Biological Forum – An International Journal **16(6): 10-14(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Seasonal Incidence of Pink Bollworm *Pectinophora gossypiella* (Saunders) on *Bt* Cotton and Influence of Weather Parameters

Nutalapati Vaishnavi[1*], D.R. Kadam[2] and Marella Sai Manoj[3]
[1]PG Scholar, College of Agriculture,
Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani (Maharashtra), India.
[2]Associate Professor, College of Agriculture,
Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani (Maharashtra), India.
[3]Ph.D. Scholar, ICAR – Indian Agricultural Research Institute (New Delhi), India.

(Corresponding author: Nutalapati Vaishnavi)*
(Received: 23 March 2024; Revised: 10 April 2024; Accepted: 29 April 2024; Published: 15 June 2024)
(Published by Research Trend)

ABSTRACT: An investigation was undertaken with the objective of studying the seasonal incidence of pink bollworm in *Bt* cotton and its association with weather parameters at the research farm, Department of Entomology, VNMKV, Parbhani Maharashtra in the year 2022-2023. Seasonal incidence observed in a separate plot, revealed that the larval damage was maximum in 49th and 50th SMW revealing the larval population was highest before the boll opening stage of the crop and at the time of harvesting. Rosette flowers, per cent green boll damage and locule damage were observed highest in 45th, 44th and 48th SMW, respectively. In correlation with weather parameters, all the observations recorded exhibited an overall negative non-significant relation and all the parameters investigated.

Keywords: *Pectinophora gossypiella*, *Bt* cotton seasonal incidence, rosette flower, green boll damage, locule damage, weather parameters.

INTRODUCTION

Cotton (*Gossypium hirsutum*) holds significant global importance as a natural fibre crop and plays a crucial role in the economies of cotton-producing countries worldwide. India stands out as one such nation, with a thriving textile production sector mainly centered on cotton, cultivated by over 4.5 million people across the country. India holds a cotton cultivation area of about 11.91 million hectares, equivalent to approximately 36 per cent of the world's cotton cultivation area. With an estimated production of 31.20 million bales (2021-2022), India ranks one of the world's top cotton producing country. However, India's overall cotton yield of 445 kg/hectare (2021-2022) places it at the 38th global rank in terms of productivity. The lowest productivity of Indian cotton routes to various biotic and abiotic factors. Insect pests are the major biotic factors leading to tremendous yield loss of cotton annually.

Pink bollworm (PBW) *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechidae) was the most destructive and key pest of cotton in India accounting for yield losses to a level of 20 – 90%, before the introduction of transgenic cotton (Patil, 2003). Indian cotton ecosystem phenomenally changed pest status with the introduction of Bollgard I (Cry 1Ac) and Bollgard II (Cry 1Ac + Cry 2Ab) Bt cotton hybrids during 2002 and 2006, respectively (Choudhary and Gaur 2010), targeting the notorious bollworm complex including pink bollworm. However, the PBW emerged as a key pest status in Bt cotton of all major cotton growing tracts of India developing resistance to transgenic Bt hybrids. In Maharashtra state alone yield losses are anticipated to range between 10 and 30% due to PBW infestation in Bt cotton during the cotton season of 2017. The occurrence of pest on the cotton was reported to be in the later stages of crop growth starting from the flowering where the damaging larvae of PBW feed on the anther and pollen of flowers by living in a thin web, resulting in the characteristic rosette formation and flower drop. Subsequently, the larvae bore into the early bolls and feeding on them by tunnelling across the locules results in lint staining and a reduction of fiber quality (Singh *et al.,* 1988). The identification of PBW infestation symptomsis very difficult with only an inconspicuous small pinhead-sized hole on the affected bolls, giving the name "Hidden Pest" (Agarwal *et al.,* 1984). Pink bollworm damage in cotton can be noticed as rosette flower formation, locule damage, open boll damage and green boll damage. The studies conducted on damage potentials and seasonal occurrence of PBW reported that PBW causes 10.81 per cent of rosette flowers (Nayak *et al.,* 2023), locule damage of 37.5 per cent and 13.58 per cent on non-*Bt* and *Bt* cotton, respectively, at 160 days of planting, leading to substantial yield losses (Naik *et al.,* 2014). The infestation pattern and fluctuations of the pest population knowledge are very crucial to devising management strategies, especially in the case of key pests like PBW. The population fluctuation and damaging status of PBW were mostly influenced by seasonal conditions and various abiotic factors. Considering the above challenges, it is essential to

