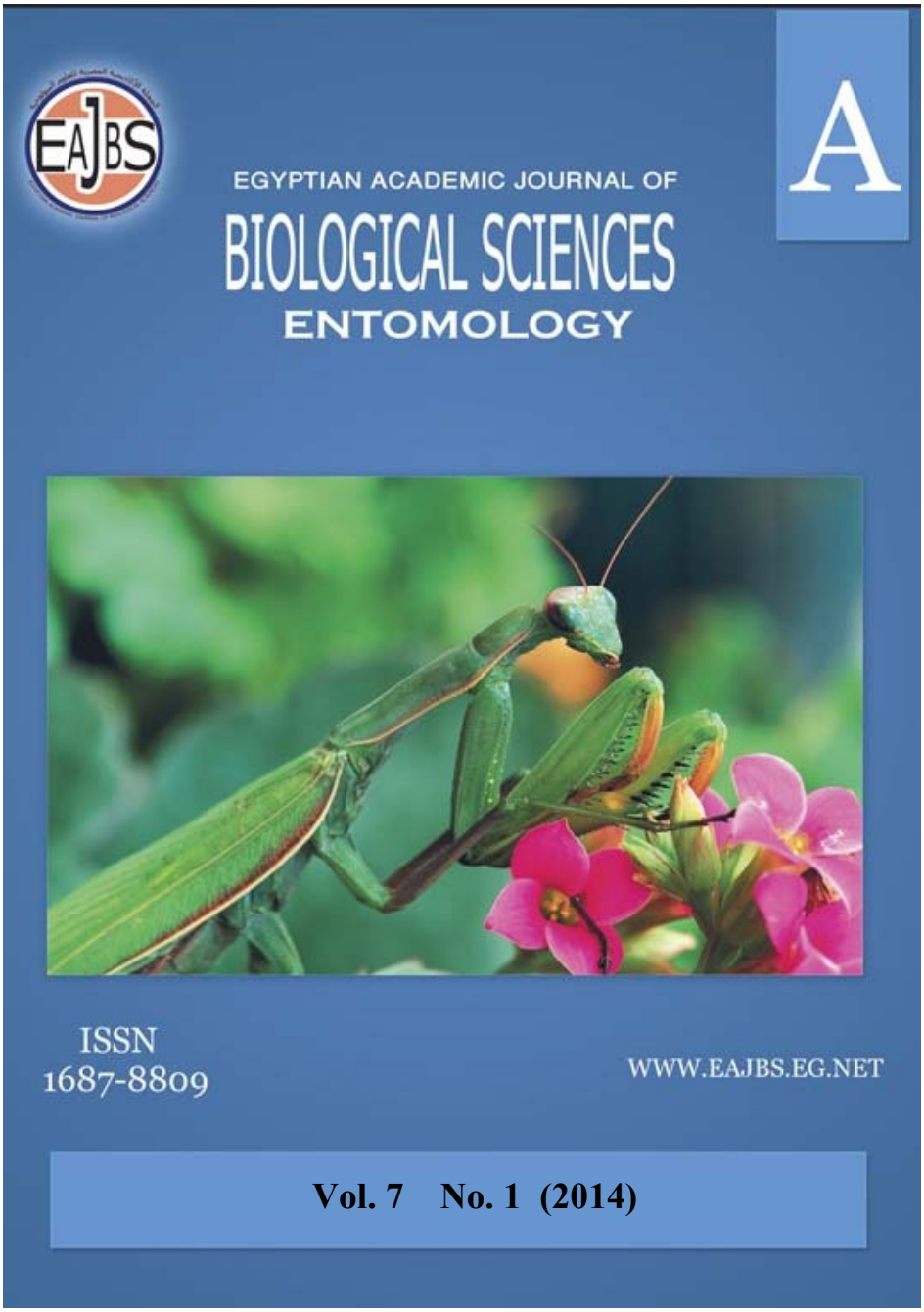

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Seasonal activity of the pine scale, *Leucaspis pusilla* Löw (Hemiptera: Diaspididae) on Aleppo pine trees, *Pinus halepensis* at Alexandria, Egypt.

Suzan A. Badr
Plant Protection Research Institute Sabahia Alexandria

ABSTRACT

The seasonal activity of the pine scale, *Leucaspis pusilla* Löw (Hemiptera: Diaspididae) was conducted for two successive years (Mar., 2009 - mid-Feb., 2011) on Aleppo pine trees (*Pinus halepensis*) (Pinales: Pinaceae) cultivated at International Center For Training and Development at El-Amriya district, Alexandria Governorate. The obtained results revealed that, *L. pusilla* has two overlapping generations a year on Aleppo pine trees occurred in spring and autumn seasons. The insect population reached its maximum activity during May and October/November, peaked during May in the 1st generation and October/ November in the 2nd one. The shortest generation occurred in spring with duration of 5.5 months at 21.3 - 22.3ºC and 64.7 - 69.5%R.H. whereas the longest one occurred in autumn with duration of 7 months at 21ºC & 66.4 - 67.6%R.H. The autumn generation is the largest one (495.5 - 557.4 insects) and spring generation is smaller one (336.7 - 360.6 insects). On the other hand, the insect population reached to minimum numbers in summer season. The tested climatic factors (daily mean max. and min. temperatures as well as R.H.%) showed significant effect on the insect population in the both generations in the two years, the changes in the half monthly counts of nymph and adult populations referred to the combined effect of the tested climatic factors on the insect population in the 1st generation (spring generation) were 56.9 - 57.2% for nymphal stage; 53.7 - 65.3 for adult stage and 56.4 - 61.0% for insect population (nymph and adult) in the two years, respectively. In the 2nd generation (autumn generation) were 73.6 - 73.8% for nymphal stage; 62.4 -72.7% for adult stage and 70.7 -73.9%for insect population (nymph and adults) in the two years, respectively.

