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Influence of abiotic factors on the incidence of aphid, *Aphis gossypii* glover on brinjal in coastal areas of Cuddalore district Tamil Nadu

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Abstract
The present study was conducted at the farmer's field at vallampadugai village near Annamalai University, Chidambaram (Tamil Nadu), India, to investigate how abiotic factors affect the seasonal occurrence of the aphids (*A. gossypii*) on brinjal plants. The study focus on the aphid population during the Kharif-2022 (June to September) and Rabi-2022-23 (November to March) seasons. *A. gossypii* were found from the 24th to the 39th standard meteorological weeks (SMWs) in the Kharif season and from the 47th to the 10th SMWs in the Rabi season. The population increased gradually and reached to peak in the second week of August with population of 19.26 aphids in Kharif 2022 and fourth week of February with population of 47.86 aphids in Rabi 2022 -23 respectively. The population of this pest started to be declined in fourth week of August (1.33 aphids) in Kharif and declined to the level of 8.06 aphids in the second week of December in Rabi season. The aphid population gradually decreased with fall in the temperature during both the seasons.

Keywords: Aphids, *Aphis gossypii*, correlation coefficient, seasonal incidence weather parameters

Introduction
Brinjal, scientifically known as *Solanum melongena* L., is a native Indian vegetable belonging to the Solanaceae family. It reigns as the third most important vegetable crop grown year-round across all regions of India, contributing a remarkable 17.8% to the country's total vegetable production. On a global scale, India stands second to China in terms of vegetable production. It boasts 16.7% of the global vegetable-growing area and contributes a significant 15.4% to worldwide vegetable production (Rai *et al*., 2014) [10]. Aphids are small sap sucking insects that belong to the superfamily Aphidoidea. These sap sucking insects thrive due to their remarkable ability to reproduce asexually (parthenogenesis) and their rapid life cycle. This combination makes them ecological champions, with over 5,000 identified species. However, for farmers, they are a major concern, as more than 450 species cause damage to the crops worldwide (Blackman and Eastop, 2017) [3]. Besides weakening plants by sucking sap, which often leads to leaf deformations, aphids also act as carriers for numerous plant viruses (Jarosova *et al*. 2016; Blackman and Eastop, 2017) [7, 3]. To minimize the losses from aphids in brinjal crops, understanding the weather parameters are crucial. It influences the occurrence and growth of these pest populations. This study aimed to investigate the impact of weather parameters on aphids in brinjal to contribute an effective IPM strategy.

Materials and Methods
The experiment was carried out in two growing seasons, Kharif (2022) and Rabi (2022-23), to examine how weather conditions affected the population of the aphid, Aphis gossypii, on brinjal plants. The brinjal variety PLR (BR) 2 was cultivated following recommended agricultural practices from May 2022 to September 2022 and from mid-October 2022 to March 2023. The study was conducted at the at the farmer's field at vallampadugai village near Annamalai University, Chidambaram (Tamil Nadu). Throughout the experiment, brinjal aphid populations were monitored on a weekly basis.
The study monitored the crop from the time seedlings were transplanted until harvest. Five Randomly selected plants, excluding those on the border, were chosen and marked for observation. Three leaves were selected from the upper, middle, and lower canopy of each tagged plant. The number of nymphs and adults of aphids were counted on the underside of these leaves. Weekly weather data, including maximum and minimum temperatures, relative humidity, HBSS and rainfall, was collected from the Section of Agro-Meteorology at Annamalai University. These data were then analyzed using simple correlation and linear regression techniques.

Result and discussion
Aphid incidence was recorded on brinjal during Kharif 2022, with 9.06 and 11.33 aphids on the 24th and 25th SMWs, respectively. The peak population of *Aphis gossypii* (19.26 aphids) was observed on the 32nd SMW. (Table 1.)
The brinjal crops were infested by aphids (*A. gossypii*) during the Kharif season, starting in June 2022 (24th week). The initial observation revealed an average of 9.06 aphids. The monitoring of aphid activity continued throughout the season until September (39th week).
The aphid population peaked at 19.26 aphids observed in 32nd standard meteorological week (SMW) of 2022. It then declined steadily until the 34th SMW, reaching a low of 1.33 aphids. The population then rose slightly from the 37th to 39th SMW, averaging 8.47 aphids throughout the observed period. (Table 1). Ghuge *et al*. (2020) [5] reported that the population of aphids increased gradually and reached at peak in 32nd SMW and then suddenly decreased in 33th and 34th SMW due to heavy rainfall. Ismail *et al.* (2020) [6] reported that peaks of activity were observed for