understand the seasonal incidence of pink bollworm and the role of biotic factors influencing the pest incidence on Bt cotton.

MATERIALS AND METHODS

The Experiment was carried out in Research Farm, Department of Agriculture Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, (Maharashtra) during *Kharif* 2022- 23. Cotton Hybrid NHH- 44, BG- II was sown on 4th July 2022 by dibbling 1 seed per hill with a spacing of 120 x 60 cm in an area of plot size 10 × 10 m. All the recommended agronomical practices were followed to maintain a good crop stand except for any pest control activities.

Observations recorded. The total 100 mt. sq area was divided into 4 quadrants of equal size and the following observations were recorded from a total of 20 plants (5 plants/quadrant) randomly selected avoiding the border rows.

Larval population. Population incidence recorded from standing crop starting from the 35thStandard Meteorological Week (SMW) till harvest. The number of larvae per plant count was taken from 20 randomly selected plants in weekly intervals.

Rosette flowers damage. The rosette flower damage (%) was taken by randomly selecting a total of 20 plants from four quadrants, with five plants distributed in each quadrant. Observations were recorded starting from 37SMW to 51 SMW.

$$\text{Per cent rosette flowers} = \frac{\text{Damaged flowers}}{\text{Total no. of green fruiting bodies}} \times 100$$

Green boll damage. Green boll damage was recorded by manual opening of 5 bolls per plant from all the 20 plants selected. A total of 4 observations were recorded in 110, 120, 135, and 150 DAS respectively. These bolls were dissected out and observed for the presence of pink bollworm larvae and their infestation. The number of pink bollworm larvae per boll was counted and per cent infestation of pink bollworm in the green bolls stage was calculated.

Both the locule damage and opened boll damages were taken four times corresponding with the 3 pickings of cotton and expressed in percentage of damage.

$$\text{Locule damage (\%)} = \frac{\text{No. of damaged locules}}{\text{Total no. of locules}} \times 100$$

$$\text{Opened boll damage (\%)} = \frac{\text{BOBs}}{\text{Total opened bolls}} \times 100$$

Correlations studies. All the weather parameters recorded from the standing crop were correlated with weather parameters – temperature, rainfall, humidity and wind speed. All the meteorological data was collected from the Meteorological Observatory, Department of Meteorology, VNMKV Parbhani, Maharashtra.

RESULTS AND DISCUSSION

Population incidence of Pink bollworm

Larval incidence. The incidence of pink bollworm population (larvae/plant) in *Bt* Cotton ranged from 0.0 to 1.52 larvae/plant. The initial record of pink bollworm on the crop was started from 36th SMW (0.65 larvae/plant) and the highest incidence has been reported from 50th SMW with 1.52 larvae/plant. The overall seasonal average of larvae was 0.61 larvae/ plant (Table 1).

Rosette flower damage. The damage started from the 36th SMW (1.52 %) and gradually increased to the 45th SMW reporting maximum damage of 11.1 %. After the 45th week, the damage has steadily declined to the harvesting stage of the crop. The seasonal average damage was 5.24 % (Table 1).

Green boll damage. The percentage of green boll damage was recorded from 37thto 49th SMW. A gradual increase in the green boll damage from the first report during the 37th SMW to the 44th SMW was observed, after which the incidence decreased steadily till the 49th SMW.A 17.35 % damage was recorded as overall mean damage in the season (Table 1).

