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ECOLOGICAL STUDIES ON THE GREEN SHIELD SCALE, *Pulvinaria psidii* (MASK.) (HEMIPTERA: COCCIDAE) INFESTING MULBERRY TREES IN QALUBYIA GOVERNORATE, EGYPT.

Radwan, Sawsan G. and Nagwa A. Hassan
Scale insects and mealybugs Dept., Plant Protection Res. Inst., Agric. Res.Center, Dokki, Giza, Egypt.

ABSTRACT

The present investigation was carried out through two successive years (2005/2006 and 2006/2007) in Qalubyia governorate to determine some ecological aspects of the green shield scale, *Pulvinaria psidii* (Mask.) (Hemiptera: Coccidae) on mulberry trees.

The obtained results showed that, *P. psidii* had two main periods of seasonal activity occurred in autumn (one generation) and summer (two overlapping generations) per each year. The 1st period of seasonal activity lasted for 4 months, started from mid September to early January and had one generation, peaked in mid November or early December with mean numbers of 26.5-69.6 insect/leaf. The 2nd period of seasonal activity extended from early May to mid August with duration of 4 months and had two overlapping generations. The 1st generation peaked in early June and the 2nd in mid July / early August in both studied years.

The population abundance of *P. psidii* considerably decreased from mid January to mid April (in both studied years) forming a long depressive period due to falling of the infested leaves in winter and occurrence of unfavorable environmental conditions as well as emergence of new leaves in spring.

The combined effect of the tested weather factors (daily mean max. & min. temperatures and %R.H.) on the seasonal activity of *P. psidii* ranged 65.7-74.7% in autumn and 68.9-89.4% in summer seasons, respectively.

INTRODUCTION

Mulberry (*Morus* spp.) is one of the oldest cultivations in the world, it cultivate for sericulture as *Morus nigra*; for fruits as *M. alba* (Butani, 1978) Also, as shadow trees in most native fields. Recently Egypt exalts the cultivation of mulberry trees to encourage the silk production from silk-worm, *Bombyx mori* L. (Hosny *et al.* 1995) or to manufacture the mulberry fruits to edible products such as Jam; syrup and juice.

Mulberry is subject to attack with many prejudicial pests belonging to large number of insect orders which affect on the growth of mulberry trees and causes damage to the trees as well as loss in the leaves yield (Sengonca *et al.*,1998). The green shield scale, *Pulvinaria psidii* (Mask.) (Hemiptera: Coccidae) is one of the most serious insect pests in the Egyptian orchards. This pest is well known with its preferability to euonymus trees such as guava, mango, citrus, coffee and ornamental plants (El-Minshawy and Moursi, 1976; Elwan, 2000; Radwan, 2003, Hassan, 2003 and El-Serafi *et al.*, 2004).

The green shield scale, *P. psidii* causes direct damage to mulberry trees by sucking the plant sap from the leaves causing dryness of the leaves and losing of the leaf yield whereas indirect damage causes by excreting the honey-dew which encourages the growth of sooty mould on the leaves causing darkness and contamination of the leaves and subsequently the photosynthesis process was suppressed. The severe infestation affected greatly on the quality and quantity of mulberry crops.

The pest begins to invade the deciduous trees especially mulberry trees and causes more damage for the leaves. However, falling of the leaves during the winter season can't interrupt this pest; it can make conformation for surviving.

For the success of the integrated pest management control program (IPM), its essential to know several information concerning the ecology of the pest. So, the present study is the first work for studying some ecological aspects of the green shield scale, *P. psidii* on mulberry trees under field conditions to design an integrated pest management program for its control.

MATERIALS AND METHODS

The population dynamics of *P. psidii* was studied on mulberry trees cultivated in El-Khanka, Qalubyia Governorate throughout a period of 24 months extending from early September, 2005 until the second half of August, 2007. Three trees similar in size, height and vigor growth as well as homogeneous in their infestations with *P. psidii* were selected as representative for the whole orchard.

1- Sample collection

Fortnightly samples were taken for two successive years, started from early September, 2005 to mid August, 2007. Each sample consists of 45 infested leaves were picked up at random from each tree with rate of 15 leaves per tree (15x3 replicates).

2- Examination and assessment

The collected samples were transferred to the laboratory for examination by using stereomicroscope. The number of alive insects per each sample was counted and sorted into nymphs, adult females and ovipositional females. The average number of alive individuals per leaf was taken as population index.

Number of annual generations of *P. psidii* was estimated from the obtained data throughout the two studied years (2005-2007) by using the changes in the half-monthly counts of the nymphal population.

