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Population Fluctuation of the White Peach Scale Insect, *Pseudaulacaspis pentagona* (Targioni), Associated Parasitoid and Predacious Mites Attacking Peach Trees at Dakahlia Governorate

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ABSTRACT

Seasonal abundance of the white peach scale insect, *P. pentagona* and its associated parasitoid, predacious mites and the relation between the population activity, weather factors and number of generations were studied for two successive seasons (2013/2014 and 2014/2015) seasons on peach trees in Dakahlia governorate. The total population of *P. pentagona* had three peaks on April, September and November. The pre adult stages had four high infestation periods during the same time, while the adult stage had four infestation periods during February, May, July and January. The gravid females began to appear and laying eggs started from February and reach the maximum period of infestation during May. Larval population of the parasitoid *Aphytis* sp. had a dynamic curve with 3 peaks; on April, September and January. Whereas, pupal population of *Aphytis* sp. had also dynamic curve with 3 peaks; on May, October and January. Five species of predacious mites [*Hemisarcoptes malus* (Shimer), *Agistemus exsertus* Gonzalez, *Cheyletogenes ornatus* (C.&F.), *Saniosulus nudus* Summers and *Euseius scutalis* A.-H.] were associated with *P. pentagona*. The population of *H. malus* and *C. ornatus* had one dynamic curve and had one peak on November. While, the other three species *A. exsertus*, *S. nudus* and *E. scutalis* of predacious mites had one dynamic curve; and their population had one peak on October. Simple correlation and simple regression between the maximum, minimum temperature and relative humidity were non-significant the monthly mean of total population, preadult, adults and gravid females of *P. pentagona* as well as on the monthly mean of the parasitoid *Aphytis* sp., while the maximum, minimum temperatures and relative humidity were significant on the monthly mean of the five predacious mites. Generally the infestation of *P. pentagona* also the population of parasitoid and predacious mites in the 2nd (2014/2015) more than in the 1st season (2013/2014).

Key words:

Introduction

The white peach scale, *Pseudaulacaspis pentagona* (Targioni–Tozzetti, 1880) is one of the most important pests of ornamentals and fruit trees (Kosztarab and Kozár 1988, Miller and Davidson 2005). *P. pentagona* belonging to Order: Homoptera, Family: Diaspididae, which attacks branches and twigs of peach trees. The scale is most often seen in large numbers on the bottom of stems. The scale feeds on plant sap, and infestations cause leaves to yellow with a loss of healthy growth. It sucks a great amount of sap causing dry of branches and defoliation of leaves. Fruit size may be reduced and premature drop is likely. Heavy infestations can result in stunting and the death of branches and dieback (Ezzat and Nada, 1986). The life cycle, which lasts about 45 days, is complex. Females are covered by a roughly circular scale, about 2-2.5 mm across; beneath the scale is the insect itself, 0.8-0.9 mm long, pink to yellow, and without legs. Egg laying begins 2 weeks after mating, and about 100 eggs are laid over 8-9 days. The first eggs laid become female, those later, male. Crawlers emerge after 3-4 days of being laid.

The aim of this work studies the population dynamics of white peach scale insect, *P. pentagona* and natural enemies on peach trees under field conditions in Dakahlia Governorate throughout two successive seasons 2013/2014 and 2014/2015.

Material and Methods

Population fluctuation of P. pentagona and its parasitoid and predacious mites at Dakahlia Governorate:

The ecological studies were carried out in a Privet farm in Dakahlia Governorate, Egypt. Twenty infested peach trees, nearly of the same age and size were used for sampling. Twenty branches (15-20 cm long) were replicated 3 times at random from all parts of the tree were randomly taken at monthly intervals. Counting

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started from February till January during two successive seasons 2013/2014 and 2014/2015. The branches were kept separately in paper bags and transferred to the laboratory for counting by the aid of a stereomicroscope. Branches were inspected and the preadults, adults and gravid females were counted. The number of generations of this scale was estimated from the changes in monthly preadult stage throughout the two successive seasons. The seasonal fluctuation of the main associated parasitoid, *Aphytis* sp. and different predacious mites as biotic mortality factors for the white peach scale insect, *P. pentagona* was also studied where the parasitized scale insect were counted and classified into larvae and pupae, also predacious mites were classified and recorded throughout the two successive seasons.

Weather factors:

Effects of weather factors on the population of *P. pentagona*, parasitoids and predacious mites included day-maximum temperature (D.Max.T.), day minimum temperature (D. Min. T.) and daily mean relative humidity (D.M. R.H.) were studies. Records of the weather factors of Dakahlia Governorate was obtained from the Central Laboratory for Agriculture Meteorology, Agriculture Research Center, Ministry of Agriculture. The daily records of each weather factor were grouped into monthly averages according to the sampling dates. These averages were assumed to represent the field experimental records at sampling times.

Statistical analysis:

The simple correlation (r) and regression coefficient value (b) were adopted to clarifies the change in population of the white peach scale insect, *P. pentagona* and its associated parasitoid and predacious mites due to change in each of weather factors and the mean values compared with the least significant differences as well as, SAS program (SAS Institute 1988).

Results and Discussion

Seasonal abundance of the white peach scale insect, *P. pentagona* and its associated parasitoid, predacious mites and the relation between the population activity, weather factors and number of generations were studied for two successive seasons (2013/2014 and 2014/2015) on peach trees in Dakahlia governorate.

