Study on spatial distribution and occurrence of pink boll worm on cotton

ABSTRACT:

An investigation was carried out to "Study on spatial distribution and occurrence of pink boll worm on cotton" under Agricultural Research Station (ARS), Adilabad, Professor Jayashankar Telangana State Agricultural University during *Kharif*, 2018 and 2019. The main objective of this study was to determine distance and migration of pink boll worm adults from ginning mill to cropping area of different location through GIS tools and the results revealed that spatial distribution of pink bollworm was found to be low in the villages which are 15 kms away from the ginning mill i.e. pheromone catches (1515 and 1267) and PBW larvae/20 bolls (13.76 % and 15.00%) and villages which are 5kms away from the ginning mill was found to be high incidence i.e. pheromone catches (2185 and 1929) and PBW larvae/20 bolls (38.14 % and 28.10%) during *Kharif* 2018 and 2019, respectively.

KEY WORDS: *Kharif*, pink boll worm, spatial distribution, ginning mills, migration, GIS tools, pheromone catches, PBW larvae.

INTRODUCTION:

Cotton is one of the most commercially important fiber crop in the world, cultivated in tropical and subtropical regions of more than 70 countries. In India, cotton is mainly cultivated in three distinct agro-ecological zones North, Central and South. It is an important raw material for the Indian textile industry and plays a key role in the national economy in terms of both employment generation and foreign exchange. In India, cotton is cultivated in 119.78 lakh hectare with a production of 365 lakh bale of seed cotton (Sathyan *et al*., 2016).

The cotton species recognized in the world are about 50 of which 4 are cultivated. Two of these (*Gossypium arboreum* and *G. herbaceum*) are diploids, and two (*G. hirsutum* and *G. barbadense*) are tetraploids. More than 80% of the world's cotton area is covered by tetraploids. However, diploid cottons are cultivated in Asia and the Middle East. India is the only country where all the cultivated species and some of their hybrid combinations are commercially grown (khadi *et al.,* 2015).

Insect pest attack is one of the most important limiting factors in the successful cultivation of this crop. Amongst various causes of low yield, losses due to insect pests are one of the important factors in cotton. Many insect pests are encountered on cotton crop from

germination to harvesting. Among the important key pests of cotton the sucking pests viz., leafhopper, *Amrasca Amrasca devastans* (Distant), aphid *Aphis gossypii* (Glover), whitefly *Bemisia tabaci* (Gennadius) and thrips, *Thrips tabaci* (Linnman) cause severe damage and serious threat to the crop at early stage of the crop growth and can also affect the crop stand and yield of cotton.

Pink bollworm has become apparent as a threat to cotton cultivation in south and central cotton growing zones of India where the pest has developed resistance to Cry1Ac and Cry2Ab expressing cotton also developing resistance to insecticides and infesting late season cotton. The pink bollworm is assuming a major pest status even in some regions of northern India where there are ginning and oil extraction units which are procuring cotton seeds from central and south Indian cotton states where pink bollworm has demonstrated resistance to Cry toxins in the field. So there is possibility of resistant pink bollworm infesting Bt cotton in North India through movement of seed. The evolution of resistance and pest adaptation to Bt crops containing Cry1Ac and Cry2Ab has been observed recently. The development of resistance is due to multiple factors such as absence of refuge or supply of fraudulent refuge, mono cropping, cultivation of long duration hybrids, extended cropping season (Naik *et al*., 2020).

MATERIALS AND METHODS:

The present experiment was carried out at Agriculture research station, Adilabad during *Kharif*, 2018 and 2019, in order to Study on spatial distribution and occurrence of pink boll worm on cotton based on distance from ginning mills and to find out the effect of distance on spatial distribution of pink boll worm on cotton crop through GIS tools. Data has been taken at seven days interval from boll formation stage from three different locations *i.e.,* 5km, 10km, and 15km from ginning mills and selected five villages from each location.

Monitoring of pink bollworm population using sex pheromone traps: The adult male moth population of main lepidopterous pest, pink bollworm of cotton crop is being monitored with installation of sex pheromone traps at selected villages and at ginning mill and also the larvae of *P. gossypiella* were collected from green bolls.

