Original Research Article

Incidence of aphid, *Aphis gossypii* (Glover) in *Bt* and non-*Bt* cotton and their relation to weather parameters

ABSTRACT

Investigations on population dynamics of cotton aphid, *Aphis gossypii* (Glover) on cotton hybrids *Bt* (G.Cot.Hy.8 BG II) and non-*Bt* (G.Cot.Hy.8) were carried out at Main Cotton Research Station, Navsari Agricultural University, Surat, Gujarat during the *Kharif,* 2020-21. The aphids incidence was initiated in the first week of July (27th SMW) in *Bt* cotton hybrid and in the second week of July (28th SMW) in non-*Bt* cotton hybrid and continued till the crop harvest in second week of January (2nd SMW) in both hybrids. The peak activity of aphids was recorded during third week of December (51st SMW) in *Bt* as well as non-*Bt* cotton hybrid. In both *Bt* and non-*Bt* cotton, the aphid population had a non-significant negative correlation with maximum temperature and significant negative correlation with morning relative humidity. As far as association with abiotic factors were concerned, there was a highly significant negative correlation with minimum temperature, evening relative humidity, rainfall and rainy days. Only sunshine hours showed significant positive correlation with aphid population.

KEYWORDS: *Aphis gossypii, Bt and non-Bt cotton, correlation, population dynamics*

1. INTRODUCTION

Cotton, *Gossypium hirsutum* (L.) is the most important cash crop in over 60 countries around the world. India is the largest producer and exporter of cotton yarn. Cotton is one of the most important cash crops as textile industries playing a key role (5% in GDP) in the economy of India. The total crop production was recorded 113.32 million bales from 32.20 million hectares of total cultivated area with productivity of 766 kg/ha in the world. The production of cotton was 29.00 million bales from the 13.35 million hectares of cultivated area and the productivity was 473 kg/ha in India (Anon., 2021). The major cotton producing states are Gujarat, Maharashtra, Telangana, Andhra Pradesh, Karnataka, Madhya Pradesh, Haryana, Rajasthan and Punjab in India. The introduction of transgenic *Bt* cotton for commercial cultivation in India during 2002 has become boon to the cotton growing farmers and protected the crops from bollworms damage and saved the yield losses. Insect pests damage is the major cause of loss in cotton quality, net profit and higher cost of production. The spectrum of cotton is quite complex and as many as 200 species of insects have been recorded as pests in cotton of different crop growth in India (Anon., 2011). Among various insect pests infesting cotton, *Aphis gossypii* is a major pest of cotton causing heavy loss in the yield of cotton. Aphid is also known as “Plant louse, Greenfly or Ant cow” (Britannica, 2020). It is a small, yellow to dark green, polyphagous pest and has the ability to cause serious damage. Aphid nymph and adult feed on sap which cause crumpling and downward curling of leaves, sticky cotton due to deposit of honey dew like substance on leaves and bolls (CICR, 2014). They are adapted to a wide range of environmental conditions and can easily spread. The study on population dynamics helps in making decisions regarding the timings

UNDER PEER REVIEW

of application of various control measures. Therefore, the present investigation was carried out on population dynamics of aphid in *Bt* and non-*Bt* cotton. Due to continuous changing atmospheric pattern, the correlation of aphid population with the weather parameters was also studied.