Population fluctuation of P. pentagona and its parasitoid and predacious mites on peach trees at Dakahlia Governorate:

First season 2013/2014:

Total population:

Data in Table (1) and Fig. (1) shows that the monthly numbers of the white peach scale insect, *P. pentagona* individuals/20 branches of peach trees during the 1st season 2013/2014 in Dakahlia Governorate were taken and examined.

The results indicated that the infestation with *P. pentagona* beginning February, then increased gradually until to make the 1st activity peak on April with 2208 individuals/20 branches when maximum temperature was 25.9ºC and minimum temperature was 14.6ºC also the relative humidity was 44.5% after that the population decreased until beginning of August after that increased again to make the 2nd generation on September with mean number reached to 552 individuals/20 branches when maximum temperature was 33.4ºC and minimum temperature was 22.9ºC also the relative humidity was 56.9%, the 3rd generation was noticed during November with 916 individuals/20 branches when maximum temperature was 26.3ºC and minimum temperature was 17.1ºC also the relative humidity was 63.2%.

Results in Table (2) show that the simple correlation between the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of total population of *P. pentagona* (r = -0.19682, -0.09472 and -0.31360), respectively. Also, results in Table (2), show that the simple regression of the maximum, minimum temperature and relative humidity on the monthly mean of total population of *P. pentagona* were non-significant (b = -0.63, -0.30 and -1.04), respectively.

The obtained data agree with those obtained by Habibian and Assadi (1989) recommended that white peach scale insect had three generations annually, the first begins in early May, the second around mid July and the third in early September.

Different stages:

Data in Table (1) and Fig. (1) show that the pre adult stages of *P. pentagona* had three high infestation periods during April, September and November with 2095, 529 and 755 individuals/20 branches when maximum temperatures were 25.9, 33.4 and 26.3ºC while minimum temperatures were 14.6, 22.9 and 17.1ºC also the relative humidity were 44.5, 56.9 and 63.2%, respectively.

Statistical analysis in Table (2) in 2013/2014 season show that the simple correlation between the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of preadult

Table 1: The mean number of the white peach scale insect, *Pseudaulacaspis pentagona* and its associated parasitoid and predacious mites infesting peach trees during 2013/2014 season at Dakahlia governorate.

Sampling date	Pseudaulacaspis pentagona				Parasite Aphytis sp.		Predacious mites					Temp.		RH%
	Preadult	Adult	Gravid females	Total pop.	Larvae	Pupae	*H. malus*	*A. exsertus*	*C. ornatus*	*S. nudus*	*E. scutalis*	Min	Max	
Feb. 2013	34	338	9	381	14	4	3	1	0	6	11	11.0	20.2	47.8
March	11	106	47	164	29	3	19	4	0	14	17	13.1	24.4	45.0
April	2095	48	74	2208	61	9	14	9	2	16	21	14.6	25.9	44.5
May	847	381	170	1403	30	37	19	12	7	21	25	17.3	29.2	45.8
Jun	743	14	46	803	21	21	26	17	11	38	34	19.1	30.9	46.7
July	128	95	43	266	7	4	42	23	16	47	41	22.5	33.0	55.4
August	280	35	5	320	4	4	65	31	28	71	63	23.3	34.1	54.0
Sept.	529	15	8	552	14	4	101	47	33	99	72	22.9	33.4	56.9
Oct.	144	81	13	238	3	7	121	68	43	106	98	20.0	29.9	53.7
Nov.	755	140	21	916	13	1	133	56	47	81	33	17.1	26.3	63.2
Dec.	199	336	1	536	21	3	67	17	11	25	9	14.2	21.7	54.8
Jan. 2014	33	685	5	723	36	29	13	0	0	13	3	9.6	18.6	60.4
Mean	483	190	37	709	21	11	52	24	17	45	36	-	-	-

Hemisarcoptes malus (Shimer), *Agistemus exsertus* Gonzalez, *Cheyletogenes ornatus* (C.&F.), *Saniosulus nudus* Summers,

stages of *P. pentagona* (r = 0.04937, 0.14943 and -0.34245), respectively. Also, the simple regression of the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of preadult stages of *P. pentagona* (b = 0.16, 0.48 and -1.15), respectively.

On the other hand, results in Table (1) and Fig. (1) show that the adult stages of *P. pentagona* had four infestation periods during February, May, July 2013 and January 2014 individuals/20 branches when maximum temperatures were 20.2, 29.2, 33.0 and 18.6ºC while minimum temperatures were 11.0, 17.3, 22.5 and 9.6 also the relative humidity were 47.8, 45.8, 55.4 and 60.4%, respectively.

Statistical analysis in Table (2) in 2013/2014 season show that the simple correlation between the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of adult stages of *P. pentagona* (r = -0.71319, -0.74677 and 0.22003), respectively. Also, the simple regression of the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of adult stages of *P. pentagona* (b = -3.22, -3.55 and 0.71), respectively.

Data in Table (1) and Fig. (1) show that the gravid females began to appear and laying eggs started from February and reach the maximum period of infestation during May with 70 individuals/20 branches when maximum temperature was 29.2ºC while minimum temperature was 17.3 ºC also the relative humidity was 45.8%.