Locule damage: The percentage locule damage recorded in the 46th to 51st SMW by selecting 20 bolls after each picking from the 4 quadrants. The highest locule damage was recorded from the 46th SMW (Table 1).

Open boll damage: The percentage open boll damage was recorded just before each picking *i.e.,* 46th MW to 49th SMW where the percentage open boll damage was more during the last picking of the cotton (14.56%) (Table 1)

The mean locule and open boll damage from all four observations was 27.96 % and 10.57 % respectively.

Influence of weather parameters on pink bollworm incidence in *Bt* Cotton: The present analysis aimed to investigate the relation between various environmental factors and, flower and boll damage in order to gain insights into the factors that contribute to these occurrences. The results indicated that rainfall (r = 0.12) had a positive non-significant correlation, while maximum temperature (r = 0.16) had a positive on-significant correlation with rosette flower damage. Conversely, minimum temperature (r = -0.39) had a negative non-significant correlation with rosette flower damage, while morning (r = -0.47) and evening (r = -0.43) relative humidity exhibited negative non-significant correlations with it. Wind velocity (-0.21) was found to have a negative and non-significant correlation with rosette flower damage as well (Table 2). In correlation with the larval population, maximum temperature (r = -0.15) had a negative non-significant correlation, while minimum temperature (r = 0.28) had a positive non-significant correlation was noticed. Morning (r = 0.25) and evening (r = -0.13) relative humidity had negative non-significant correlations with the larval population, as similar to wind speed (r = -0.53). Rainfall (r = -0.17) had a negative non-significant correlation with the larval population of pink bollworm (Fig. 1). For per cent green boll damage, the results indicated that rainfall (r = 0.02) and morning relative humidity (r = 0.05) had negative non-significant correlations, while maximum temperature (r = 0.10), minimum temperature (r = 0.12), and evening relative humidity (r = 0.15) had positive and non-significant correlations (Fig. 2). Wind velocity (r = -0.33) was found to have a significantly negatively correlated impact on per cent locule damage, while

rainfall (r = 0.29), maximum temperature (r = 0.11), minimum temperature (r = 0.12), and evening relative humidity (r = 0.47) had positive non-significant correlations. However, morning relative humidity (r = -0.84) had negative non-significant correlations with per cent locule damage (Fig. 3). Lastly, for per cent open boll damage, the analysis showed that there was no correlation for rainfall in that particular SMW. Maximum temperature (r = -0.23) and wind velocity (r =-0.11) had negative non-significant correlations, while minimum temperature (r = 0.94), morning relative humidity (r = 0.55), and evening relative humidity (r = 0.77) had positive but non-significant correlation with open boll damage (Fig. 4).

The present findings are crucial in understanding of PBW behaviour on Bt cotton in relation to seasonal variation. Our findings are in supportive to prior studies conducted on season dynamics of PBW, highlighting its current locality perspectives. More *et al.* (2009) demonstrated that the population dynamics of pink bollworms in rainfed conditions are negative and that fruiting body damage ranges from 0.30% to 3.55%, with a peak during the second week of October. Chavan *et al.* (2016) reported that the incidence of pink bollworm, *P. gossipiella*, was negligible, with the lowest population of pink bollworm (0.10 larvae/5 plants) during the 48th MW (26 Nov-2 Dec). Verma *et al.* (2017) found that the infestation of pink bollworm, *P. gossypiella*, on flowers was highest in the second week of September, with an intensity of 6 and 7 larvae/30 flowers during both years. The peak larval population on bolls was recorded in the second week of September, with an intensity of 7 larvae/30 bolls in 2012 and 8 larvae/30 bolls in 2013.

