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Prediction of the Population of the Peach White Scale Insect (*Pseudaulacaspis pentagona*) Employing Climatic Factors and the Efficacy of two Bioinsecticides Against It in the field

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ABSTRACT

Climatic variables (e.g., temperature, relative humidity, and light) Affect the biology and ecology of insect pests and diseases. The current investigation deals with the prediction of the populations of white peach scale insect (*Pseudaulacaspis pentagona*) using the climatic factors depending on the pest populations during the years of the study ($1^{st.}$ February 2022 till mid-January 2023), at Meet Ghamer, Dakahliya governorate, Egypt. Moreover, the population of the associated parasite *Aphytis sp*. is considered in this study as well the rate of parasitism. To acquire information about climatic factors affecting the Insect populations at different stages, a stepwise was regression analysis conducted. Moreover, the data collected about climatic Factors and population studied insects in different stages were exposed to stepwise regression analysis. Results indicated that the population of *P. pentagona* stages is possible to predict using specific elements of the weather i.e. minimum air temperature and average relative humidity are predictors for a population of pre-adults, maximum air temperature and light are predictors for a population of adults. however, the prediction of the gravid population depends on maximum, minimum, and average air temperature and light. Finally, total population prediction model mainly depends on maximum air temperature and relative humidity. It has also been evaluated the efficiency of some alternative insecticides for controlling the white peach scale *P. pentagona* under field conditions. The obtained results proved that, some alternative insecticides for controlling the white peach scale, *P. pentagona* compared with organophorus compounds. So, it prefers to use the bio-insecticides and IGR compounds. To control scale insects in the IPM program and more studies should be carried out on the bio-insecticides to improve their efficiency for controlling insect pests to minimize the environmental pollution of pesticides.

Keywords: *Pseudaulacaspis pentagona*, climatic factors, prediction, population, rate of parasitism, bioinsecticides.

Introduction

The importance and association of the weather on the development of plant insect pests and diseases. It was known more than two thousand years ago. Pests are “stop and go” developers in relation to temperature. They develop more rapidly during periods of time with suitable temperatures (Das *et al.,* 2011). Increased temperatures will accelerate the development of plant insects. That is resulting in more cycles of generations (and crop damage) per year (Awmack *et al*., 1997). This means climatic conditions influenced the abundance, physiology, phenology and distribution of insect pests (Lastuvka 2009), and the major factors include temperature, natural enemies, and their host plant.

Temperature is the most important climatic factor influencing insect behavior, distribution, development, survival, and reproduction. Some researchers believe that the effect of temperature on insects largely overwhelms the effects of other environmental factors (Bale *et al.*, 2002).

Temperatures in its applicable range with increased rates of development, insects respond to the above temperatures and more population of generations with less time between generations. Higher

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temperatures shrink the lifespan of insects. longevity. Warmer winters will reduce winterkill, and consequently, there may be increased insect populations in Warmer winter will next growing seasons.
Pseudaulacaspis pentagona is considered as one of the most important scale insect pests in the world. Scale insects have been reported as serious pests attacking a huge number of host plants around the world (Mansour *et al*., 2017). It is a polyphagous pest with a very wide host plant range, especially on fruit trees and ornamental plants including peach, plum, and apple trees in many parts of the world (Kosztarab & Kozar, 1988 and Miller and Davidson 2005). The pest affected the host by removing the sap. Infested trees become sparse and yellow moreover, fruit size is reduced, and premature fruit drops. Heavy infestations Young plants can die very quickly after infestation. When these insects were introduced in the absence of their natural enemies it caused major problems. In addition, *P. pentagona* can cause severe damage to ornamental plants in cities and cities.