2. MATERIALS AND METHODS

In order to study the population dynamics and impact of weather parameters on incidence of aphid in *Bt* and non-*Bt* cotton, a field experiment was carried out on short to medium duration hybrid, G.Cot.Hy.8 BG II and G.Cot.Hy.8 non-*Bt* which are widely cultivated in South Gujarat region. The research work comprising field trials was conducted at Main Cotton Research Station, Navsari Agricultural University, Surat (Gujarat) during the *Kharif,* 2020-21. The population of aphid (nymphs and adults) was recorded from three leaves (each from top, middle and bottom canopy) on fifty randomly selected plants. Observations were recorded during morning hours (between 8 to 10 AM) on account of low movement helping in assessing population counts. The observations were recorded at weekly intervals from seven days after germination till the removal of the crop. For recording observations, the whole plot was divided into ten equal quadrates and five plants were selected randomly in each quadrate. Plots were kept completely free from the insecticides spray during the whole season. In order to study the instantaneous effect of weather parameters on population fluctuation of aphid*,* the data of physical factors of environment *viz.,* maximum (MAXT) and minimum (MINT) temperature, morning (MRH) and evening (ERH) relative humidity, bright sunshine hours (BSS), rainfall (RF) and rainy days (RD) were correlated. Week-wise data on various parameters recorded by Meteorology Observatory, Main Cotton Research Station, Navsari Agricultural University, Surat were used to work out the association with the incidence of aphids during 2020-21.

3. RESULTS AND DISCUSSION

3.1 Population dynamics of aphid in *Bt* cotton hybrid

The periodical week wise data on population of aphids per three leaves are summarized in Table 1 and illustrated in Figure 1. The pest was observed from first week of July (27th SMW) and continued till the crop harvest in second week of January (2nd SMW). *A. gossypii* population ranged between 0.16 to 74.28 aphids/3 leaves in *Bt* cotton. The population of aphids was increasing slowly up to third week of September (38th SMW). The population gradually increased for some days and increased drastically in end of September and the first peak was observed in first week of December (49th SMW) with 72.44 aphids/3 leaves. The second peak (74.28 aphids/3 leaves) was observed during the third week of December (51st SMW), which was the highest population recorded in experiment. The incidence of aphids was observed above the economic threshold level (ETL) during the fourth week of September (39th SMW) to second week of January (2nd SMW). The population of aphids gradually decreased (64.38 aphids/3 leaves) from fourth week of December (52nd SMW) to second week of January (48.60 aphids/3 leaves). A more or less similar observations were reported by Patel *et al.* (2016) noted that the highest population of aphid during the 50th SMW (2nd week of December); Nagendra (2015) reported that the aphid infestation started during 32nd SMW with the peak (41.4 aphids/3 leaves) population during 36th SMW; Bhanderi *et al.* (2016) showed that the peak activity of aphid during 48th SMW (4th week of November) with 61.20 aphids/3 leaves.

UNDER PEER REVIEW

Table 1: Population dynamics of aphid, *A. gossypii* in *Bt* and non-*Bt* cotton

Sr. No.	Months and weeks		Standard Meteorological Week (SMW)	No. of aphids/3 leaves	
				Bt cotton (G.Cot.Hy.8 BG II)	Non *Bt* cotton (G.Cot.Hy.8 Non *Bt*)
1	**July**	I	27	0.16	0.00
2		II	28	0.40	0.20
3		III	29	0.66	0.32
4		IV	30	0.94	0.54
5		V	31	1.20	0.94
6	**August**	I	32	2.40	1.60
7		II	33	1.96	1.26
8		III	34	3.82	2.66
9		IV	35	8.66	5.98
10	**September**	I	36	12.42	7.40
11		II	37	16.80	11.42
12		III	38	24.96	20.02
13		IV	39	32.42	24.22
14	**October**	I	40	35.68	29.30
15		II	41	32.72	28.66
16		III	42	36.42	30.48
17		IV	43	36.86	32.00
18		V	44	42.44	36.06
19	**November**	I	45	48.68	40.20
20		II	46	50.22	42.24
21		III	47	53.86	45.42
22		IV	48	66.88	51.68
23	**December**	I	49	72.44	52.20
24		II	50	68.48	55.64

UNDER PEER REVIEW

25		III	51	74.28	61.40
26		IV	52	64.38	53.80
27	**January**	I	01	56.52	48.40
28		II	02	48.60	41.88
29			**Mean**	**31.97**	**25.93**