Keywords: Hemiptera, Diaspididae, *Leucaspis pusilla*, Seasonal activity

INTRODUCTION

The pine scale, *Leucaspis pusilla* Löw (Hemiptera: Diaspididae) was recorded for the first time in Egypt on Aleppo pine trees in 1922 (Hall, 1922). In Egypt, few taxonomic studies were carried on *L. pusilla* (Ezzat,1958 ; Mohammed and Ghabbour, 2008) and up to now no further studied were recorded on its bionomics, this may be refers to rareness of its host plants which cultivated only with view numbers as ornamental plants or refers to unsuitable environmental conditions. Recently, about twenty years ago the cultivated area with pine trees increased rapidly as ornamental plants in parks, public gardens and many private gardens in Alexandria and Marina resort (North Coast). Also, about two acres (4094 m^2) were cultivated with Aleppo pine trees at Horticulture Research Institute Farm at El-Nubaria district, Behaira Governorate specially the *Pinus halepensis* Mill which is the

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common *Pinus* species in the cultivated area. The pine scale, *L. pusilla* start to appear with high population on Aleppo pine trees causing damages for pine needles. Although the pine leaves are very small and needles shape, they are not protecting the pine trees from insect infestation.

The pine scale, *L. pusilla* is economic importance pest all over the world (Kosztarab and Kozar, 1988; Watson, 2002 and Ben-Dov *et al*., 2005), it specific scale for pine trees and common in the coastal areas (Raspi and Antonelli, 1989). Amitai (1973) reported two *Leucaspis* species occur together on pine trees, they cause severe damage to pines in Israel. *Leucaspis pini* (Hartig) (Hemiptera: Diaspididae) is normally found on the outside of the lamina, and *L. pusilla* on the inside of the lamina of the needles.

Badr (2014) found *L .pusilla* more dominant on the ornamental trees, especially Aleppo pine trees (*Pinus halepensis*) in Alexandria Governorate, it appears with high frequency and high density on pine trees in Alexandria, Behaira and North Coast. The infested needles become yellow, then red and get next to the shots and as a result their foliage and emptiness, especially in the median and lower sides, where the loss of the needles is more marked. In case of severe infestation, the pine trees showed poor appearance and become susceptible to infestation with secondary pests.

The present work was conducted to study the seasonal activity of the pine scale, *Leucaspis pusilla* on Aleppo pine trees (*Pinus halepensis*); number and duration of annual field generations and effect of certain climatic factors on its activity to design an integrated pest management program for its control.

MATERIALS AND METHODS

The seasonal activity of the pine scale, *L. pusilla* was monitored for two years (Mar., 2009 - mid-Feb., 2011) on heavily infested Aleppo pine trees (*Pinus halepensis*) cultivated at International Center For Training and Development at El-Amriya district, Alexandria Governorate. The present work was carried out on four pine trees received the normal agricultural practices without using any chemical control measures before and during the studying period. The selected pine trees have similar size, shape, height and vegetation. Half-monthly samples were picked up at random from the cardinal directions of the selected pine trees with rate of 20 leaves/tree.

The collected samples were kept in paper bags and transferred to the laboratory for further examination by using stereoscopic-microscope. The population of *L. pusilla* per each sample was sorted into nymphs and adults.

Meteorological data of the half monthly means of the some climatic factors (daily mean maximum and minimum temperatures as well as relative humidity) were obtained from the Meteorological Center Laboratory, Agricultural Research Center, Dokki, Giza. The half monthly means of the tested climatic factors were correlated with the insect population and the simultaneous effect (Fisher, 1950) of the tested factors on the variability within the insect population was done by using computer (MSTATC Program) to determine their effect on the insect activity in the two studied years.

RESULTS AND DISCUSSION

Seasonal activity of *L. pusilla*

The seasonal activity of *L. pusilla* on Aleppo pine trees was studied for two years (Mar., 2009 to mid Feb., 2011). The obtained results were illustrated in Figs. (1&2) and discussed as follows:

Nymphal population

The nymphal population showed gradual increase in March (Figs., 1&2) ranged 13.8 - 14.5 nymph/leaf at daily mean temperature and %R.H ranged 16.8-18.47ºC and 59.5-62.5%R.H. in the two years. The nymphal population increased rapidly during April (20.5-26.5 nymph/leaf) in the two years at 17.5-18.3ºC & 60.9- 63.9% R.H. During May, the population increased highly in the two years recording a peak for nymphal activity in early May (33.5 nymph/leaf) in the 1st year and mid May (28.5 nymph/leaf) in the 2nd year at prevailing field conditions ranged 21.0-22.1ºC and 60.5-69.2% R. H., respectively.