Statistical analysis in Table (2) in 2013/2014 season show that the simple correlation between the maximum and minimum temperatures were non-significant on the monthly mean of gravid females of *P. pentagona* (r = 0.00959 and 0.17140), respectively, while between and relative humidity and monthly mean of gravid females was significant (r = 0.56875). Also, the simple regression of the maximum and minimum temperatures were non-significant on the monthly mean of gravid females of *P. pentagona* (b = 0.03 and 0.55), respectively, while between and relative humidity and monthly mean of gravid females was significant (b = 2.19).

The obtained results are agreed with those obtained with Ding (2003) who showed that the mulberry white scale, *P. pentagona* had 4 generations a season in Gutian area. The adult females hibernate on the branches and start egglaying when the mean daily temperature reaches 17ºC. The peak periods of the young scales are in mid-April, early to mid-July, early-mid September and mid-late October.

Parasitoid, Aphytis sp.:

Results in Table (1) and Fig. (1) show that the parasitoid *Aphytis* sp. (Hymenoptera: Aphelinidae) associated with *P. pentagona* and is specific ectoparasite of white peach scale insect.

Data in Table (1) and Fig. (1) proved that *Aphytis* sp. larval population had a dynamic curve with 3 peaks; the 1st peak started from February 2013 and increased gradually the peak on April with 61 individuals/20 branches, when maximum and minimum temperatures were 25.9 and 14.6ºC, respectively, while the relative humidity was 44.5%. However, the 2nd peak appear on September with 14 individuals/20 branches, when maximum and minimum temperatures were 33.4 and 22.9ºC, respectively, while the relative humidity was 56.9%, while the 3rd peak top happened on January 2014 with 36 individuals/20 branches, when maximum and minimum temperatures were 18.6 and 9.6ºC, respectively, while the relative humidity was 60.4%.

Whereas, pupal population of *Aphytis* sp. had also dynamic curve with 3 peaks; the 1st peak appeared on May 2013 with 36 individuals/20 branches, when maximum and minimum temperatures were 29.2 and 17.3ºC, respectively, while the relative humidity was 45.8%. However, the 2nd small peak appear on October with 7 individuals/20 branches, when maximum and minimum temperatures were 29.9 and 20.0ºC, respectively, while the relative humidity was 53.7%, while the 3rd peak top happened on January 2014 with 29

