POPULATION DYNAMICS OF MASKELL SCALE, *INSULASPIS PALLIDULA* (GREEN) (HOMOPTERA – DIASPIDIDAE) ON MANGO TREES IN EGYPT

EL-SAYED ABDEL-HAMEID ELWAN

Plant Protection Research Institute, Agricultural Research Centre Dokki, Giza, Egypt

(Manuscript received 14 September 2004)

Abstract

Maskell scale, *Insulaspis pallidula* (Green) is common scale insect on mango trees, *Mangifera indica*, resulting falling the leaves and the drying branches. Population dynamics, number and duration of generations and effect of two weather factors on the insect activity were studied at Horticulture Research Station in El-Qanater El-Khairia,Qalubia Governorate (25 km north Cairo) in 2001/2002 and 2002/2003 years. Results revealed that, pre-adult and adult populations peaked four times per year during May, July, September/October and November. The pest had four annual overlapping generations and the highest generation occurred during autumn in both studied years.

The daily mean temperature was entirely under the optimum range of pre-adults and adults activities in the two years, whereas, the daily mean relative humidity within the optimum range of the pre-adults and adults activities in 2001/2002 year, and entirely under the optimum range of the pre-adults and adults activities in 2002/2003. The combined effect of the two weather factors on the pre-adults and adults activities was highly significant in both studied years.

INTRODUCTION

Maskell scale, *Insulaspis pallidula* (Green) (= *Lepidosaphes pallida* (Green) is common scale insect on mango trees, *Mangifera indica* in Egypt. The pest causes severe damage to leaves, branches, and the heavy infestation falling the leaves and drying the branches. The scale has a wide range of host plants and recorded in many countries in Ceylon, Hawaiian Islands, Japan (Fernald, 1903) on Willow and Podocarpus, North Austria (Green, 1914) on *Citrus acida,* Egypt (Hosny & Ezzat, 1956) on mango and guava, USA (Florida and neighbouring land areas (Dekle, 1976) on

Juniperus spp. and *Citrus aurantifolia,* Bermuda (Sterrer, 1998) on cedar forests, Atlantic and Gulf of Mexico coastal states (Stimmel, 1999) on many species of coniferous and in New Zealand (Charles & Henderson, 2002) on *Cryptomeria japonica.*

The present work was carried out for two successive years (2001/2002 & 2002/2003) on a mango orchard cultivated at Horticulture Research Station in El-Qanater El-Khairia, Qalubia Governorate to study the population dynamics, number and duration of generations under field conditions and effect of daily mean temperature and relative humidity on the insect activity in both studied years.

MATERIALS AND METHODS

Four mango trees, *Mangifera indica* similar in size, age, height (6-7 m) vegetative growth and receive the same horticultural practices were selected for the study. The selected trees did not receive any chemical control measures for several years ago and through the studying period. Regular half-monthly samples were picked up at random. The sample size was 25 leaves per tree, each contain 20 leaves for cardinal directions and 5 leaves for center core. The collected samples were transferred to the laboratory in paper bags for inspection and the pre-adults and adults were counted. Records of Meteorological data, mainly daily mean temperature and relative humidity were obtained from Shalakan Meteorological Station, Qalubia Governorate. The population dynamics, number and duration of generations per year were studied The meteorological factors were correlated with the insect population and the simultaneous effect (Fisher, 1950) of the daily mean temperature and relative humidity on the variability within the insect population was done by computer (MSTATC Program) to determine it's effect on the insect activity in both studied years.

RESULTS AND DISCUSSION

A- Population dynamics

1- Pre-adult population the obtained results in Fig. 1& 2 showed that, the pre-adult population increased rapidly through March and April in the two years. During May, the pre-adult population attained the 1st peak in both years, early May in the 1st year (2001/2002) and mid-May in the 2nd year (2002/2003). The pre-adult population ranged 34.8 - 39.2 insects/leaf in the two peaks of the both years under field conditions of 16.5 - 19 °C and 66.2 – 67.2 %R.H., respectively.

In June, the population declined in the two years and start to increase through July to reach the 2nd peak in mid-July in the both years (2001/2002&2002/2003) with mean numbers of 47.6 - 54.4 insects/ leaf at 24.1 – 26 °C and 60.2 –62.3 %R.H., respectively.