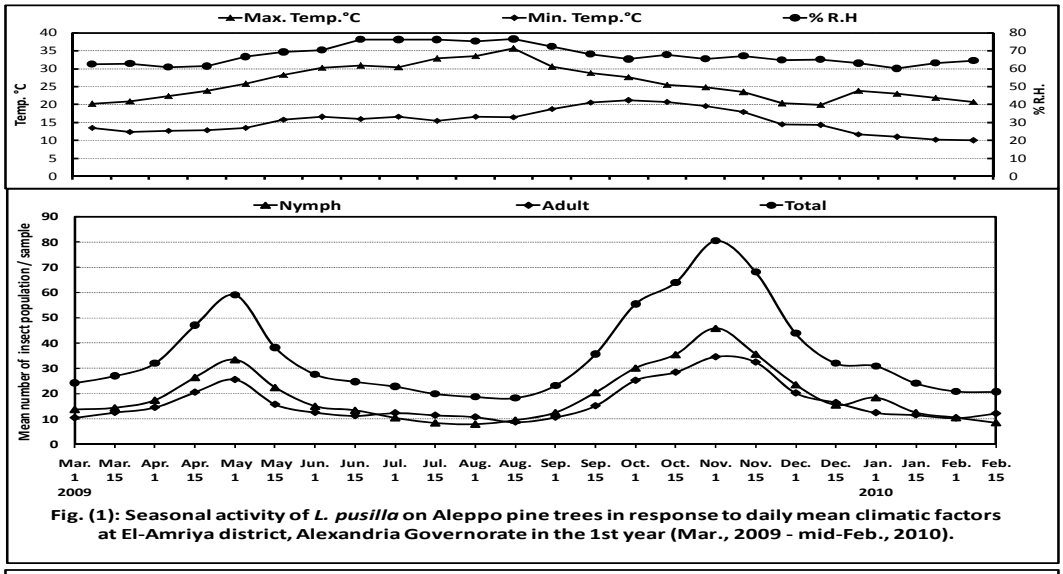

Fig. (1): Seasonal activity of *L. pusilla* on Aleppo pine trees in response to daily mean climatic factors at El-Amriya district, Alexandria Governorate in the 1st year (Mar., 2009 - mid-Feb., 2010).

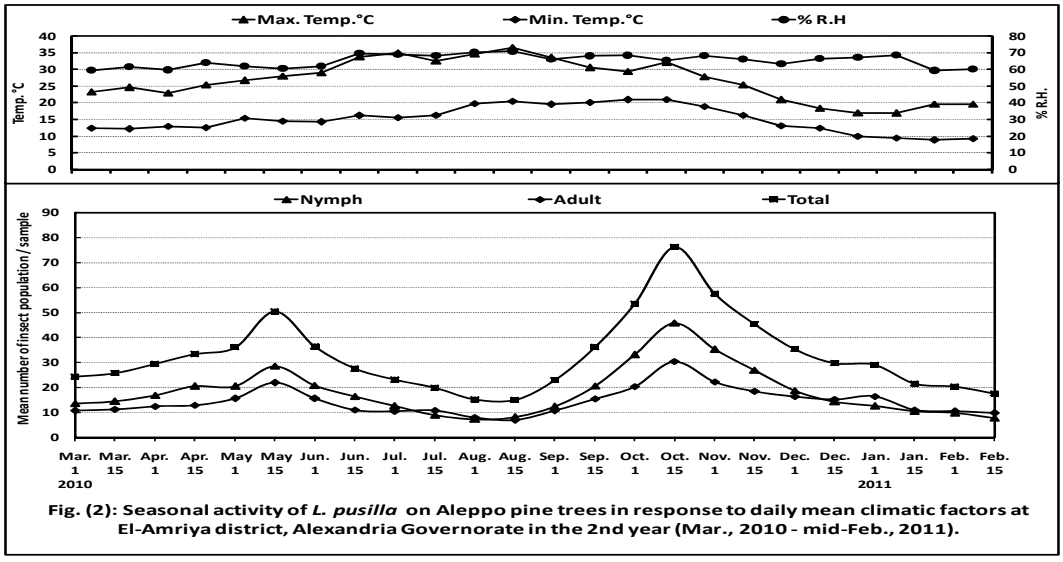

Fig. (2): Seasonal activity of *L. pusilla* on Aleppo pine trees in response to daily mean climatic factors at El-Amriya district, Alexandria Governorate in the 2nd year (Mar., 2010 - mid-Feb., 2011).

Gradual decrease was recorded in the nymphal population during June, the population decreased to 13.5 nymph/leaf in the 1st year and 16.5 nymph/leaf in the 2nd one at 22.1 - 25ºC & 62.0 - 70.3% R.H. in the two years. Continuous decreasing was observed in the nymphal population during July (8.5-9.0 nymph/leaf) in the two years at field conditions ranged 23.5 - 25.3ºC & 68.2 -76.1% R.H., respectively.

In August, the nymphal population declined to minimum numbers in the both years, ranged 8.0 - 9.6 nymph/leaf in the 1st year at 25.1 - 26.0ºC & 75.2 - 76.5%R.H. and 7.3-8.1 nymph/leaf at 27.2-28.5 ºC & 70.1-70.8%R.H in the 2nd year. The population of *L. pusilla* showed gradual increase during September in the both years, it increase from 12.6 to 20.5

nymph/leaf in the 1st year and from 12.3 to 20.7 nymph/leaf in the 2nd year at field conditions of 26.5ºC & 72.3%R.H. During October, the population increased greatly (30.2-35.5 nymph/leaf) in the 1st year at 23.1-24.4ºC & 65.3-67.8%R.H. The same trend was observed in the 2nd year, it increased from 33.1 to 45.8 nymph/leaf at 24.5-25.6ºC & 66.1 - 65.5%R.H. recording a peak for nymphal activity by mid-October.

In November, the nymphal population showed 2nd peak (45.9 nymph/leaf) for nymphal activity in the 1st year at 22.2 ºC and 65.5 %R.H. followed by gradual decrease in mid-November reached to 35.7 nymph/leaf. In the 2nd year, the population decreased gradually during November (35.2 - 26.9 nymph/leaf) with decreasing of daily mean temperature (23.4 - 20.9ºC).

During December, the population decreased continuously in the two years from 23.6 to 15.6 nymph/leaf in the 1st year and from 18.8 to 14.4 nymph/ leaf in the 2nd year at 17.7 - 15.4ºC and 63.5 - 66.5% R.H., respectively. The nymphal population declined to lower numbers during January and February reached to 8.6 - 7.8 nymph/leaf by mid-February at 14.5 - 15.3ºC & 60.2 - 64.5% R.H. in the two studied years, respectively.

Adult population

The adult population showed gradual increase during March and April in the two year. The population increased greatly during May recording a peak for adult population in early May (25.6 adult/leaf) in the 1st year and mid-May (21.9 adult/leaf) in the 2nd one at 21.3-22.1ºC & 60.5-69.2%R.H., respectively. The population decreased gradually in June (15.1-13.5& 15.8-11.0 adult/leaf) in the two years. Continuous decreasing was observed in the adult population during July reached to 10.8 and 11.5 adult/leaf by mid July at 24.1-25.3ºC & 69.0 - 76.1%R.H. in the two years, respectively.