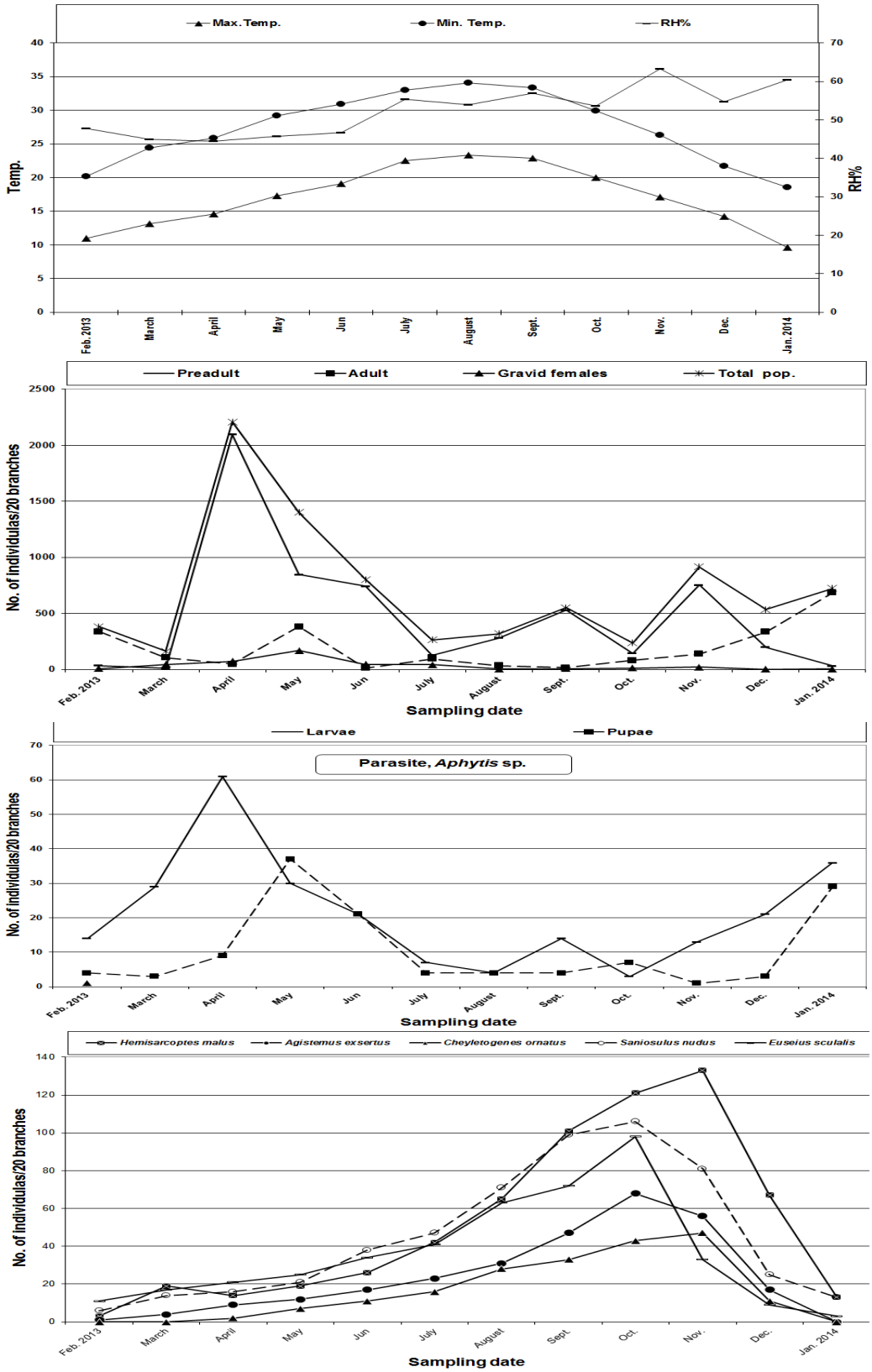

Fig. 1: The mean number of the white peach scale insect, *Pseudaulacaspis pentagona* and its associated parasitoid and predacious mites infesting peach trees during 2013/2014 season at Dakahlia governorate.

Table 2: Simple correlation and regression values between the weather factors and monthly number of the white peach scale insect, *Pseudaulacaspis pentagona*, parasitoid and predacious mites attacking peach trees during 2013/2014 season at Dakahlia governorate.

Variable			Simple correlation "r"	Probability "P"	Regression	Probability "P"
Pseudaulacaspis pentagona	Preadult	Max. Temp.	0.04937	0.8789	0.16	0.8789
		Min. Temp.	0.14943	0.6430	0.48	0.6430
		R.H. %	-0.34245	0.2759	-1.15	0.2759
	Adult	Max. Temp.	-0.71319	0.0092	-3.22	0.0092
		Min. Temp.	-0.74677	0.0053	-3.55	0.0053
		R.H. %	0.22003	0.4920	0.71	0.4920
	Gravid females	Max. Temp.	0.00959	0.9764	0.03	0.9764
		Min. Temp.	0.17140	0.5943	0.55	0.5943
		R.H. %	0.56875	0.0536	2.19	0.0536
	Total pop.	Max. Temp.	-0.19682	0.5398	-0.63	0.5398
		Min. Temp.	-0.09472	0.7697	-0.30	0.7697
		R.H. %	-0.31360	0.3209	-1.04	0.3209
Aphytis sp.	Larvae	Max. Temp.	-0.56653	0.0548	-2.17	0.0548
		Min. Temp.	-0.44102	0.1513	-1.55	0.1513
		R.H. %	-0.43612	0.1564	-1.53	0.1564
	Pupae	Max. Temp.	-0.23218	0.4677	-0.75	0.4677
		Min. Temp.	-0.11799	0.7150	-0.38	0.7150
		R.H. %	-0.21246	0.5074	-0.69	0.5074
Predacious mites	*H. malus*	Max. Temp.	0.53128	0.0755	1.98	0.0755
		Min. Temp.	0.38966	0.0105	1.34	0.0105
		R.H. %	0.65212	0.0216	2.72	0.0216
	C. ornatus	Max. Temp.	0.65288	0.0214	2.73	0.0214
		Min. Temp.	0.53875	0.0707	2.02	0.0707
		R.H. %	0.60631	0.0366	2.41	0.0366
	A. exsertus	Max. Temp.	0.64697	0.0230	2.68	0.0230
		Min. Temp.	0.54253	0.0684	2.04	0.0684
		R.H. %	0.51520	0.0865	1.90	0.0865
	S. nudus	Max. Temp.	0.75434	0.0046	3.63	0.0046
		Min. Temp.	0.65867	0.0198	2.77	0.0198
		R.H. %	0.52378	0.0805	1.94	0.0805
	E. scutalis	Max. Temp.	0.79625	0.0019	4.16	0.0019
		Min. Temp.	0.75419	0.0046	3.63	0.0046
		R.H. %	0.20043	0.0322	0.65	0.0322

individuals/20 branches, when maximum and minimum temperatures were 18.6 and 9.6ºC, respectively, while the relative humidity was 60.4%.

Statistical analysis in Table (2) in 2013/2014 season show that the simple correlation between the maximum, minimum temperatures and relative humidity were non-significant on the monthly mean of *Aphytis* sp. larval population (r = -0.56653, -0.44102 and -0.43612), respectively. In addition, the simple regression of the maximum, minimum temperatures and relative humidity were non-significant on the monthly mean of *Aphytis* sp. larval population (b = -2.17, -1.55 and -1.53), respectively. Whereas, on the monthly mean of *Aphytis* sp. pupal population the simple correlation between the maximum, minimum temperatures and relative humidity were non-significant (r = -0.23218, -0.11799 and -0.21246), respectively. In addition, the simple regression of the maximum, minimum temperatures and relative humidity were non-significant on the monthly mean of *Aphytis* sp. pupal population (b = -0.75, -0.38 and -0.69), respectively.

The obtained results were not agree with those obtained with Shinano (1976) who found two generations of the parasite *Aphytis* sp. were produced annually at Nara where the average temperature was 12.7ºC, and 3 at Norinsho where it was 14.6ºC. In between, three low peaks of *Aphytis* sp. parasitoid total population were recorded during mid April, early June, August (1997) with 274, 287 and 303 individuals of *Aphytis* sp. total population /30 branches.

Predacious mites:

Results in Table (1) and Fig. (1) show that the five species of predacious mites [*Hemisarcoptes malus* (Shimer), *Agistemus exsertus* Gonzalez, *Cheyletogenes ornatus* (C.&F.), *Saniosulus nudus* Summers, *Euseius scutalis* A.-H.] associated with *P. pentagona*.

