Biological Forum – An International Journal **15(10): 371-374(2023)**

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

Studies on Seasonal Dynamics of Pink Bollworm, *Pectinophora gossypiella* (Saunders) on *Bt* Cotton

Gangappa Nayak[1]*, S. B. Patil[2], D. N. Kambrekar[3] and Shamarao Jahagirdar[4]

[1]Ph.D. Scholar, College of Agriculture, Raichur, UAS, Raichur (Karnataka), India.
[2]Professor Entomology (Retd.), University of Agricultural Sciences, Dharwad (Karnataka), India.
[3] Professor Department of Entomology, UAS, Dharwad (Karnataka), India.
[4] Professor and Head, Department of Pathology, UAS, Dharwad (Karnataka), India.

(Corresponding author: Gangappa Nayak)*
(Received: 22 July 2023; Revised: 26 August 2023; Accepted: 22 September 2023; Published: 15 October 2023)
(Published by Research Trend)

ABSTRACT: The field experiments were carried out in the farmer field of Somapur village (Dharwad taluka) during *Kharif* 2018-19. The peak moth activity was observed during the first week of December 46th meteorological standard week (421.50 moths / trap/week). Later the activity of moths declined gradually and become to its negligible level at December 4th week (49th MSW). The rosette flowers were ranged from 2.61 to 19.54 per cent with seasonal mean of 10.18 per cent. However, pink bollworm incidence in green bolls was noticed from the first fortnight of September (34th MSW) and increased gradually to reach its peak during the first fortnight of December (46th MSW). Total larval incidence was ranged from 5 to 81 larvae/50 bolls with a mean of 44.62 larvae /50 bolls and the green boll damage ranged from 6 to 54.00 per cent with mean of 28.25 per cent. Moreover, open boll damage was ranged from 33.58 to 41.27 per cent with a mean of 36.32 per cent during the cropping season. Furthermore, locule damage ranged from 24.50 to 48.50 per cent with mean of 35.87 per cent.

Keywords: Cotton, *Pectinophora gossypiella* (Saunders), Sleeve trap, Moth, Boll damage.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.), is an important fibre crop of the world and plays a significant role in the economy, social affair and employment. By far, cotton is the most important natural fibre or vegetable wool which has been in the commercially cultivation for domestic consumption and export needs in about 111 countries worldwide and hence called "King of fibres" (Santosh *et al*., 2009). The commercial cultivation of *Bt* cotton from 2002, a shift from erstwhile conventional varieties and hybrids changed the paradigm of cotton cultivation in India.

Worldwide cotton is being grown on area of 33.40 million hectare with an annual production of 121.40 million bales and productivity of 792 kg per ha. In India it is grown in area of 12.30 million hectare with a production of 28.50 million bales and productivity of 504 kg per ha (Johnson *et al.*, 2018).

Karnataka is the fourth largest producer of cotton in India with an area of 0.56 million hectare, production of 1.90 million bales and productivity of 571.68 kg per ha (Johnson *et al.*, 2018). Which is mainly grown in northern parts of the Karnataka *viz*., Raichur, Haveri, Dharwad, Belagavi and Ballari which offers ideal conditions for cotton production. Though the problems (biotic) associated with it are more but still farmers prefer to grow it because of profitability, drought resistant and minimum assured income.

Among many factors, those jeopardize the productivity of cotton are spectrum of insect pests, *viz*., American bollworm, *Helicoverpa armigera* (Hubner), Spiny bollworm, *Earias insulana* (Boiusduval), Spotted bollworm, *Earias vitella* (Fabricius) and pink bollworm *Pectinophora gossypiella* (Saunders) normally referred as bollworm complex, pose greater threat to cotton production, (Ghosh, 2001).

On average farmers apply 6 to 8 rounds of insecticides in the rainfed situation and 12 to 18 rounds in the irrigated situation (Kulkarni *et al*., 2003). Out of this, bollworm management alone consumes about 80 per cent of the insecticides (Gupta, 2001).

To reduce the pesticide usage on cotton, as an alternative approach to manage bollworm, transgenic *Bt* cotton has been developed to afford protection against cotton bollworms. However, the demonstration conducted across the country on *Bt* cotton has indicated that *Bt* technology is not panacea for all the pests, instead of integrated approach essential for the management of pests.

In *Bt* cotton, the expression of cry toxin varied thought the cropping period and declines after 85-100 DAS in the plant system, particularly under moisture stress and poor soil nutritional condition (Blaise and Kranthi 2011). Since, the pink bollworm is a late-season pest, its awareness coincides with the declination of cry protein. Hence, there is every chance for its survival in *Bt* cotton and inflict damage to the later formed bolls.