During August, the adult population decreased to minimum numbers in the two years (7.0-8.8 adult/leaf) at 25.1-28.5ºC & 70.8-75.2%R.H., respectively. In September, the adult population started to increase gradually in the two years, reached to 2nd peak by mid-October (30.4 adult/leaf) in the 2nd year and early November (34.6 adult/leaf) in the 1st year at 23.2-25.2ºC and 65.5 - 66.2%R.H., respectively.

The population showed gradual decrease during December in the two years, reached 16.5 adult/leaf in the 1st year and 15.3 adult/leaf in the 2nd one at field conditions ranged 15.4 -17.4ºC & 63.4-65.0% R.H., respectively. Gradual decrease was recorded in the adult population during January and February reached to 9.8 and 12.2 adult/leaf by mid February in the two years, respectively.

The above mentioned results showed two overlapping generations a year for the pine scale, *L. pusilla* on pine trees in Nubaryia district, Alexandria Governorate occurred in spring and autumn seasons. The insect population reached its maximum activity during May and October/November in the two years where the environmental conditions become more suitable for insect activity in the two years. The insect population peaked during May in the 1st generation at field conditions ranged 21.3-22.1ºC and 60.5-69.2%R.H. whereas the 2nd generation peaked in mid-October/early November at 24.4-26.6ºC & 65.3-65.5%R.H., respectively. On the other hand, the insect population has one depression occurred in summer season, the population reached to minimum numbers in August in the two years.

In Italy, Viggiani and Iaccarino (1971) reported the bionomics of *L. pusilla* which damages the needles of pine trees in Campania; they found two separate life-cycles for *L. pusilla* occurred according to the stage in which the coccid overwintered. Most individuals overwintered as second-instar nymphs, remaining in this instar from June until the following March or April and giving rise to adults in March-July and to the eggs and nymphs of the next generation in April-August. The coccids that overwintered as adult females from August to the following April produced eggs and young nymphs from late March to the end of May,

second-instar nymphs in May-July, males from mid-June to the end of August and females from August onwards.

Number and duration of annual field generations

Number and duration of annual field generations of *L. pusilla* were determined by integration the population curves in each generation. The obtained results showed that, *L. pusilla* has two overlapping generations a year (Figs., 1&2 and Table, 1) occurred in spring and autumn seasons under environmental conditions of El-Amriya district, Alexandria Governorate as follows:

1st generation

The 1st generation started from early March to mid-August in the both years, peaked in first May (35.5 nymph/leaf) in the 1st year and mid-May (28.5 nymph/leaf) in the 2nd one. The generation duration has 5.5 months per year under prevailing environmental conditions ranged 21.3 - 22.3ºC and 64.7 - 69.5%R.H., respectively. The generation size ranged 188.9 - 193.5 nymphs and 147.8 -167.1 adults with total population ranged 336.7 - 360.6 insects in the two years, respectively.

The 2nd generation

The 2nd generation occurred between mid-July and mid-February in the two years, peaked in 1st November (45.9 nymph/leaf) in the 1st year or mid-October (45.8 nymph/ leaf) in the 2nd one, respectively. The generation duration lasted for 7 months in the two years under field conditions ranged 21ºC & 66.4 - 67.6%R.H. in the two years. The generation size ranged 272.3 - 296.0 nymphs and 223.2 - 261.4 adults with total population ranged 495.5 - 557.4 insects in the two ears, respectively.

Table 1: Number and duration of annual field generations of *L. pusilla* on Aleppo pine trees cultivated at International Center For Traning and Development at El-Amriya district, Alexandria Governorate during the two studied years (Mar., 2009 - mid-Feb., 2011)

Generation	1st year (March, 2009 to mid-Feb., 2010)										
	Generation duration			Duration / month	Generation size			Daily mean climatic factors			
	From	To	Peak		Nymph	Adult	Total	Max. Temp.°C	Min. Temp.°C	Mean. Temp.°C	RH %
1st Generation	1st March	Mid-Aug.	1st May	5.5	193.5	167.1	360.6	27.8	14.8	21.3	69.5
2nd Generation	Mid-Jul.	Mid-Feb.	1st Nov.	7	296.0	261.4	557.4	26.1	15.9	21.0	67.6
Generation	2nd year (March, 2010 to mid-Feb., 2011)										
	Generation duration			Duration / month	Generation size			Daily mean climatic factors			
	From	To	Peak		Nymph	Adult	Total	Max. Temp.°C	Min. Temp. °C	Mean Temp. °C	RH %
1st Generation	1st March	Mid Aug.	Mid-May	5.5	188.9	147.8	336.7	29.3	15.3	22.3	64.7
2nd Generation	Mid-Jul.	Mid-Feb.	Mid-Oct.	7	272.3	223.2	495.5	26.2	15.8	21.0	66.4

The obtained results revealed that, the generation duration of *L. pusilla* was varied in the two studied years. The shortest generation occurred in spring with duration of 5.5 months at 21.3 - 22.3ºC and 64.7- 69.5%R.H. whereas the longest one occurred in autumn with duration of 7 months at 21ºC & 66.4 - 67.6%R.H. On the other hand, the generation size was

varied in the two generations; the autumn generation is the largest one with mean number of 495.5 - 557.4 insects followed by spring generation with mean number of 336.7 - 360.6 insects, respectively.

In Hungary, *L. pusilla* has one generation a year on pine trees and overwinter as adult females (Kosztarab and Kozar, 1988). In Italy, *L. pusilla* was common in coastal areas on pine forests (*Pinus pinaster*; *P. pinea* and *P. halepensis*) in Tuscany and completed 2 generations a year, overwintering in the 2nd nymphal instar ; causes much damage in some of the pine forests in which trees had already been weakened by abiotic or biotic factors (Raspi and Antonelli, 1989). In California, *L. pusilla* has three generation a year on pine trees (Gill, 1997). In Romania, Isaia and Manea (2008) showed that *Leucaspis pusilla* has one generation per year depending on the climatic conditions, the scale overwinter as a first instar nymph and rarely as immature females.

