Studies on Seasonal Incidence and Correlation of Tomato Aphids, *Aphis gossypii* (Glover) in Konkan Region

Abstract

A field experiment was conducted during *Rabi* 2021-2022 and *Rabi* 2022-23 to ascertain the influence of various meteorological parameters on population fluctuations of Aphids, *Aphis gossypii* Glover on tomato at Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The population of aphids ranged from 0.25 to 4.50 and 0.20 to 4.66 per three leaves per plant during *rabi* 2021-22 and *rabi* 2022-23, respectively. During the *rabi* season of 2021-22, the peak population of aphids was recorded during the 6th Standard Meteorological Week (SMW), whereas in the *rabi* season of 2022-23, the peak population was observed during the 7th SMW. However, pooled data on both years revealed that the aphid population was in the range of 0.23 to 4.30 per three leaves per plant, whereas peak population was observed during 7th SMW. During *rabi* 2021-22 the minimum temperature (r=-0.560*) recorded negative significant correlation with mean population of aphids. Other parameters were non-significantly correlated with aphid population. During *rabi* 2021-22 the aphid population had positive highly significant correlation with bright sunshine hours (r=0.710**) and wind speed (r=0.623**), whereas negative significant correlation with minimum temperature (r=-0.482*) and evening relative humidity(r=-0.737**). Remaining parameters were non-significantly correlated with aphid population.

Keywords: *Aphis gossypii*, Tomato, Seasonal incidence, correlation

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most significant vegetables cultivated globally due to its high nutritional value and extensive culinary applications. It is a domesticated and genetically refined member of the genus *Solanum* within the Solanaceae family, commonly known as the nightshades. It can be grown outdoors, in greenhouses, or net houses all over the globe. Tomatoes are a rich source of essential vitamins, minerals, and secondary metabolites (Luthria et al., 2006). Consuming 100 grams of fresh tomatoes can provide over 46% of the daily recommended intake of potassium, 8% of vitamin C, and 3.4% each of vitamins A and K (Gebhardt and Thomas, 2002; Canene-Adams et al., 2005). At present, India ranks second in production followed by China. In India, tomato is grown over an area of 872.9 thousand ha with a production of 21238.1 thousand MT and productivity 24.33 MT/ha of fruits. In Maharashtra, it is grown on area of 55.23 thousand ha with a production of

1332.09 MT and productivity of 24.12 MT/ha (Anonymous, 2023). Tomato production and the total cultivated area have steadily increased in recent years in our country. However, productivity remains significantly lower than the global average, primarily due to various abiotic and biotic factors, including insect pests (Harshita *et al*., 2019). Among these pests, the aphid, *Aphis gossypii* Glover, is a major sucking pest that inflicts considerable damage to tomato crops across the country (Reddy and Kumar, 2004; Jamadar, 2006). *Aphis gossypii* and *Myzus persicae* have been reported to cause significant yield losses in tomato crops, ranging from 25% to 80% (Kishore and Parihar, 2002). The economic impact of such infestations is considerable, as aphids not only reduce yields but also adversely affect overall plant health (Allam *et al*., 2021). Meteorological factors significantly influence the seasonal incidence of insect pests. Understanding the relationship between pest occurrence and weather parameters is crucial for developing effective pest management strategies. Studying the seasonal incidence of pests at various growth stages of the tomato crop can aid in formulating an appropriate management schedule. With these considerations in mind, the present experiment was undertaken.

Materials and methods

A field experiment was carried out at the Vegetable Improvement Scheme, CES, Wakawali, during the *Rabi* seasons of 2022–23 and 2023–24 to investigate the seasonal incidence of aphids on tomato. The tomato cultivar Konkan Vijay was grown in plots measuring 27.72 m² with a spacing of 60 × 60 cm.

Method of recording observations

Ten plants were selected randomly for observation. Population was counted on three leaves top, middle and bottom and expressed as number on three leaves. The observations of pests infesting tomato were recorded at weekly interval (SMW) in a crop season. All recommended cultivation practices was followed. At the same time a corresponding weekly record of meteorological data viz. minimum and maximum temperature, morning and evening percent relative humidity, wind speed, evaporation, bright sunshine were maintained. The influences of different meteorological parameters on pest population were studied by graphical super imposition technique (Wade *et al*., 2020).

