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Effect of certain climatic factors and plant age on population density of *Aphis gossypii* (Glov.) infesting tomato plants at Mansoura district, Dakhlia Governorate, Egypt

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Abstract

The aim of this research is to determine the impacts of some climatic factors and plant age on the population density of the cotton aphid, *Aphis gossypii* (Glov.) on tomato plants. Field experiments were conducted at Mansoura district, Dakhlia Governorate, Egypt, during two successive growing seasons (2018/2019 and 2019/2020) to study the population density of *A. gossypii* (Glov.) (Hemiptera: Aphididae) on tomato plants (Hybrid T4 84 cultivar). Results indicated that *A. gossypii* infested tomato plants from beginning of October to mid-January during the two growing seasons. The cumulative counts of *A. gossypii* were 523.79 and 533.06 individuals per season for the two growing seasons, respectively. The total mean of *A. gossypii* population through the whole season was 65.47 ± 4.61 and 66.63 ± 3.86 individuals per five plants over the first and second growing seasons, respectively.

Generally, it was, found that the climatic conditions of half-monthly inspection dates were more favorite for *A. gossypii* to grow its population during October, November and December during the two growing seasons. Furthermore, it was found that the number of *A. gossypii* decreased during January month in two consecutive growing seasons. Results revealed that the combined effects of the climatic factors and the plant age can explain the variation in the population density of *A. gossypii*. The percentages of explained variance (E.V.%) were 99.92 and 99.95% for the two successive growing seasons, respectively. These information can be useful for planning an IPM program of aphid on tomato plants.

Keywords: *Aphis gossypii*, population density, tomato plants, environmental conditions, plant age, growth stage

Introduction

Tomato (*Lycopersicon* spp.) is economically one of the most important vegetables (Polston and Anderson, 1999) [20]. Tomato plants and fruits are attacked by many insect pests. The cotton aphid (*Aphis gossypii* Glov.) is one of the basic pest of tomato. It is a direct plant sucking pest and it can cause serious problems on leaves, stems and fruits (Sharma and Joshi, 2010) [24]. It also causes direct damage by secreting honeydew that causes development of sooty-mould, which prevents photosynthesis resulting in wilt and death of the plants. These factors cause economic losses in yield and quality of crops (Blackman and Eastop, 2000) [7].

The pest effects very nearly all the area parts of the tomato plant from the early development stages till to the fruit maturation stage (Cruz and Bernardo, 1971 and Contagelo *et al*., 1971) [11, 10]. Feeding frequently brings about stunting, twisting or yellowing of plant green foliage (Berlendier and Sweetingham, 2003) [6]. Extreme infestations may eliminate the plant absolutely (Sharma and Bhatangar, 2004) [23]. Loss acquired because of sucking to the growing tomato crop is difficult (Bergman *et al*., 1984) [5].

To develop an effective control against *A. gossypii*, it is essential to know its bio-ecology including population dynamics under different climatic factors influencing the different phenological stages. The temperature has a direct effect on insect activity and the rate of development (Lamb, 1992) [17]. In addition, such changes in climatic conditions could profoundly affect the population dynamics and the status of insect pests of crops (Woiwod, 1997) [26]. Hence understanding the late patterns of seasonal abundance of *A. gossypii* is essential to create an integrated management system for this pest. Such time bound perception will help to visualize about the periodicity of the population and the degree of infestation. Perception on population dynamics of *A. gossypii* in light of pest management decision making is in this way discovered essential. The association between pest movement and abiotic components helps in inferring at prescient models that supports in estimate of pest occurrence (Shakeel *et al*., 2014) [22].

The objective of the study was to estimate the effect of certain climatic factors and plant age on the population density of *A. gossypii* on tomato plants under Mansoura conditions over the two growing seasons to plan an effective program for its control.

Materials and Methods

Seasonal abundance of *A. gossypii* infesting tomato plants

Field experiments on tomato plants were carried out at Mansoura district, Dakhlia Governorate, Egypt, during two successive growing seasons (2018/2019 and 2019/2020). Four replicates (of 5 m × 5 m log ═ 25 m^2 each). Replicates were distributed in complete randomized blocks design and it sown using the commercial tomato cultivar (Hybrid T4 84 cultivar) in autumn sowing date (beginning of September every season). All agricultural practices were followed except pest control. For estimating the population density of *A. gossypii*, five plants were sampled randomly in the morning every week, using 10x lenses in the field. Sampling was started when the seedlings grew above ground and continued until crop harvesting. Direct count of aphids sample was conducted on the same day as described by Dewar *et al*. (1982) [13]. Numbers of alive insects' (nymphs and apterous individuals) on tillers were counted and recorded to represent every inspection date. Identification of aphid was carried out by taxonomy specialists at the Department of Piercing-Sucking insects, Plant Protection Research Institute, Agriculture Research Center at Giza, Egypt.