During August, the pre-adult population declined in early August to 31.1-38.7 insects/ leaf in the both years. The population start to increase by mid-August in the two years and continued through September to reach the 3rd peak in mid-September (77.4 insects/ leaf) at 28.4 °C & 67.4% R. H. in the 1st year (2001/2002) whereas in the 2nd year, the pre-adult population peaked (3rd peak) by early October (75.3 insects /leaf) under field conditions of 27.8 °C & 68.4 %R.H.

In late autumn, the pre-adult population recorded another peak (4th peak) in early and mid-November in both years (2001/2002&2002/2003) with mean numbers of 87.1-90.9 insects/leaf in the both peaks under field conditions of 23.9 – 25.6 °C and 69.3 – 70.2 %R.H. in both years, respectively. In December, the pre-adult population decreased continuously until mid-February in the both studied years, respectively.

The above-mentioned results revealed that, the pre-adult population has four peaks per year in early May, mid-July, mid – September and early November in the 1st year (2001/2002) and mid-May, mid-July, early October and mid-November in the 2nd year (2002/2003), respectively.

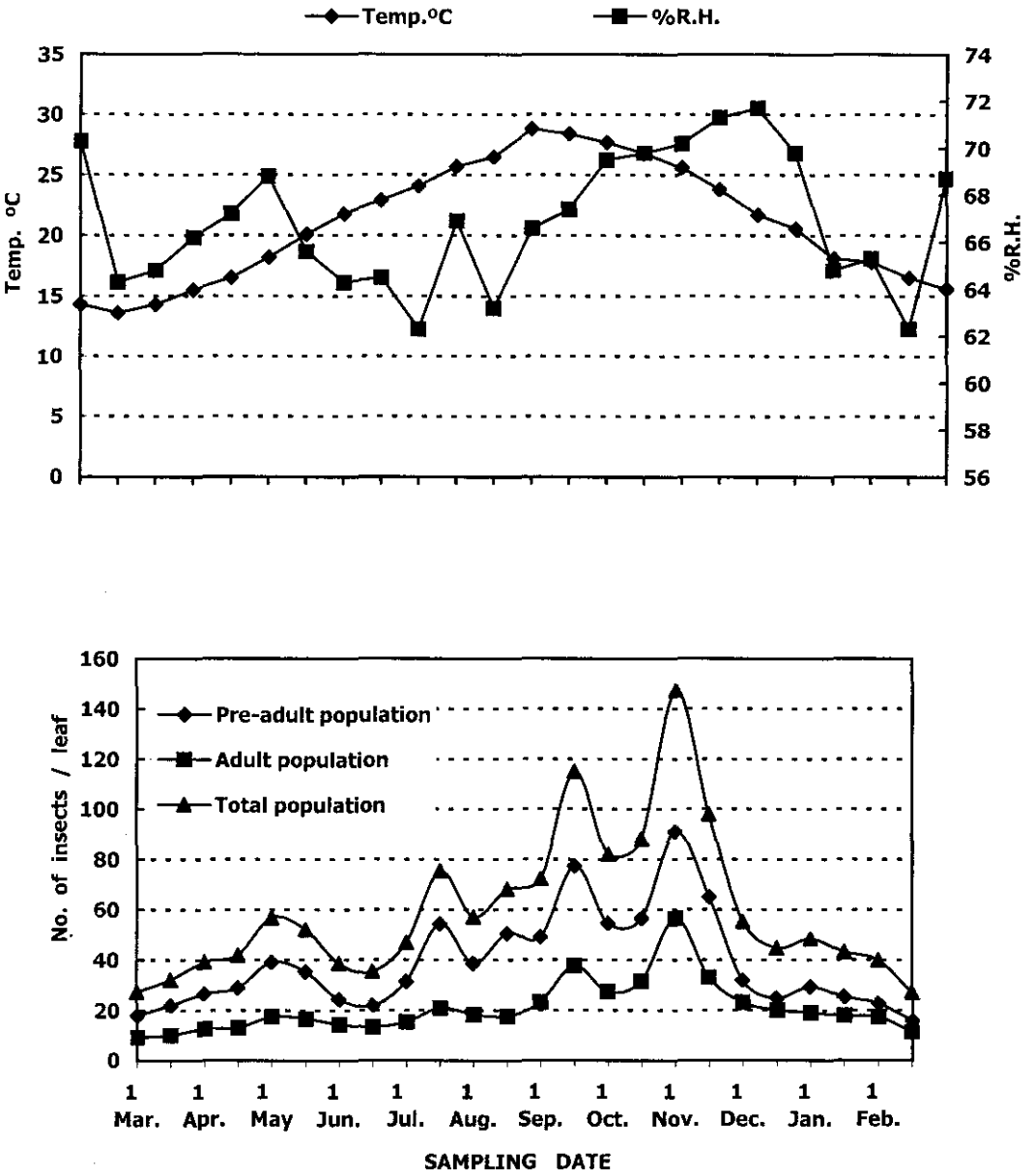

Fig. 1. Population dynamics of Insulaspis pallidula on mango trees in El-Qanater El Khairia Qalubia Governorate during the 1st year(2001/2002).

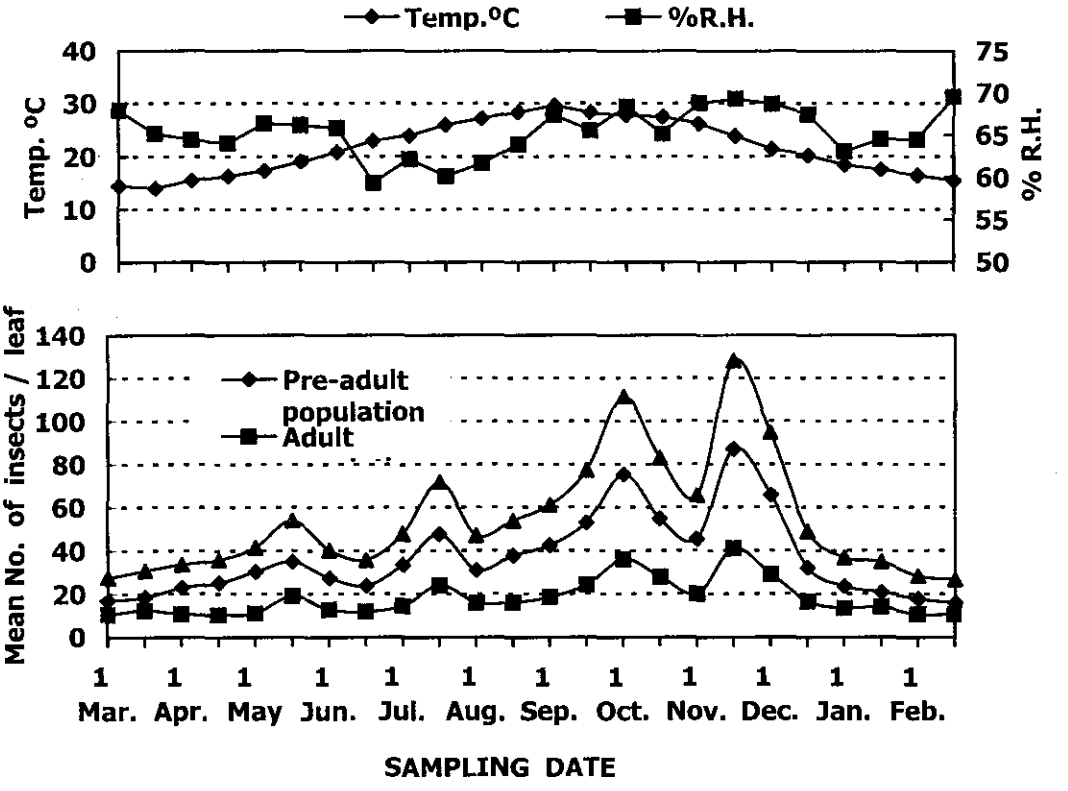

Fig. 2. Population dynamics of Insulaspis pallidula on mango trees in El-Qanater El-Khairia, Qalubia Governorate during the 2nd year (2002/2003).

2- Adult population the adult population takes the same trend as the pre-adult population in the two years, in March and April, the population increased gradually to reach the 1st peak by early May in the 1st year (2001/2002) and mid-May in the 2nd year (2002/2003). The population ranged 17.5 – 19.1 insects/leaf in the two peaks in the both years at 16.5 -19 °C and 66.2 - 67.2%R.H., respectively.

During June, the adult population decreased in the both studied years. In July the population increased gradually and attained the 2nd peak in mid-July in both years (2001/ 2002& 2002/2003) with mean numbers ranged 21 – 24.2 insects/leaf in the both peaks under field conditions of 24.1 – 26 °C & 60.2-62.3 %R.H. in the both years, respectively.

