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Seasonal incidence of pink bollworm, *Pectinophora gossypiella* (Saunders) in cotton

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Abstract

The field experiment was carried out during *kharif*-2021 at AICCIP, MPKV, Rahuri, Maharashtra. The contemporary research unveiled that peak moth activity was observed during 49th standard meteorological week (318 moths / week). Later on, the trap catches declined gradually. The rosette flowers were ranged between 2.00 to 48.00. While the incidence in green bolls was noticed from 38th SMW and rose gradually and reached its peak during 52nd SMW. The larval incidence ranged from 1.20 to 37.60 larvae/ 20 bolls and the green boll damage ranged from 3.10 to 88.70 per cent. Moreover, open boll damage ranged from 43.68 to 58.74 per cent with a mean of 49.97 per cent during the cropping season. Furthermore, locule damage ranged from 27.12 to 36.82 per cent with a mean of 31.76 per cent. The trap catches had a negative and non-significant relationship with rainfall and a negative and significant relationship with maximum temperature.

Keywords: Pink bollworm, *Pectinophora gossypiella*, cotton, Maharashtra

Introduction

Cotton, *Gossypium hirsutum* L. (Family: Malvaceae) is an important fibre crop in India as well as in more than seventy other countries all across the world. The lower productivity of cotton in India corresponds to the world average (786 kg ha⁻¹) is due to the spectrum of insects pests on cotton. Worldwide, about 1326 insect species are enlisted in cotton (Hargreaves, 1948; Atwal, 2004) [4,2] of which about 162 species of insects infest at various stages of crop growth. Of these, around 15 are key pests (Kannan *et al.*, 2004) [5]. Pink bollworm, *Pectinophora gossypiella* is one of the most damaging pests for cotton, resulting in 20-30 per cent loss of bolls (Khuhro *et al.*, 2015) [6]. The knowledge about incidence of pest during the cropping season and its possible dynamics help in designing pest management strategies (Santhosh *et al.*, 2009) [11]. Information on seasonal activity of pink bollworm on cotton helps to take up effective management, hence, the present studies was taken up to correlate the seasonal incidence of pink bollworm with weather parameters.

Materials and Methods

Experiment was conducted at AICCIP, MPKV, Rahuri. The variety, Ajeet-155 was sown with a spacing of 90 x 90 cm in an area of 25 x 20 m (500 m²). Cotton crop was grown as per recommended agronomical practices and following observation were recorded.

Percent Rosette flower

The observations on rosette flowers due to pink bollworm infestation were recorded starting from August and continued till December at weekly interval. After the initiation of flowers, five plants were randomly selected and tagged for counting the total number of flowers and number of rosette flowers. The per cent rosette flowers were calculated by using the following formula.

$$\text{Percent rosette flower} = \frac{\text{No. of rosette flower}}{\text{Total no. of flower}} \times 100$$

Pink bollworm larval population per 20 green bolls

The observation on the occurrence of PBW larvae in green bolls was recorded at weekly interval. For this, 20 green bolls from five randomly chosen and tagged plants were collected from each subplot.

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Each tender green boll was cut opened along with ridges of the locules with the help of a sharp cutter carefully and number of live pink bollworm larvae in each boll were estimated by counting number of damage green bolls and number of live pink bollworm larvae in each boll.

Percent green boll damage

Pink bollworm infestation in green bolls was examined at weekly interval. From five randomly chosen and tagged plants in each subplot, 20 green bolls were picked and taken to the laboratory. The number of damaged bolls were counted in the laboratory and per cent green boll damage was calculated.

$$\text{Percent green boll damage} = \frac{\text{No. of damaged green bolls}}{\text{Total no. of green bolls observed}} \times 100$$

Percent locule damage

At the time of picking total number of locules and damaged locules due to pink bollworm were counted from 5 randomly selected plants and per cent locule damage was calculated.

