The Andhra Agric. J 66 (4): 632-636, 2019

Influence of Weather Parameters on Pheromone Trap Catch of Pink Bollworm, *Pectiniophora gossypiella* on Bt Cotton under Field Condition

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ABSTRACT

Field investigations on seasonal occurrence, pheromone monitoring, influence of abiotic factors on incidence of pink bollworm in cotton were conducted during *kharif*, 2018-19 crop season at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh. Monitoring of male adult moths of pink bollworm through pheromone trap catches of pink bollworm revealed that the catches of male moths started from the month of August and the highest trap catch was observed during 4th std. week (1756.13 moths/trap). The correlation studies revealed that pheromone trap catch exhibited significant positive correlation and significant negative correlation with morning relative humidity and minimum temperature respectively. Weather parameters have influenced the pheromone trap catch to the extent of 44.95 per cent. The knowledge may be utilized to adjust sowing date or to make acceptable modifications in the cropping system and also to time the various approaches for the control in an ecologically sound manner against PBW on Bt cotton.

keywords: *Pheromone trap, pink bollworm, weather parameters.*

Cotton considered as "white gold" is an important fiber as well as cash crop of India. There is tremendous change in cotton cultivation over the past fifteen years since Bt cotton has dominated the cultivation practices. Bt cotton is a genetically modified pest resistant cotton variety having Cry toxins leading to management of bollworms which are a serious problem in cotton cultivation. Bt cotton was first introduced in the year 1996 and it was cultivated widely across the world with 121.37 million bales of 480 lakh bales estimated production (United States Department of Agriculture, Feb 2019). In 2002, a joint venture between Monsanto and Mahyco introduced Bt cotton to India. India is the leading cotton producer in the world with highest acreage of Bt cotton with an area of 122.38 lakh hectares with an annual production of 361 lakh bales and 501 kg lint per hectare productivity. In Andhra Pradesh, Bt Cotton occupies an area of 5.51 lakh hectares with an annual production of 20 lakh bales and productivity of 688 kg lint ha^{-1} (AICCIP, Annual Report, 2018-2019). Pink bollworm is one of the most serious pests of cotton affecting yield and quality of cotton during recent past and it has emerged as a threat to cotton cultivation in southern and central parts of India due to probable break down of resistance to Cry toxins present in Bt cotton. The pink bollworm has been found to be difficult to manage in Andhra Pradesh for the last three years, as the damage levels are high recording losses to the extent of 2 to 5 q/ha. The infestation of pink bollworm on BG II cotton was reported with 55 per cent locule damage and reduction in seed cotton yield in the range of 35-90 per cent in India (Naik *et al*., 2014).

MATERIAL AND METHODS

Four pheromone baited sleeve traps were erected at two meter height in bulk plot with Jaadoo BG II cotton hybrid, for monitoring the pink bollworm adult emergence from the second week of August, 2018 till the end of March 2019 at Regional Agricultural Research Station, Lam, Guntur. The pheromone impregnated rubber septa (Pheromone lure) 1:1 mixture of (Z, Z)-and (Z, E)-7, 11-hexadecadienyl acetate under the trade name Pherosensor was used in pheromone monitoring studies and the lures were changed at 15 days interval. Every alternate day adult male moth catches in the pheromone traps were recorded. The data was pooled standard week wise and correlated with the collected weather parameter *viz.,* maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall and number of rainy days. Regression studies were also worked out between trap catch and weather parameters.

RESULTS AND DISCUSSION

Four pheromone sleeve traps were placed in a bulk plot to observe the seasonal incidence of pink bollworm from the beginning of August, 2018 till the end of March 2019. The moth catches were recorded daily and the data was pooled and presented standard week wise.

Table 1. Pheromone adult trap catch data of pink bollworm, *P. gossypiella* during *kharif,* 2018-19

Standard Metrological week	Dates	Pheromone trap catch/trap/week
33	13-19 Aug	0
34	20-26	0.13
35	27- 2 Sep	5.88
36	03-Sep	3.67
37	Oct-16	2.75
38	17-23	1.38
39	24-30	0.38
40	1 – 7 Oct	0.63
41	Aug-14	1.88
42	15-21	3
43	22-28	3.38
44	29- 4 Nov	6.88
45	05-Nov	13.38
46	Dec-18	72.88
47	19-25	137.88
48	26-2 Dec	163.38
49	03-Sep	90.25
50	Oct-16	139.75
51	17-23	160.88
52	24-31	175.63
1	1-7 Jan	51.38
2	Aug-14	158.25
3	15-21	542.25
4	22-28	1756.13
5	29- 4 Feb	1029.88
6	05-Nov	324.25
7	Dec-18	712.55
8	19-25	448
9	26- 4 Mar	527.75
10	05-Nov	856.95
11	Dec-18	434.5