To estimate the effect of the weather factors (daily mean max. & min. temperatures and % R.H.) on the main periods of seasonal activity of the pest in the both studied years, simple correlation and regression analysis were done by using MSTATC program.

RESULTS AND DISCUSSION

1- The partial population curves for the different insect stages of *P. psidii* on mulberry trees.

A- The partial population curve for nymphal stage

Data illustrated in Fig. (1) showed the average fortnightly counts of the nymphal population in both studied years. Data clearly showed that, the nymphal population had two main periods of activity throughout the first and second year of investigation. In the 1st year (2005/2006). The first period of activity occurred in autumn season with one generation peaked in early December (15 nymph/leaf), whereas the second one was in summer season and has two overlapping generations, peaked in early June (11.8 nymph/leaf) and mid July (20.4 nymph/leaf).

In the second year (2006/2007) the nymphal population had the same trend recording two periods of seasonal abundance. The 1st period occurred in autumn season and has one generation, peaked in mid November (55.5 nymph/leaf). The 2nd period of activity occurred in summer season with two overlapping generations, peaked in early June (21.1 nymph/leaf) and early August (39.4 nymph/leaf).

As shown in Fig. (1), the nymphal population reduced to its lowest abundance from mid January to mid April in both studied years. Results showed that the average number of the nymphal population in the second year was higher (2.5 times) than those in the first one.

Data also showed that, the abundance of nymphal stage was higher than pre-ovipositing and ovipositing females, this may be refers to the high fecundity of *P. psidii* (204.4 egg/female) and prolonged period of life cycle (180-210 days) as mentioned by El-Minshawy and Moursi (1976).

The above mentioned results revealed that, The nymphal population has two main periods of seasonal activity per year. The 1st period occurred in autumn season with one generation peaked in mid November or early December whereas the 2nd period of nymphal activity occurred in summer with two overlapping generations, peaked in early June and mid July/early August, respectively. So, *P. psidii* has three generations a year, one generation occurred in autumn and two in summer.

B. The partial population curve for adult females

The partial population curve of the adult females showed two periods of activity during the first year (2005/2006) and second (2006/2007) years, the 1st period of activity occurred in autumn season with one generation, peaked in early December (8.8 adult female/leaf) and mid November (11.2 adult female/leaf) in the first and second years. The 2nd period of activity was in summer with two overlapping generations peaked in early June (6.9 adult female/leaf) and mid July (9.5 adult female/leaf) in the first year, while in the second year, the two peaks were recorded in early June (7.02 adult female/leaf) and early August (9.3 adult female/leaf).

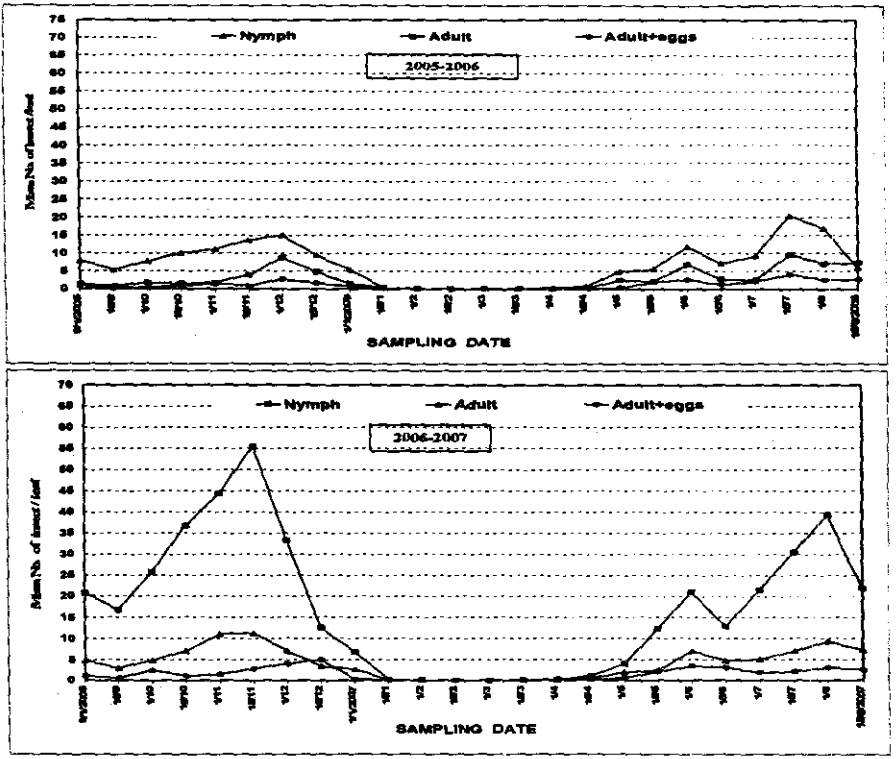

Fig. (1): The partial population curves for the nymphal, pre-ovipositing and ovipositing adult female stages of *P. psidii* on mulberry trees in Qalubyia Governorate during 2005/2006 and 2006/2007.