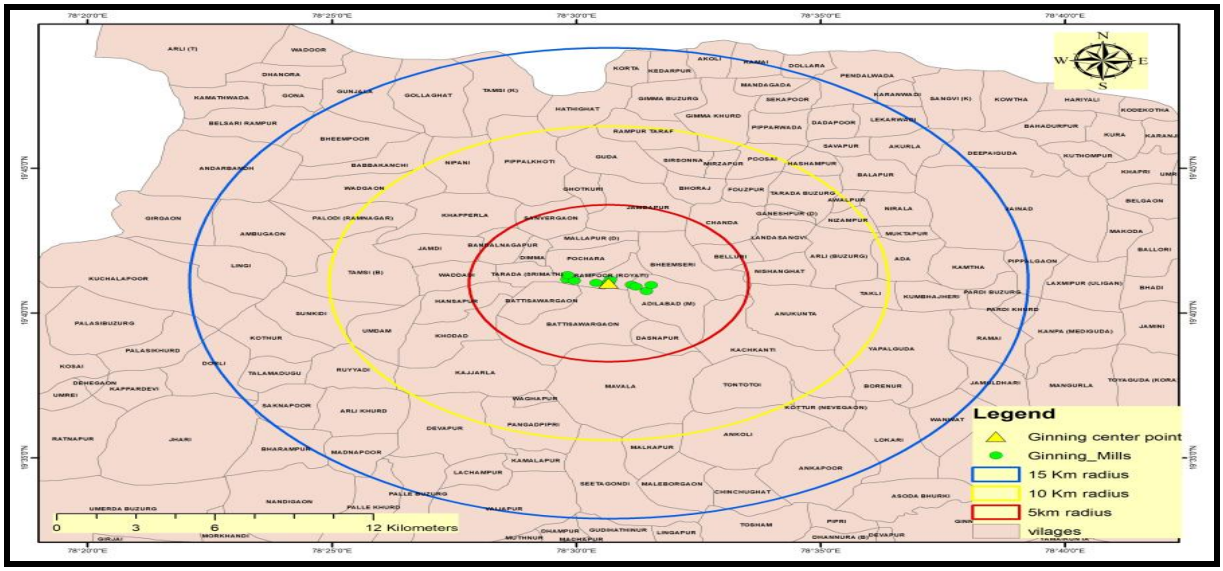

Fig 1. Map showing study location

RESULTS

The observations recorded on population dynamics of pink boll worm of cotton at eight different dates *i.e.*, 15/11/18, 22/11/18, 29/11/18, 05/12/18, 12/12/18, 19/12/18, 26/12/18, 02/01/19 during *kharif*, 2018 and at 20/11/19, 27/11/19, 04/12/19, 11/12/19, 18/12/19, 24/12/19, 31/12/19, 08/01/20 during *kharif*, 2019 are presented in figure 1 & tables 1- 6, respectively.

Spatial distribution and occurrence of pink bollworm in Adilabad district by using GIS tools (5km) during *kharif*, 2018 and 2019

The incidence of pink bollworm at boll formation stages of crop growth was observed in terms of pheromone trap catches and pink bollworm larvae per 20 bolls.

During *kharif*, 2018 high incidence of pink bollworm in pheromone trap catches and *pink bollworm* larvae per 20 bolls in five villages at an distance of 5km from ginning mills i.e., ponnari (420 and 5.63%), pochera (427 and 9.38%), anukunta (436 and 7.50%), piperwada (441 and 7.50%) and kajjarla (460 and 8.13%) pheromone traps catches and *pink bollworm* larvae, respectively.

During *kharif*, 2019 incidence of pink bollworm in pheromone trap catches and **pink bollworm** larvae per 20 bolls was high in five villages at an distance of 5km from ginning mills i.e., ponnari (390 and 7.50%), pochera (367 and 6.25%), anukunta (384 and 4.37%), piperwada (387 and 4.37%) and kajjarla (401 and 5.62%) Pheromone traps catches and PBW larvae, respectively.

Spatial distribution and occurrence of pink bollworm in Adilabad district by using GIS tools (10km) during *kharif*, 2018 and 2019

The incidence of pink bollworm at boll formation stages of crop growth was observed in terms of Pheromone tr pink bollworm ap catches and larvae per 20 bolls.

During *kharif*, 2018 high incidence of pink bollworm in pheromone trap catches and pink bollworm larvae per 20 bolls in five villages at an distance of 10km from ginning mills i.e., sunkidi (352 and 6.25%), seethagondi (332 and 4.38%), Bhoraj (379 and 5.63%), mediguda (391 and 8.13%) and yapalguda (407 and 3.75%) pheromone traps catches and pink bollworm larvae, respectively.

During *kharif*, 2019 high incidence of pink bollworm in Pheromone trap catches and PBW larvae per 20 bolls in five villages at an distance of 10km from ginning mills i.e., sunkidi (297 and 5.00%), seethagondi (308 and 4.37), Bhoraj (321 and 4.37%), mediguda (326 and 2.50%) and yapalguda (340 and 3.12%) Pheromone traps catches and PBW larvae, respectively.

