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Seasonal population fluctuation of pink bollworm, *Pectinophora gossypiella* (Saund.) as monitored by gossyplure

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Abstract
An investigation was undertaken with an objective to study the seasonal population fluctuation of pink bollworm under field condition at the Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, (Maharashtra) for two years (2016-17 and 2017-18). The results indicated that the buildup of adult trap catch of pink bollworm was in the third week of October corresponding to 42nd SW (36.2 moths/trap/week), thereafter there was gradual increase in adult trap catches and a sudden increase in moth emergence was witnessed from first week of November, corresponding to 44th SW (98.5 moths/trap/week) during 2016-17. During 2017-18, trap catches began earlier reaching to its first peak in the third week of October (43rd SW) (158.35 moths/trap/week) and second peak of adult trap catch was observed in the fourth week of November (48th SW) (119.21 moths/trap/week). The pheromone trap catches in cotton had negative and non-significant relationship with maximum temperature, rainfall, and rainy days, whereas, it had negative and significant relationship with minimum temperature, morning relative humidity and evening relative humidity during both years.

Keywords: Pink bollworm, *Pectinophora gossypiella*, pheromone traps, gossyplure, *Bt* cotton, genotypes

Introduction
Cotton, white gold is an important fibre crop of global significance, cultivated in tropical and subtropical regions of more than seventy countries. India is the largest producer of cotton in the world accounting for about 25% of the world cotton production. Average per hectare yield of cotton reduced to 519 kgs per hectare in 2017-18 as against 542 kgs per hectare in 2016-17 in India (Anonymous, 2018) [2]. Though, there are several reasons attributed to this low yield, losses due to pests assume significant importance as cotton crop is a heaven for insects. The pink bollworm, *Pectinophora gossypiella* (Saunders), was described by W.W. Saunders in 1843 as *Depressaria gossypiella* from specimens found to damaging cotton in India. At present, the pink bollworm has been recorded in nearly all cotton-growing countries of the world and is a key pest in many of these areas. In recent years, severe damage to bolls by pink bollworm and yield-losses were observed in *Bt*-cotton in many regions of Gujarat and some parts of AP, Telangana and Maharashtra. (Kranthi, 2015) [10]. Maharashtra is also having more than 90% area under *Bt* cotton genotypes. Since gossyplure, the true sex pheromone of the pink bollworm, became available in 1974, it has been widely used for survey and control work. Therefore, the present studies were designed to collect information on the incidence and population fluctuation of pink bollworm using pherosensor sleeve trap baited with gossyplure, and to study the effect of abiotic factors on population fluctuation.

Methodology
For monitoring seasonal population fluctuation of pink bollworm "Pherosensor sleeve" traps baited with gossyplure were used in cotton field at the experimental farm of AICCIP, MPKV, Rahuri. These rubber septa were impregnated with gossyplure (Cis-7, cis-11-Hexadecadien-1-yl acetate). Five such traps were installed 50 m apart from each other within the top 15 cm of the cotton foliage from the first week of August till the end of December during both seasons. The traps were rebaited at 45 days interval to maintain them at full catching efficiency. The traps were examined weekly for recording the moth catches. The temperature, relative humidity, rainfall and rainy days data were also recorded simultaneously.

Result and Discussion

The data pertaining to pink bollworm moth catches were recorded and presented standard week wise in table 1.

During the first season (2016-17), 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 third week of October corresponding to 42nd standard week (36.2 moths/trap/week), thereafter there was gradual increase in adult trap catches and a sudden increase in moth emergence was witnessed from first week of November, corresponding to 44th standard week (98.5 moths/trap/week) and continued at high level till the end of November corresponding to 47th standard week (123.5 moths/trap/week) and thereafter showed sudden decline in adult catches. The highest trap catch was observed during 45th standard week (142.6 moths/trap/week). Second peak of moth catch was observed in third week of December corresponding to 51st standard and from then onwards the pink bollworm population progressively declined.

During succeeding year (2017-18) of investigation also, similar trend was confirmed, but the adult trap catch of pink bollworm began earlier and there after increased gradually reaching to its first peak in the fourth week of October (43rd standard week) (158.35 moths/trap/week) and thereafter declined. Second peak of adult trap catch was observed in the fourth week of November (48th standard week) (119.21 moths/trap/week).

Pooled analysis of data did not deviate from the previous two years results. The adult trap catch of pink bollworm began from October second week (41st standard week) and thereafter increased gradually reaching to its first peak in 45th MW (140.39 moths/trap/week), but conversely, steady maintained population of adult moths were observed up to end of December with seasonal mean of 59.83 moths/trap/week (Table 1).