Mohamed *et al*. (2009). showed that *P. pentagona* had three complete generations a year. In the meantime, Ding and Ding (2003) showed that *P. pentagona* had four generations per year, while Chen and Shih (1984) observed six generations per year for the same species. Attia (2004) recorded that this pest had five generations per year the first generation in winter, the second in spring, the third and fourth in summer, and the fifth one in autumn which was the highest. Moharm (2006) indicated the occurrence of three generations per year for *P. pentagona* on peach and plum at Qualyobia and Giza locations. These three generations were nominated as Spring, Summer, and Fall-Winter generations. He also mentioned that the main primary natural enemies recorded in this study were the endoparasitoid, *Encarsia berlesei* (Howard) and the ectoparasitoid *Aphytis lingnanensis* (Hymenoptera: Aphelinidae).
However, a simple method for predicting the total population, nymph, and pupa from climatic data would be invaluable to both the farmers and decision-makers. Moreover, it's needed to predict the population of the associated parasite *Aphytis* sp. from climatic data. the parasitoid *Aphytis* sp. (Hymenoptera: Aphelinidae) associated with *P. pentagona* and is a specific ectoparasite of white peach scale insect. that *Aphytis* sp. The nymph population had a dynamic curve with 3 peaks; the 1st peak started in February 2014 and increased gradually the peak in April, the 2nd peak appear in September the 3rd peak top happened on January 2015 (Halawa *et al*., 2015).
Whereas, the pupal population of *Aphytis* sp. had too a dynamic curve with 3 peaks; the 1st peak appeared on May 2014. However, the 2nd small peak appear in October while the 3rd peak top happened on January 2015.

The aim of this study is to use some climatic factors to find equations that make it possible to predict a number of different stages of white peach insects as well as the population of different stages of the associated parasite.

2. Materials and Methods

Two feddans peach orchards were selected at Meet Ghamer, Dakahliya governorate to study the relationship between climatic factors and the population of different stages of *Pseudaulacaspis pentagona* as well as its associated parasite *Aphytis* sp.

The study was done considering both climatic data and insect stages examination through the years of study from 1st February 2022 till mid-January 2023. In addition, historical data were used from February 1st, 1997 till mid-January 1999. The orchard that was chosen for the present investigation it receives no chemical control at least for two years before this study.

2.1. Insect sampling

Thirty samples of 10 cm branches were picked out from the trees every 15 days (10 branches x 3 replicates) to define the number of insect stages. Samples were packed in paper bags and transferred to the laboratory for examination. Samples examination was done as well as packed samples every 15 days by counting the *P. pentagona* in different stages by means of a binocular microscope. The population of different stages of the studied pest was estimated from the age structure through the studied year. Moreover, the associated parasite Aphytis sp. was counted and classified into nymph and pupa. Also, the rate of parasitism was recorded throughout the studied year. Results of samples examination related to insect different stages and the associated parasite *Aphytis* sp. are shown in Tables (1, 2 and 3). Absolute population of each stage per sample per count can vary dramatically from one count to another. The difference between counts can be contributed to actual changes in insect population as well as sampling errors. To magnify the proportion of each stage per total, the age-structure technique was used in these studies.

2.2. Toxicity studies

Field evaluations tested compounds on *Pseudolacspis pentagona* infesting peach trees.
To control *P. pentagona* on peach trees (2022-2023), two experiments were carried out in the summer of 2022 and winter of 2023. In both seasons, sprayed with two bio-pesticides (Biosad- Runner) and standard, Actillic.

Fifteen trees were divided into five groups each treatment had three replicates, in addition, the control had three replicates, and pre-treatment had three replicates. Tested compounds sprayed with the knapsack sprayer at 25 L/water. Samples were 10 infested branches collected from both of them Double after spraying in all directions and levels of the tree (10 branches x3 replicates) 30 replicates per treatment and before spraying as a pre-treatment count. Data from the pre-treatment and post-treatment samples were recorded for the nymphs and adults to calculate the reduction percentage. The population was checked three times after treatment 1, 2, and 3 weeks. The reduction percentage of different treatments were calculated according to Henderson and Tilton (1955). Reduction percentages of different survived aspects were calculated according to Henderson and Tilton (1955).

$$\% \text{ Reduction} = [1-(Ta \times Cb/Tb \times Ca)]\ 100].$$

Obtained results were statistically analyzed as factorial, using Proc. GLM in SAS (Anonymous. 2003). Differences between means were compared by Duncan's multiple range test (P= 0.05 level) in the program itself. The tested compounds and their usage doses:

Biosad Sc22.8 % 10cm3/100Lwater (Active ingredient Spinosad)
Runner Sc 24% 150cm3/100Lwater (Active ingredient, Insect growth regulator) IGR
Actillic Ec 50% 150cm3/100Lwater (Active ingredient, Organophosphorus insecticides).

Table 1: *P. pentagona* different stages and total population of peach trees and associated parasite *Aphytis sp*. in relation to climatic factors during 2022-2023.