In recent years, the incidence of pink bollworm is assuming a major proportion even in *Bt* cotton hybrids *viz*., MRCH-7383 and MRCH-7357 BG-II hybrids suspecting that pink bollworm has developed resistance against *Bt* cotton.

MATERIALS AND METHODS

The field experiments were carried out in the farmer field of Somapur village (Dharwad taluka) during *Kharif* 2018-19. The *Bt* cotton MRCH-7383 was sown under unprotected condition in an area of about ten guntas following recommended agronomic practices in order to have good crop stand. Need based plant protection measures were taken to manage early season sucking pests and no plant protection measures were taken for pink bollworm management. The observations were recorded to ascertain seasonal dynamics of pink bollworm were like, Per cent Rosette flower, Pink bollworm population in green bolls, Per cent green boll damage, Good opened bolls (GOBs) and bad opened bolls (BOBs), Per cent locule damage and Moth trap catches.

RESULTS AND DISCUSSION

The data on pheromone trap catches of pink bollworm moth are presented in Table 1. The data revealed that, number of moth trap catches was fluctuated throughout the cropping period and ranged between 5.50 to 421.50 moths per trap per week with a mean of 169.00. The number of moth trap catches increased gradually with a initial population of 5.50 moths per trap per week during August III week (32nd standard week) and the moth trap catches reached peak population of 421.50 moths per trap per week during December I week (46th standard week). Later on the moth trap catches declined gradually and became to its negligible level at December IV week (49th standard week). These findings are in close conformity with Prasad *et al*. (2009) who reported peak adult emergence during the month of December (484 adults/trap/week). Similarly, Babu and Meghwal (2014) reported higher moth populations of pink bollworm during 41-52nd standard week corresponding with larval population in field. While, the prediction rate of populations of male moth catches of pink bollworm was 84 per cent during 2011.

Relationship between pink bollworm trap catches and weather parameters

To ascertain the relationship between activity of moths and the prevailing weather parameters, the data of trap catches and weekly weather parameters (Table 2) subjected to correlation analysis. The pink bollworm trap catches have shown significant negative correlation with rainfall (r= -0.742), morning relative humidity (r= -0.645), afternoon relative humidity (r= -0.672) and significant positive relationship with minimum temperature (r= 0.450) whereas, non-significant negative relationship with maximum temperature (r = -0.006) (Table 2).

Table 1: Average pink bollworm moths trapped/week and weekly weather parameters during (2018-19).

Standard weeks	No. moths/ trap/week (mean of two traps)	Rainfall (mm)	Temperature (°C)		Relative humidity (%)	
			Maximum	Minimum	Morning (RH_1)	Afternoon (RH_2)
AUG I (30th SMW)	0.00	6.00	26.70	20.60	89.00	83.00
II (31st SMW)	0.00	18.60	26.00	20.30	89.30	86.10
III (32nd SMW)	5.50	32.80	24.80	20.40	91.60	88.40
IV (33rd SMW)	12.50	9.00	25.90	20.00	89.40	80.00
SEP I (34th SMW)	30.50	2.20	27.80	18.70	86.30	74.90
II (35th SMW)	58.00	0.00	30.60	17.80	82.40	52.90
III (36th SMW)	77.50	24.20	29.80	19.40	81.40	68.10
IV (37th SMW)	89.50	36.80	30.90	19.40	83.30	70.40
OCT I (38th SMW)	107.50	13.80	32.50	19.80	77.30	60.00
II (39th SMW)	141.00	0.40	32.40	19.60	83.00	49.40
III (40th SMW)	169.00	62.60	30.10	19.30	82.70	71.70
IV (41st SMW)	220.50	0.00	32.10	16.80	60.00	55.90
NOV I (42nd SMW)	292.50	0.00	31.90	17.10	63.30	34.70
II (43rd SMW)	328.50	0.0.	31.20	15.60	59.00	32.30
III (44th SMW)	387.00	34.40	29.90	17.90	79.40	56.70
IV (45th SMW)	413.50	0.00	29.20	12.90	60.00	40.00
DEC I (46th SMW)	421.50	38.40	29.70	17.20	77.40	54.90
II (47th SMW)	301.50	0.00	29.40	15.10	76.60	54.10
III (48th SMW)	189.50	0.00	27.10	13.20	71.00	51.90
VI (49th SMW)	152.50	0.00	28.70	13.30	60.10	43.40

SMW= Standard Meteorological week

Table 2: Correlation between pink bollworm trap catches and weather parameters.