A. gossypii, with the highest peak occurring on the 8th of August during the first season.

During the Kharif season, the population of the aphid (*A. gossypii*) was positively linked to weather conditions. Specifically, a significant positive correlation was found between the maximum temperature and the aphid population (correlation coefficient of +0.575). However, the minimum temperature showed a weaker, non-significant positive correlation (correlation coefficient of +0.239). The analysis revealed significant correlations between environmental factors and the population of the aphid. Relative humidity exhibited a negative correlation (r = -0.727) and Hours of Bright Sun Shine (HBSS) exhibited a positive correlation (r = +0.335), while rainfall displayed an even negative correlation (r = -0.317). Prashanth *et al.* (2023) [9] reported positive correlations between aphid population and several environmental factors. Maximum temperature showed a positive and significant correlation, while minimum temperature exhibited a positive but non-significant correlation. Interestingly, relative humidity had a negative and significant relationship with aphid population. Sunshine duration also showed a positive correlation, while rainfall displayed a negative correlation.

The initial aphid population *(A. gossypii*) on brinjal was found to be 10.67 and 16.13 aphids in the 47th and 48th standard meteorological weeks (SMW) during Rabi 2022-23, respectively. The aphid population then peaked at 47.86 aphids in the 8th SMW (Table 3).

Aphids were observed on brinjal crops during the Rabi season in November 2022. The first infestation of *Aphis gossypii* was observed in the 47th week, with an average of 10.67 aphids. The study continued until the 10th week of March 2023 to monitor the aphid population throughout the season. The aphid population fluctuating increased from week 51 to week 10, with an average of 47.86 aphids during that period. The highest aphid population (47.86 aphids) occurred in week 8, while the lowest population (8.06 aphids) was recorded in week 49. Ayyanar *et al*. 2022 [2] reported that the minimum population could be observed during the 47th-50th standard week (2nd week of December). During the study period, two peaks were recorded, the first peak during the 7th standard week (2nd week of February) and the second peak coinciding with the 10th standard week (3rd week of March). Mourya *et al.* (2023) [8] reported that aphids first appeared on brinjal crops during the 3rd week of November 2022, coinciding with the early stages of crop development. The aphid population reached its peak during the 3rd week of February. Bhattacharyya *et al*. (2019) [4] recorded maximum aphids population on during the 4th week of February (8th SMW).

During the Rabi season of 2022-23, the population of the aphid (*A. gossypii*) was positively linked to weather conditions. Specifically, a significant positive correlation was found between the maximum temperature and the aphid population (correlation coefficient of +0.578). However, the minimum temperature showed a weaker, non-significant negative correlation (correlation coefficient of -0.495). The analysis revealed significant correlations between environmental factors and the population of the aphid. Relative humidity exhibited a strong negative correlation (r = -0.651), while rainfall displayed an even stronger negative correlation (r = -0.605). Ajabe *et al*. (2019) [1] reported that the population of aphids was negatively and non-significant correlated with minimum temperature and wind velocity, negatively relative humidity, positively correlated with maximum temperature and significant positive correlation was observed between aphid populations negatively significant with rainfall.

In other words, as the relative humidity and rainfall increased, the aphid population decreased. Conversely, as the temperature increased, the aphid population also increased. Interestingly, these studies also observed a significant positive correlation between maximum temperature and aphid population, suggesting that warmer temperatures favor aphid development. Our research findings align with these observations.

Conclusion

Brinjal crops planted during both the Kharif (2022) and Rabi season (2022-23) were first infested by aphid in the second week of June in Kharif and third week of November in Rabi season. The aphid population reached its peak in August and February, with an average of 19.26 and47.86 aphids. Interestingly, the aphid population increased with higher maximum temperature but decreased with lower minimum temperature and higher sunshine hours. Additionally, higher relative humidity and rainfall led to lower aphid population. This study suggests that implementing Integrated Pest Management (IPM) techniques based on these environmental factors could effectively reduce brinjal losses caused by aphids.

