.81	12.41	15.9	16.2	13.32	13.16	13.24
SD	6.41	6.26	7.38	7.21	9.41	9.90	7.73	7.79	7.76
S.Em.±	0.37	0.37	0.90	0.91	0.63	1.13	0.46	0.59	0.04
Cal t**	24.27	23.72	11.57	11.25	20.99	12.36	23.58	18.72	166.35
Tab t	2.14	2.14	2.14	2.14	2.14	2.14	2.02	2.02	1.99

DAS- Days after Sowing

\*\*Significance at 5%

### Incidence of pink boll worm on rosette flower, green boll, open boll and locule in cotton during 2021-22

A perusal of data indicated that the range of percent rosette flower by pink boll worm in the IPM module was 0.67 to 1.97 percent recorded from 50 to 65 DAS. In the case of farmer practices the percent rosette flower ranged from 5.37 to 6.13

percent which was significantly higher than the IPM module (Table 1). The percent green boll damage was 1.98 to 2.23 recorded from 120 to 150 DAS in the IPM module during 2021-22 whereas in farmer practice percent green boll damage was 10.83 to 16.20 recorded from 120 to 150 DAS which was significantly higher than IPM module (Table 2).

**Table 3:** Effect of IPM module on % open boll damage by pink boll worm in cotton

Treatment	Open boll damage (%) (at harvest)						Pooled
	2020		2021		Mean		
	1 <sup>st</sup> picking	2 <sup>nd</sup> picking	1 <sup>st</sup> picking	2 <sup>nd</sup> picking	2020	2021	
IPM module	2.87	3.40	2.77	3.20	3.14	2.99	3.06
Farmer practices	18.37	19.07	17.97	18.67	18.72	18.32	18.52
SD	10.96	11.08	10.74	10.94	11.02	10.84	10.93
S.Em.±	0.85	0.75	0.85	0.75	0.56	0.56	0.09
Cal t**	18.13	21.02	17.78	20.75	27.95	27.49	119.95
Tab t	2.14	2.14	2.14	2.14	2.05	0.05	2.00

\*\*Significance at 5%

The data (Table 3) revealed that the open boll damage of pink bollworm (*P. gossypiella*) in the IPM module was 2.77 to 3.20 percent during 1<sup>st</sup> and 2<sup>nd</sup> picking. In case of farmer practices percent open boll damage was 17.97 to 18.67 which was significantly higher than the IPM module. Also the percent open boll damage was higher in 2<sup>nd</sup> picking as

compared to the 1<sup>st</sup> picking in both the IPM module and farmer practices. The percent locule damage was 2.32 to 2.91 in the IPM module whereas in farmer practice percent locule damage was 16.43 to 15.07 which was significantly higher than the IPM module (Table 4).

**Table 4:** Effect of IPM module on % locule damage by pink boll worm in cotton

Treatment	Locule damage (%)						Pooled
	2020		2021		Mean		
	1 <sup>st</sup> picking	2 <sup>nd</sup> picking	1 <sup>st</sup> picking	2 <sup>nd</sup> picking	2020	2021	
IPM module	2.52	3.11	2.32	2.91	2.81	2.61	2.71
Farmer practices	16.83	15.47	16.43	15.07	16.15	15.75	15.95
SD	10.12	8.74	9.98	8.60	9.43	9.29	9.36
S.Em.±	0.86	0.67	0.86	0.67	0.57	0.57	0.08
Cal t**	16.71	18.32	16.48	18.02	23.58	23.23	117.57
Tab t	2.14	2.14	2.14	2.14	2.05	2.05	2.00

\*\*Significance at 5%

**Effect of IPM module and farmer practices on yield of cotton:** The data on seed cotton yield (Table 5) revealed that higher seed cotton yield was recorded in the IPM module (3321 kg/ha) as compared to the farmer practices (1778 kg/ha) which were significantly lower than the IPM module during 2020-21. The data on seed cotton yield (Table 5) of

IPM module and farmer practices during 2021-22 revealed that the IPM module seed cotton yield (3455 kg/ha) is much higher as compared with the farmer practices (1870 kg/ha) and overall pooled of both season revealed that IPM module recorded 3388 kg/ha and farmer practices recorded 1824 kg/ha which was significantly lower than IPM module.

**Table 5:** Effect of IPM module on yield of cotton in cotton

Treatment	Yield (Kg/ha)		
	2020	2021	Pooled
IPM module	3321	3455	3388
Farmer practices	1778	1870	1824
SD	1091.1	1121	1105.92
S.Em.±	43.50	27.50	521.47
Cal t**	17.74	28.82	2.00
Tab t	12.71	12.71	12.71

\*\*Significance at 5%

### Overall mean of 2020-21 to 2021-22

In general mean percent rosette flower, green boll damaged, open boll damage and locule damage by pink bollworm in cotton were found higher during 2020-21 as compared to 2021-22

### Overall pooled of 2020-21 to 2021-22

Pooled data of 2020-21 to 2021-22 of IPM module and farmer practices revealed that percent rosette flower in the IPM module was 1.44 percent which was significantly lower than farmer practices (5.86% rosette flower). The percent green boll damage pooled data of both (2020 and 2021) revealed that percent green boll damage of farmer practices (13.24% green boll damage) is much higher than the IPM module (2.26% green boll damage). Overall pooled of percent open boll damage in both seasons revealed that higher percent open boll damage was noticed in farmer practices (18.52%) as compared to the IPM module (3.06%). In the case of pooled data, percent locule damage was lower appear in the IPM module (3.06%) as compared to the farmer practices (18.52%).

### Conclusion

The present studies concluded that the range of percent rosette flower by pink bollworm during 2020-21 was 0.79 to 2.32 percent and 5.45 to 6.50 percent recorded from 50 to 65 DAS in IPM module and farmer practices, respectively. The percent green boll damage was 2.18 to 2.60 percent and 11.24 to 15.9 percent recorded from 120 to 150 DAS in IPM module and farmer practices, respectively. In addition to open boll damage during 2020-21 was 2.87 to 3.40 percent and 18.37 to 19.07 percent in IPM module and farmer practices, respectively. While, the case of locule damage during 2020-21 was 2.52 to 3.11 percent and 16.83 to 15.47 percent in IPM module and farmer practices, respectively.

During 2021-22 percent rosette flowers by pink bollworms were 0.67 to 1.97 percent and 5.37 to 6.13 percent recorded from 50 to 65 DAS in IPM module and farmer practices, respectively. The percent green boll damage was 1.98 to 2.23 percent and 10.83 to 16.20 percent recorded from 120 to 150 DAS in IPM module and farmer practices, respectively. In addition to open boll damage during 2021-22 was 2.77 to 3.20 percent and 17.97 to 18.67 percent during 1<sup>st</sup> and 2<sup>nd</sup> picking in the IPM module and farmer practices, respectively. While, in the case of locule damage during 2021-22 was 2.32 to 2.91 percent and 15.47 to 16.83 percent in the IPM module and farmer practices, respectively.

In addition to seed cotton yields during 2020-21 & 2021-22 were recorded at 3321 kg/ha and 3455 kg/ha in the IPM module, respectively. Further coming to farmer practices during 2020-21 & 2021-22 it was 1778 kg/ha and 1870 kg/ha seed cotton yield, respectively.

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