The larval population on flowers showed a negative correlation with rainfall and age of crop, and a positive correlation with temperature (maximum and minimum) and relative humidity (morning and evening). Shinde *et al.* (2018) recorded that pink bollworm larval population per 20 green bolls and locule damage in green bolls were observed during the 46th, 47th, and 48th SMW, respectively. However, the peak green boll damage was observed in the 46th, 47th, and 48th SMW. Found that peak moth activity was observed in the 49th SMW, while the incidence of green bolls was noticed in the 38th SMW and rose gradually, reaching its peak during the 52nd SMW. The larval incidence ranged from 1.20 to 37.60 larvae/20 bolls. Reddy *et al.* (2022) concluded that Pink bollworm larvae per 10 green bolls showed a significant negative correlation with minimum temperature and morning relative humidity. Overall, these studies provide valuable insights into the population dynamics and incidence of pink bollworm and contribute crucial information for the effective management of pink bollworm.

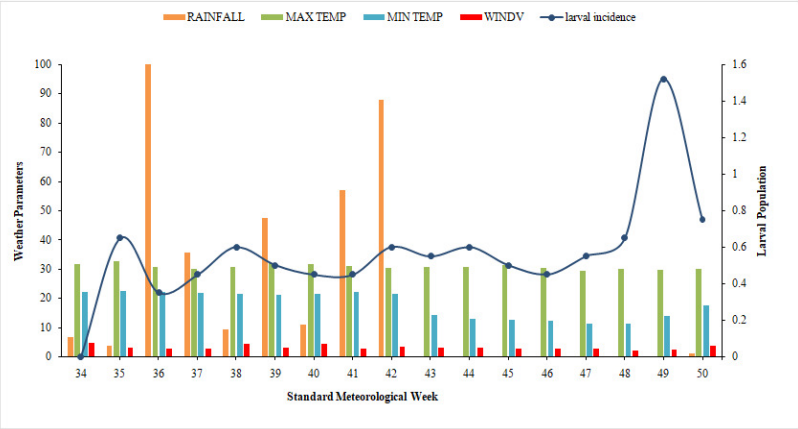

Fig. 1. Effect of Weather Parameters on Incidence of Pink Bollworm in *Bt* Cotton – Kharif, 2022-23.

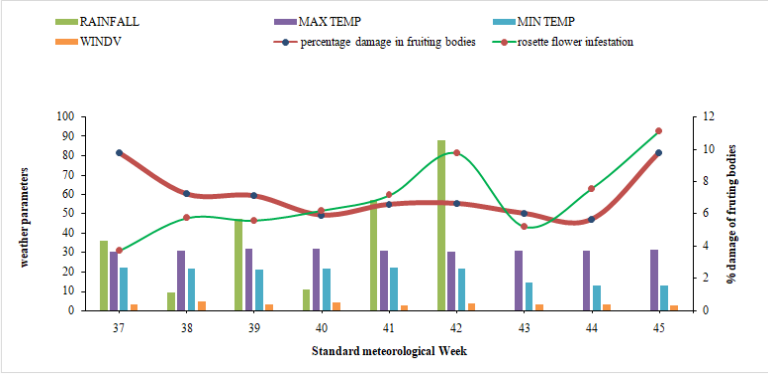

Fig. 2. Effect of Weather Parameters on Fruiting Bodies and Rosette Flowers due to Pink Bollworm in *Bt* Cotton – Kharif, 2022-23.

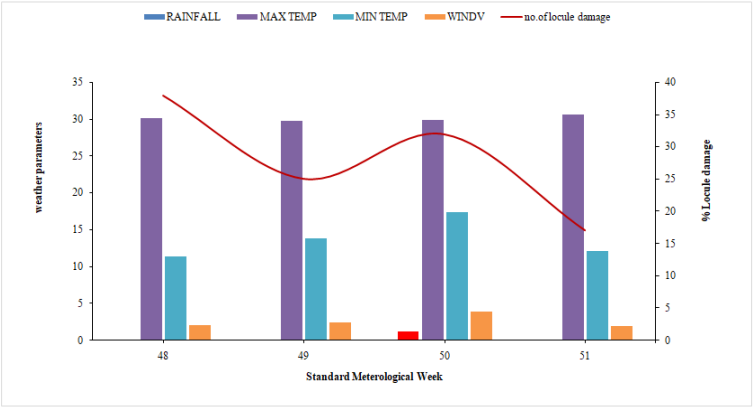

Fig. 3. Effect of Weather Parameters on Per cent Locule Damagedue to Pink Bollworm in *Bt* Cotton – Kharif, 2022-23.