Spatial distribution and occurrence of pink bollworm in Adilabad district by using GIS tools (15km) during *kharif*, 2018 and 2019:

The incidence of pink bollworm at boll formation stages of crop growth was observed in terms of pheromone trap catches and pink bollworm larvae per 20 bolls.

During *kharif*, 2018 high incidence of pink bollworm in pheromone trap catches and PBW larvae per 20 bolls in five villages at an distance of 15km from ginning mills i.e., jainath (270 and 6.25%), nirala (283 and 4.38%), talamadugu (303 and 1.25%), gudihatnoor (326 and 0.63%) and tantoli (333 and 1.25%) Pheromone traps catches and PBW larvae, respectively.

During *kharif*, 2019 high incidence of pink bollworm in Pheromone trap catches and PBW larvae per 20 bolls in five villages at an distance of 15km from ginning mills i.e., jainath (237 and 5.00%), nirala (242 and 3.75%), talamadugu (256 and 2.50%), gudihatnoor (261 and 1.25%) and tantoli (271 and 2.50%) Pheromone traps catches and PBW larvae, respectively.

From the above study during *kharif*, 2018-19 spatial distribution of pink bollworm was found to be low in the villages which are 15 kms away from the ginning mill i.e. pheromone catches were 1515 and pink bollworm larvae/20 bolls 13.76 %, villages which are 10kms away from the ginning mill was found to be average incidence i.e. pheromone catches were 1861 and pink bollworm larvae/20 bolls 28.14 % and villages which are 5kms away from the ginning mill was found to be high incidence i.e. pheromone catches were 2185 and pink bollworm larvae/20 bolls 38.14 %.

During 2019-20, from the above study spatial distribution of pink bollworm was found to be low in the villages which are 15kms away from the ginning mill i.e. pheromone catches were 1267 and pink bollworm larvae/20 bolls 15.00 %, villages which are 10kms away from the ginning mill was found to be average incidence i.e. pheromone catches were 1592 and pink bollworm larvae/20 bolls 19.30 % and villages which are 5kms away from the ginning mill was found to be high incidence i.e. pheromone catches were 1929 and pink bollworm larvae/20 bolls 28.11 %.

Discussion

The flight potential and propensity of *Pectinophora gossypiella* (Saunders) in the laboratory were measured using a 32-channel, computer-monitored flight-mill system. Females flew significantly farther within a 72-hour flight period than males did. According to Wu et al. (2006), the mean accumulated flight distance and flight duration of 1-day-old female individuals in a tethered-flight test were 41.25 ± 7.76 km and 23.87 ± 2.55 hours, respectively, whereas for male individuals, the corresponding parameters were 23.46 ± 2.13 km and 14.12 ± 1.12 hours. The flight ability of adults was significantly positively correlated with pupal weight.

Milonas *et al.,* (2016) reported that in Central Greece, spatial and temporal variations in population dynamics were examined. In 2007, captures of male *H. armigera* increased in late July and declined at the end of August. For *P. gossypiella* male captures remained at low levels during summer, increased late in August, peaked at mid of September and declined towards the end of the season. Spatial analysis produced a spatial trend map over space, a temporal stability map over time which could lead in separating the field into management zones and direct control to areas that exhibit high densities of the pest population and are stable over time.

Conclusion

We have found during the Kharif seasons of 2018 and 2019, villages situated 5 km away from the ginning mills exhibited high incidence rates of pink bollworm, as evidenced by the higher numbers of pheromone trap catches and pink bollworm larvae per 20 bolls. In contrast, villages located 15 km away showed lower incidence rates. The findings of this study contribute valuable insights for cotton growers and pest management authorities to develop more effective strategies for managing pink bollworm infestations and safeguarding cotton yields.

Table 1: Spatial distribution and occurrence of Pink bollworm in Adilabad district by using GIS tools (5km) during *kharif*, 2018

Ponnari	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	48	1
22/11/18	50	1
29/11/18	52	1
05/12/18	43	1
12/12/18	52	1
19/12/18	52	1
26/12/18	59	2
02/01/19	64	1
TOTAL	**420**	**9**
PER CENT	**-**	**5.63**
Pochera	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	52	2
22/11/18	51	2
29/11/18	48	3
05/12/18	39	2
12/12/18	54	1
19/12/18	56	1
26/12/18	62	2
02/01/19	65	2
TOTAL	**427**	**15**
PER CENT	**-**	**9.38**
Anukunta	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	49	0
22/11/18	52	1
29/11/18	50	1
05/12/18	42	2
12/12/18	55	3
19/12/18	61	3
26/12/18	58	2
02/01/19	69	0
TOTAL	**436**	**12**
PER CENT	**-**	**7.50**
Piperwada	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	51	0
22/11/18	53	1
29/11/18	53	1