Aphid-days and the cumulative aphid-days

Aphid days are cumulative number was used as a term to express the total impact of an ever-changing population over time. Aphid-days, also, allow better comparisons between treatments, locations and other variations observed during the experiment. The obtained data of aphid population at the two successive growing seasons are used here to calculate the Aphid-days cumulative values according to the following formula (Ruppel, 1983) [21].

$$\text{Aphid-days} = 3 \times [(a_1+a_2) / 2]$$

Where

a_1= Mean of aphids count per five plants before the present inspection date**.**

a_2= Mean of aphids count per five plants at the present inspection date.

Cumulative aphid-days = Aphid-days from last inspection + Aphid-days from present inspection, for each sampling date to obtain a running, cumulative total.

Accumulated numbers of aphids' population

Mean numbers of *A. gossypii* per five tomato plants were counted every week. To facilitate the comparisons of each season and season to each other, the seasonal population density above criteria was expressed in terms of percentage of the estimated numbers in each inspection date from the overall season. It was done by pooling the collected individuals over the inspected periods of each week. Then, the accumulated numbers of aphids per five plants in each inspection date were calculated by adding the number of individuals of aphids that accumulate at each sampling date, and the percentages of accumulated numbers relative to the overall season individuals number were calculated during the two successive seasons. Afterward, the percentages of individual numbers were used, to reflect the general trend of the population density (Bakry, 2018) [3].

Furthermore, the rate of half-monthly variation in the population (R.V.P) was calculated as follows**:**

$$(\text{R.V.P}) = \frac{\text{Av. count of insect at the present inspection date}}{\text{Av. count given at the preceding inspection date}}$$

Simultaneous effects of the abiotic factors (four climatic factors) and biotic factors *i.e.*, plant phenology as [plant age (in days)] on *A. gossypii* population density infesting tomato plants

The half-monthly counts of four climatic weather factors viz., mean daily maximum temperature (X_1), minimum temperature (X_2), mean of % relative humidity (X_3) and mean daily wind velocity (X_4) of Dakhlia Governorate, during two successive growing seasons (2018/2019 and 2019/2020) were obtained from the Central Laboratory for Agricultural Climate, Agricultural Research Center, Ministry of Agriculture at Giza. The daily records of these factors were recalculated to obtain the daily averages within two weeks before the sampling date.

Concerning, the biotic factors *i.e*. (plant phenology), the biotic factor was considered as plant age (X_5) were determined during two successive experimental seasons (2018/2019 and 2019/2020).

The data were statistically analyzed by using different models of correlation and regression to find out the relationships between tested main weather factors and plant phenology (plant age) as independent variables on *A. gossypii* population density (dependent variable) according to Fisher (1950) [15]. As well as, the percentage of explained variance (E.V.%) was calculated for demonstrating basic information about the amount of variability in the population size under these tested factors. All statistical analysis of the data was carried out by MSTATC Program software (1980) [18]. All data were subjected to calculations and were depicted graphically by Microsoft Excel 2010.

Results and Discussion

The weekly counts of *A. gossypii* that infested tomato plants at Mansoura district, Dakhlia Governorate were recorded through the two successive growing seasons (2018/2019 and 2019/2020). As well as, weekly mean records of climatic weather factors and plant age for tomato plants throughout the two growing seasons of investigation are tabulated in Tables (1 and 2) and Figs. (1). The effects of the climatic factors and plant phenological properties of tomato plants on the seasonal abundance of *A. gossypii* were estimated based on the average number of alive insects (nymphs and apterae individuals) counts per five plants in the successive sampling dates.