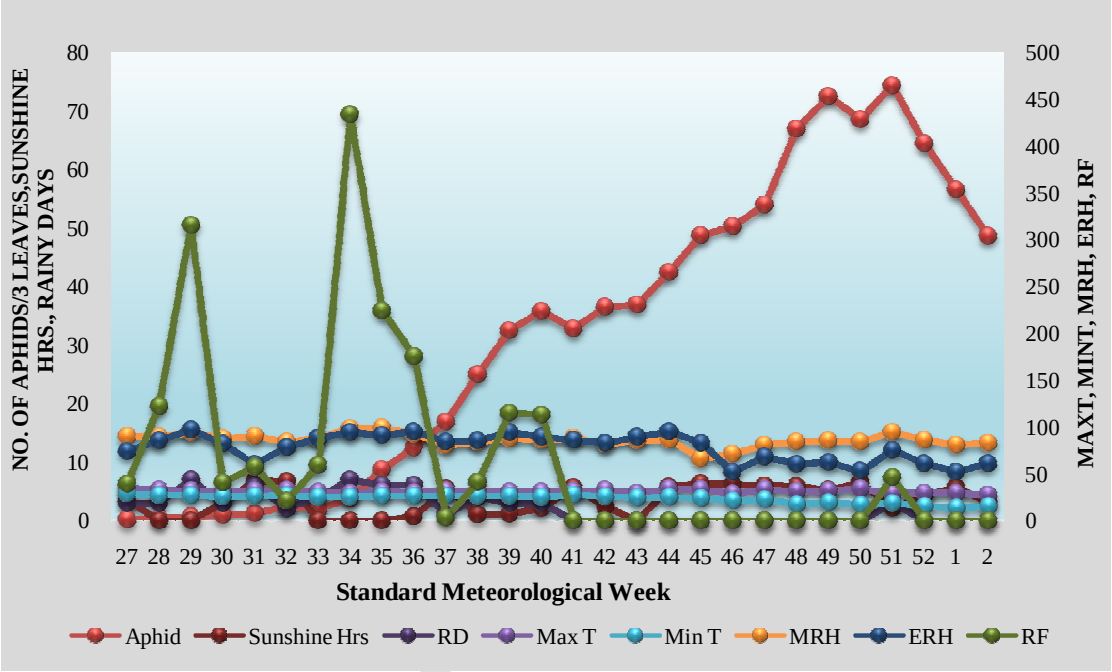

Fig. 1: Incidence of aphid, *A. gossypii* in *Bt* cotton in relation to weather parameters

The results on correlation between incidence of aphids and different weather parameters revealed that only maximum temperature (r = -0.148) showed a non-significant negative association whereas, minimum temperature (r = -0.803**), evening relative humidity (r = -0.577**), rainfall (r = -0.529**) and rainy days (r = -0.716**) showed highly significant negative association with the aphids population. Morning relative humidity (r = -0.425*) showed significant negative correlation with aphid population. However, sunshine hours (r = 0.439*) had a significant positive correlation with the incidence of aphids infesting *Bt* cotton hybrid. These findings are in accordance with those of Sarode *et al.* (2020) who noticed that the aphid population was negatively significant with the rainfall (r= -0.404*), maximum temperature (r = -0.574*) and negatively non-significant with morning relative humidity (r = -0.304). The aphid population was positively non-significant with bright sunshine hours (0.387). Bhanderi *et al.* (2016) reported that the aphid population in *Bt* cotton was highly significant and negatively correlated with minimum temperature (r = -0.819**) and morning relative humidity (r = -0.760**) which are also in accordance with the present findings.

Table 2: Correlation between incidence of *A. gossypii* and weather parameters in *Bt* and non-*Bt* cotton

UNDER

Weather parameters	Correlation co-efficient (r)	
	***Bt* cotton (G.Cot.Hy.8 BG II)**	**Non *Bt* cotton (G.Cot.Hy.8 N*Bt*)**
Maximum Temperature, ^{0}C (MaxT)	-0.148	-0.164
Minimum Temperature, ^{0}C (MinT)	-0.803**	-0.808**
Morning Relative Humidity, % (MRH)	-0.425*	-0.439*
Evening Relative Humidity, % (ERH)	-0.577**	-0.580**
Bright Sunshine Hours, hrs. (BSS)	0.439*	0.441*
Rainfall, mm (RF)	-0.529**	-0.541**
Rainy days (RD)	-0.716**	-0.731**