In August, the population decreased gradually in the both years. During September, the population increased rapidly to reach the 3rd peak by mid-September (37.7 insects / leaf) at 28.4 °C & 67.4 %R.H. in the 1st year (2001/2002). The population increased through the second half of September in the 2nd year and peaked (3rd peak) in early October (36.2 insects/leaf) at 27.8 °C & 68.4 %R.H.

In late autumn, the population peaked (4th peak) at early and mid-November in the both years (2001/2002 & 2002/2003) with mean numbers of 41 – 56.5 insects/leaf in the both peaks under field conditions of 23.9 – 25.6 °C & 69.3 –70.2 %R.H.

In December, the adult population takes the same trend as the pre-adult population and decreased continuously until mid-February in the both studied years, respectively.

The afore-mentioned results revealed that, the adult population peaked four times per year in early May, mid-July, mid – September and early November in the 1st year (2001/2002) and mid-May, mid-July, early October and mid-November in the 2nd year (2002/2003), respectively.

B- Number and duration of generations the obtained results in Table 1 and Figure 3 indicate that, Maskell scale, *Insulaspis pallidula* has four annual successive overlapping generations per year under field conditions as follows:

Table 1. Duration of annual generations of *I. pallidula* on mango leaves in El-Qanater El-Khairia, Qalubia Governorate in 2001/2002& 2002/2003.

Generation	1st year (2001/2002)					2nd year (2002/2003)				
	Generation Duration		Length (Week)	Temp. °C	R.H. %	Generation Duration		Length (Week)	Temp. °C	R.H. %
	From	To				From	To			
1st generation	Early March	Mid-July	18	18.1	65.8	Mid-March	Mid-July	16	19.6	63.8
2nd generation	Mid-May	Mid-Sep.	16	24.1	66.5	Mid-May	Mid-Sep.	16	25.2	63.6
3rd generation	Mid-July	Mid–Nov.	16	26.4	67.5	Early Aug.	Early Dec.	16	26.7	66.6
4th generation	Early Sep.	Mid-Jan.	18	22.6	68.1	Mid-Sep.	Mid-Jan.	16	22.1	66.8

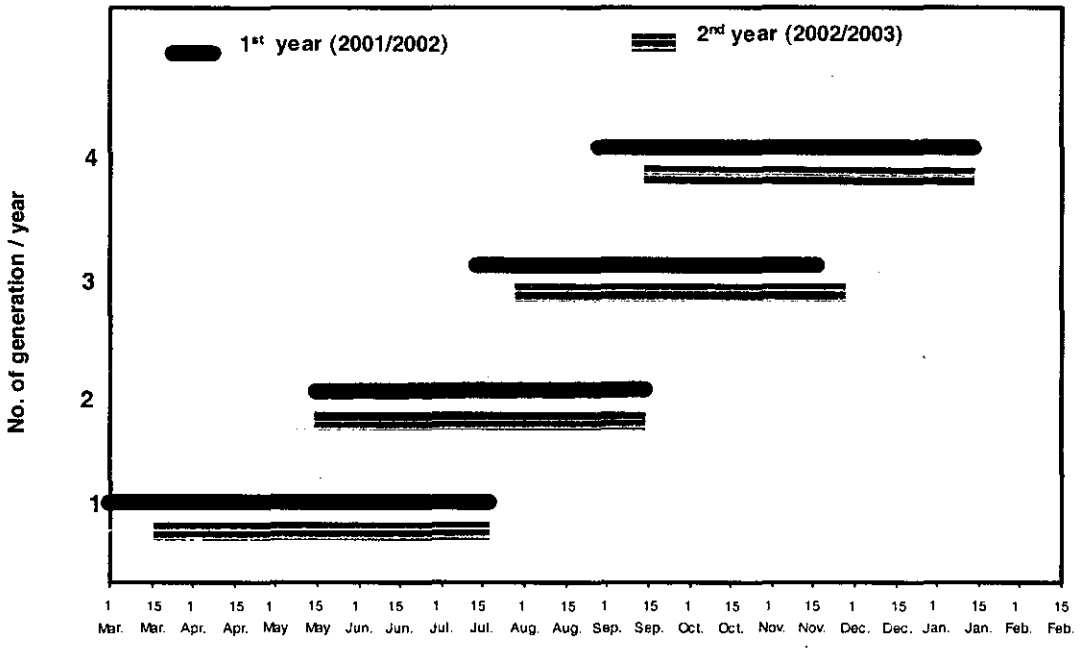

Fig. 3. Generation duration of the four successive annual generations of *I. pallidula* (Green) on mango trees in El-Qanater El-Khairia, Qalubia Governorate during 2001 /2002 &002/2003).