Data in Table (1) and Fig. (1) indicated that the five species of predacious mites populations had only one dynamic curve; the population of *H. malus* and *C. ornatus* started from February 2013 and increased gradually to make the activity peak on November with 133 and 47 individuals/20 branches, respectively when maximum and minimum temperatures were 26.3 and 17.1ºC, respectively, while the relative humidity was 63.2%. On the other hand, the other three species of predacious mites also the populations had only one dynamic

curve; the population of *A. exsertus*, *S. nudus* and *E. scutalis* started from February 2013 and increased gradually to make the activity peak on October with 68, 106 and 98 individuals/20 branches, respectively when maximum and minimum temperatures were 29.9 and 20.0ºC, respectively, while the relative humidity was 53.7%.

Statistical analysis in Table (2) show that the simple correlation between the maximum, minimum temperatures and relative humidity were significant on the monthly mean of the five predacious mites (*H. malus*, *A. exsertus*, *C. ornatus*, *S. nudus*, *E. scutalis*) which associated with *P. pentagona*.

Second season 2013/2014:

Total population:

Data in Table (3) and Fig. (2) show that the monthly numbers of the white peach scale insect, *P. pentagona* individuals/20 branches of peach trees during the 2nd season 2014/2015 in Dakahlia Governorate were taken and examined.

The white peach scale insect had four generations annually, the infestation with *P. pentagona* beginning February, then increased gradually until to make the 1st activity peak in April with 2255 individuals/20 branches when maximum temperature was 25.4ºC and minimum temperature was 14.2ºC also the relative humidity was 49.5% after that the population decreased until of May after that increased again to make the 2nd generation on June with mean number reached to 850 individuals/20 branches when maximum temperature was 32.3ºC and minimum temperature was 20.7ºC also the relative humidity was 44.8%, the 3rd generation was noticed during November with 994 individuals/20 branches when maximum temperature was 26.8ºC and minimum temperature was 17.7ºC also the relative humidity was 52.6%.

Statistical analysis in Table (4) in 2014/2015 season show that the simple correlation between the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of total population of *P. pentagona* (r = -0.18069, -0.09191 and -0.44066), respectively. Also, results in Table (4), show that the simple regression of the maximum, minimum temperature and relative humidity on the monthly mean of total population of *P. pentagona* were non-significant (b = -0.58, -0.29 and -1.55), respectively.

Mousssa *et al.* (2010) studied ecology of *P. pentagona* at Meet-Ghamer, Dakahliya Governorate throughout two successive season s (1997- 1999), the total population of *P. pentagona* had five peaks recorded on mid February, early of April, July, November 1997 and January 1998. In the second season , peaks were recorded on mid of March, May, July, early November and mid December 1998.

Table 3: The mean number of the white peach scale insect, *Pseudaulacaspis pentagona* and its associated parasitoid and predacious mites infesting peach trees during 2014/2015 season at Dakahlia governorate**.**

Sampling date	*Pseudaulacaspis pentagona*				Parasite *Aphytis sp.*		Predacious mites					Temp.		RH%
	Preadult	Adult	Gravid females	Total pop.	Larvae	Pupae	*H. malus*	*A. exsertus*	*C. ornatus*	*S. nudus*	*E. scutalis*	Min	Max	
Feb. 2014	37	364	13	414	19	7	5	0	0	2	9	10.6	20.1	55.4
March	13	121	54	188	34	9	21	7	1	17	21	12.7	21.8	52.9
April	2103	63	89	2255	72	13	24	12	5	19	27	14.2	25.4	49.5
May	877	423	198	1498	38	43	27	16	9	27	29	18.9	30.1	43.0
Jun	765	17	68	850	29	31	36	21	13	42	41	20.7	32.3	44.8
July	138	103	59	300	11	9	49	29	18	51	49	22.7	34.7	49.4
August	301	41	9	351	7	5	63	44	32	83	75	23.9	34.1	53.6
Sept.	587	22	12	621	19	9	113	52	37	103	81	24.2	34.5	53.9
Oct.	167	101	18	286	8	11	119	63	49	114	108	21.4	31.2	52.8
Nov.	802	163	29	994	18	3	145	47	53	79	65	17.7	26.8	52.6
Dec.	211	399	4	614	27	8	52	12	14	17	21	13.7	22.1	61.1
Jan. 2015	41	772	7	820	44	36	9	0	0	11	8	10.1	17.6	54.0
Mean	504	216	47	766	27	15	55	25	19	47	45	-	-	-

Hemisarcoptes malus (Shimer), *Agistemus exsertus* Gonzalez, *Cheyletogenes ornatus* (C.&F.), *Saniosulus nudus* Summers, *Euseius scutalis* A.-H

Different stages:

Data in Table (3) and Fig. (2) show that the preadult stages of *P. pentagona* had three high infestation periods during April, September and November with 2103, 587 and 802 individuals/20 branches when maximum temperatures were 25.4, 34.5 and 26.8ºC while minimum temperatures were 14.2, 24.2 and 17.7ºC also the relative humidity were 49.5, 53.9 and 52.6%, respectively.

Statistical analysis in Table (4) in 2014/2015 season show that the simple correlation between the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of preadult stages of *P. pentagona* (r = 0.06817, 0.16135 and -0.45120), respectively. Also, the simple regression of the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of preadult stages of *P. pentagona* (b = 0.22, 0.52 and -1.60), respectively.