Table 2. Correlation between pink bollworm incidence and weather parameters during *khari,* 2018-19

variable	'r' values
Trap catch	-
Maximum temperature	-0.181
Minimum temperature	- 0360**
Morning relative humidity	0.499**
Evening relative humidity	-0.32
Rainfall	-0.223
Number of rainy days	0.215

** Correlation is significant at 0.01 level (2 tailed)
*Correlation is significant at 0.05 level (2 tailed)

Table 3. Regression coefficients of pink bollworm, *P. gossypiella* incidence on BG II cotton hybrid (Jaadoo BGII) v/s weather parameters during *kharif,* 2018-19

Variable	Regression model	R^2
Trap catch Vs Weather parameters	$Y= 1247.29 -153.37 X_1 + 72.01X_2+ 45.71 X_3 – 26.63 *X_4 -34.61X_5 +37.54X_6$	0.44

X_1 = Maximum temperature
X_2 = Minimum temperature
X_3 = Morning relative humidity
X_4 = Evening relative humidity
X_5 = Rainfall
X_6 = Number of rainy days

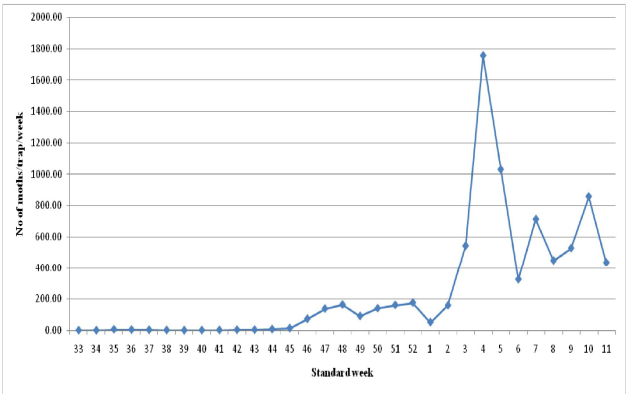

Fig. 1. Sex pheromone adult trap catch of pink bollworm *P. gossypiella* during *kharif*, 2018-19

The recorded data showed that the adult trap catch of pink bollworm has started from the month of August and its build up was more or less steady till the second week of November corresponding to 45th std. week (13.38 moths/trap), thereafter there was a gradual increase in adult trap catch from 3rd week of November corresponding to 46th standard week (72.88 moths/trap) to 3rd week of December corresponding to 51th standard week (160.88 moths/trap), and the crop was at full bloom stage. A sudden spurt in moth emergence was witnessed from 4th week of December, corresponding to 52nd standard week (175.63moths/ trap) and continued with the highest trap catch during 4th week of January corresponding to 4th std. week (1756.13 moths/trap) and the crop was at peak boll formation stage. From then, it was a sudden decline in adult emergence in 2nd week of February corresponding to 6th standard week (324.25 moths/ trap) but the moth catch was more *i.e.* 712.55 in 3rd February corresponding to 7th std. Week and later decreased (Table 1 and Fig.1).

The preset findings are in line with Gupta *et al.* (1990) who reported that populations of adult males were observed from the 2nd fortnight of August to the 1st week of November and these results were in close conformity with the findings of Gopalaswamy *et al.* (2001) who reported that progressive build up of pink bollworm starts from November.

The results of our findings with respect to peak pheromone catch are in harmony with the findings of Babu and Meghwal (2014) who observed that the peak activity of pink bollworm moths was occurred at 41st to 52nd standard week. Kaur *et al.* (2016) reported that the peaks of moth collection was recorded during 41st and 43rd SMW and Sharma *et al.* (2015) reported that the highest pink bollworm moth catches were recorded during 4th standard week during 2010-2011 Ali *et al.* (2016) also reported that the highest emergence of pink bollworm was observed in the April, October and November 2009-10 in Multan and also these results were in close association with Shinde *et al.* (2018) who reported that the peak adult trap catch of pink bollworm was found in the first week of November, corresponding to 44th SW during 2016-17. These results are also in accordance with the findings of Anonymous (2017), who reported that, in Rahuri, the population of *P. gossypiella* moth varied from 3 to 14 adults/ trap/day during 40th to 50th standard week. Similar results were also obtained by Sandhya Rani *et al.* (2010) who 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), Zala *et al.* (2015) also found that pink bollworm was active from second week of November in Vododara, Gujarat, India.