First generation the 1st generation started in early March and extended until mid-July in the 1st year (2001/2002) with duration of 18 weeks. Peak counts of pre-adult and adult populations were recorded around early May (30.2 & 14.4 insects /leaf) at 18.1 °C & 65.8 %R.H.

In the 2nd year, this generation appeared at mid-March and lasted to mid-July with duration of 16 weeks. Peak counts of pre-adult and adult populations were recorded around mid-May (29.3 & 14.1 insects /leaf) at 19.6 °C & 63.8 %R.H.

Second generation for the both years of study, the 2nd generation attacking mango fruits in summer and elapsed about16 weeks extending from mid-May until mid–September. Peak counts of pre-adult and adult populations were found around mid-July (42.6 & 19.7 insects/leaf) in the 1st year and 36.8 & 17.5 insects/leaf in the second year under field conditions ranged 24.1-25.2 °C and 63.6-65.5%R.H., respectively.

Third generation the 3rd generation occurred between mid-July and mid-November in the 1st year (2001/2002) and covered a period of 16 weeks at 26.4 °C & 67.5 %R.H. The peak counts of pre-adult and adult populations were found around mid-September (59.7 & 29.6 insects/leaf).

In the 2nd year, this generation was found from early August to early December with duration of 16 weeks. Peak counts of pre-adult and adult populations were found around early October (54.7& 25.5 insects/leaf) at 26.7 °C & 66.6 %R.H.

Fourth generation the 4th generation elapsed about 18 weeks in the 1st year (2001/2002) extending from early September until mid - January. Peak counts of pre-adult and adults populations were found around early November (50.5 & 29 insects/leaf) at 23.9 °C & 68.6 %R.H., whereas in the 2nd year (2002/2003) this generation started from mid-September to mid-January with duration of 16 weeks. Peak counts of pre-adult and adults populations were found around mid-November (47.5 & 23.4 insects/leaf) at 22.8 °C & 66.6 % R.H.

The obtained results showed that, the scale has four annual overlapping generations per year on mango trees in Egypt, one generation in spring, one generation in summer and two height generations in autumn, respectively.

In Egypt, Salama and Hamdy (1973) showed that, *Lepidosaphes pallida* passes through 3 generations per year (in January, April and October) whereas the present study showed 4 annual generations per year (in May, July,

September/October and November). Stimmel (1999) revealed that Maskell scale, *Lepidosaphes pallida* has two generation a year in New Jersey and Pennsylvania.

Numbers of generations in *Lepidosaphes* species were varied, in South Africa, *Lepidosaphes pinnaeformis* has 4-5 generations per year on citrus trees (Stofberg, 1937). In Egypt, *Lepidosaphes beckii* has 4 annual generations per year on citrus trees (Habib *et al.*, 1971) in May, August, November and February. Also, Amin *et al.* (1981) found 3 distinct peaks for *L. beckii* on citrus in Egypt in mid-December, in May and November. On *Psidium guajava, Lepidosaphes tapleyi* has 5 annual generations (Swailem, 1973) in May, June, July, September and November.

C- Effect of main climatic weather factors on the insect population

1- Pre-adult population

1- Effect of daily mean temperature results of the statistical analysis Table 2 showed positively highly significant correlation between the daily mean temperature and the pre-adult population (r values =0.749 & 0.646) in the both years (2001/2002 & 2002/2003), respectively. The real effect of daily mean temperature on the pre-adult population was positive (P. reg. values = 2.85 & 2.56) and highly significant effect (t values = 5.06 & 4.98) in the both years, respectively. The above results revealed that, daily mean temperature was entirely under the optimum range of pre-adults activity in both studied years, respectively.