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

3.2 Population dynamics of aphid in non-*Bt* cotton

The periodical week wise data on population of aphid per three leaves are summarized in Table 1 and illustrated in Figure 2. The pest *A. gossypii* appeared in second week of July (28th SMW) and continued till the crop harvest in second week of January (2nd SMW) in G.Cot.Hy.8 non-*Bt* cotton hybrid. The population ranged between 0.20 to 61.40 aphids/3 leaves. The population of aphids was increasing slowly up to second week of October (41st SMW). The peak population was observed in third week of December (51st SMW) with 61.40 aphids/3 leaves, which was the highest population recorded in experiment. The above ETL incidence of aphids was observed during the third week of October (42nd SMW) to second week of January (2nd SMW). The population of aphids gradually decreased (53.80 aphids/3 leaves) from fourth week of December (52nd SMW) to second week of January (48.60 aphids/3 leaves). Thus, it is clear from the data that relatively higher activity (30.48 to 61.40 aphids/3 leaves) observed during third week of October to third week of December. Similar findings are also stated by Laxman *et al.* (2013) who observed that the incidence of aphids reached at maximum during first week of December (>43 aphids/3 leaves) and after gradually population decreased; Bhanderi *et al.* (2016) found the peak activity of aphid during 48th SMW (4th week of November) with 76.25 aphids/3 leaves on DCH 32 non-*Bt* cotton.

UNDER PEER REVIEW

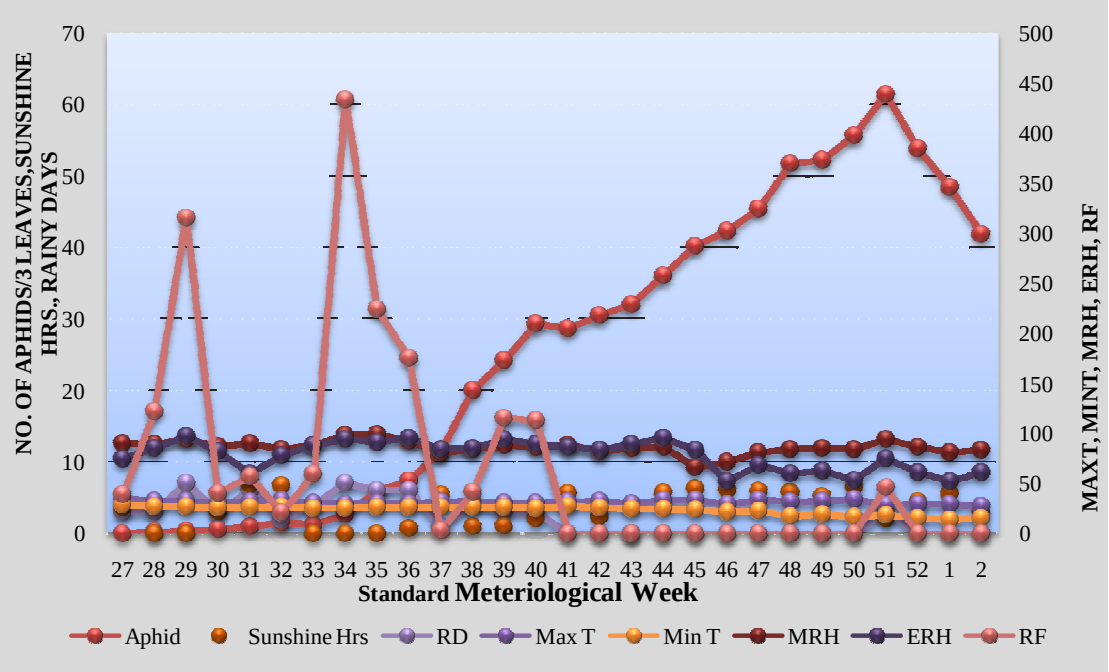

Fig. 2: Incidence of aphid, *A. gossypii* in non-*Bt* cotton in relation to weather parameters