Statistical analysis

The data on aphid infestation in tomato crops were averaged, and correlation and regression analysis were conducted to examine the relationship between aphid populations and weather parameters. These analysis were performed using Microsoft Excel.

Results and Discussion

Seasonal incidence of aphids infesting tomato

The data on seasonal incidence of aphids infesting tomato during *Rabi* 2022-23, *Rabi* 2023-24 and pooled data are presented in Table 1 and graphically depicted in Fig. 1. The data revealed that, during *Rabi* 2022-23 the incidence of aphids population ranged from 0.25 to 4.50 /three leaves/plant. The pest incidence was first noticed in the 49th SMW (03rd December to 09th December) *i.e.* 0.25 /three leaves/plant, then incidence increased continuously up to the 6th SMW (05th February to 11th February) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (4.50/three leaves/plant) was recorded in 6th SMW (05th February to 11th February) and minimum pest incidence (0.25 /three leaves/plant) was recorded in 49th SMW (03rd December to 09th December).

Table 1: Seasonal incidence of aphids, *A. gossypii* infesting tomato during *Rabi* 2022-23, *Rabi* 2023-24 and pooled data

SMW	Period	Mean no. of aphids /three leaves/plant		
		2022-23	2023-24	Pooled
49	03 Dec – 09 Dec	0.25	0.20	0.23
50	10 Dec – 16 Dec	0.40	0.26	0.33
51	17 Dec – 23 Dec	0.65	0.42	0.54
52	24 Dec – 31 Dec	0.66	0.31	0.49
1	01 Jan – 07 Jan	1.05	1.25	1.15
2	08 Jan – 14 Jan	3.27	2.10	2.69
3	15 Jan – 21 Jan	3.60	2.48	3.04
4	22 Jan – 28 Jan	3.86	3.21	3.54
5	29 Jan – 04 Feb	4.11	3.53	3.82
6	05 Feb – 11 Feb	4.50	4.1	4.30
7	12 Feb – 18 Feb	3.80	4.66	4.23
8	19 Feb – 25 Feb	3.42	3.99	3.71
9	26 Feb – 04 Mar	2.93	3.45	3.19
10	05 Mar – 11 Mar	2.40	2.95	2.68
11	12 Mar – 18 Mar	2.20	2.65	2.43
12	19 Mar – 25 Mar	1.75	1.90	1.83
13	26 Mar – 01 Apr	0.95	0.99	0.97
SD (±)		**1.46**	**1.48**	**1.36**

SMW- Standard Meteorological Week

During *Rabi* 2023-24 the incidence of aphids population ranged from 0.20 to 4.66 /three leaves/plant. The pest incidence was first noticed in the 49th SMW (03rd December to 09th December) *i.e.* 0.20 /three leaves/plant, then incidence increased continuously up to the 7th SMW (12th February to 18th February) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (4.66 /three leaves /plant) was recorded in 7th SMW (12th February to 18th February) and minimum pest incidence (0.20/three leaves/plant) was recorded in 49th SMW (03rd December to 09th December).

The pooled data of both the years revealed that, the incidence of aphids population was in the range of 0.23 to 4.30 /three leaves /plant. The pest incidence started from 49th SMW (03rd December to 09th December) *i.e.* 0.23 /three leaves /plant, then incidence increased continuously up to the 6th SMW (05th February to 11th February) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (4.30/three leaves/plant) was recorded in 7th SMW (12th February to 18th February) and minimum pest incidence (0.23/three leaves/plant) was recorded in 49th SMW (03rd December to 09th December).