05/12/18	49	2
12/12/18	58	3
19/12/18	63	3
26/12/18	55	2
02/01/19	59	0
TOTAL	**441**	**12**
PER CENT	**-**	**7.50**
Kajjarla	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	52	1
22/11/18	54	3
29/11/18	55	3
05/12/18	52	1
12/12/18	56	1
19/12/18	64	2
26/12/18	60	1
02/01/19	67	1
TOTAL	**460**	**13**
PER CENT	**-**	**8.13**

Table 2: Spatial distribution and occurrence of Pink bollworm in Adilabad district by using GIS tools (10km) during *kharif*, 2018

Sunkidi	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	36	3
22/11/18	39	2
29/11/18	40	2
05/12/18	42	0
12/12/18	46	0
19/12/18	47	0
26/12/18	50	1
02/01/19	52	2
TOTAL	**352**	**10**
PER CENT	**-**	**6.25**
Seethagondi	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	39	1
22/11/18	40	4
29/11/18	39	0
05/12/18	39	0
12/12/18	39	0
19/12/18	43	0
26/12/18	44	1
02/01/19	49	1
TOTAL	**332**	**7**
PER CENT	**-**	**4.38**
Bhoraj	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	41	0
22/11/18	42	1

29/11/18	46	1
05/12/18	48	1
12/12/18	49	1
19/12/18	50	2
26/12/18	51	2
02/01/19	52	1
TOTAL	**379**	**9**
PER CENT	**-**	**5.63**
Mediguda	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	42	2
22/11/18	39	3
29/11/18	47	2
05/12/18	52	2
12/12/18	53	2
19/12/18	52	1
26/12/18	53	1
02/01/19	53	0
TOTAL	**391**	**13**
PER CENT	**-**	**8.13**
Yapalguda	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	43	1
22/11/18	46	2
29/11/18	48	1
05/12/18	50	0
12/12/18	50	1
19/12/18	53	1
26/12/18	58	0
02/01/19	59	0
TOTAL	**407**	**6**
PER CENT	**-**	**3.75**

Table 3: Spatial distribution and occurrence of Pink bollworm in Adilabad district by using GIS tools (15km) during *kharif*, 2018

Jainath	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	25	1
22/11/18	28	1
29/11/18	30	0
05/12/18	32	1
12/12/18	35	0
19/12/18	39	1
26/12/18	40	0
02/01/19	41	2
TOTAL	**270**	**6**
PER CENT	**-**	**6.25**
Nirala	**Pheromone catches**	**PBW larvae/ 20bolls**

15/11/18	28	2
22/11/18	30	0
29/11/18	32	1
05/12/18	33	1
12/12/18	36	0
19/12/18	38	1
26/12/18	42	1
02/01/19	44	1
TOTAL	**283**	**7**
PER CENT	**-**	**4.38**
Talamadugu	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	29	1
22/11/18	34	1
29/11/18	35	0
05/12/18	39	0
12/12/18	38	0
19/12/18	40	0
26/12/18	43	0
02/01/19	45	0
TOTAL	**303**	**2**
PER CENT	**-**	**1.25**
Gudihatnoor	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	30	0
22/11/18	36	1
29/11/18	39	0
05/12/18	42	0
12/12/18	45	0
19/12/18	42	0
26/12/18	45	0
02/01/19	47	0
TOTAL	**326**	**1**
PER CENT	**-**	**0.63**
Tantoli	**Pheromone catches**	**PBW larvae/ 20bolls**
15/11/18	32	1
22/11/18	39	1
29/11/18	40	0
05/12/18	41	0
12/12/18	43	0
19/12/18	44	0
26/12/18	46	0
02/01/19	48	0
TOTAL	**333**	**2**
PER CENT	**-**	**1.25**

Table 4: Spatial distribution and occurrence of Pink bollworm in Adilabad district by using GIS tools (5km) during *kharif*, 2019