Population studies

Population density of *A. gossypii* population on tomato plants

The first growing season (2018/2019)

Concerning, the data in the first year of (2018/2019), as recorded in Tables (1) and graphed illustrated in Fig. (1), it was observed that the population of *A. gossypii* started to increase gradually to reach the first peak. The first peak was recorded in the mid of October with mean numbers of 77.13 ± 6.28 individuals per five plants under field conditions at (28.72 °C, Max. temp.; 23.75 °C Min. temp., 68.92% R.H. and 81.00 km/h wind velocity), respectively. As well, the phenological character of tomato plants was (plant age, 45 days). After that, the population decreased took place in beginning of November. Then, the population increased gradually to reach the second peak of this insect, was recorded in mid- November when the mean population reached 95.04 ± 6.00 individuals per five plants under field conditions at (24.18 °C, Max. temp.; 21.47 °C Min. temp., 69.85% R.H. and 63.69 km/h wind velocity), respectively. The plant age of tomato plants was (75 days). Thereafter, the population decreased in beginning of December and then reincreased gradually to reach third peak in mid-December, when 105.12 ± 7.39 individuals per five plants under field conditions at 21.92 °C, Max. temp.; 18.89 °C Min. temp., 73.42% R.H. and 56.92 km/h wind velocity), respectively. As well, the plant age of tomato plants was (105 days). A continues decrease was observed in insect population during January are shown in Tables (1) and illustrated in Fig. (1).

The second growing season (2019/2020)

The results presented in (Table, 2) and illustrated in Fig. (1), indicated that *A. gossypii* on tomato plants appeared to increase numbers to reach the first peak. The first peak was recorded in the mid of October with mean numbers of 76.16 ± 6.20 individuals per five plants under field conditions at (29.30 °C, Max. temp.; 24.02 °C Min. temp., 76.50% R.H. and 81.81 km/h wind velocity), respectively. As well, the plant age was (45 days). Thereafter, the population decreased in beginning of November and then reincreased gradually to reach second peak in mid-November, when 84.48 ± 5.33 individuals per five plants under field conditions at (24.67 °C, Max. temp.; 21.71 °C Min. temp., 77.53% R.H. and 64.33 km/h wind velocity), respectively. The plant age of tomato plants was (75 days). After that, the population decreased took place in beginning of December. Then, the population increased gradually to reach the third peak of this insect, was recorded in mid-December when the mean population reached 99.88 ± 7.02 individuals per five plants under field conditions at (22.35 °C, Max. temp.; 19.10 °C Min. temp., 81.50% R.H. and 57.49 km/h wind velocity), respectively. As well, the plant age of tomato plants was (105 days). A continues decrease was observed in insect population during January are shown in Tables (2) and illustrated in Fig. (1). Population of aphid increased with decrease in temperature, lowest population was found on tomato at temperature of 32.5 °C and the highest population was recorded at temperature of 27.5 °C (Shakeel *et al*., 2014) [22].

The obtained results cleared that the mean total population density of *A. gossypii* through the whole season was 65.47 ± 4.61 and 66.63 ± 6.86 individuals per five plants over the first and second growing seasons, respectively. This may be due to the influence of environmental factors in this region and the plant phenology of tomato as recorded in Tables (1 and 2) and illustrated in Fig. (1). It was obvious that infestation by *A. gossypii*, decreased on tomato plants during January during the two growing seasons. This may be due to the low temperature during these periods. Dent (1991) [12] clarified that the rate of insect's population abundance at any location is influenced by the environmental factors at that location.

Weekly incidence of *A. gossypii* population, its accumulation and their percentages in relation to the seasonal total

To facilitate comparisons within each season compared to another, the seasonal population density of the above criteria, was expressed in terms of percent of counted numbers, in each inspected week relative to the overall season grand total of the insect population. As well, the percentages of accumulated counts of each week were related to that of the overall seasonal number, to reflect the general trend of the population density as presented in Tables (1 and 2) and illustrated in Fig. (1).

Results in Tables (1 and 2) and illustrated in Fig. (1), indicating that the highest percentages of *A. gossypii* numbers (14.73 and 14.29%) were recorded in mid of October, (18.14 and 15.85%) in mid of November and (20.07 and 18.74%) in mid of December, occurred during the first and second growing season, respectively, may be attributed to the suitable climatic conditions during these periods.

Data recorded in Tables (1 and 2) showed that the cumulative numbers of *A. gossypii* were 523.79 and 533.06 individuals per season for the two growing seasons, respectively. As well, the percentages of accumulated numbers of *A. gossypii* were increase with increasing the periods the inspection during the growing season.