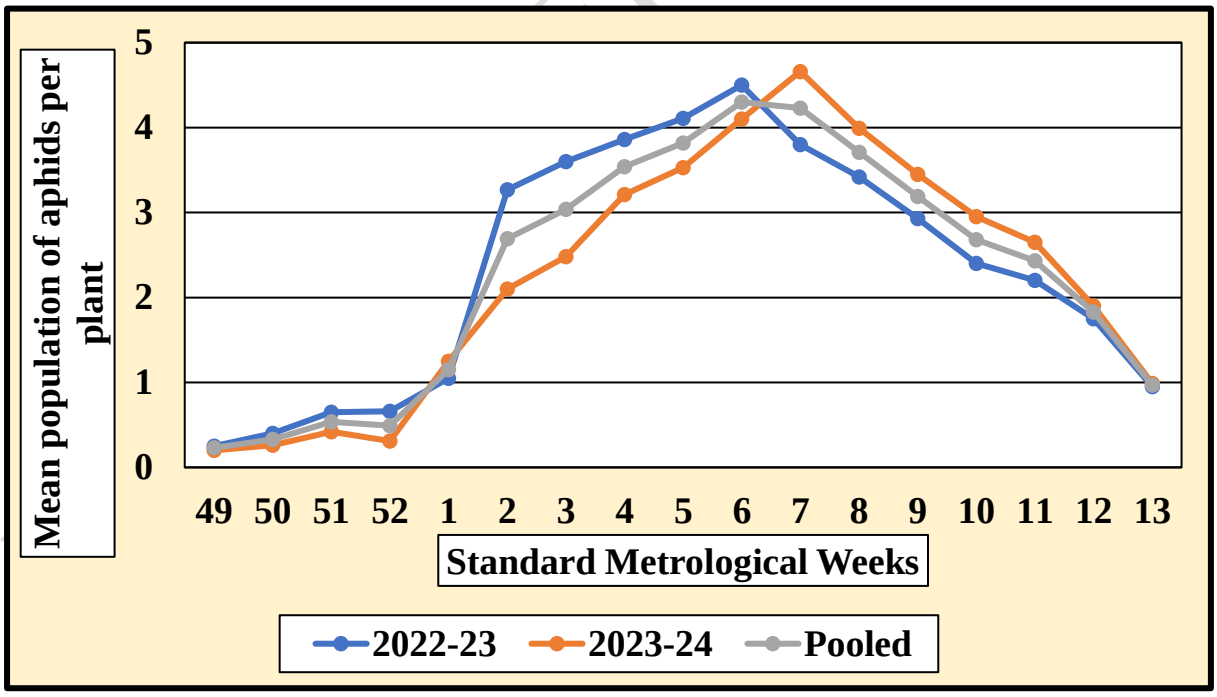

Fig. 1: Seasonal incidence of aphids infesting tomato during *Rabi* 2022-23, *Rabi* 2023-24 and pooled data

Correlation and regression between aphid population and weather parameters

Correlation studies

The data on correlation coefficient of mean population of aphids in relation to different weather parameters during *Rabi* 2022-23 and *Rabi* 2023-24 are shown in table 2.

During *Rabi* 2022-23, the mean population of aphids exhibited positive correlation with maximum temperature, bright sunshine hours, wind speed and evaporation, while negative correlation with morning and evening relative humidity. The minimum temperature (r=-0.560*) recorded negative significant correlation with mean population of aphids. Other parameters were non-significantly correlated with aphid population.

Table 2: Correlation coefficient of aphids, *A. gossypii* infesting tomato in relation to different weather parameters during *Rabi* 2022-23 and *Rabi* 2023-24

Weather parameters	Correlation coefficient (r)	
	2022-23	2023-24
Temp. Max.	0.241	0.274
Temp. Min.	-0.560*	-0.482*
RH-I	-0.111	-0.413
RH-II	-0.366	-0.737**
BSS	0.302	0.710**
WS	0.121	0.623**
EVP	0.275	0.478

* Correlation is Significant at the 0.05 level 'r' value = 0.482
** Correlation is significant at the 0.01 level 'r' value = 0.606

The mean population of aphids during *Rabi* 2023-24 showed positive correlation with maximum temperature and evaporation, while negative correlation with evening relative humidity. The aphid population had positive highly significant correlation with bright sunshine hours (r=0.710**) and wind speed (r=0.623**), whereas negative significant correlation with minimum temperature (r=-0.482*) and evening relative humidity(r=-0.737**). Remaining parameters were non-significantly correlated with aphid population.