Table 1: Pheromone trap catches during 2016-17, 2017-18 and pooled

Date	MW	Average Pink bollworm moths trapped/trap		
		2016-17	2017-18	Pooled
30 Jul - 05 Aug	31	0.2	0.8	0.50
06 Aug - 12 Aug	32	0.6	1.4	1.00
13 Aug - 19 Aug	33	0.4	3.25	1.83
20 Aug - 26 Aug	34	1.4	4.36	2.88
27 Aug - 02 Sep	35	5.2	6.21	5.71
03 Sep – 09 Sep	36	11.4	13.25	12.33
10 Sep – 16 Sep	37	19.7	39.68	29.69
17 Sep – 23 Sep	38	33.9	56.32	45.11
24 Sep – 30 Sep	39	42.8	51.24	47.02
01 Oct – 07 Oct	40	56.9	41.25	49.08
08 Oct – 14 Oct	41	49.7	65.33	57.52
15 Oct – 21 Oct	42	36.2	109.68	72.94
22 Oct – 28 Oct	43	52.6	158.35	105.48
29 Oct – 04 Nov	44	98.5	148.35	123.43
05 Nov – 11 Nov	45	142.6	138.17	140.39
12 Nov – 18 Nov	46	134.5	98.32	116.41
19 Nov – 25 Nov	47	123.5	54.25	88.88
26 Nov – 02 Dec	48	68.8	119.21	94.01
03 Dec – 09 Dec	49	58.2	106.35	82.28
10 Dec – 16 Dec	50	55.6	85.24	70.42
17 Dec – 23 Dec	51	124.2	65.24	94.72
24 Dec – 31 Dec	52	102.4	48.39	75.40
Seasonal Mean		55.42	64.24	59.83

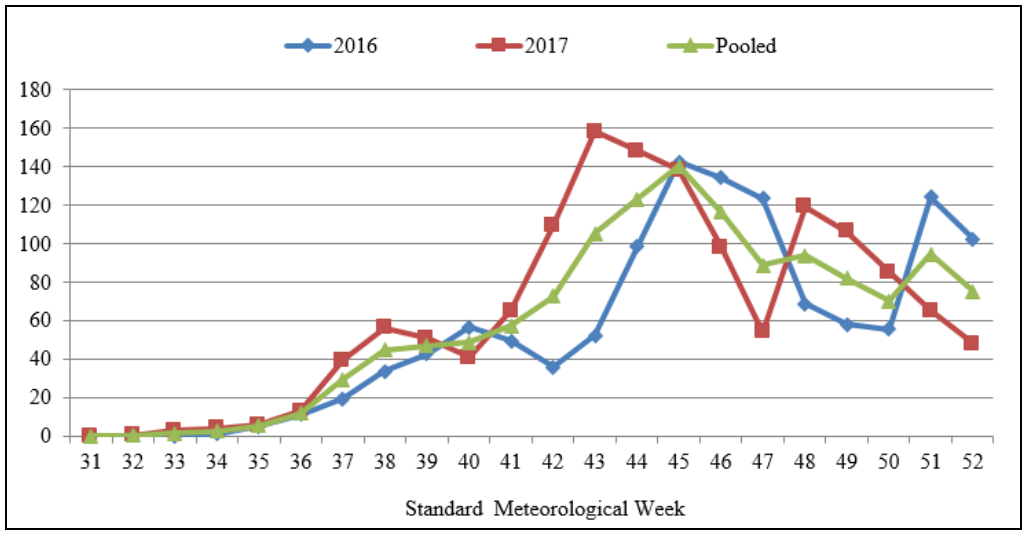

Fig 1: Pheromone trap catches during 2016-17, 2017-18 and pooled

These results are in accordance with the findings of Anonymous (2017) [1], 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 obtained by Sandhya Rani *et al.* (2010) [15] 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), 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). Results on pheromone trap catches was also supported by Qureshi *et al.* (1984) [13], Dhawan and Sidhu (1984) [5], Cividanes (1989) [3], Gupta *et al.* (1990) [6], Michel (1992) [11], Korat and Lingappa (1996) [9], Naik *et al.* (1996) [12], De Melo *et al.* (2012) [4], Ramesh Babu and Meghwal (2014) [14], Khuhro *et al.* (2015) [8] and Sharma *et al.* (2015) [17].

Relationship between Pheromone trap catches and weather parameters

During first year (2016-17) of investigation, the pheromone trap catches in cotton had negative and non-significant relationship with maximum temperature (r = - 0.341), rainfall (r = - 0.210), and rainy days (r = - 0.274). Whereas, it had negative and significant relationship with minimum temperature (r = - 0.829), morning relative humidity (r = - 0.673) and evening relative humidity (r = - 0.694). Similar trends were observed during year 2017-18

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

S. No.	Weather parameters	Correlation coefficient (r)	
		2016-17	2017-18
1	Maximum temperature (^{0}C)	-0.341^{NS}	0.012^{NS}
2	Minimum temperature (^{0}C)	-0.829*	-0.589*
3	Morning relative Humidity (%)	-0.673*	-0.638*
4	Evening Relative Humidity (%)	-0.694*	-0.608*
5	Rainfall (%)	-0.210 ^{NS}	-0.276^{NS}
6	Rainy days	-0.274 ^{NS}	-0.413^{NS}

The present findings on correlation of pheromone trap catches and weather parameters in line with the findings of Sharma *et al.* (2015) [17], who reported that the pink bollworm pheromone catches showed a significant but negative correlation with minimum temperature (r = -0.79), morning relative humidity (r = -0.59) and evening relative humidity (r = -0.85). Ramesh Babu and Meghwal (2014) [14], Sanga Reddy and Patil (1997) [16] and Gupta *et al.* (1996) [7], reported negative significant correlation with minimum temperature (r = -0.662) and non-significant negative with maximum temperature (r = -0.206), rainfall (r = -0.296) and rainy days (r = -0.399).

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