	Pre-adult	Adult	Gravid females	Total pop.	Parasite			Rate of Parasitism
					Nymph	Pupa	Total pop.	
01/02/2022	34	160	1	195	2	1	3	1.5
15/02/2022	0	178	8	186	12	3	15	7.5
01/03/2022	4	64	9	77	7	1	8	9.4
15/03/2022	7	42	38	87	22	2	24	21.6
01/04/2022	548	32	74	654	58	5	63	8.6
15/04/2022	1547	16	0	1563	3	4	7	0.4
01/05/2022	776	71	0	847	7	1	8	6.9
15/05/2022	76	310	170	556	23	36	59	4.9
01/06/2022	163	10	43	216	16	14	30	4.9
15/06/2022	580	4	3	587	5	7	12	1
01/07/2022	124	12	7	143	3	3	6	3.4
15/07/2022	4	83	36	123	4	1	5	2.3
01/08/2022	166	20	1	187	1	2	3	2.6
15/08/2022	114	15	4	133	3	2	5	5.1
01/09/2022	62	10	7	79	4	3	7	12.8
15/09/2022	467	5	1	473	10	1	11	1.5
01/10/2022	116	46	3	165	1	6	7	1.7
15/10/2022	28	35	10	73	2	1	3	4
01/11/2022	52	40	18	110	2	1	3	10.7
15/11/2022	703	100	3	806	11	0	11	0.5
01/12/2022	124	35	0	159	4	0	4	2.5
15/12/2022	75	301	1	377	17	3	20	5
01/01/2023	25	563	2	590	30	7	37	5.9
15/01/2023	8	122	3	133	6	22	28	16

Table 2: Historical data of *P. pentagona* different stages and total population on peach trees and associated parasite *Aphytis* sp. during 1997-1998.

	Pre-adult	Adult	Gravid females	Total pop.	Parasite			Rate of Parasitism
					Nymph	Pupa	Total pop.	
01/02/1997	123	261	15	399	255	73	328	45.1
15/02/1997	358	303	65	726	393	5	398	35.4
01/03/1997	43	74	67	193	536	30	566	74.6
15/03/1997	52	148	71	271	423	6	429	61.3
01/04/1997	500	20	68	588	228	5	233	28.4
15/04/1997	250	16	53	319	272	2	274	46.2
01/05/1997	115	70	21	206	221	7	228	52.5
15/05/1997	64	120	11	195	196	3	199	50.5
01/06/1997	35	146	15	195	278	9	287	59.4
15/06/1997	75	91	38	204	238	14	252	55.3
01/07/1997	234	54	43	331	93	27	120	26.6
15/07/1997	68	38	89	195	187	29	216	52.6
01/08/1997	14	10	47	71	249	54	303	81.0
15/08/1997	20	13	19	52	187	66	253	83.0
01/09/1997	112	22	36	170	164	41	205	54.7
15/09/1997	150	24	136	310	177	65	242	43.8
01/10/1997	313	50	99	462	162	75	237	33.9
15/10/1997	617	88	51	756	140	80	220	22.5
01/11/1997	748	91	14	853	108	43	151	15
15/11/1997	377	150	6	533	260	32	292	35.4
01/12/1997	177	190	0	367	289	13	302	45.1
15/12/1997	29	311	0	420	402	7	409	49.3
01/01/1998	21	686	0	647	717	20	737	53.3
15/01/1998	6	103	0	109	333	36	369	77.2

Table 3: Historical data of *P. pentagona* different stages and total population of peach trees and associated parasite *Aphytis* sp. during 1998-1999

	Pre-adult	Adult	Gravid females	Total pop.	Parasite			Rate of Parasitism
					Nymph	Pupa	Total pop.	
01/02/1998	37	269	2	308	45	75	120	28.0
15/02/1998	63	136	7	206	26	22	98	32.2
01/03/1998	170	12	42	224	39	32	71	24.1
15/03/1998	286	15	65	366	61	20	81	18.1
01/04/1998	202	49	45	296	324	33	357	54.7
15/04/1998	112	45	33	190	49	7	56	22.8
01/05/1998	313	164	6	483	113	14	127	20.8
15/05/1998	154	322	14	490	771	77	848	63.4
01/06/1998	97	182	56	335	464	52	516	60.6
15/06/1998	210	95	45	350	216	5	221	38.7
01/07/1998	548	143	22	713	114	15	129	15.3
15/07/1998	296	424	12	732	288	25	313	30
01/08/1998	156	220	17	393	147	8	155	28.3
15/08/1998	137	40	21	198	56	3	59	23.0
01/09/1998	167	69	59	295	288	0	288	49.4
15/09/1998	195	79	128	402	65	0	65	13.9
01/10/1998	344	82	76	502	191	0	191	27.6
15/10/1998	410	98	43	551	183	3	186	25.2
01/11/1998	340	218	6	564	93	9	102	15.3
15/11/1998	159	86	48	293	294	24	318	52.1
01/12/1998	146	314	21	481	354	-	354	42.4
15/12/1998	138	602	7	747	600	42	642	46.2
01/01/1999	107	359	3	469	572	9	581	55.3
15/01/1999	50	119	1	170	575	27	602	78.0