In non-*Bt* cotton, maximum temperature (r = -0.164) had non-significant negative association whereas, minimum temperature (r = -0.808**), evening relative humidity (r = -0.580**), rainfall (r = -0.541**), rainfall (r = -0.541**) and rainy days (r = -0.731**) showed highly significant negative association with the aphids population. Morning relative humidity (r = -0.439*) had significant negative correlation with aphid population. However, bright sunshine hours (r = 0.441*) had a significant positive correlation with the incidence of aphids infesting non-*Bt* cotton. The present findings are in accordance with Panwar *et al.* (2015) revealed that correlation was significant and negative between aphid population in maximum temperature (r = -0.546*), minimum temperature (r = -0.577*) and morning relative humidity (r = -0.588*). Bhanderi *et al.* (2016) stated that the aphid population in non-*Bt* cotton was highly significant and negatively correlated with minimum temperature and morning relative humidity.

4. CONCLUSION

The peak population of aphid was observed during the third week of December (51st SMW) in *Bt* and non-*Bt* cotton. Looking to the activity of aphid in *Bt* and non-*Bt* cotton, *Bt* hybrid recorded higher mean population (31.97 aphids/3 leaves) compared to non-*Bt* hybrid (25.93 aphids/3 leaves) in present study. The aphid population showed non-significant negative association with maximum temperature. Morning relative humidity had significant negative association whereas minimum temperature, evening relative humidity, rainfall and rainy days had highly significant negative correlation with the

UNDER PEER RE

aphid population. Sunshine hours had a significant positive correlation with the incidence of aphids infesting *Bt* as well as non-*Bt* cotton hybrid.

REFERENCES

Anonymous (2011). ICAR-AICRP (Cotton) Annual Report (2010-11). ICAR- All India Coordinated Research Project on Cotton, Tamil Nadu. p. E-9.

Anonymous (2021). ICAR-AICRP (Cotton) Annual Report. ICAR-All India Coordinated Research Project on Cotton, Coimbatore, Tamil Nadu, pp. A1-A5.

Bhanderi, G. R., Patel, R. D., Desai, H. R., Sandipan, P. B. and Solanki, B. G. (2016). Interaction of abiotic factors on population of insect pests and its natural enemies in *Bt* and non *Bt* cotton. *Adva. Life Sci.,* **5**(12): 5327-5336.

Britannica, T. (2020). Aphid: Encyclopedia Britannica. Retrieved from *https://www.britannica.com/animal/aphid.* [Accessed 6 July, 2021]

CICR (2014). CICR Vision 2030. Published by Central Institute for Cotton Research, PB No. 2, Shankamagar, PO, Nagpur 440 010. *www.cicr.org.in*

Laxman, P., Samatha C. H. and Sammaiah, C. H. (2013). Sucking pests on *Bt* and non *Bt*- cotton. *Indian J. Ent.,* **75**(2): 167-179.

Nagendra, S. (2015). Studies on population dynamics of key pests of cotton. *J. Agric. Tech.*, **11**(5): 1161-1176.

Panwar, T. S., Singh, S. B. and Garg, V. K. (2015). Influence of meteorological parameters on population dynamics of thrips (*T. tabaci* Lindeman) and aphid (*Aphis gossypii* Glover) in *Bt* and non *Bt* cotton at Malwa region of Madhya Pradesh. *J. Agromet.,* **17**(1): 136-138.

Patel, M. L., Patel, R. K., Sheth, D. B. and Patel, P. R. (2016). Influence of abiotic factors on population dynamics of sucking insect pests in transgenic cotton. *Advances in Life Sciences*, **5**(5): 1871-1875.

Sarode, A. D., Zanwar, P. R., Matre, Y. B. and Latpate, C. B. (2020). Seasonal incidence of major insect pests and their correlation with weather parameters in cotton. *J. Ent. Zool. Studies.,* **8**(4): 1371-1374.

UNDER PEER REVIEW