Cumulative Aphid-Days

Data in Tables (1 and 2) and illustrated in Fig. (1), presented the aphid-days and the cumulative aphid-days for *A. gossypii* on tomato plants to express the total impact of an ever-changing population over time. These present results indicated that the impact of *A. gossypii* population on tomato plants was higher at the second growing season (1529.50 cumulative aphid-days) as compared to the first one (1512.25 cumulative aphid-days). The cumulative aphid-days method was used to express the total impact of an ever-changing population over time in the field by El-Fatih (2006) [14] that used the same technique for cereal aphids on barely plant.

Rate of variation in population of *A. gossypii* (R.V.P)

The half monthly variation rates in the population of *A. gossypii* on tomato plants were calculated (Tables, 1 and 2). The rate of half monthly variation in the population is considered an indicator of the favorable period for insect activity expressed as the period of higher increase of this insect population through the season. When R.V.P. was > 1, that meant more activity, < 1 means lower activity and = 1 means no change in the insect activity.

The obtained results cleared that the favorable periods of increase for *S. graminum* population during the two growing season were recorded in mid of October, when the rates of half-monthly variation were (2.26 and 2.05), respectively and were observed in mid of November, when the rates of half-monthly variation were (1.38 and 1.19), respectively and were found in mid of December, when the rates of half-monthly variation were (2.32 and 2.03), respectively; Tables, 1 and 2).

Generally, it was clear the climatic conditions in October, November and December during the two growing seasons, were more favorable for the insect multiplication and build up. Furthermore, it was found that the unfavorable periods of *A. gossypii* were observed in January month in two consecutive growing seasons.

Effect of the abiotic and biotic factors on population density of *A. gossypii* infesting tomato plants

Effect on independent variables [four climatic factors (X_1, X_2, X_3 and X_4) and plant age (X_5)] on total population of *A. gossypii* (Y) (dependent variable)

Effect of daily mean maximum temperature (X_1)

Results presented in Table (3) showed that the simple correlation (r) between the daily mean maximum temperature and the total insect population of *A. gossypii* was insignificantly negative (-0.03 and -0.11) for the first and second growing seasons, respectively. As well as, the simple regression coefficient indicated that a 1˚C increase in the daily mean maximum temperature would decrease the population by 0.21 and 0.57 individuals per five plants for the two growing seasons, respectively (Table, 3).

The partial regression coefficient values for the effect of daily mean maximum temperature on the total *A. gossypii* population are shown in Table (3). Data revealed that this factor had a highly significant negative relation with the insect's population (P. reg. values; -10.90 and -4.83) during the two growing season, respectively. The t-test values were (-14.34 and -10.61) respectively. The obtained results revealed that daily mean maximum temperature entirely above the optimum range of total *A. gossypii* population activity during the two growing season (Table, 3).

Effect of daily mean minimum temperature (X_2)

The results of statistical analysis of simple correlation (Table, 3) showed an insignificantly positive correlation between the daily mean minimum temperature and the total population of *A. gossypii* (r values; 0.23 and 6.79) during the two growing seasons, respectively.sss As well, the calculated regression coefficient (b) for the effect of this factor indicated that every 1˚C increase in the mean daily minimum temperature would increase the population by 1.24 and 0.83 individuals per five plants during the two seasons of study, respectively.

The precise effects of mean minimum temperature on the total insect population of *A. gossypii* are presented in Table (3), those showed highly significantly positive relation for the first season (P. reg. value; 8.36 and 6.79) during the first and second seasons, respectively. The obtained results revealed that, mean daily minimum temperature entirely under the optimum range of total *A. gossypii* population activity during the two growing season (Table, 3).

Effect of the mean relative humidity (X_3)

Data in Table (3), showed that the correlation between relative humidity and the total population of *A. gossypii* was insignificantly negative (r-values; -0.18 and -0.04) for the two growing seasons, respectively. In the same time, the simple regression coefficient indicated that an increase by 1% in the mean relative humidity would decrease the population by 1.06 and 0.17 individuals per five plants during the first and second seasons, respectively (Table, 3).