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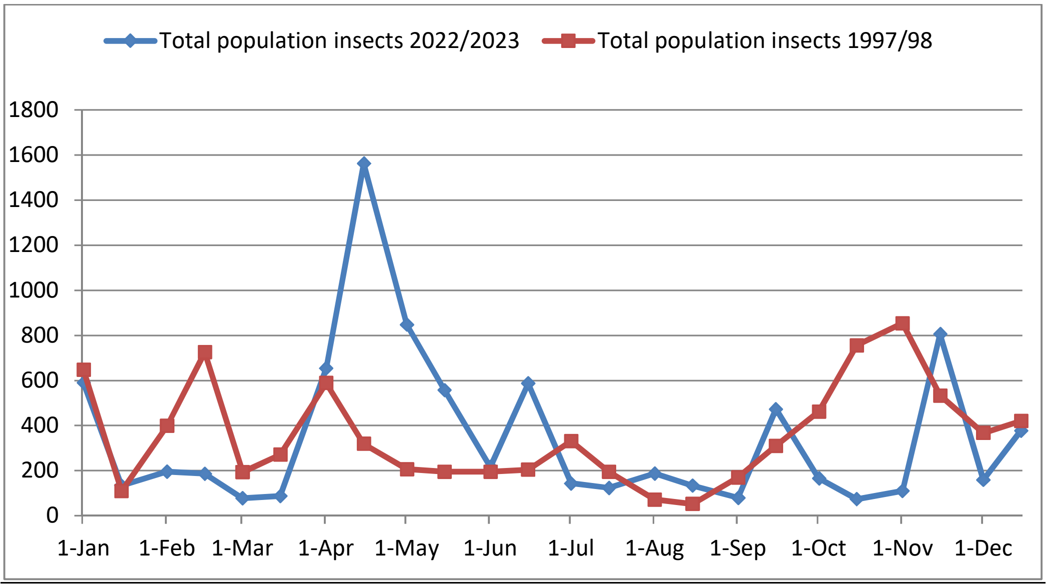

Fig. 1: *P. pentagona* total population on peach trees in relation to climatic factors during 2022/23 and 1997/98.

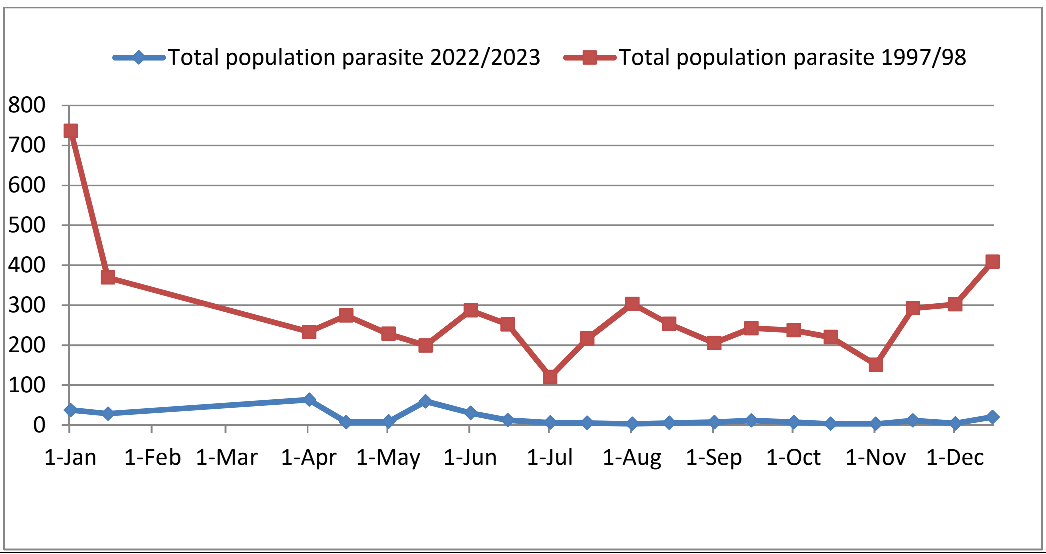

Fig. 2: Parasite *Aphytis* sp. total population on peach trees in relation to climatic factors during 2022/23 and 1997/98.