2- Effect of daily mean relative humidity results in Table 2 revealed that, the correlation coefficient was positive and insignificant (rvalue = 0.284 & 0.355) in the 1st and 2nd year, respectively. The exact effect of daily mean relative humidity on the pre-adults activity was insignificant (t value = 1.13) and positive effect (P. reg. value = 1.11) in the 1st year (2001/2002) and highly significant (t value = 3.08) positive effect (P. reg. value = 2.92) in the 2nd year (2002/2003), respectively. The obtained results showed that, daily mean relative humidity within the optimum range of the pre-adults activity in the 1st year and under the optimum range of the pre-adults activity in the 2nd year.

Table 2. Effect of daily mean temperature and relative humidity on the population dynamics of *I. pallidula* on mango trees in Qalubia governorate during the both years (2001/2002&2002/ 2003).

Insect Stage	Weather Factors	1st year (2001/2002)					2nd year (2002/2003)				
		Simple Correlation and Partial regression values			Analysis of Variance		Simple Correlation and Partial regression values			Analysis of Variance	
		r	P. reg. ± SE	t value	F value	E.V. %	r	P. reg. _ SE	t value	F value	E.V. %
Pre-adult	Mean temp.	0.749**	2.85 _ 0.563	5.06**	14.9**	58.6	0.646**	2.56 ± 0.514	4.98**	15.7**	59.9
	%R. H.	0.284	1.11 _ 0.982	1.13			0.355	2.92 ± 0.946	3.08**		
Adult	Mean temp.	0.647**	1.25 ± 0.323	3.88**	11.8**	52.8	0.592**	1.05 ± 0.248	4.23**	11.8**	52.8
	%R. H.	0.436*	1.24 _ 0.564	2.20*			0.356	1.28 ± 0.456	2.81**		
Total	Mean temp.	0.728**	4.11 _ 0.856	4.80**	14.5**	58	0.633**	3.61 ± 0.753	4.79**	14.7**	58.3
	%R. H.	0.345	2.36 _ 1.492	1.58			0.357	4.20± 1.386	3.03**		

3- Combined Effect of daily mean temperature and relative humidity on the pre-adults activity the combined effect Table 2 of daily mean temperature and relative humidity on the pre-adults activity was highly significant (F values = 14.9 & 15.7) in the both studied years. The amount of variability on the pre-adult population that could be attributed to the combined effect of the two weather factors was 58.6% and 59.9% in the 1st and 2nd year, respectively. The remaining unexplained variances were assumed to be due to the influence of other unconsidered factors.

11-- Adult population

1- Effect of daily mean temperature the results Table 2 showed positively highly significant correlation between the daily mean temperature and the adults activity (r values = 0.647 & 0.592) in the both years, respectively. The exact effect of daily mean temperature on the adults activity was positive (P. reg. values = 1.25 & 1.05) and highly significant effect (t values = 3.88 & 4.23) in the both years. The obtained results revealed that, daily mean temperature was entirely under the optimum range of the adults activity in the two years (2001/2002 & 2002/2003), respectively.

2- Effect of daily mean relative humidity table 2 showed significant positive relation (r value = 0.436 between the daily mean relative humidity and the adult population in the 1st year (2001/2002) and insignificant positive relation (r value = 0.356) in the 2nd year (2002/2003). The real effect of daily mean relative humidity on the adults activity revealed that, it was significant (t value = 2.20) positive effect (P. reg. Value = 1.24) in the 1st year and highly significant (t value = 2.81) positive effect (P. reg. value = 1.28) in the 2nd year. The above-mentioned results showed that, daily mean relative humidity under the optimum range of adults activity in the 1st year and entirely under the optimum range of adult's activity in the 2nd year.

3- Combined Effect of daily mean temperature and relative humidity on the adults activity the combined effect Table 2 of the two tested weather factors on the adults activity during the both studied years was highly significant (F value = 11.8) in the both years, respectively. the amount of variability on the pre-adult population that could be attributed to combined effect of the two tested weather factors were 52.8% in the 1st and 2nd year, respectively. The remaining unexplained variances were assumed to be due to the influence of other unconsidered factors.

111- Total population

1- Effect of daily mean temperature the results Table 2 showed positively highly significant correlation between the daily mean temperature and the insect population (r values = 0.728 & 0.633) in the both years, respectively. The exact effect of daily mean temperature on the insect population was positive (P. reg. values = 4.11 & 3.61) and highly significant effect (t values = 4.80 & 4.79) in the both years. The obtained results revealed that, daily mean temperature was entirely under the optimum range of the insect population in the two years (2001/2002 & 2002/2003), respectively.