Nalepa and Meyer (1990) showed that the white peach scale insect exhibited three peaks of crawler emergence, and a partial fourth generation was observed in both season s .

On the other hand, results in Table (3) and Fig. (2) show that the adult stages of *P. pentagona* had four infestation periods during February, May, July 2014 and January 2015 with 364, 423, 103 and 772 individuals/20 branches, respectively when maximum temperatures were 20.1, 30.1, 34.7 and 17.6ºC while minimum temperatures were 10.6, 18.9, 22.7 and 10.1 also the relative humidity were 55.4, 43.0, 49.4 and 54.0%, respectively.

Statistical analysis in Table (4) in 2014/2015 season show that the simple correlation between the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of adult stages of *P. pentagona* (r = -0.67040, -0.70864 and 0.22134), respectively. Also, the simple regression of the maximum, minimum temperature and relative humidity were non-significant on the monthly mean of adult stages of *P. pentagona* (b = -2.86, -3.18 and 0.72), respectively.

Mousssa *et al.* (2010) studied ecology of *P. pentagona* at Meet-Ghamer, Dakahliya Governorate throughout two successive season s (1997- 1999), the nymphal stage had four high infestation periods through the 1st and 2nd season .

Data in Table (3) and Fig. (2) show that the gravid females began to appear and laying eggs started from February and reach the maximum period of infestation during May with 198 individuals/20 branches when maximum temperature was 30.1ºC while minimum temperature was 18.9ºC also the relative humidity was 43.0%.

Statistical analysis in Table (3) in 2013/2014 season show that the simple correlation between the maximum and minimum temperatures were non-significant on the monthly mean of gravid females of *P. pentagona* (r = 0.08587 and 0.20029), respectively, while between and relative humidity and monthly mean of gravid females was significant (r = 0.82024). Also, the simple regression of the maximum and minimum temperatures were non-significant on the monthly mean of gravid females of *P. pentagona* (b = 0.27 and 0.65), respectively, while between and relative humidity and monthly mean of gravid females was significant (b = 4.53).

The obtained data agree with those obtained by Kreiter *et al*. (1997) found that in field studies in Emilie-Romagne, Italy in 1995, *P. pentagona* had 3 generations per season ; the 1st one occurred in April to July, the 2nd from July to September and the 3rd one from September, overwintering as gravid females. Mousssa *et al.* (2010) found the ovipositing females had a curve of three peaks *P. pentagona* throughout two successive season s (1997- 1999).

Parasitoid, Aphytis sp.:

Results in Table (3) and Fig. (2) show that the parasitoid *Aphytis* sp. (Hymenoptera: Aphelinidae) associated with *P. pentagona* and is specific ectoparasite of white peach scale insect.

Data in Table (3) and Fig. (2) proved that *Aphytis* sp. larval population had a dynamic curve with 3 peaks; the 1st peak started from February 2014 and increased gradually the peak on April with 72 individuals/20 branches, when maximum and minimum temperatures were 25.4 and 14.2ºC, respectively, while the relative humidity was 49.5%. However, the 2nd peak appear on September with 19 individuals/20 branches, when maximum and minimum temperatures were 34.5 and 24.2ºC, respectively, while the relative humidity was 53.9%, while the 3rd peak top happened on January 2015 with 44 individuals/20 branches, when maximum and minimum temperatures were 17.6 and 10.1ºC, respectively, while the relative humidity was 54.0%.

Whereas, pupal population of *Aphytis* sp. had also dynamic curve with 3 peaks; the 1st peak appeared on May 2014 with 43 individuals/20 branches, when maximum and minimum temperatures were 30.1 and 18.9ºC, respectively, while the relative humidity was 43.0%. However, the 2nd small peak appear on October with 11 individuals/20 branches, , when maximum and minimum temperatures were 31.2 and 21.4ºC, respectively, while the relative humidity was 52.8%, while the 3rd peak top happened on January 2015 with 36 individuals/20 branches, when maximum and minimum temperatures were 17.6 and 10.1ºC, respectively, while the relative humidity was 54.0%.

Statistical analysis in Table (4) in 2014/2015 season show that the simple correlation between the maximum, minimum temperatures and relative humidity were non-significant on the monthly mean of *Aphytis* sp. larval population (r = -0.54995, -0.46567 and -0.24683), respectively. In addition, the simple regression of the maximum, minimum temperatures and relative humidity were non-significant on the monthly mean of *Aphytis* sp. larval population (b = -2.08, -1.66 and -0.81), respectively. Whereas, on the monthly mean of *Aphytis* sp. pupal population the simple correlation between the maximum, minimum temperatures and relative humidity were non-significant (r = -0.13419, -0.09027 and -0.62286), respectively. In addition, the simple regression of the maximum, minimum temperatures and relative humidity were non-significant on the monthly mean of *Aphytis* sp. pupal population (b = -0.43, -0.29 and -2.52), respectively.

Mousssa *et al.* (2010) found *Aphytis* sp. parasite attacking *P. pentagona* had five peaks; the larval stage of *Aphytis* sp. recorded five annual peaks while the pupal stage showed low density in compared with the larval stage. The percentage of parasitism of *Aphytis* sp. immature stage had a curve of five peaks in the two seasons.