So, the proper time for its control would be carried by application the recommended pesticides either in autumn or winter season to save Aleppo pine trees form insect infestation.

III- Effect of tested climatic factors on the insect activity

The effect of tested climatic factors on the annual field generations of *L. pusilla* was statistically analyzed to determine the effect of each climatic factor on the insect population in each generation per each year. Results of statistical analyses were shown in Tables (2&3) and discussed as follows:

The 1st generation

A: Nymphal population

1-Effect of daily mean maximum temperature

Data in Tables (2 & 3) showed negative relation, insignificant effect for daily mean maximum temperature (r values = -0.308 & -0.521) on the nymphal activity during the 1st generation in the two years, respectively. The partial regression analysis showed the real effect of this factor on the nymphal activity in the 1st generation in the two years which was positive (P.reg. values = 5.4 & 1.6) and insignificant in the both years (t values = 1.8 & 1.6) when the daily mean minimum temperature and relative humidity become around their means. The obtained results revealed that, daily mean maximum temperature within the optimum range of nymphal activity in the two years, respectively.

Table 2: Effect of the tested climatic factors on *L. pusilla* population on Aleppo pine trees cultivated at International Center For Training and Development at El-Amriya district, Alexandria Governorate during the 1st year (Mar., 2009 to mid-Feb., 2010).

Insect population	Climatic factors	1st generation					2nd generation				
		Simple correlation	Multiregression analysis		ANOVA TABLE		Simple correlation	Multiregression Analysis		ANOVA TABLE	
		r value	P. reg. ± s.e	t value	F value	E.V. %	r value	P. reg. ± s.e	t value	F value	E.V. %
Nymphal population	Max. Temp.°C	-0.308	5.4 ± 2.9	1.8	1.8	57.2	-0.198	-1.10 ±0.8	-1.3	9.4**	73.8
	Min. Temp.°C	-0.428	-8.4 ± 5.5	-1.5			0.613*	2.9 ± 0.6	5.2**		
	%R.H.	-0.469	-1.5 ± 1.1	-1.4			-0.210	-0.71± 0.4	-0.8		
Adult population	Max. Temp.°C	-0.310	3.4 ± 1.9	1.7	1.6	53.7	-0.258	-1.3 ± 0.6	-2.1*	8.9**	72.7
	Min. Temp.°C	-0.439	-5.8 ± 3.7	-1.6			0.573*	2.1 ± 0.4	4.1**		
	%R.H.	-0.437	-0.75±0.7	-1.1			-0.198	-0.6± 0.3	-0.1		
Total population	Max. Temp.°C	-0.311	8.8 ± 4.8	1.8	1.7	56.4	-0.225	-2.4 ± 1.4	-1.7	9.4**	73.9
	Min. Temp.°C	-0.436	-14.2±9.2	-1.6			-0.600*	5.0 ± 1.0	5.1**		
	%R.H.	-0.460	-2.3 ± 1.8	-1.3			-0.207	-1.31±0.8	-0.50		

Table 3: Effect of the tested climatic factors on *L. pusilla* population on Aleppo pine trees cultivated at Horticulture Research Institute Farm in El-Amriya district, Alexandria Governorate during the 2nd year (Mar., 2010 – mid-Feb., 2011).

Insect population	Climatic factors	1st generation					2nd generation				
		Simple correlation	Multiregression analysis		ANOVA TABLE		Simple correlation	Multiregression analysis		ANOVA TABLE	
		r value	P. reg. ± s.e	t value	F value	E.V. %	r value	r value	P. reg. ± s.e	t value	F Value
Nymphal population	Max. Temp.°C	-0.521	1.6 ± 1.0	1.6	3.5	56.9	0.644*	-2.9 ± 1.5	-2.1*	7.4**	73.6
	Min. Temp.°C	-0.563*	-1.1± 0.9	-1.0			0.773**	5.9 ± 2.0	2.9*		
	%R.H.	-0.662*	-2.0± 0.9	-2.2*			0.386	-1.5 ± 1.1	-1.4		
Adult population	Max. Temp.°C	-0.438	1.3± 0.6	2.3*	5.0*	65.2	0.488	-1.9± 0.9	-2.1*	4.4*	62.4
	Min. Temp.°C	-0.461	-0.49±0.2	-0.8			0.641*	3.2 ± 1.2	2.7*		
	%R.H.	-0.639*	-1.7± 0.5	-3.2**			0.364	-0.8± 0.6	-1.2		
Total population	Max. Temp.°C	-0.495	2.9 ± 1.5	1.9	4.1*	61.0	0.598*	-4.8 ±2.3	2.1*	6.4**	70.7
	Min. Temp.°C	-0.530	-1.5± 1.1	-0.9			0.737**	9.1 ± 3.2	3.0**		
	%R.H.	-0.662*	-3.7± 1.4	-2.6*			0.382	-2.3 ± 1.7	-1.4		

2- Effect of daily mean minimum temperature

Daily mean minimum temperature (Tables, 2 & 3) had negative relation on the nymphal activity in the two years insignificant (r value = -0.428) in the 1st year and significant (r values = -0.563) in the 2nd one. The single effect of this factor on the nymphal activity was negative (P.reg. values = -8.4 & -1.1) and insignificant (t values = 1.45 & 0.58) in the both years when the mean daily maximum temperature and relative humidity become around their means. The obtained results revealed that, daily mean minimum temperature around the optimum range of the nymphal activity in the two years, respectively.