The real effect of this factor appeared from the partial regression values which showed that the effect of relative humidity on the total population activity *A. gossypii* was significant negative (P. reg. value; -1.87) for the first growing season and insignificant negative (P. reg. value; -0.52) during the second growing season. Also, the t-test values were (-6.37 and -3.21) for both seasons, respectively. Results revealed that, mean relative humidity was above the optimum range of total population activity during the first season and around the optimum range of total population activity of *A. gossypii* during the second season (Table, 3).

Effect of the wind velocity (X_4)

Data presented in Table (3), showed that the wind velocity had an insignificantly positive effect on the total *A. gossypii* population in the two growing seasons, since the correlation coefficient was (0.24 and 0.12), respectively. The unit effect (regression coefficient) indicated that one km/h increase in wind velocity, would increase the population by 0.40 and 0.16 individuals per five plants, for the two seasons, respectively.

The real effect of the wind velocity on the total population activity *A. gossypii* was clear from the partial regression values (Table, 3), which showed a highly significant positive effect (P. reg. values; 2.13 and 1.89) in the two growing seasons, respectively. The obtained results revealed that, mean daily wind velocity entirely under the optimum range of total *A. gossypii* population activity during the two growing season (Table, 3).

Effect of the plant age (X_5)

Data in Table (3) show the effect of the plant age on total population of *A. gossypii*. The correlation coefficient (r) was insignificantly positive (r-values; 0.01 and 0.11) for the two growing seasons, respectively. The calculated regression coefficient (b) for the effect of this factor indicated that for everyday increase in the plant age of tomato, the total population of *A. gossypii* would increase by 0.01 and 0.06 individuals per five plants during the two seasons of study, respectively.

The exact relation between the tomato plant age and total population of *A. gossypii* was determined by the partial regression values (Table, 3), which were highly significantly positive (P. reg. values; 0.92 and 1.20) for the first and second growing seasons, respectively, Table (3).

The combined effect of [three climatic factors (X_1, X_2, X_3 and X_4), and plant age (X_5) on the total population of *A. gossypii*

As shown in Table (3), the combined effect of these tested factors on the *A. gossypii* total population during the two growing seasons was highly significant where the "F" values were 499.66 and 886.78, respectively. The amounts of variability were 99.92 and 99.95% for the two growing seasons, respectively.

Climatic factors exert a great influence on the growth, development, distribution, and population dynamics of insect pests (Chang *et al.* 2008) [9]. Both the physical and biological factors are much vital causing the variations in the densities of aphid population (Naeem, 1996) [19].

Aphid population on tomato showed a significant negative correlation with minimum and maximum temperatures (Shakeel *et al*., 2014) [22]. They recorded also, significant positive correlation with relative humidity and non-significant negative correlation with rainfall. The same authors reported that the determination of effects of different weather factors on the population of aphids in tomato plantations was essential for effective pest management.

Aphid population on tomato varied due to temperature (Aheer *et al*., 2008) [1]. They indicated that the aphid population showed, significant negative correlation with maximum and minimum temperatures and precipitation, whereas relative humidity was positively correlated. The significant negative correlation of the aphid population with maximum temperature was reported by Chandrakumar *et al.* (2008) [8].

The highest aphid population occurred during March (Aheer *et al*., 2007; Wains *et al*., 2010 and Iqbal *et al*., 2008) [2, 25, 16].

The population of aphid increased with the decrease in temperature, lowest population was found on tomato at 32.5 °C, while, the highest population was recorded at 27.5 °C (Shakeel *et al*., 2014) [22].

Plant phenology can have a significant impact on the status of aphid species infestation (Bakry *et al*., 2020) [4].

Table 1: Half-monthly mean numbers, aphid days, % Cumulative, cumulative aphid-days and R.V.P. of *Aphis gossypii* on tomato plants, with climatic factors, at Mansoura district, Dakhlia Governorate during the first growing season (2018/2019)