The afore-mentioned results revealed that the adult females had two periods of seasonal activity occurred in autumn and summer seasons in the two years. While, the lowest population of the adult females was recorded from the mid January and continued until early April in both years of study. As shown in Fig. (1), the obtained results illustrated that the average number of the adult females in the second year (2006/2007) was higher (1.5 time) than in the first one.

C- Ovipositing females (gravid females)

Partial population curve of the ovipositing females were illustrated in Fig, (1). The presented data predicated the presence of two prepotent periods of seasonal activity. The first period occurred in autumn season with one generation peaked in early December (2.7 – 4.04 oviparous female/leaf) in the two years, respectively. The 2nd period of seasonal activity occurred in summer season with two overlapping generations, peaked in early June (2.7 – 3.5 oviparous female/leaf) and mid July (4.1 oviparous female/leaf) or early August (3.07 oviparous female/leaf), respectively.

2- Total partial population curve of *P. psidii* on mulberry trees

The seasonal activity of *P. psidii* population on mulberry trees showed two main periods of seasonal abundance in both years of study (Fig., 2) and the changes of insect population was approximately the same.

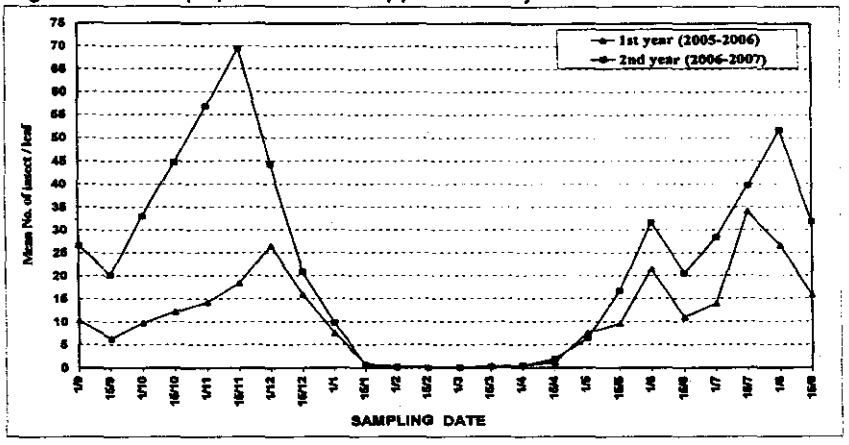

Fig. (2): Total population curve of *P. psidii* on mulberry trees in Qalubyia Governorate during 2005/2006 and 2006/2007.

The 1st period of seasonal abundance appeared in autumn with one generation peaked in mid November or early December (26.5 – 69.5 insect/leaf) in the two years, respectively.

The 2nd period of seasonal activity occurred in summer with two peaks of abundance. The 1st peak recorded in early June (21.4 – 31.6 insect/leaf) in both years whereas the 2nd peak occurred in mid July (34 insect/leaf) in the 1st year or early August (51.77 insect/leaf) in the 2nd year. As shown in Fig. (2), the insect population was higher in the 2nd year than the 1st one and the average number of insect population ranged 11.01 – 23.16 insect/ leaf in both years, respectively.

The afore-mentioned results showed that, the main periods of seasonal activity of *P. psidii* occurred in autumn and summer seasons in both years, this may be refers to the favorable environmental conditions for the insect activity especially the weather factors (daily mean max. & min. temperatures and %R.H.). On the other hand, the insect population reduced to minimum numbers from mid January to mid April in both studied years forming a long depressive period for *P. psidii* populations due to falling of the infested leaves in winter and occurrence of the unfavorable environmental conditions as well as emergence of new leaves in spring.

3- Number and duration of *P. psidii* generations on mulberry trees

Number of annual generations of *P. psidii* was estimated from the nymphal populations in the both studied years (2005/2006 & 2006/2007). The obtained results revealed two periods of seasonal activity with three generations per year as follows:

The 1st period of seasonal activity occurred in autumn with one generation started from mid September to early January, peaked in mid November or early December in both years with duration of about 4 months.

The 2nd period of seasonal activity occurred in summer with two overlapping generations peaked in early June and mid July / early August in both studied years, respectively. This period extended from early May to mid August with duration of about 4 months.