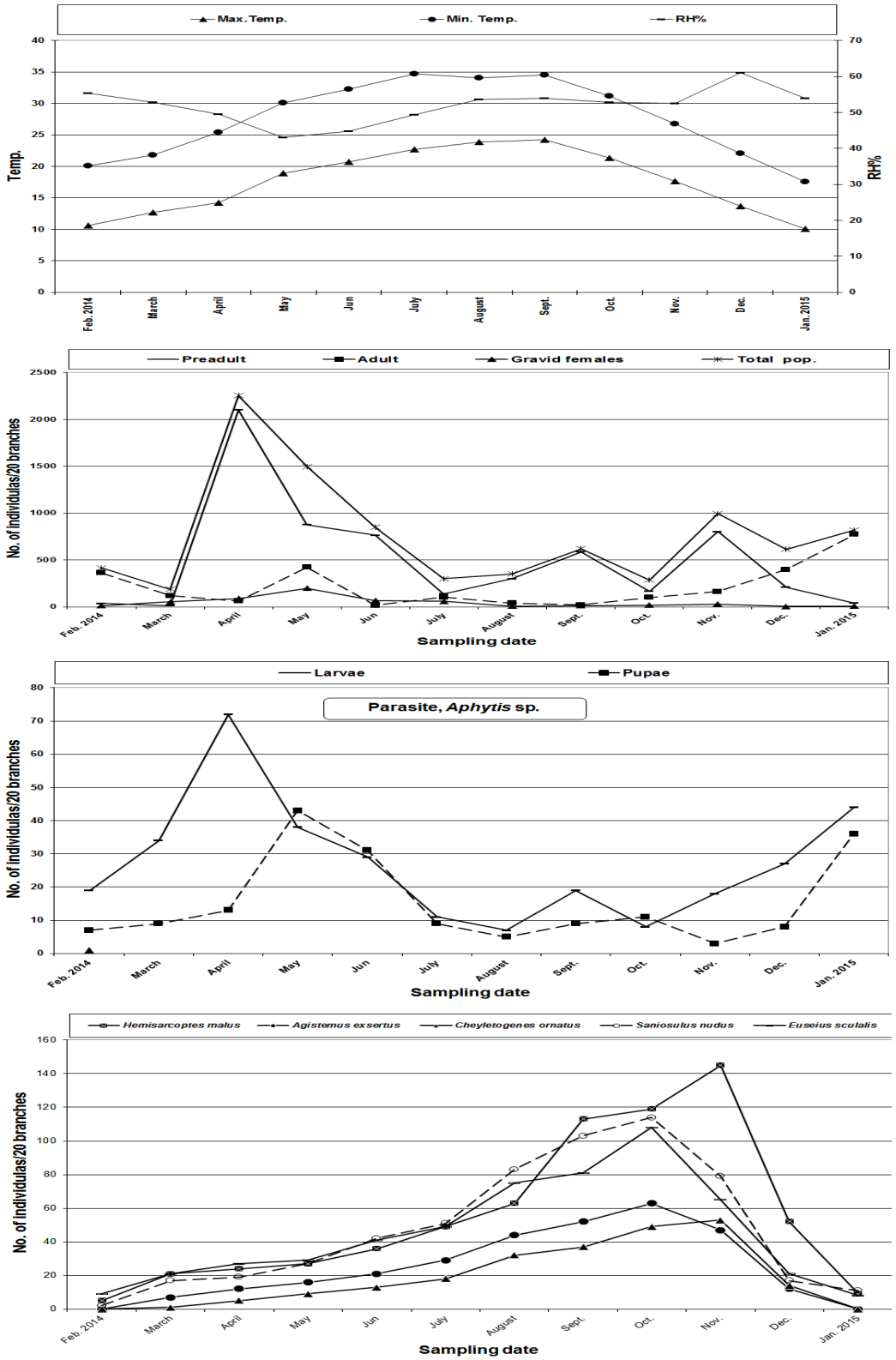

Fig. 2: The mean number of the white peach scale insect, *Pseudaulacaspis pentagona* and its associated parasitoid and predacious mites infesting peach trees during 2014/2015 season at Dakahlia governorate.

Predacious mites:

Results in Table (3) and Fig. (2) shows that the five species of predacious mites [*Hemisarcoptes malus* (Shimer), *Agistemus exsertus* Gonzalez, *Cheyletogenes ornatus* (C.&F.), *Saniosulus nudus* Summers, *Euseius scutalis* A.-H.] associated with *P. pentagona*.

Data in Table (3) and Fig. (2) indicated that the five species of predacious mites populations had only one dynamic curve; the population of *H. malus* and *C. ornatus* started from February 2014 and increased gradually to make the activity peak on November with 145 and 53 individuals/20 branches, respectively when maximum and minimum temperatures were 26.8 and 17.7ºC, respectively, while the relative humidity was 52.6%. On the other hand, the other three species of predacious mites also the populations had only one dynamic curve; the population of *A. exsertus*, *S. nudus* and *E. scutalis* started from February 2014 and increased gradually to make the activity peak on October with 63, 114 and 108 individuals/20 branches, respectively when maximum and minimum temperatures were 31.2 and 21.4ºC, respectively, while the relative humidity was 52.8%.

Statistical analysis in Table (4) show that the simple correlation between the maximum and minimum temperatures and relative humidity were significant on the monthly mean of the five predacious mites (*H. malus*, *A. exsertus*, *C. ornatus*, *S. nudus*, *E. scutalis*) which associated with *P. pentagona* while relative humidity were significant non-significant.