3- Effect of daily mean relative humidity

Daily mean relative humidity (Tables, 2 & 3) showed negative relation on the nymphal activity, insignificant (r value = -0.469) in the 1st year and significant (r value = -0.662) in the 2nd one. The exact effect of this factor on the nymphal activity was negative (P.reg. values = -1.5 & -2.0) in the two years, insignificant (t value = -1.4) in the 1st year and significant (t value = -2.2) in the 2nd one when the daily mean maximum and minimum temperatures become around their means. The obtained results revealed that, daily mean relative humidity around the optimum range of the nymphal activity in the 1st year and above the optimum range of the nymphal activity in the 2nd year.

4-The combined effect of the tested climatic factors on the nymphal activity

The combined effect of the tested climatic factors on the nymphal activity in the 1st generation (Tables, 2&3) showed insignificant effect (F values = 1.8 & 3.5) in the two years. The obtained results revealed that, the changes in the half monthly counts of the nymphal population referred to the single effect of each climatic factor than the combined effect of tested factors. The amount of variability in the nymphal population ranged 56.9 - 57.2% in the 1st generation in the two years, respectively.

B: Adult population

1-Effect of daily mean maximum temperature

Results in Tables (2&3) stated that, daily mean maximum temperature has negative relation (r values = -0.310 & -0.438) insignificant effect on the adult activity in the 1st generation in the two years. The true effect of this factor on the adult activity was positive (P.reg. values = 3.4 & 1.3) insignificant in the 1st year (t value = 1.7) and significant (t value = 2.3) in the 2nd one when daily mean minimum temperature and relative humidity become

around their means. The obtained results revealed that, daily mean maximum temperature within the optimum range of the adult activity in the 1st year and under the optimum range of adult activity in the 2nd one, respectively.

2- Effect of daily mean minimum temperature

Daily mean minimum temperature (Tables, 2&3) showed negative relation (r values = -0.439 & -0.461) insignificant effect on the adult population in the both years. The single effect of this factor was negative (P.reg. values = -5.8 & -0.49) insignificant (t values = 1.6 & 0.8) on the adult population in the two years when daily mean maximum temperature and relative humidity) become around their means. The obtained results revealed that, daily mean minimum temperature around the optimum range of adult activity in the 1st generation in the two years, respectively.

3- Effect of daily mean relative humidity

Daily mean relative humidity (Tables, 2 & 3) had negative relation (r values = -0.437 & -0.639) on the adult activity insignificant in the 1st year and significant in the 2nd one. The true effect of this factor on the adult activity was negative (P.reg. values = -0.75 & -1.7) insignificant (t value = 1.1) in the 1st year and significant (t value = 3.2) in the 2nd one when daily mean maximum and minimum temperatures become around their means. The obtained results revealed that, daily mean relative humidity around the optimum range of adult activity in the 1st year and above the optimum range of adult activity in the 2nd year, respectively.

4-The combined effect of the tested climatic factors on the adult activity

The combined effect (Tables, 2&3) of the tested climatic factors on the adult activity was insignificant (F values = 1.6) on the 1st generation in the 1st year and significant (F values = 5.0) in the 2nd one. The obtained results revealed that, the changes in the half monthly counts of the adult population ranged 53.7 – 65.2% in the 1st generation in the two years, respectively.

C: Total population

The effect of tested climatic factors on the *L. pusilla* population in the 1st generation has the same trend as the nymph and adult populations in the two years as follows:

1-Effect of daily mean maximum temperature

Results in Tables (2&3) showed that, daily mean maximum temperature has negative relation (r values = -0.311 & -0.495) insignificant effect on the 1st generation in the two years. The true effect of this factor on the insect population was positive (P.reg. values = 8.8 & 2.9) insignificant (t values = 1.8 & 1.9) in the two years when the daily mean minimum temperature and relative humidity become around their means. The obtained results revealed that, daily mean maximum temperature within the optimum range of the insect activity in the two years, respectively.

2- Effect of daily mean minimum temperature

Daily mean minimum temperature (Tables, 2&3) showed negative relation (r values = -0.436 & -0.530) insignificant effect on the insect population in the 1st generation in the two years, respectively. The exact effect of this factor was negative (P.reg. values = -14.2 & -1.5) and insignificant (t values = 1.6 & 0.9) on the insect activity in the two years when daily mean maximum temperature and relative humidity become around their means. The obtained results revealed that, daily mean minimum temperature around the optimum range of adult activity in the 1st generation in the two years, respectively.

3- Effect of daily mean relative humidity

Daily mean relative humidity (Tables, 2 & 3) had negative relation (r values = -0.460 & -0.662) on the insect activity insignificant in the 1st year and significant in the 2nd one. The true effect of this factor on the insect activity was negative (P.reg. values = -0.2.3 & -3.7) insignificant (t value = 1.3) in the 1st year and significant (t value = 2.6) in the 2nd year when the daily mean maximum and minimum temperatures become around their means. The

obtained results revealed that, daily mean relative humidity around the optimum range of insect activity in the 1st year and above the optimum range of activity in the 2nd one, respectively.

4-The combined effect of the tested climatic factors on the insect population

The combined effect (Tables, 2&3) of the tested climatic factors on the insect population in the 1st generation was insignificant (F values = 1.7) in the 1st year and significant (F values = 4.1) in the 2nd one. The obtained results revealed that, the changes in the half monthly counts of the insect population ranged 56.4 - 61% in the two years, respectively.

11- The 2nd generation

A: Nymphal population

1-Effect of daily mean maximum temperature

Daily mean maximum temperature (Tables, 2 & 3) showed negative relation on the nymphal activity (r value = -0.198) insignificant in the 1st year and positive relation (r value = 0.644) significant effect in the 2nd year, respectively. The real effect of this factor on the nymphal activity in the 2nd generation was negative (P.reg. values = -1.10 & -2.9) insignificant (t value = 1.3) in the 1st year and significant (t value = 2.1) in the 2nd one when the daily mean minimum temperature and relative humidity become around their means. The obtained results revealed that, daily mean maximum temperature around the optimum range of the nymphal activity in the 1st year and above the optimum range of the nymphal activity in the 2nd year, respectively.