Sampling date		Plant age (days)	Aphids count per five plants ± S.E.	% No. aphids from overall seasonal total	Cumulative numbers per five plants	% Cumulative	Aphid - Days	Cumulative aphid-days	R.V.P	Climatic factors			
										Max. temp.	Min temp.	% R.H.	Wind velocity (km/h)
Oct., 2018	1	30	34.13 ± 2.69	6.52	34.13	6.52	51.19	51.19	—	29.69	24.46	69.25	70.38
	15	45	77.13 ± 6.28	14.73	111.26	21.24	166.89	218.08	2.26	28.72	23.75	68.92	81.00
Nov.	1	60	68.73 ± 4.45	13.12	179.99	34.36	218.80	436.88	0.89	28.21	23.97	67.53	66.65
	15	75	95.04 ± 6.00	18.14	275.03	52.51	245.66	682.54	1.38	24.18	21.47	69.85	63.69
Dec.	1	90	45.36 ± 3.14	8.66	320.39	61.17	210.60	893.14	0.48	23.94	18.78	72.91	45.12
	15	105	105.12 ± 7.39	20.07	425.51	81.24	225.72	1118.86	2.32	21.92	18.89	73.42	56.92
Jan., 2019	1	120	58.86 ± 4.16	11.24	484.37	92.47	245.97	1364.83	0.56	21.31	18.82	80.53	32.47
	15	135	39.42 ± 2.78	7.53	523.79	100.00	147.42	1512.25	0.67	18.49	5.46	75.47	50.41
Total			523.79	100.00			1512.25						
General average			65.47 ± 4.61							24.56	19.45	72.24	58.33

Table 2: Half-monthly mean numbers, aphid days, % Cumulative, cumulative aphid-days and R.V.P. of *Aphis gossypii* on tomato plants, with climatic factors, at Mansoura district, Dakhlia Governorate during the second growing season (2019/2020)

Sampling date		Plant age (days)	Aphids count per five plants ± S.E.	% No. aphids from overall seasonal total	Cumulative numbers per five plants	% Cumulative	Aphid - Days	Cumulative aphid-days	R.V.P	Climatic factors			
										Max. temp.	Min temp.	% R.H.	Wind velocity
Oct., 2019	1	30	37.20 ± 2.93	6.98	37.20	6.98	55.80	55.80	—	30.28	24.73	76.87	71.08
	15	45	76.16 ± 6.20	14.29	113.36	21.27	170.04	225.84	2.05	29.30	24.02	76.50	81.81
Nov.	1	60	70.80 ± 4.59	13.28	184.16	34.55	220.44	446.28	0.93	28.77	24.23	74.96	67.31
	15	75	84.48 ± 5.33	15.85	268.64	50.40	232.92	679.20	1.19	24.67	21.71	77.53	64.33
Dec.	1	90	49.20 ± 3.40	9.23	317.84	59.63	200.52	879.72	0.58	24.41	18.98	80.93	45.57
	15	105	99.88 ± 7.02	18.74	417.72	78.36	223.62	1103.34	2.03	22.35	19.10	81.50	57.49
Jan., 2020	1	120	68.88 ± 4.87	12.92	486.60	91.28	253.14	1356.48	0.69	21.74	19.03	89.39	32.80
	15	135	46.46 ± 3.27	8.72	533.06	100.00	173.02	1529.50	0.67	18.86	5.52	83.77	50.92
Total			533.06	100.00			1529.50						
General average			66.63 ± 3.86							25.05	19.66	80.18	58.91