Ponnari	**Pheromone catches**	**PBW larvae/ 20bolls**

20/11/19	18	1
27/11/19	32	1
04/12/19	41	1
11/12/19	48	1
18/12/19	58	1
24/12/19	60	2
31/12/19	64	3
08/01/20	69	2
TOTAL	**390**	**12**
PER CENT	**-**	**7.50**
Pochera	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	15	0
27/11/19	26	1
04/12/19	44	1
11/12/19	52	2
18/12/19	54	1
24/12/19	56	1
31/12/19	58	2
08/01/20	62	2
TOTAL	**367**	**10**
PER CENT	**-**	**6.25**
Anukunta	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	19	0
27/11/19	30	0
04/12/19	49	2
11/12/19	50	1
18/12/19	54	2
24/12/19	58	0
31/12/19	60	1
08/01/20	64	1
TOTAL	**384**	**7**
PER CENT	**-**	**4.37**
Piperwada	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	14	1
27/11/19	28	1
04/12/19	40	1
11/12/19	53	1
18/12/19	58	1
24/12/19	61	1
31/12/19	65	0
08/01/20	68	1
TOTAL	**387**	**7**
PER CENT		**4.37**
Kajjarla	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	16	0
27/11/19	32	1
04/12/19	45	1
11/12/19	51	2

18/12/19	59	2
24/12/19	62	1
31/12/19	67	1
08/01/20	69	1
TOTAL	**401**	**9**
PER CENT	**-**	**5.62**

Table 5: Spatial distribution and occurrence of Pink bollworm in Adilabad district by using GIS tools (10km) during *kharif*, 2019

Sunkidi	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	9	0
27/11/19	20	1
04/12/19	34	1
11/12/19	40	1
18/12/19	45	1
24/12/19	47	0
31/12/19	50	2
08/01/20	52	2
TOTAL	**297**	**8**
PER CENT	**-**	**5.00**
Seethagondi	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	11	1
27/11/19	18	0
04/12/19	30	1
11/12/19	41	0
18/12/19	48	2
24/12/19	50	1
31/12/19	52	1
08/01/20	58	1
TOTAL	**308**	**7**
PER CENT	**-**	**4.37**
Bhoraj	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	8	0
27/11/19	19	1
04/12/19	32	0
11/12/19	45	1
18/12/19	49	0
24/12/19	53	2
31/12/19	56	1
08/01/20	59	2
TOTAL	**321**	**7**
PER CENT	**-**	**4.37**
Mediguda	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	8	0
27/11/19	17	0
04/12/19	36	1

11/12/19	42	0
18/12/19	48	1
24/12/19	54	1
31/12/19	59	0
08/01/20	62	1
TOTAL	**326**	**4**
PER CENT	**-**	**2.50**
Yapalguda	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	7	0
27/11/19	21	0
04/12/19	38	1
11/12/19	50	1
18/12/19	46	1
24/12/19	55	1
31/12/19	56	1
08/01/20	67	0
TOTAL	**340**	**5**
PER CENT	**-**	**3.12**

Table 6: Spatial distribution and occurrence of Pink bollworm in Adilabad district by using GIS tools (15km) during *kharif*, 2019

Jainath	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	4	0
27/11/19	12	0
04/12/19	26	1
11/12/19	32	1
18/12/19	36	1
24/12/19	39	2
31/12/19	42	1
08/01/20	46	2
TOTAL	**237**	**8**
PER CENT	-	**5.00**
Nirala	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	5	0
27/11/19	14	0
04/12/19	21	0
11/12/19	30	1
18/12/19	38	1
24/12/19	41	1
31/12/19	45	2
08/01/20	48	1
TOTAL	**242**	**6**
PER CENT	-	**3.75**
Talamadugu	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	5	0

27/11/19	14	0
04/12/19	27	1
11/12/19	34	0
18/12/19	38	1
24/12/19	42	0
31/12/19	47	1
08/01/20	49	1
TOTAL	**256**	**4**
PER CENT	-	**2.50**
Gudihatnoor	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	7	0
27/11/19	10	0
04/12/19	23	0
11/12/19	36	1
18/12/19	40	0
24/12/19	46	0
31/12/19	49	1
08/01/20	50	0
TOTAL	**261**	**2**
PER CENT	-	**1.25**
Tantoli	**Pheromone catches**	**PBW larvae/ 20bolls**
20/11/19	10	0
27/11/19	18	1
04/12/19	27	0
11/12/19	39	1
18/12/19	35	0
24/12/19	43	1
31/12/19	48	0
08/01/20	51	1
TOTAL	**271**	**4**
PER CENT	-	**2.50**

Table 7: Spatial distribution and occurrence of Pink bollworm in Adilabad district by using GIS tools (5, 10 and15km)

Distances (2018-19)	Pheromone catches	PBW larvae in percent
5 km distance total (five villages)	2185	38.1
10 km distance total (five villages)	1861	28.1
15 km distance total (five villages)	1515	13.7

Distances (2019-20)	Pheromone catches	PBW larvae in percent
5 km distance average (five villages)	1929	28.1

10 km distance average (five villages)	1592	19.3
15 km distance average (five villages)	1267	15.0

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