$$\text{Percent locule damage} = \frac{\text{No. of damaged locule}}{\text{Total no. of locule}} \times 100$$

Percent opened boll damage

Total number of good opened bolls and bad opened bolls due to pink bollworm were counted at the time of picking from five randomly selected plants, and per cent opened boll damage was calculated.

$$\text{Percent open boll damage} = \frac{\text{No. of bad open boll}}{\text{Total no. of open boll}} \times 100$$

Pheromone Trap Catches

To monitor the moth activity of pink bollworm during the cropping period, two sleeve pheromone traps of pink bollworm, *P. gossypiella* (Saunders) were installed in cotton field at AICCIP, MPKV, Rahuri. The septa with Pectnio-lure (cis-7 hexadecen-1-ol acetate) were changed at 15 days interval for the pink bollworm. A weekly collection of moths from each trap was made and the total number of moths of pink bollworm was pooled separately for every standard week and the mean number of catches of pink bollworm per standard week was calculated.

Result and Discussion

The seasonal incidence of pink bollworm on cotton started from 31st SMW till 52nd SMW during *kharif*-2021. The number of moth catches were recorded and shown in Table 3 week wise. The adult trap catch of pink bollworm started from 33rd SMW till 52nd SMW and ranged from 1 to 318 moths/ week. There was gradual increase in the trap catch of pink bollworm adult and reached its first peak during 46th SMW (102 moths/ week). The adult moth trap catch was noticed highest during 49th SMW (318 moths/ week) and reduced gradually till December end. These findings are in close congruity with (Pazhanisamy and Deshmukh, 2011) [9] who observed the highest peak catch of pink bollworm during 48th MW (432.5/ trap/ week). Similarly, Sandhya Rani *et al.* (2010) [10] reported that the incidence of pink bollworm was started from the month of September and its build up was more or less steady till the second week of November

corresponding to 45th SW (8.2 moths/ trap), thereafter, there was gradual increase in adult trap catch from 3rd week of November corresponding to 46th SW (26.44 moths/ trap) to 2nd week of December corresponding to 49th SW (44.52 moths/ trap).

The per cent rosette flowers on cotton due to pink bollworm (Table 1) ranged between 2.00 to 48.00 (37th SMW till 52nd SMW) with highest incidence observed during 49th SMW. Thereafter, the pest incidence decreased gradually till December end. The findings stands in line with Shinde *et al.* (2018) [13, 14] who revealed that rosette flower due to pink bollworm started in 38th MW and attained its peak severity in 47th MW. Similarly, stated that rosette flowers were appeared from September and attained its peak during 45th MW. Yalawar and Patil (2019) [16] also reported that rosette flower incidence started from 34th MW and reached its peak during 36th MW.

The per cent green boll damage on cotton due to pink bollworm (Table 1) started from 38th SMW (3.10 percent/ 20 green bolls) and increased gradually till 52nd SMW. The peak incidence was occurred in 52nd SMW (88.70 per cent/ 20 green bolls). Similar results were reported by Yalawar and Patil (2019) [16] that the green boll damage by pink bollworm was noticed from 2nd fortnight of September (7.6 percent) and went on increasing till it reached its peak (42.21 per cent) at December 2nd fore night. Green boll damage started from 39th MW which gradually increased and reached its peak during 48th MW and thereafter, declined gradually (Shinde *et al.*, 2018) [13, 14].

The incidence of pink bollworm larvae on green bolls of cotton were shown in Table 1 which varied from 1.20 to 37.60 larvae per 20 green bolls. The incidence started from 38th SMW, increased gradually and attained its peak during 52nd SMW. The present results stand in the persuasion of (Yalawar and Patil, 2019) [16] who reported that pink bollworm larvae incidence on green bolls was observed from 2nd fortnight of September (9 larvae/ 50 bolls) and increased gradually to attain its peak incidence during the second fortnight of December (51 larvae/ 50 bolls). Similarly, Verma *et al.*, (2017) [15] revealed that the peak incidence of pink bollworm larvae on green bolls was during 3rd week of September.