Pink bollworm	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning (RH1)	Afternoon (RH2)	
P. gossypiella	-0.006	0.450*	-0.645**	-0.672**	-0.742**

*. Correlation is significant at the 0.05 level.
**. Correlation is significant at the 0.01 level

The incidence of pink bollworm was recorded on the flowers by counting the total number of rosetted flowers on 50 randomly selected plants. The incidence was noticed from first fortnight of August (31th standard week) and increased gradually with the advancement of crop growth reaching it's peak incidence (19.54 %) during second fortnight of September (37th standard week). Thereafter, the incidence of pink bollworm in rosetted flowers was declined gradually and became negligible with the formation of bolls. The percent rosetted flower ranged from 2.61 to 19.54 during cropping period (Table 3).

During the peak incidence, considerably higher percentage of 19.54 rosetted flowers was noticed during second fortnight of September with seasonal mean of 10.18 percent. The population of pink bollworm in cotton flowers revealed that, even the *Bt* cotton had significant incidence of pink bollworm on cotton flower (Table 3). These results are in confined with Patil (2002) who recorded higher percentage of rosetted flowers during 2001-02 (21.12 %) and 2004-05 (23.55 %) with higher incidence of green bolls damage to the tune of 38.75 to 54.45 per cent. Similarly, Verma *et al.* (2017) recorded 3.33 per cent rosetted flower during month of July 2017.

Data on per cent green boll damage due to pink bollworm infestation in *Bt* cotton during 2018-19 are presented in table 3. The per cent green boll damage due to PBW was noticed from first fortnight of September (35th standard week) (6.00 %) and increased gradually and reached its peak (54.00 %) during first fortnight of December (47th standard week). Thereafter, the green boll damage due to pink bollworm infestation was declined with the maturity of bolls. The green boll damage ranged between 6.00 to 54.00 per cent with a mean of 28.25 per cent during the cropping period. Present results are in line with Kalkal *et al*. (2014) who reported maximum (3.75 %) infestation of pink bollworm in green bolls during the 2nd fortnight of December. Similarly, Kranthi (2015) reported higher incidence of pink bollworm larvae on BG-II during 2012, 2013 and 2014 and the damage ranged between 0-80 per cent on BG-II hybrids. Further, Babu *et al*. (2015) recorded 2.50 to 47.79 and 0.05 to 1.90 per cent infestation of pink bollworm in green bolls in Vadodara and Kheda districts, respectively. In contrast to these findings, Badiger *et al*. (2011) recorded 1.19 larvae per 20 green bolls in MRC-7918 BG-II hybrid.

In the present study, the larval incidence of pink bollworm in green bolls was observed from first fortnight of September (35th standard week) (5 larvae/50 bolls) and increased gradually with advancement of cropping period, reaching its peak (81 larvae /50 bolls) during first fortnight of December (47th standard week). Thereafter, the larval population in green bolls was declined and became negligible. However, the population was continued to observe till the entire crop was harvested. Present findings are in conformity with Verma *et al*. (2017) who reported, the peak larval population on cotton bolls in the 2nd week of September with intensity of 7.00 larvae per 30 bolls during 2012 and peak infestation was recorded during 3rd week of September 2013 with intensity of 8.00 larvae per 30 bolls. Similarly, Patil *et al*. (2007) recorded the highest pink bollworm larvae of 67.00 and 42.00 larvae per 20 green bolls during 2005-06 and 2006-07, respectively.

Table 3: Incidence of pink bollworm on *Bt* cotton.

Fortnight intervals	Rosetted flower (%)	Green boll damage (%)	No. of larvae /50 bolls
August			
I fortnight (31st SMW)	7.51	0.00	0.00
II fortnight (33rd SMW)	10.86	0.00	0.00
September			
I fortnight (35th SMW)	17.63	6.00	5.00
II fortnight (37th SMW)	19.54	8.00	17.00
October			
I fortnight (39th SMW)	12.42	16.00	34.00
II fortnight (41st SMW)	11.63	26.00	39.00
November			
I fortnight (43rd SMW)	9.81	38.00	47.00
II fortnight (45th SMW)	6.33	42.00	66.00
December			
I fortnight (47th SMW)	3.45	54.00	81.00
II fortnight (49th SMW)	2.61	36.00	68.00
Mean	**10.18**	**28.25**	**44.62**
SD ±	**5.25**	**18.28**	**28.28**

Table 4: Open boll damage and locule damage due to incidence of pink bollworm.