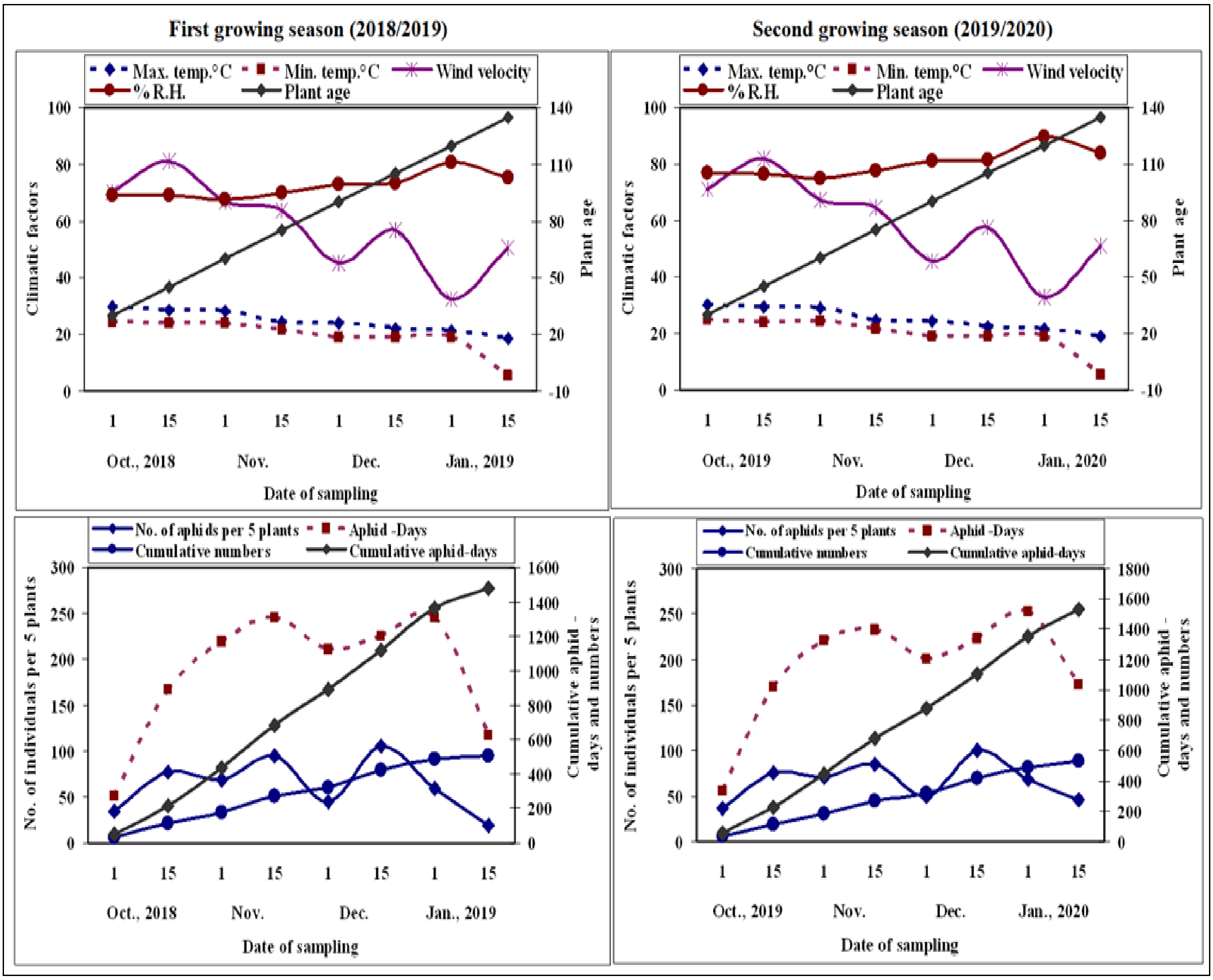

Fig 1: Half-monthly mean numbers of aphid days, % cumulative, cumulative aphid-days of *A. gossypii* on tomato plants, with climatic factors at Mansoura district, Dakhlia Governorate during the two seasons (2018/2019 and 2019/2020)

Table 3: Different models of correlation and regression analyses for describing the relationship between some weather factors and plant age on population fluctuations of *A. gossypii* on tomato plants during the two successive growing seasons (2018/2019 and 2019/2020)

Season	Tested Variables	Simple correlation and regression values				Partial correlation and regression values			Analysis variance			
		r	b	S.E	t	P. reg.	S.E	t	F values	MR	R^2	E.V. %
2018/2019	Max temp (X1)	-0.03	-0.21	2.65	-0.08	-10.90	0.76	-14.34 **	499.66 **	0.9996	0.9992	99.92
	Min temp (X2)	0.29	1.24	1.64	0.75	8.36	0.18	45.40 **				
	R.H.% (X3)	-0.18	-1.06	2.43	-0.44	-1.87	0.29	-6.37 *				
	Wind velocity (X4)	0.24	0.40	0.67	0.59	2.13	0.08	25.12 **				
	Plant age (X5)	0.01	0.01	0.29	0.01	0.92	0.09	10.33 **				
2019/2020	Max temp (X1)	-0.11	-0.57	2.10	-0.27	-4.83	0.46	-10.61 **	886.78 **	0.9998	0.9995	99.95
	Min temp (X2)	0.24	0.83	1.34	0.62	6.79	0.11	60.96**				
	R.H.% (X3)	-0.04	-0.17	1.81	-0.10	-0.52	0.16	-3.21				
	Wind velocity (X4)	0.12	0.16	0.55	0.30	1.89	0.05	36.88**				
	Plant age (X5)	0.11	0.06	0.23	0.27	1.20	0.05	22.23**				

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