2.3. Climatic measurements

Climatic factors Prepare in this study were maximum, minimum, and average air temperature, average relative humidity, and light. The mentioned studied climatic factors were daily recorded inside the selected peach orchard by using a digital hygrometer / thermo Art. No.30.5000/30.5002 (Produced by TFA, Germany). Regarding light intensity, +++ was measured by using Luxmeter INS Dx-200, serial No. 949275. Moreover, historical data for the selected location was got it from Central Laboratory for Agricultural Climate (CLAC), Agriculture research center. Historical climatic data as well as the measured climatic factors during the studied seasons are shown in Table (4).

Table 4: Historical climatic data at the selected peach orchard in Meet Ghamer, Dakahliya governorate.

Date	Min Temp	Max Temp	Aver. Temp	RH%	light	Date	Min Temp	Max Temp	Aver. Temp	RH%	Light
01/02/1997	08.3	24.0	16.2	62	10.4	**01/02/1998**	11.1	22.0	16.6	61	11.3
15/02/1997	10.6	21.4	16.0	67	13.3	**15/02/1998**	09.3	22.9	16.1	64	11.5
01/03/1997	09.3	20.5	14.9	65	12.2	**01/03/1998**	10.8	22.8	16.8	63	11.1
15/03/1997	11.4	26.2	18.8	67	12.2	**15/03/1998**	12.2	25.4	18.8	66	12.2
01/04/1997	11.6	27.0	19.3	64	12.4	**01/04/1998**	13.8	27.0	20.4	64	12.5
15/04/1997	12.2	29.2	20.7	53	12.9	**15/04/1998**	14.3	29.0	21.7	58	12.9
01/05/1997	13.3	33.0	23.2	55	13.1	**01/05/1998**	18.2	25.3	21.8	61	13.1
15/05/1997	18.5	33.1	25.8	58	13.5	**15/05/1998**	19.8	34.9	27.4	59	13.5
01/06/1997	20.0	34.8	27.4	55	13.6	**01/06/1998**	20.1	35.8	28.0	65	13.6
15/06/1997	20.1	34.0	27.1	60	13.7	**15/06/1998**	21.8	36.5	29.2	67	13.7
01/07/1997	22.3	33.1	27.7	63	13.6	**01/07/1998**	22.1	33.5	27.8	64	13.6
15/07/1997	20.7	33.4	27.1	67	13.4	**15/07/1998**	23.2	33.6	28.4	61	13.4
01/08/1997	20.3	38.0	29.2	64	13.2	**01/08/1998**	22.9	34.9	28.9	56	13.2
15/08/1997	20.0	35.7	27.9	64	13.8	**15/08/1998**	23.2	33.3	28.3	63	12.8
01/09/1997	19.5	33.4	26.5	63	12.6	**01/09/1998**	22.7	35.2	29.0	61	12.5
15/09/1997	20.4	31.5	26.0	58	12.1	**15/09/1998**	22.3	34.8	28.6	59	12.1
01/10/1997	19.2	31.2	25.2	55	11.8	**01/10/1998**	20.4	30.0	25.2	62	11.8
15/10/1997	17.1	30.6	23.9	58	11.4	**15/10/1998**	14.3	28.6	21.5	60	11.4
01/11/1997	13.8	27.8	20.8	62	11.1	**01/11/1998**	15.4	27.0	21.2	58	11.3
15/11/1997	11.2	25.2	18.2	60	10.8	**15/11/1998**	13.7	25.9	19.8	60	10.9
01/12/1997	08.5	19.6	14.1	63	10.7	**01/12/1998**	10.9	23.4	17.2	63	10.7
15/12/1997	09.5	21.2	15.4	65	10.6	**15/12/1998**	10.2	22.1	16.2	65	10.6
01/01/1998	09.0	22.3	15.7	68	11.0	**01/01/1999**	9.8	21.1	15.5	60	10.6
15/01/1998	07.3	20.5	13.9	64	10.9	**15/01/1999**	8.4	19.7	14.1	62	10.9

2.4. Statistical analysis

To quantify the relationship between effectively studied climatic factors and the population of different stages of *Pseudaulacaspis pentagona* as well as its associated parasite *Aphytis sp.* Step-wise regression was done by the GLM procedure (SAS, 1996). Summary of step-wise regression is shown in Table (5).