2- Effect of daily mean relative humidity table 2 showed insignificant positive relation (r values = 0.345 & 0.357) between the daily mean relative humidity and the insect population in the two years (2001/2002 &2002/2003). The real effect of daily mean relative humidity on the insect population revealed that, it was insignificant (t value = 1.58) positive effect (P. reg. Value = 2.36) in the 1st year and highly significant (t value = 3.03) positive effect (P. reg. value = 4.20) in the 2nd year. The above-mentioned results showed that, daily mean relative humidity under the

optimum range of insect population in the 1st year and entirely under the optimum range of insect population in the 2nd year.

3- Combined Effect of daily mean temperature and relative humidity on the adults activity the combined effect Table2 of the two tested weather factors on the insect population during the both studied years was highly significant (F value = 14.5 & 14.7) in the both years, respectively. The amount of variability on the pre-adult population that could be attributed to combined effect of the two tested weather factors were 58% - 58.3 in the both years, respectively. The remaining unexplained variances were assumed to be due to the influence of other unconsidered factors.

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ديناميكية تعداد حشرة المانجو القشرية *Insulaspis pallidula* (Green) (Homoptera – Diaspididae) على أشجار المانجو في مصر

السيد عبد الحميد علوان

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – الجيزة

حشرة المانجو القشرية *insulaspis pallidula* (Green) من الآفات الحشرة الهامة التى تصيب بساتين المانجو في مصر ، تسبب الإصابة الشديدة بالحشرة أضرار بالغة للأشجار المصابة حيث تؤدى الى موت الشتلات الصغيرة بالمشتل بالإضافة الى جفاف الأفرع وموتها في الأشجار المثمرة ، كما تؤدى الى تشوة الثمار المصابة مما يقلل من قيمتها التسويقية.

اجريت الدراسة الحالية في محطة بحوث البساتين بالقناطر الخيرية بمحافظة القليوبية لمدة عامين متتاليين (٢٠٠١/٢٠٠٢ – ٢٠٠٢/٢٠٠٣) حيث تم دراسة النشاط الموسمي للحشرة على مدارالعامين ، عدد اجيال الحشرة ومدة كل جيل تحت الظروف البيئية السائدة في تلك المنطقة وكذلك تأثير عوامل الطقس من حرارة ورطوبة نسبية على نشاط الحشرة .

تبين من الدراسة وجود أربع قمم لنشاط الحشرة على مدار العام (مايو، يونيو ، سبتمبر/ اكتوبر ونوفمبر) ولها أربعة أجيال متداخلة في العام ، جيل في الربيع ، وجيل في الصيف وجيلين في الخريف وكان الجيل الثالث والرابع أقوى الأجيال حجما ونشاطا في كلا العامين .

اتضح من دراسة تأثير عوامل الطقس المختبرة (درجة الحرارة والرطوبة النسبية) على نشاط الحشرة ، أن درجة الحرارة كان تأثيرها معنويا جدا على نشاط طوري الحورية والحشرة الكاملة خلال عامي الدراسة نظرا لأن درجة الحرارة كانت اقل من الدرجة المثلى لنشاط الحشرة في كلا العامين على التوالي . وكان تأثير الرطوبة النسبية غير معنوي على نشاط طور الحورية في العام الأول ومعنويا جدا في العام الثاني حيث أن الرطوبة النسبية كانت في الدرجة المثلى لنشاط طور الحورية في العام الأول (٢٠٠١ /٢٠٠٢) واقل من الدرجة المثلى للنشـــاط في العـــام الثاني (٢٠٠٢/٢٠٠٣) .

وكان تأثير الرطوبة النسبة على طور الحشرة الكاملة معنوي في العام الأول ومعنويا جدا في العام الثاني نظرا لان الرطوبة النسبية كانت قريبة من الدرجة المثلى لنشاطها في العام الأول واقل منها في العام الثاني . كما اتضح من الدراسة أيضا أن التأثير المشترك لعوامل الطقس المختبرة كان معنويا جدا على نشاط الحشرة في كلا العامين حيث تراوحت كمية الاختلاف التى يمكن اعزاءها إحصائيا الى التغير في عوامل الطقس المختبرة من ٥٢,٨% الى ٥٩,٩ % في كلا العامين .