Table 4: Simple correlation and regression values between the weather factors and monthly number of the white peach scale insect, *Pseudaulacaspis pentagona*, parasitoid and predacious mites attacking peach trees during 2014/2015 season at Dakahlia governorate.

Variable			Simple correlation "r"	Probability "P"	Regression "b"	Probability "P"
Pseudaulacaspis pentagona	Preadult	Max. Temp.	0.06817	0.8333	0.22	0.8333
		Min. Temp.	0.16135	0.6164	0.52	0.6164
		R.H. %	-0.45120	0.1409	-1.60	0.1409
	Adult	Max. Temp.	-0.67040	0.0170	-2.86	0.0170
		Min. Temp.	-0.70864	0.1199	-3.18	0.1199
		R.H. %	0.22134	0.4893	0.72	0.4893
	Gravid females	Max. Temp.	0.08587	0.7907	0.27	0.7907
		Min. Temp.	0.20029	0.5325	0.65	0.5325
		R.H. %	0.82024	0.0011	4.53	0.0011
	Total pop.	Max. Temp.	-0.18069	0.5741	-0.58	0.5741
		Min. Temp.	-0.09191	0.7764	-0.29	0.7764
		R.H. %	-0.44066	0.1516	-1.55	0.1516
Aphytis sp.	Larvae	Max. Temp.	-0.54995	0.0640	-2.08	0.0640
		Min. Temp.	-0.46567	0.1271	-1.66	0.1271
		R.H. %	-0.24683	0.4393	-0.81	0.4393
	Pupae	Max. Temp.	-0.13419	0.6776	-0.43	0.6776
		Min. Temp.	-0.09027	0.7803	-0.29	0.7803
		R.H. %	-0.62286	0.0305	-2.52	0.0305
Predacious mites	*H. malus*	Max. Temp.	0.58764	0.0445	2.30	0.0445
		Min. Temp.	0.49275	0.1036	1.79	0.1036
		R.H. %	0.16025	0.6188	0.51	0.6188
	A. exsertus	Max. Temp.	0.81436	0.0013	4.44	0.0013
		Min. Temp.	0.73855	0.0061	3.46	0.0061
		R.H. %	-0.01069	0.9737	-0.03	0.9737
	C. ornatus	Max. Temp.	0.66416	0.0185	2.81	0.0185
		Min. Temp.	0.57114	0.0524	2.20	0.0524
		R.H. %	0.10634	0.7422	0.34	0.7422
	S. nudus	Max. Temp.	0.81626	0.0012	4.47	0.0012
		Min. Temp.	0.73347	0.0066	3.41	0.0066
		R.H. %	-0.00618	0.9848	-0.02	0.9848
	E. scutalis	Max. Temp.	0.81460	0.0013	4.44	0.0013
		Min. Temp.	0.74421	0.0055	3.52	0.0055
		R.H. %	-0.03046	0.9251	-0.10	0.9251

References

Ding, X.Y., 2003. The occurrence regularity of plum mulberry scale. China-Fruits; 4: 9-11.

Ezzat, Y. M. and S. M. Nada, 1986. List of superfamily Coccoidea as known to exist in Egypt. Boll. Lab. Ent. Agr. Fillippo Silvestri, 43:85-90.

Habibian, A. and H. Assadi, 1989. Some complementary studies of biological control with *Pseudaulacaspis pentagona* (Torg.-Tozz.) in Guilan province (Iran). Monograph. British-Crop-Protection-Council. 43, 249; In progress and prospects in insect control. Proceedings of an Inter. Conf. held at the Univ. of reading, Uk. 18-20 pp.

Kosztarab, M. and F. Kozár, 1988. Scale Insects of Central Europe. Akadémiai Kiadó, Budapest, pp. 1–456.

Kreiter, P., C. Pinet, A. Pains, L. Dijoux, P. Cravedi, C. Hartfield, and E. Mazzoni, 1997. Study on the biological cycle of the white scale of peach, *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Homoptera,

Diaspididae) and its natural enemies in Emilie, Romagne (Italy). Integrated plant protection in stone fruit. Proceedings of the meeting at Zaragoza, Spain, 24-26 September 1996. Bulletin OILB SROP., 20(6):14-20.

Miller, D.R. and J.A. Davidson, 2005. Armored Scale Insect Pests of Trees and Shrubs. Cornell University Press.

Mousssa, S.F.M., R.H. Ramdan, and S.A. Attia, 2010. Seasonal fluctuation of the white peach scale insect, *Pseudulacaspis pentagona* (Targioni) and its associated parasitoid, *Aphytis* sp. At Mett-Ghamer, Dakahlyia Governorate, Egypt. Egypt. Acad. J. biolog. Sci., 3 (1): 1-9.

Nalepa, C. and J. Meyer, 1990. The seasonal history of white peach scale (Homoptera : Diaspididae) and its Hymenopteran natural enemies in North Carolina. J. Entomol. Sci., 25(2): 303-310.

SAS Institute, 1988.SAS/STAT User`s Guide, Ver. 6.03. SAS Institute Inc., Cary, North Carolina.

Shinano, K., T. Terada, and M. Imanishi, 1976. The frequency of generations of *Pseudaulacaspis pentagona* on tea plants. Bulletin-of-the-Nara-Agricultural-Experiment-Station; 7: 47-52.