Table 1: Influence of weather parameters on the incidence of *A. gossypii* during the Kharif season 2022

SMW	Period (2022)	Mean no. of aphids/3 leaves/plant	Temperature (^{0}C)		Relative Humidity (%)	HBSS (Hrs)	Rainfall (mm)	Wind speed (kmph)
			Max.	Min.				
24	11 Jun – 17 Jun	9.06	37.8	24.6	67	7.5	028.0	5.0
25	18 Jun – 24 Jun	11.33	35.2	24.5	68	5.0	000.0	3.8
26	25 Jun – 01 Jul	16.86	37.2	25.0	69	6.3	005.8	5.0
27	02 Jul – 08 Jul	15.73	35.6	24.7	66	3.7	023.6	5.3
28	09 Jul – 15 Jul	12.53	35.5	25.2	65	4.3	001.0	7.9
29	16 Jul – 22 Jul	17.46	36.0	24.4	70	7.2	022.4	4.2
30	23 Jul – 29 Jul	3.13	34.4	23.3	73	6.4	050.5	3.4
31	30 Jul – 05 Aug	4.93	33.2	24.3	78	3.3	013.0	2.6
32	06 Aug – 12 Aug	19.26	34.3	24.0	67	6.1	000.0	6.5
33	13 Aug – 19 Aug	13.73	36.2	23.9	69	7.5	047.4	4.2
34	20 Aug – 26 Aug	1.33	33.9	24.7	76	4.5	038.6	3.7
35	27 Aug – 02 Sep	3.40	32.3	23.6	81	4.1	027.0	1.9
36	03 Sep – 09 Sep	5.86	33.5	23.7	74	5.0	001.2	2.9
37	10 Sep – 16 Sep	8.53	34.9	23.9	70	6.2	002.0	6.1
38	17 Sep – 23 Sep	7.93	35.3	24.3	68	6.4	000.0	4.5
39	24 Sep – 30 Sep	8.47	35.4	26.2	73	5.5	048.6	3.2

Table 2: Correlation factors between the incidence of *A. gossypii* and weather parameters during Kharif season, 2022

Weather parameters	Correlation coefficient
Maximum temperature	0.575**
Minimum temperature	0.239NS
Relative humidity	-0.727*
Hours of Bright Sun Shine (HBSS)	0.335NS
Rainfall	-0.317NS
Wind velocity	0.602**

(* = Highly Significant at 1%; ** = Significant at 5%; NS= Non- Significant)

Table 3: Influence of weather parameters on the incidence of *A. gossypii* during the Rabi season, 2022-23

SMW	Period (2022-23)	Mean no. of aphids /3 leaves/plant	Temperature (^{0}C)		Relative Humidity (%)	HBSS (Hrs)	Rainfall (mm)	Wind speed (kmph)
			Max.	Min.				
47	19 Nov – 25 Nov	10.67	30.9	21.1	74	3.7	000.0	3.0
48	26 Nov – 02 Dec	16.13	31.0	21.5	90	5.7	070.8	2.1
49	03 Dec – 09 Dec	8.06	29.0	21.3	91	2.8	076.2	4.4
50	10 Dec – 16 Dec	10.73	28.5	20.7	91	3.3	049.4	2.6
51	17 Dec – 23 Dec	17.93	29.0	20.5	87	4.1	000.0	4.7
52	24 Dec – 31 Dec	24.46	31.7	21.0	89	7.1	014.9	3.1
1	01 Jan – 07 Jan	29.20	30.3	19.5	74	7.2	001.0	2.7
2	08 Jan – 14 Jan	20.73	29.4	18.0	72	7.3	017.0	3.3
3	15 Jan – 21 Jan	23.66	29.1	17.4	73	7.9	000.0	2.8
4	22 Jan – 28 Jan	30.20	29.2	19.3	74	6.4	000.0	3.4
5	29 Jan – 04 Feb	9.67	28.2	20.9	82	2.7	044.4	4.8
6	05 Feb – 11 Feb	17.06	29.8	18.2	73	8.6	000.0	2.4
7	12 Feb – 18 Feb	31.53	30.5	16.8	69	8.7	000.0	1.9
8	19 Feb – 25 Feb	47.86	31.0	17.6	70	9.1	000.0	2.3
9	26 Feb – 04 Mar	41.27	30.9	19.5	71	7.6	000.5	3.3
10	05 Mar – 11 Mar	43.13	31.4	20.3	71	7.0	000.0	3.4

Table 4: Correlation factors between the incidence of *A. gossypii* and weather parameters during Rabi season, 2022-23

Weather parameters	Correlation coefficient
Maximum temperature	0.578**
Minimum temperature	-0.495NS
Relative humidity	-0.651*
Hours of Bright Sun Shine (HBSS)	0.748*
Rainfall	-0.605**
Wind velocity	-0.329NS

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