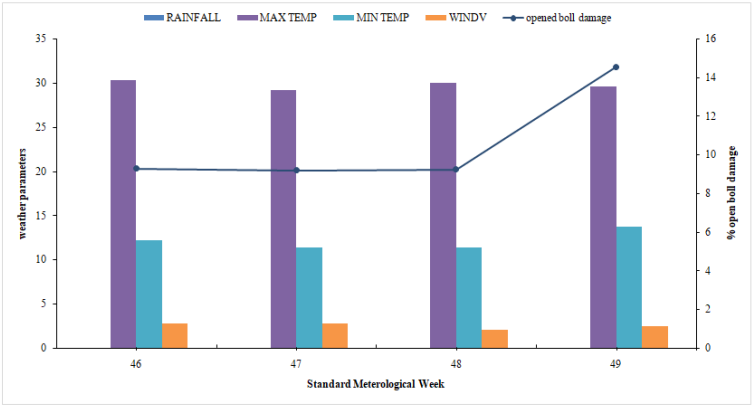

Fig. 4. Effect of Weather Parameters on Per cent Open Boll Damage due to Pink Bollworm in *Bt* Cotton – Kharif, 2022-23.

Table 1: Seasonal Incidence parameters of pink bollworm in *Bt* Cotton, Kharif, 2022-23.

SMW	Duration	Rosette flowers (%)*	PBW larval incidence*	Green boll damage (%)*	No. of pickings	Locule damage (%)*	Open boll damage (%)*
35	27-02 Sep	00	0	0.00			
36	03-09 Sep	1.52	0.65	0.00			
37	10-16 Sep	3.72	0.35	5.00			
38	17-23 Sep	5.74	0.45	10.00			
39	24-30 Sep	5.58	0.6	5.00			
40	01-07 Oct	6.20	0.5	25.00			
41	08-14 Oct	7.14	0.45	30.00			
42	15-21 Oct	9.75	0.45	35.00			
43	22-28 Oct	5.20	0.6	40.00			
44	29-04 Nov	7.56	0.55	40.00			
45	05-11 Nov	11.1	0.6	35.00	1st picking		
46	12-18 Nov	5.63	0.5	35.00		37.91	9.29
47	19-25 Nov	4.44	0.45	20.00	2nd picking	25.01	9.20
48	26-02 Dec	3.84	0.55	10.00		31.91	9.26
49	03-09 Dec	6.20	0.65	5.00	3rd picking	17.02	14.56
50	10-16 Dec	2.12	1.52	0.00			
51	17-23 Dec	3.00	0.75	0.00			
52	24-31 Dec	0.34	0.70	0.00			
#Average		5.24	0.61	17.35		27.96	10.5775

*Mean of 20 plants ; #Seasonal Mean

Table 2: Relationship between weather parameters and pink bollworm in *Bt* Cotton, Kharif, 2022-23.

Parameters	Rainfall	Max. Temp	Min. Temp	RH (Mrg)	RH (Evg)	Wind speed
Rosette flowers	0.12 NS	0.16 NS	-0.39 NS	-0.47 NS	-0.43 NS	-0.21 NS
Larvae damage /20 bolls	-0.17 NS	-0.15 NS	0.28 NS	-0.25 NS	-0.13 NS	-0.53 NS
Green boll damage (%)	-0.02	0.10	0.12	-0.05	0.15	-0.36*
Locule damage (%)	0.29 NS	0.11 NS	0.12 NS	-0.84 NS	0.47 NS	-0.33 NS
Open boll damage (%)	-	-0.23 NS	0.94 NS	0.55 NS	0.77 NS	-0.11 NS