Table 5: Summary of stepwise regression analysis results.

Insect stage	Predictor climatic factors	R^2	Parasite stage	Predictor climatic factors	R^2
Pre-adult	Minimum air temperature, light	0.1521	Nymph	Maximum, minimum air temperature, light	0.7502
Adult	Maximum air temperature, light	0.2392	Pupa	Maximum, minimum and average air temperature	0.3486
Gravid females	Maximum, minimum and average air temperature, light	0.2600	Total pop.	Maximum and minimum air temperature, relative humidity and light	0.7671
Total pop.	Maximum air temperature, relative humidity	0.0743	Rate of Parasitism	Maximum, minimum air temperature and light	0.6764

3. Results

3.1. Predicting preparation of *Pseudaulacaspis pentagona* stages

3.1.1. Population of Pre-adult: Step-wise regression an analysis for the relationship between tested climatic factors and population of *Pseudaulacaspis pentagona* pre-adult showed that, both The minimum air temperature and relative humidity were the two main climatic factors which was valid a predictor for this character.

The prediction equation for the population of the pre-adult was concluded from a statistical analysis and presented as follows:

Population of pre-adult = 15.669 + (0.0066 * minimum air temperature) – (12.131 * RH%)

3.1.2. The population of adults: Data in Table (1). showed that from all tested climatic factors the maximum air temperature and light were the major climatic factors that affected the population of *Pseudaulacaspis pentagona* adults. In addition, the mentioned two climatic factors were valid to use as a predictor for a population of *Pseudaulacaspis pentagona* adults. Predictor factors correlated with the population of adults by R2 = 0.239. Through the results of stepwise regression analysis Equation for population forecasting of adults was concluded. The equation presented as follows:

Population of adults = 7.659 – (0.050 * air temperature maximum) – (0.194 * light)

3.1.3. The population of Gravid: Results of step-wise regression analysis for the relationship between tested climatic factors and the population of gravid *Pseudaulacaspis pentagona* confirmed that the studied characters are mainly affected by all types of air temperature however, maximum, minimum or average air temperature as well as light. The mentioned effective climatic factors are considered also predictors for a population of gravid.

Population prediction equation of gravid was concluded according to the statistical analysis and presented as follows:

Population of gravid = -2.1939 – (0.0618 * air temperature maximum) + (0.0249 * air temperature maximum) + (0.0352 * air temperature average) + (0.3933 * light)

3.1.4. Total population: it's concluded from Table (2). that, both of air temperature maximum and percentage of relative humidity were the driving climatic factors related to the total population of Pseudaulacaspis pentagona. Moreover, the mentioned climatic factors were valid to be employed in a predictor equation as follows:
Total population = 9.314 – (0.0112 * air temperature maximum) – (3.7179 * RH%)

3.2. Predicting the population of the associated parasitoid *Aphytis sp* stages
Larva: a statistical analysis using step-wise regression analysis for the relationship between tested climatic factors and the population of larvae presented maximum and minimum air temperature and light as the essential climatic factors for driving and predicting larvae.

All mentioned climatic factors were employed in a predicting equation and presented as follows:

Population of larva = 2.279 – (0.1713 * air temperature maximum) + (0.1093 air temperature maximum) + (0.202 * light)

3.2.1. Pupa: regarding the population of pupa and its relationship with studied climatic factors, the statistical analysis showed that maximum, minimum, and average air were the key factors to predict the population of Aphytis sp pupa. Statistical analysis arranges the main effective climatic factors in a predictor equation as follows:

The Population of pupa = 1.8483 – (0.0718 * air temperature maximum) + (0.0495 * minimum air temperature) + (0.0309 * average air temperature

3.2.2. Parasite total population: it's concluded from The data in Table No. (3) that, the total population of *Aphytis sp* is mainly affected by maximum, minimum air temperature, relative humidity and light. Such climatic factors were statistically valid to be predictors for the total population of the parasite. The prediction equation is shown as

Parasite total population = 3.697 – (0.154 * air temperature maximum) + (0.0944 * air temperature maximum) – (1.221 * RH%)

3.2.3. Rate of parasitism: from all studied climatic factors, maximum, minimum air temperature, and light were statistically selected to be effective and predictor factors. Both predictors are statistically employed to present a prediction equation as follows:

Rate of parasitism = 0.1325 – (0.0248 * air temperature maximum) + (0.0164 * air temperature maximum) + (0.04002 * li)

Data from Tables (6-7) are the obtained results of two bio-insecticides and Actillic spray on peach trees in two consecutive seasons.