The incidence showed a sudden decline in adult emergence in 2nd week of February corresponding to 6th standard week and another peak moth emergence was observed from 2nd week of March corresponding to 10th standard week. These findings are in agreement with the reports of Sanga Reddy and Patil (1997) who observed that February month is very much congenial for population build up. Similarly Ahmed (1979) from Pakistan also reported that the increased infestation of pink bollworm was observed during February to March. The results are also supported by Gopalaswamy *et al.* (2001) who reported that peak level of pink bollworm activity was observed from February to the beginning of April. In contrast to these results Cividanes (1989) reported that the peak population of pink bollworm was recorded in April, May, June, October and November. From February 2nd week (6th std. week) onwards the pink bollworm population progressively declined to negligible level in March by 11th standard week, when the crop was completely harvested. These results are in agreement with the reports of Sanga Reddy and Patil (1997) who recorded the low trap catches of pink bollworm adults in the month of April and May.

Seasonal occurrence of a pest with reference to favorable stage of the crop growth suitable for breeding as well as feeding will give a clue about the extent of activity. The knowledge may be utilized to adjust sowing date or to make acceptable modifications in the cropping system and also to time the various approaches for the control to have an ecologically sound method to check the pest population.

Correlation studies between pheromone trap catch and weather parameters:

The pheromone trap catches of adult moth and the corresponding meteorological data were statistically correlated to understand the relationship between pink bollworm incidence and weather

parameters. The correlation coefficient values (r) are presented in the (Table 2).

The pheromone trap catch was non significant and negatively correlated with the weather parameters like maximum temperature (r=-0.181), evening relative humidity (r=-0.320), rainfall (r=-0.223). Number of rainy days (r=0.215) is non significant and positively correlated, whereas morning relative humidity (r=0.499**) and minimum temperature (r=-360**) exhibited significant positive correlation and significant negative correlation respectively.

These results are in close conformity with Pazhanisamy and Deshmukh (2011) who reported that minimum temperature had significant positive correlation with trap catch and morning relative humidity had a significant negative correlation with trap catch. Regarding rainy days and relative humidity the present results corroborate with Ali *et al*.(2016) who reported that number of rainy days is positive and non significant and the negative impact of evening relative humidity on moth catch. Shinde *et al*. (2018) also reported that morning relative humidity had significant negative correlation with trap catch and maximum temperature, rainfall had a non significant negative correlation with pheromone catch. The present findings in which pheromone traps had a significant negative correlation with minimum temperature was supported by Sharma *et al.,* 2015 and Babu and Meghwal, 2014. Shivanna *et al*. (2012) also observed that trap catches of *P. gossypiella* showed significant positive correlation with minimum temperature and negative correlation with humidity and rainfall.

Regression studies

The data pertaining to the incidence of pink bollworm and weather parameters were analysed with MLR technique by using SPSS tool and the regression equations were furnished in the Table 3.

Pheromone trap catch Vs Weather parameters

The pheromone trap catch data with the weather parameters was analysed with MLR technique by using SPSS tool and the following multiple regression equation was obtained.

$$Y= 1247.29 -153.37 X_1 + 72.01X_2+ 45.71 X_3 – 26.63*X_4-34.61X_5 +37.54X_6$$

Where Y = Trap catch
X_1= maximum temperature (^{0}C)
X_2= minimum temperature (^{0}C)
X_3= morning relative humidity(%)
X_4= evening relative humidity (%)
X_5= rain fall (mm)
X_6 = rainy days

The weather parameters influenced the trap catch to the extent of 44.95 per cent (R^2=0.44).

In contrast Gopalaswamy *et al*. (2002) reported that weather parameters together influenced the trap catch to an extent of 16.53 per cent only which is not a significant representation. Sandhya Rani *et al*. (2010) reported that weather parameters together influenced the trap catch to an extent of 48.95 per cent which is a significant representation and also Ali *et al*. (2016) reported that 72.75 per cent of weather factors significantly contributed the variation in population fluctuation of moth catches during 2010, while in 2011 the weather factor contributed only 12.64 per cent which is non significant impact on population fluctuation. From the present studies, it is evident that pheromone trap catches were appreciably influenced by the weather parameters put together. The pheromone trap catch can serve as a valuable tool for regular monitoring of pink bollworm build up in cotton ecosystem and facilitate timely chemical intervention in cotton as influenced by weather parameters to a considerable extent.