The per cent open boll damage due to pink bollworm ranged between 43.68 per cent to 58.74 per cent (1st to 3rd picking) with maximum damage noticed in 3rd picking (58.74 per cent) as shown in table 2 and the average open boll damage of all the three pickings was 49.97 per cent. These results stand in line with Yalawar and Patil, (2019) [16] who reported that open boll damage was ranged from 48.36 to 53.48 per cent with a mean of 50.97 per cent. Similarly, (Verma *et al.*, 2017) [15] observed average open boll damage were 28.88 per cent and 29.99 per cent during *kharif* 2012 and 2013, respectively.

The per cent locule damage due to pink bollworm ranged between 27.12 per cent to 36.82 per cent (1st to 3rd picking) with highest damage observed in 3rd picking (36.82 per cent) as shown in Table 2 and the average locule damage of all the three pickings was 31.76 per cent. The findings are comparable to Yalawar and Patil, (2019) [16] who reported that locule damage ranged from 24.71 to 39.35 per cent with a mean of 31.65 per cent. Similar results were also obtained by Verma *et al.*, (2017) [15] where average locule damage were 17.22 per cent and 18.05 per cent during *kharif* 2012 and 2013, respectively.

Table 1: Incidence of pink bollworm on cotton (Vegetative stage)

MW	Duration	Rosetted flower (%)	No. of larvae/20 bolls	Green boll damage (%)
31	30-05 Aug	0	0	0
32	06-12 Aug	0	0	0
33	13-19 Aug	0	0	0
34	20-26 Aug	0	0	0
35	27-02 Sept	0	0	0
36	03-09 Sept	0	0	0
37	10-16 Sept	2.00	0	0
38	17-23 Sept	2.65	1.20	3.10
39	24-30 Sept	6.30	2.44	5.68
40	01-07 Oct	9.10	2.90	7.72
41	08-14 Oct	15.38	2.22	11.45
42	15-21 Oct	32.55	4.40	26.90
43	22-28 Oct	37.22	11.92	37.40
44	29-04 Nov	39.38	12.82	32.80
45	05-11 Nov	34.24	13.02	36.00
46	12-18 Nov	42.35	13.80	43.20
47	19-25 Nov	43.50	18.56	50.30
48	26-02 Dec	45.62	23.60	55.10
49	03-09 Dec	48.00	25.18	64.50
50	10-16 Dec	31.82	29.24	73.90
51	17-23 Dec	14.24	31.55	85.30
52	24-31 Dec	6.35	37.60	88.70

Table 2: Incidence of pink bollworm on cotton (at harvesting stage)

At picking	Open boll damage (%)	Locule damage (%)
1 st picking	43.68	27.12
2 nd picking	47.50	31.35
3 rd picking	58.74	36.82
Average	49.97	31.76

Table 3: Average moth catch/ trap/ week of pink bollworm and average weather parameters during 2021.

MW	No. of moths trap/ week	Rainfall (mm)	Temperature (°C)		Relative humidity (%)	
			Maximum	Minimum	Morning (RH ₁)	Afternoon (RH ₂)
31	0	2.60	22.06	23.97	81.71	61.43
32	0	2.20	27.34	24.06	81.43	56.86
33	1	1.80	30.91	23.49	81.71	60.86
34	3	82.80	26.71	22.37	93.14	78.14
35	5	1.20	30.49	22.53	90.29	57.43
36	2	98.80	29.57	23.00	89.43	66.29
37	2	102.2	29.37	23.34	89.00	71.00
38	6	4.00	29.26	23.41	83.71	60.71
39	3	80.60	29.11	22.93	91.29	73.57
40	2	50.60	29.66	22.37	92.57	69.71
41	3	67.80	30.00	23.01	94.14	66.86
42	8	0.00	32.46	22.07	89.29	45.57
43	19	0.00	32.26	19.49	82.57	34.43
44	34	0.00	31.37	18.00	80.57	32.57
45	40	0.00	31.54	19.91	82.14	41.43
46	102	0.00	30.09	15.59	82.00	32.71
47	124	0.20	30.60	21.60	88.43	56.00
48	236	49.00	30.80	19.51	90.57	44.71
49	318	45.40	24.34	22.40	95.00	56.00
50	142	0.00	28.30	19.10	72.00	46.00
51	135	0.00	26.00	20.30	87.00	46.00
52	118	23.20	29.80	14.40	98.00	89.00