The results illustrated in Table (6) clearly that, the mean number of pre-adults (nymphs) and adults of *P. pentagona* on the peach branches is very highly decreased after spray application with the two bio-insecticides and Actillic. The tested bio-insecticides and Actillic were compared to the control and pre-treatment trees. The three post-treatments were counted and taken at 1 week, 2 weeks, and 3 weeks after sparing. On the other hand in the first spray (summer 2021), the second week scored the highest reduction percent of nymphs and adults (82.71% - 92.77%) with Biosad compared to Runner(68.26% - 67.90%) , and there was no significant difference compared to Actillic (88.63 % - 83.00%) for both of the nymphs and adults, followed by the third week recorded (69.90%-85.50%) percent reduction with Biosad for both of the nymphs and adults, compared to (88.15 %-89.14%) for both of the nymphs and adults with Actillic. While, the first week achieved the lowest reduction percent (68.89%) of nymphs with Biosad, the percentage of reduction in adults was higher when using Biosad (83.17%) than Actillic (81.70%) compared to Runner (69.73%). There was a significant difference compared to Actillic and Runner in the three reduction percents after spraying for both of the nymphs and adults.

The results of the table clear that, Runner recorded a lower percent reduction in nymphs than Biosad and Actillic, both the first week and the third week, there was a highly significant difference in the percent reduction of nymphs between high to Biosad, low to Runner and Actillic. Data was obtained that high depression in the mean number of adults of *P. Pentagona* in the first, second, and third week after application with the two the bio-insecticides and Actillic compared with control and before treatment trees. There was a significant difference in the reduction percentage of adults of *P. pentagona* between the two tested treatments. Biosad gave a higher reduction percentage in the third week than the high others. the second week scored the highest reduction percentage of 92.77% followed by the third week recorded 85.50% and the first week gave 83.17 % Runner compared to Actillic recorded 83.00, 89.14 and 81.70 % percent reductions with the second and third weeks and the first week respectively.

Results of Table (7) showed a high decrement in the mean number of nymphs and adults of *P. pontagona* in the tested treatments on peach trees during the winter season, after 2 weeks then, after 1 week then, after 3 weeks of treatment with the tested compounds, bio-insecticides, and the standard, Actillic compared with untreated control and before spray trees. Biosad recorded the highest reduction percentage (77.53%-78.32%-73.1%), followed by, Actillic (74.72 %-68.60%) for three weeks after spraying for nymphs. While the highest reduction percentage of Adults was to Actillic (82.17%) followed by Biosad (70.98%) of adults of *P. pontagona* after 2 weeks. After one week, Biosad recorded the highest reduction percentage of nymphs (77.53%) followed by, Actillic (74.72%-), and finally, Runner recorded the lowest reduction percentage of nymphs and Adults after 1,2,3 week compared with other treatments. Actillic recorded the highest reduction percentage (82.17% 82.20% - 90.48%) for three weeks after spraying of adults compared with Biosad and Runner treatments. At the same treatment, Biosad compared to Actillic recorded (74.72%) for nymphs after 1,2 weeks. However, after 3 weeks, Actillic recorded 90.48% for adults then, after 1, and 2 weeks achieved (82.20%-82.17%) respectively. after one week and (74.72% - 82.20%) after two weeks. There was no significant difference found in the reduction percentage of nymphs and adults between the two Bio-insecticides, Biosad and Runner after one week and after two weeks, while there was a significant difference between them and the standard, Actillic.

4. Conclusion

It's concluded from the obtained results that, the number of stages of white peach scale insects is driven by climatic factors. Each of the studied insect stages is mainly affected by a specific climatic factor(s). Some of the effective climatic factors were valid to use as predictors for the different stages as well as the total population and rate of parasitism. The population of the pre-adult was predicted by both minimum air temperature and relative humidity. However, the population of adult insects was predicted mainly by maximum air temperature and light. Moreover, maximum, minimum, and average air temperature and light were considered as predictors for a population of gravid. While the total

Table 6: Mean number and reduction percentage of nymph and adult of *Pseudolacspis pentagona* after spraying three of insecticides on peach trees during summer season of 2021 2022.