**Correlation significance @ 1%; *Correlation significance @ 5%; NS – non-significant

CONCLUSIONS

The impact of pink bollworm on rosette flower formation, fruiting bodies, green bolls, larval population, locules, and open bolls analysed in the Kharif, 2022-23. Studies analysing correlations between pest populations and weather patterns have revealed that factors such as rainfall, maximum and minimum temperatures, morning and evening relative humidity and wind speed can all affect pest populations in diverse patterns of influence.

Acknowledgement. The authors are thankful to VNMKV, Parbhani, Maharastra, for providing facilities and relevant to conduct the experiment.
Conflict of Interest. None.

REFERENCES

Agarwal, R. A., A. P. Gupta, and D. O. Garg. (1984). Cotton pest management research. *Co-Publications, East Azad Nagar, Delhi*, 91.

Chavan, D. R., Zanwar, P. R., Ramesh, K. B., Babu, H. S., and Manjunatha, M. K. (2016). Population dynamics of sucking pests and their natural enemies of *Bt* cotton. *Advances in Life Sciences*, *5*(3), 954-958.

Choudhary, B., & Gaur, K. (2010). Bt cotton in India: A country profile. ISAAA series of biotech crop profiles. Ithaca, NY: ISAAA.

More, D. G., Gitte, A. N., Bhosle, B. B., Awaz, H. B., and Pawar, S. V. (2009). Population dynamics of different pests of *Bt* cotton under rainfed conditions. In "*National Symposium on Bt cotton: Opportunities and Prospects"* at CICR, Nagpur, pp-123.

Naik, V. C., Jothi, D., Dabhade, P. L., and Kranthi, S. (2014). Pink Bollworm *Pectinophora gossypiella* (saunders) infestation on *Bt* and Non-*Bt* Hybrids in India in 2011–2012. *Cotton Research Journal*, *6* (1), 37-40.

Nayak, G., S. B. Patil, D. N. Kambrekar and Shamarao Jahagirdar (2023). Studies on Seasonal Dynamics of Pink Bollworm, *Pectinophora gossypiella* (Saunders) on Bt Cotton. *Biological Forum – An International Journal*, *15*(10), 371-374

Patil, S. B. (2003). Studies on management of cotton pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechidae). Ph.D. thesis, University of Agricultural Sciences, Dharwad, Karnataka, India.

Reddy, V. S., Awasthi, A. K., Grace, G. D., and Kerketta, A. (2022). Seasonal incidence of pink bollworm *Pectinophora gossypiella* (Saunders) in cotton. *The Journal of Research Angrau*, *50*(2), 28-36.

Shinde, P. R., Hole, U. B., and Gangurde, S. M. (2018). Seasonal incidence of pink bollworm, *Pectinophora gossypiella* (Saund.) in *Bt* and non *Bt* cotton. *Journal of Entomology and Zoology Studies*, *6*(5), 1980-1983.

Singh, J. P., Lather, B. P. S., and Mor, B. R. (1988). Exit behavior of pink bollworm (*Pectinophora gossypiella*) larvae. *Indian Journal of Agricultural Sciences, 58*(3), 236–237.

Verma, H., Singh, V. K., Singh, P. P., Singh, S. K., Ansari, W. A. and Pandey, K. D. (2017). Role of *Pseudomonas* spp. in sustainable agriculture and disease management. *Agriculturally Important Microbes for Sustainable Agriculture: Volume 2: Applications in Crop Production and Protection*, 195-215.

How to cite this article: Nutalapati Vaishnavi, D.R. Kadam and Marella Sai Manoj (2024). Seasonal Incidence of Pink Bollworm *Pectinophora gossypiella* (Saunders) on *Bt* Cotton and Influence of Weather Parameters. *Biological Forum – An International Journal, 16*(6): 10-14.