2- Effect of daily mean minimum temperature

Daily mean minimum temperature (Tables, 2 & 3) had positive relation (r values = 0.613 & 0.773) significant effect on the nymphal activity in the two years, respectively. The single effect of this factor on the nymphal activity was positive (P. reg. values = 2.9 &5.9) highly significant (t value = 5.2) in the 1st year and significant (t value = 2.9) in the 2nd one when daily mean maximum temperature and relative humidity become around their means. The obtained results revealed that, daily mean minimum temperature under the optimum range of the nymphal activity in the two years, respectively.

3- Effect of daily mean relative humidity

Daily mean relative humidity (Tables, 2 & 3) showed insignificant effect (r values = -0.210 & 0.386) on the nymphal activity negative in the 1st year and positive in the 2nd one. The exact effect of this factor on the nymphal activity was negative (P.reg. values = -0.71& -1.5) and insignificant (t values = -0.8 & -1.4) in the two years when the daily mean maximum and minimum temperatures become around their means. The obtained results revealed that, daily mean relative humidity around the optimum range of the nymphal activity in the two years, respectively.

4- The combined effect of the tested climatic factors on the nymphal activity

The combined effect (Tables, 2&3) of the tested climatic factors on the nymphal activity was significant (F values = 9.4 & 7.4) on the 2nd generation in the two years. The obtained results revealed that, the changes in the half monthly counts of the nymphal population referred to effect of the daily mean minimum temperature as well as the combined effect the tested factors. The amount of variability in the nymphal population ranged 73.6 - 73.8% for the 2nd generation in the two years, respectively.

B: Adult population

1-Effect of daily mean maximum temperature

The obtained results (Tables, 2&3) showed insignificant relation for daily mean maximum temperature on the adult population in the two years negative (r value = -0.258) in the 1st year and positive (r value = 0.488) in the 2nd one. The true effect of this factor on the adult activity was negative (P.reg. values = -1.3 & -1.9) and significant (t value = 2.1) on the

adult population in the two years when daily mean minimum temperature and relative humidity become around their means. The obtained results revealed that, daily mean maximum temperature above the optimum range of the adult activity in the two studied years, respectively.

2- Effect of daily mean minimum temperature

Daily mean minimum temperature (Tables, 2&3) showed positive relation (r values = 0.573 & 0.641) significant effect on the adult population in the two years. The single effect of daily mean minimum temperature on the adult population was positive (P.reg. values = 2.1& 3.2) highly significant (t value = 4.1) in the 1st year and significant (t value = 2.7) in the 2nd one when daily mean maximum temperature and relative humidity become around their means. The obtained results revealed that, daily mean minimum temperature under the optimum range of adult activity in the 2nd generation in the two years, respectively.

3- Effect of daily mean relative humidity

Daily mean relative humidity (Tables, 2 & 3) showed insignificant relation on the adult population in the 2nd generation, negative (r value = -0.198) in the 1st year and positive (r values = 0.364) in the 2nd one. The true effect of this factor on the adult activity was negative (P.reg. values = -0.6 & -0.8) insignificant (t values = -0.10 & -1.2) in the two years when the daily mean maximum and minimum temperatures become around their means. The obtained results revealed that, daily mean relative humidity around the optimum range of adult activity in the two years, respectively.

4-The combined effect of the tested climatic factors on the adult activity

Data in Tables (2 &3) showed the combined effect of the tested climatic factors on the adult activity in the 2nd generation which was highly significant (F values = 8.9) in the 1st year and significant (F values = 4.4) in the 2nd one. The obtained results revealed that, the changes in the half monthly counts of the adult population refers to effect of daily mean maximum and minimum temperatures as well as the combined effect of the tested climatic factors which ranged 62.4 - 72.7% in the two years, respectively.

C: Total population

The effect of tested climatic factors on *L. pusilla* population in the 2nd generation was discussed in the two years as follows:

1-Effect of daily mean maximum temperature

The obtained results (Tables, 2&3) showed that, daily mean maximum temperature has negative relation (r value = -0.225) insignificant on the insect population in the 1st year and has positive relation (r value = 0.598) significant in the 2nd one. The true effect of this factor on the insect activity was negative (P.reg. values = -2.4 & -4.8), insignificant (t value = 1.7) in the 1st year and significant (t value = 2.1) in the 2nd one when the daily mean minimum temperature and relative humidity become around their means. The obtained results revealed that, daily mean maximum temperature around the optimum range of the insect activity in the 1st year and under the optimum range of activity in the 2nd one, respectively.

2- Effect of daily mean minimum temperature

Daily mean minimum temperature (Tables, 2&3) showed significant effect on the insect population negative (r value= -0.600) in the 1st year and positive (r value = 0.737) in the 2nd one. The exact effect of this factor was positive (P.reg. values = 5.5 & 9.1) and highly significant (t values = 5.1& 3.0) on the insect population in the two years when daily mean maximum temperature and relative humidity become around their means. The obtained results revealed that, daily mean minimum temperature under the optimum range of insect activity in the 2nd generation in the two years, respectively.

3- Effect of daily mean relative humidity

Daily mean relative humidity (Tables, 2 & 3) showed insignificant relation on the insect activity, negative in the 1st year (r value = -0.207) and positive (r value = 0.382) in the

2nd one. The true effect of this factor on the insect activity was negative (P.reg values = -1.3 & -2.3) and insignificant (t values = -0.5 & 1.4) in the two years when daily mean maximum and minimum temperatures become around their means. The obtained results revealed that, daily mean relative humidity around the optimum range of insect activity in the two years, respectively.