Tested treatments	After one week				After two weeks				After three weeks			
	Nymph		Adult		Nymph		Adult		Nymph		Adult	
	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction
Control	23.2	--	12.7	--	23.2	--	10	--	26.25	--	13.75	--
Pre-spraying	18.8	--	12.2	--	18	--	8	--	23.80	--	11	--
Actellic Ec 50%	3.7	80.25a	2.25	81.70ab	2	88.63 a	1.2	83.00 ab	2.75	88.15 a	1.75	89.14 a
Runner Sc 24%	7.8	58.40c	3.5	69.73b	5.7	68.26 b	2.6	67.90 b	10.25	55.73 c	4.50	70.90 b
Biosad Sc 22.8%	6.2	68.90b	2	83.17a	6.3	82.71 a	1.8	92.77 a	7.3	69.90 b	2.42	85.50 ab
F	--	13.75	--	3.4	--	15.85	--	4.88	--	26.13	--	3.76
P	--	<.0001	--	0.049	--	< .0001	--	0.016	--	< .0001	--	0.037

Data with different letters within the column are significant different (p < 0. 05).

Table 7: Mean number and reduction percentage on nymph and adult on *Pseudolacspis pentagona* after spraying three of insecticides on peach trees during winter season of 2021 2022.

Tested treatments	After one week				After two weeks				After three weeks			
	Nymph		Adult		Nymph		Adult		Nymph		Adult	
	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction	Mean number	% Reduction
Control	40	--	9.25	--	28.5	--	9	--	43	--	10.25	--
Pre-spraying	42.2	--	8.30	--	28.8	--	8.3	--	44.3	--	9	--
Actellic Ec 50%	10.6	74.72 ab	1.30	82.20 a	11	74.72 ab	0.7	82.17 a	13.9	68.60 ab	0.83	90.48 a
Runner Sc 24%	12.9	69.37 b	3.40	56.94 b	9.2	69.37 b	2.5	56.94 b	15.58	64.88 b	4.8	46.82 b
Biosad Sc 22.8%	9.5	77.53 a	3.30	62.20 b	10	78.32 a	4.2	70.98 ab	12	73.1 a	4.5	49.29 b
F	--	4.03	--	7.80	--	4.43	--	8.83	--	3.96	--	32.29
P	**--**	**0.03**	**--**	**0.0023**	**--**	**0.02**	**--**	**0.0013**	**--**	**0.032**	**--**	**< .0001**

Data with different letters within the column are significant different (p < 0. 05).

population of the insect mainly depends on both maximum air temperature and relative humidity to predict it. In addition, the associated parasite is also affected by a certain climatic factor, such factors are also valid to predict a number of these parasite stages. Maximum and minimum air temperature and light are considered predictors for a population of larvae. Hence maximum, minimum, and average air temperatures were considered as predictors for a population of the pupa. The total population of the parasite is possible to be predictable using maximum and minimum air temperature, relative humidity, and light. Finally, the rate of parasitism mainly predicts using climatic factors maximum and minimum air temperature, and light. The present work was conducted to evaluate the efficiency of some alternative insecticides for controlling the white peach scale *P. pentagona* under field conditions. The obtained results proved that, some alternative insecticides for controlling the white peach scale, *P. pentagona* compared with organophorus compounds. So, it prefers to use the bio-insecticides and IGR compounds for controlling the scale insects in the IPM program and more studies should be carried out on the bio-insecticides to improve their efficiency for controlling insect pests to minimize the environmental pollution of pesticides.

5. Dissection

For increasing crop production of this common fruit, agriculture precautions (Reda *et al*., 2009) must be applied; The organophosphorus compounds must be replaced (due to its high systemic toxicity) by these other friendly alternatives during pest control management, the right time must be considered; Several previous studies were conducted on the life tables of R. cardinalis in different regions of the world and under various environmental conditions (Cuaston *et al*. (2004), Ghanim *et al*. (2006), and Abdel-Salam *et al*. (2013) can be repeated during Jun (Hendawy, 1999 and El Serafi *et al*. 2004).

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