Correlation between Weather Factors and Field Incidence of Pink Bollworm in Cotton

The data on correlation between weather factors and pink bollworm pheromone trap catch were shown in Table 4

Table 4: Correlation between pink bollworm trap catches and weather parameters.

Sr. No.	Correlation coefficient (r)	Weather factors				
		Temperature (°C)		Relative humidity (%)		Rainfall (mm)
		Maximum	Minimum	Morning	Evening	
1	PBW male moths/week	-0.489*	-0.350	0.092	-0.226	-0.148
2	Rosette flower (%)	0.131	-0.297	-0.297	-0.738*	-0.461
3	Green boll damage (%)	-0.401	-0.601*	-0.034	-0.073	-0.346
4	PBW larvae/20 green bolls	-0.427	-0.605*	0.002	0.019	-0.260

*- Significant at 5%

The pheromone trap male moth catches in relation to minimum temperature ($r=-0.350$), evening RH ($r=-0.226$) and rainfall ($r=-0.148$) were negatively non significant. The pheromone trap catches of pink bollworm male moth in relation to maximum temperature ($r=-0.489^*$) shows negatively significant while morning RH ($r=0.092$) shows positively non significant. These findings are in parallel with Shinde *et al.* (2018) ^[13, 14], Yalawar and Patil (2019) ^[16], Likhitha *et al.* (2021) ^[7], Pazhanisamy and Deshmukh (2011) ^[9].

The rosette flowers had a negative non significant relation with minimum temperature ($r=-0.297$), morning RH ($r=-0.297$) and rainfall ($r=-0.461$). However, it had a positive non significant relation with maximum temperature ($r=0.131$) and negatively significant with evening relative humidity ($r=-0.738$). These findings are in conformity with Verma *et al.* (2017) ^[15] and Sarode *et al.* (2020) ^[12].

The green boll damage had a negative non significant relation with respect to maximum temperature ($r=-0.401$), morning RH ($r=-0.034$), evening RH ($r=-0.073$) and rainfall ($r=-0.346$). Moreover, it had a significant negative relation with minimum temperature ($r=-0.601^*$). The population of pink bollworm larvae had a non significant negative relation with maximum temperature ($r=-0.427$) and rainfall ($r=-0.260$) and positively non significant with morning RH ($r=0.002$) and evening RH ($r=0.019$). However, it had a negative significant relation with minimum temperature ($r=-0.605$). The present findings are in agreement with the findings of Nadaf and Goud (2007) ^[8] who observed green boll damage shows negative significant correlation with minimum temperature whereas maximum temperature shows positive significant correlation. Divya *et al.* (2020) ^[3] reported that morning RH had positive non significant relation and rainfall had negative non significant with incidence of pink bollworm larvae. Akhtar and Farooq (2019) ^[1] noticed bollworm infestation showed significant negative correlation with minimum temperature ($r=-0.739$) whereas evening RH ($r=-0.424$), maximum temperature ($r=-0.308$) and rainfall ($r=-0.073$) showed non-significant negative correlation.

Conclusion

The present studies concluded that weather factor determines the seasonal activity and population buildup of pink bollworm in cotton. The correlation studies clearly shows the importance of weather parameters in predicting the pink bollworm incidence and this studies will definitely helpful to farmers and extension workers for developing efficient pest management strategies for increased cotton production.

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