4-The combined effect of the tested climatic factors on the insect population

Data in Tables (2 & 3) showed the combined effect of the tested climatic factors on the insect activity in the 2nd generation, it was highly significant (F values = 9.4 & 6.4) in the 1st and 2nd years, respectively. The obtained results revealed that, the changes in the half monthly counts of the insect population ranged 70.7 - 73.9% in the two years, respectively.

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ARABIC SUMMARY

النشاط الموسمى لحشرة الصنوبر القشرية *Leucaspis pusilla* على أشجارالصنوبر الحلبى فى محافظة الاسكندرية - مصر

سوزان بدر
معهد بحوث وقاية النباتات - محطة بحوث وقاية النباتات بالصبحية - الاسكندرية

حشرة الصنوبر القشرية *Leucaspis pusilla* من الحشرات الهامة التى تصيب اشجار الصنوبر فى مصر، سجلت الحشرة لأول مرة عام 1922 ولم تنل الحشرة حظا من الدراسات البيئية حتى الأن عدا بعض الدراسات التصنيفية البسيطة وقد يكون هذا راجعا الى ندرة عوائلها من اشجار الصنوبر وتواجد أعداد قليلة منها خلال هذه الفترة أوقد يكون راجعا لعدم ملائمة الظروف البيئية لنشاطها . وفى خلال العشرين سنة الاخيرة انتشرت زراعة اشجار الصنوبر بأعداد كبيرة كنباتات زينة فى كثير من الحدائق العامة والخاصة وفى المنتجعات السياحية بالساحل الشمالى بالأسكندرية ، كما تم زراعة حوالى فدان تقريبا (4094 م^2) بأشجارالصنوبر وخاصة الصنوبر الحلبى *Pinus halepensis* فى مزرعة معهد بحوث البساتين بالعامرية حيث يعتبر من العوائل المفضلة لنشاطها . بدأت الحشرة فى التواجد بأعداد كبيرة على الاوراق مما ادى الى اصفرارها وسقوط كثير منها مما يؤدى الى ضعف اشجار الصنوبر .

اجريت الدراسة الحالية فى المركز الدولى للتدريب و التنمية بالعامرية على اشجار الصنوبر الحلبى لمدة عامين متتاليين (من بداية مارس 2009 وحتى منتصف فبراير 2011) بغرض دراسة النشاط الموسمى لحشرة الصنوبر القشرية وعدد اجيالها على مدار العام ومدة كل جيل تحت الظروف البيئية السائدة فى منطقة العامرية مع دراسة تأثر بعض العوامل الجوية على نشاطها.

اتضح من نتائج الدراسة وجود جيلين متداخلين للحشرة على مدار العام ، ظهرالجيل الاول فى الربيع (جيل الربيع) والجيل الثانى فى الخريف (جيل الخريف) من كل عام . بدأ الجيل الاول (جيل الربيع) نشاطة من بداية مارس فى العامين وحتى منتصف اغسطس فى العامين على التوالى ، وكانت ذروة نشاطة فى بداية مايو فى العام الاول أو فى منتصف مايو من العام الثانى ، وبلغت فترة نشاطة 5.5 شهر فى العامين على التوالى ، تراوح تعداد حشرة الصنوبر القشرية فى الجيل الاول (جيل الربيع) 188.9- 193.5 حورية و 147.8 - 167.1 حشرة كاملة وتراوح التعداد الكلى لطورى الحورية والحشرة الكاملة 336.7 - 360.6 حشرة فى العامين على التوالى ، وكانت درجة الحرارة المثلى لنشاط الحشرة 21.3 - 22.3 مº و الرطوبة النسبية 64.7 - 69.5 % فى العامين على التوالى.

بدأ الجيل الثانى (جيل الخريف) نشاطة من منتصف يوليو وحتى منتصف فبرايرفى العامين على التوالى ، وكانت ذروة نشاطة فى بداية نوفمبر فى العام الاول ومنتصف اكتوبر من العام الثانى وكانت فترة نشاطه 7 شهور فى كل عام ، تراوح تعداد حشرة الصنوبر القشرية فى الجيل الثانى (جيل الخريف) 272.3 - 296.0 حورية و 223.2 - 261.4 حشرة كاملة وتراوح التعداد الكلى لطورى الحورية والحشرة الكاملة 495.5- 557.4 حشرة فى العامين على التوالى. كما تبين من الدراسة ان جيل الخريف اكثر تعدادا (495.5- 557.4 حشرة) من جيل الربيع (336.7 - 360.6 حشرة) فى كلا العامين على التوالى ، وكانت درجة الحرارة المثلى لنشاط الحشرة 21.0مº والرطوبة النسبية 66.4 - 67.6% فى العامين على التوالى. واتضح من نتائج الدراسة وجود انخفاض فى نشاط حشرة الصنوبر القشرية فى فصل الصيف على مدار العامين وهذا راجع الى ارتفاع درجة الحرارة فى فصل الصيف فى العامين على التوالى.

كما تبين من نتائج التحليل الاحصائى وجود ارتباط قوى ومعنوى لعوامل المناخ المختبرة (متوسط درجة الحرارة العظمى ، ومتوسط درجة الحرارة الدنيا ومتوسط الرطوبة النسبية) وخاصة درجة الحرارة الدنيا على نشاط الحشرة فى جيلى الربيع والخريف فى العامين وان كمية الاختلاف فى تعدادها والتى يمكن اعزاءها احصائيا الى التغير فى عوامل المناخ المختبرة تراوحت فى جيل الربيع 56.9 - 57.2 % لطور الحورية و 53.7 - 65.2 لطور الحشرة الكاملة وكانت 56.4 - 61.0% لتعداد الحشرة (طورى الحورية والحشرة الكاملة) فى العامين على التوالى . وتراوحت فى جيل الخريف 73.6 - 73.8 % لطور الحورية و 62.4 - 72.7 % لطور الحشرة الكاملة وكانت 70.7 - 73.9% لتعداد الحشرة (طورى الحورية والحشرة الكاملة) فى العامين على التوالى .