Pickings	Open boll damage (%)	Locule damage (%)
First	33.58	24.50
Second	36.42	26.00
Third	41.27	48.50
Fourth	34.86	44.50
Mean	**36.53**	**35.87**
SD ±	**2.91**	**10.73**

The higher percentage open boll damage (36.53) was recorded during the season. These results are in close conformity with Verma *et al*. (2017) who reported 22.97 and 28.88 per cent of open boll damage during 2012 and 2013, respectively.

The highest (48.50 %) locule damage due to pink bollworm infestation was recorded at third picking of the crop. Similar results were given by Patil (2002) who reported the increased locule damage of about 44.80 per cent during 2001-02 and 62.56 per cent during 2004-05 of cropping season.

CONCLUSION

The seasonal dynamic studies helped in regarding pest appearance and its infestation at early stage of cropping period so, that helped to take up preventive measures to avoid the anticipatory crop loss.

FUTURE SCOPE

(i) By knowing the seasonal dynamics, management practices will be taken at right time.
(ii) Eco-friendly management

REFERENCES

Babu, R. S. and Meghwal, M. L. (2014). Population dynamics and monitoring of sucking pests and bollworms on *Bt* cotton in humid zone of Southern Rajasthan. *International Quarterly Journal of Life Sciences*, *9*(2), 629-632.

Babu, C. V., Sujit, K. and Dhanajay (2015). Cotton innovate. Weekly newsletter, Central Institute of Cotton Research, Nagpur, pp. 17-23.

Badiger, H. K., Patil, S. B., Udikeri, S. S., Biradar, D. P., Chattannavar, S. N., Mallapur, C. P. and Patil, B. R. (2011). Comparative efficacy of interspecific cotton hybrids containing single and stacked *Bt* genes against pink bollworm, *Pectinophora gossypiella* (Saund.) and tobacco caterpillar, *Spodoptera litura* (Fab.). *Journal of Farm Sciences*, *24*(3), 320-324.

Blaise, D. and Kranthi, K. R. (2011). Cry1Ac expression in transgenic *Bt* cotton hybrids is influenced by soil moisture and depth. *Current science*, *101*(6), 783-786.

Ghosh P. K. (2001). ISCI Silver Jubli Lecture Series-Lecture on "Genetically modified crops in India with special references to *Bt* –cotton". *Journal of the Indian Society for Cotton Improvement*, *18*(4), 1106-107.

Gupta G, P. (2001). Role of neem in sustainable cotton pest management, *National Journal of Plant Improvement*, *30*(4), 37-43.

Johnson, J., Stephen, M., Meyer, L. and Stone, L. (2018). Cotton outlook. UASD'S 94th Agricultural outlook forum, United States Department of Agriculture.

Kalkal, D., Roshan, L., Dahiya, K. K., Jat, B. L. and Ankit, K. (2014). Effect of abiotic factors on population dynamics of pink bollworm in relation to genetically modified cotton. *Journal of Cotton Research and Development*, *28*(2), 280-285.

Kranthi, K. R. (2015). Pink bollworm strikes *Bt* cotton. *Cotton Statistics News*, *35*, 1-6.

Kulkarni, K. A., Patil, S.B and Udikeri S. S. (2003). Sustainable insect pest management. In: "*National Symposium for Sustainable Insect Pest Management*" Chennai. February, pp.232-240.

Patil, B.V., Bheemanna, M., Hanchinal, A. C., Hosmani, A. C. and Bansi, A. B. (2007). Studies of pink bollworm, *Pectinophora gossypiella* (Saunders) on cotton at Raichur, *Journal of Cotton Research and Development*, *21*(2), 224-226.

Patil, S. B. (2002). Studies on management of cotton pink bollworm *Pectionophora gossypiella* (Saunders) (Lepidoptera: Gelechidae). *Ph.D. Thesis*, *University of Agricultural Sciences*, Dharwad (India), pp. 43-61.

Prasad, N. V. V. S. D., Rao, M. and Rao, N. H. (2009). Performance of *Bt* cotton and non *Bt* cotton hybrids against pest complex under unprotected conditions. *Journal of biopesticides*, *2*(1), 107-110.

Santosh, B. M., Patil, B. V., Udikeri, S. S., Awaknavar, J. S. and Katageri, I. S. (2009). Impact of *Bt* cotton on pink bollworm, *Pectinophora gssypiella* (Saunders) infestation. *Journal of Farm Sciences*, *22*(2), 322-326.

Verma, S. K., Singh, D. R., Jeewesh, S., Saurabh, S. and Nirvesh, Y. (2017). Population dynamics of pink bollworm, *P. gossypiella* (Saunders) in cotton crop. *International journal of pure and applied bioscience*, *5*(2), 801-806.

How to cite this article: Gangappa Nayak, 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.