CONCLUSION

Pheromone monitoring of male adult catches of pink bollworm revealed that the catches of male moths of pink bollworm was started from the month of August.The ETL was crossed at 46th std. week *i.e.,* 72.88 moths/trap/week corresponding to 2nd week of November. The highest trap catch was observed during 4th std. week (1756.13 moths/trap/week). The correlation studies showed that pheromone trap catch exhibited significant positive correlation and significant negative correlation with morning relative humidity and minimum temperature respectively Weather parameters have influenced the pheromone trap catch to the extent of 44.95 per cent. The knowledge may be utilized to adjust sowing date or to make acceptable modifications in the cropping system and also to time the various approaches for the control to have an ecologically sound method to check the pest population.

LITERATURE CITED

Ahmed Z 1979 Monitoring the seasonal occurrence of the pink bollworm in Pakistan with sex pheromone traps. *Plant Protection Bulletin FAO*. 27:19-20.

AICCIP – Annual Report, 2018-19. *http : // accip. Cicr.org.in*

Ali A, Haffez F, Muhammad F, Karar H, Abbas M and Khan B T 2016 Influence of weather

factors on the trapped population of pink bollworm (*Pectinophora gossypiella*) under Multan Agro-ecosystem. *Journal of Entomology and Zoology Studies*. 4 (1): 02-06.

Anonymous ICAR - All India Coordinated Research Project on Cotton - *Annual Report* (2016–17), E6-E26, 2017.

Babu S R and Meghwal M 2014 Population dynamics and monitoring of sucking pests and bollworms on Bt cotton in humid zone of southern Rajasthan. *The Bioscan*. 9(2): 629-632.

Cividanes F J 1989 Population dynamics of *Pectinophora gossypiella* (Saunders) (Lepidoptera:Gelechiidae) in the northern region of Parana. *Cientifica*. 17 (2):251-259.

Gopalaswamy S V S, Rao N H P and Khalid Ahmed 2002 Influence of weather on incidence of pink bollworm in cotton in Andhra Pradesh. *Journal of Cotton Research and Development.* 16 (2):203-207.

Gopalaswamy S V S, **Rao N H P, Khalid Ahmed and Hanumantha Rao V 2001** Seasonal occurrence of pink bollworm (*Pectinophora gossypiella*) on cotton in Andhra Pradesh. *The Andhra Agricultural Journal*. 48: 257-262.

Gupta G P, Kishore P and Dashisht A K 1990 Monitoring of pink bollworm, *Pectinophora gossypiella* (Saunders), males through pheromone traps and weather parameters affecting population build up. *Journal of Entomological Research*. 14 (1): 21-29.

Kaur A, Vijay Kumar and Dhawan A K 2016 Population monitoring of cotton bollworm moth with sex Pheromones in Punjab, India. *International Journal of Agricultural Science and Research*. 6 (3): 235-240.

Naik C B V, 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*. 6:37–40.

Pazhanisamy M and Deshmukh S D 2011 Influencing of weather parameters on pheromone trap catches of cotton bollworms. *Recent Research in Science and Technology*. 3(4): 136-139.

Sandhya Rani B, Prasad N V V S D, Arjuna Rao P and Srinivasa Rao V 2010 Seasonal progression and incidence of *Pectinophora gossypiella* (Saunders) on cotton. *Annals of Plant Protection Sciences*. 18: 323-26.

Sanga Reddy N K and Patil B V 1997 Studies on the seasonal incidence of pink bollworm, *Pectinophora gossypiella* (Saunders) on cotton. *Karnataka Journal of Agricultural Sciences*. 10 (1): 233-236.

Sharma A S R, Rama Reddy Y, Jaffar Basha S and Padmalatha Y 2015 Population dynamics of cotton insect pests in scarce rainfall zone of Andhra Pradesh. *National Symposium on "Future Technologies*: *Indian Cotton in the Next Decade*" held on Dec. 17-19th, 2015 at Guntur. pp. 157-164.

Shinde P R, Hole U B and Patil P V 2018 Seasonal population fluctuation of pink bollworm, *Pectinophora gossypiella* (Saund.) as monitored by gossyplure. *Journal of Entomology and Zoology Studies*. 6 (5): 1998-2000.

Shivanna B K, Somashekharappa P R, Imran Khan H S and Noor Nawaz A S 2012 Monitoring cotton bollworms with pheromone trap catches and their relation with weather parameters. *Environment and Ecology*. 30 (3A): 683-688.

United States Department of Agriculture Foreign Agricultural Service reports, February 2019. *https://apps.fas.usda.gov/psdonline/circulars/cotton.*

Zala M B, Thumar R K, Bharpoda T M and Borad P K 2015 Emerging insect pests of Bt cotton in middle Gujarat. In: *National Symposium on "Future Technologies: Indian Cotton in the Next Decade*" held on Dec. 17-19th, 2015 at Guntur, Book of Papers, p.463-468.

Received on 24.06.2019 and revised on 18.11.2019