Multiple linear regression studies

The multiple regression was worked out between aphid population and weather parameters during *Rabi* 2022-23 and regression coefficient (b) and intercept (a) are presented in Table 3. The regression equation of *Rabi* 2022-23 was worked out is as follows

$$Y= 22.993+ 0.022X_1 -0.776X_2 + 0.027X_3 - 0.128 X_4 - 0.849 X_5 +1.002 X_6 -0.137 X_7$$

The coefficient of determination (R^2) represents the proportion of common variation in the two variables. The investigation revealed that the weather parameters contributed for 62 per cent of total variation in the population of aphids on tomato.

Table 3: Multiple linear regression between aphids, *A. gossypii* and weather parameters during *Rabi* 2022-23

Sr. No.	Weather parameters	Regression coefficient (b)	S.E. (b)	't' values
(X_1)	Temp. Max.	0.022	0.538	0.041
(X_2)	Temp. Min.	-0.776	0.250	-3.097
(X_3)	RH-I	0.027	0.099	0.276
(X_4)	RH-II	-0.128	0.188	-0.681
(X_5)	BSS	-0.849	0.545	-1.558
(X_6)	WS	1.002	2.628	0.380
(X_7)	EVP	-0.137	1.348	-0.102
Intercept (a) = 22.993, N=15, F value = 2.137, R^2 = 0.62				

During *Rabi* 2023-24, the multiple regression was worked out between aphid population and weather parameters and regression coefficient (b) and intercept (a) are presented in Table 4.

The regression equation worked out of *Rabi* 2023-24 is as follows

$$Y= -3.363 + 0.007\ X_1\ -0.270X_2 + 0.158\ X_3\ -0.153\ X_4\ -0.968\ X_5\ +1.425\ X_6\ +0.062\ X_7$$

The coefficient of determination (R^2) represents the proportion of common variation in the two variables. The investigation revealed that the weather parameters contributed for 55 per cent of total variation in the population of aphids on tomato.

Table 4: Multiple linear regression between aphids and weather parameters during *Rabi* 2023-24

Sr. No.	Weather parameters	Regression coefficient (b)	S.E. (b)	't' values
(X_1)	**Temp. Max.**	0.007	0.384	0.017
(X_2)	**Temp. Min.**	-0.270	0.266	-1.017
(X_3)	**RH-I**	0.158	0.211	0.752
(X_4)	**RH-II**	-0.153	0.079	-1.943
(X_5)	**BSS**	-0.968	0.709	-1.366

(X_6)	**WS**	1.425	1.422	1.002
(X_7)	**EVP**	0.062	1.248	0.051
Intercept (a) =-3.363, N=15, F value = 1.574, R^2 = 0.55				

Discussion

The findings of present investigation are in conformity with Wade *et al*. (2020) observed that the aphid during 2nd SMW, with peak population of 4.53 per three leaves in 7th and 12th SMW in tomato. Similar results were reported by Chakraborty *et al*. (2011) reported that population of *A. gossypii* was initiated during second fortnight of November and gradually increased the population and reached peak in last fort night of February.

Similarly, the findings of Chavan *et al*. (2013) revealed that the aphid population commenced from transplanting with 1.35 aphids per leaves reached to peak level (7.31 aphid per leaves) at 11WAT. The present results were in close agreement with Shigwan *et al*. (2022) reported that the aphid population indicated positive significant correlation with wind speed (r= 0.884*) and bright sunshine hours (r= 0.708*) while negative significant correlation with morning relative humidity (r=-0.856*) and evening relative humidity (r= 0.828*) in cabbage. Jadhav *et al.* (2017) reported that the bright sunshine had significant positive correlated with aphid population in okra and noticed weather parameter contributed (R^2 = 0.890) 89 per cent of variation occurred in aphid population.

Conclusion

The seasonal incidence of aphids infesting tomato crops is significantly influenced by weather parameters, including maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, bright sunshine, wind speed, evaporation. A detailed analysis revealed that aphid populations peak during specific climatic conditions, emphasizing the critical role of meteorological factors in pest dynamics. Understanding these seasonal patterns provides valuable insights for developing timely and effective pest management strategies, ensuring better crop protection and yield optimization.

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