The obtained results in agreement with results of Radwan (2003) she found three annual peaks for the nymphal activity of *P. psidii* on guava trees in Qalubyia Governorate; the highest peak took place in 1st December whereas the other two peaks occurred in mid June and early August. Elwan (2000) determined three overlapping generation a year for *Chloropulvinaria* (*Pulvinaria*) *pisidii* on mango trees in Qalubyia Governorate, these generations occurred in spring, summer and autumn, respectively. Also, Hassan (2003) founded three annual peaks for *P. pisidii* on coffee trees in Qalubyia Governorate whereas Salama and Saleh (1970) reported two annual generations for *P. psidii* on guava trees near Alexandria district.

4- Effect of weather factors on the main periods of seasonal activity of *P. psidii* on mulberry trees in both studied years.

The effect of the tested weather factors on the nymphal activity was determined during the first (in autumn) and second (in summer) periods of activity in both years of the present study.

A- In autumn :

Statistical analysis (Table, 1) indicated that, in autumn season nymphal population of *P. psidii* exhibited a positive response to the increase of maximum temperature. However, there were a highly significant and significant correlations between the nymphal activity and maximum temperature in the first (r value = 0.786 & b.reg = 1.11) and second (r value = 0.676 & b.reg = 1.60) years. Partial regression coefficient determined the exact effect of this factor on the nymphal activity in the both studied years which was within the optimum range of nymphal activity in the 1st year (P.reg.= 1.24) and around the optimum range of nymphal activity in the 2nd one (P.reg.= -1.55), respectively.

In respect to daily mean min. temperature, the nymphal population showed negative and positive response in the first and second years (Table, 1). Partial regression coefficient revealed that, there was significantly negative effect of minimum temperature on the nymphal population in the first year (P.reg. = -3.31) and positively high significant in the second year (P. reg. = 3.99). The obtained results showed that this factor was far from the optimum range of nymphal activity in the 1st year and under the optimum range of insect activity in the 2nd year.

The effect of daily mean relative humidity (%.R.H.) on the nymphal activity in both studied years showed insignificantly positive effect (Table, 1), partial regression coefficient values were(P. reg. = 2.31) and (P. reg. = -1.10) in the first and second years.. These results revealed that, this factor was in the optimum range of nymphal activity in the 1st year and uround the optimum range of nymphal activity in the 2nd year.

The combined effect of the tested weather factors on 1st period of nymphal activity:

The combined effect of the tested weather factors on the nymphal activity in both studied years (F value = 4.47 & 6.88) are presented in Table (1). The amount of variability of the nymphal population in the autumn season could be referring to the simultaneous effect of these factors with 65.7 – 74.7%, respectively.

B- In summer season:

The effect of the tested weather factors on the nymphal activity in summer season could be summarized as follows:

The nymphal population exhibited highly significant negative response (r = -0.939) for daily mean max. temperature on in the 2nd period of seasonal activity in the 1st year and insignificantly positive response (r= 0.439) in the 2nd year. The exact effect of this weather factor on the nymphal activity was insignificant effect and around the optimum range of nymphal activity in both studied years, respectively

The simple correlation and regression values for daily mean min. temperature and the activity of nymphal population in summer season showed negative relation with highly significant value (r = - 0.915) in the 1st year and positively insignificant (r = 0.471) in the 2nd one. The real effect of daily mean min. temperature on nymphal population was positive insignificant effect in both years. The obtained results showed that daily mean min. temperature within the optimum range of nymphal activity in the 1st and 2nd year, respectively.

Statistical analysis revealed that daily mean relative humidity showed insignificantly positive relation in the 1st year (r = 0.133) and significantly negative relation (r = -0.646) in the 2nd year. The obtained results showed that the partial regression values were negative insignificant effect in the 1st year and highly significant effect in the 2nd one. So, daily mean %.R.H was around the optimum range of nymphal activity in the 1st year and far from the optimum range of nymphal activity in the 2nd year.

The combined effect of the tested weather factors on 2nd period of nymphal activity.

The obtained results in Table (1) showed the combined effect of the tested weather factors on the nymphal activity of *P. psidii*. The combined effect was significant on the nymphal activity in the both years (F value = 6.88 & 5.16), respectively. The amount of variability in the nymphal population could be refers to the simultaneous effect of these factors with 68.9 – 89.4%.

The present results showed that, the changes in the nymphal population in autumn and summer seasons refers to the combined effect of the tested weather factors which ranged 65.7-74.7% in autumn season and 68.9-89.4% in summer season. The effect of weather factors on the activity of some soft scale insects were studied by Ghanim (2003), he proved that climatic factors have important effect on the population dynamics of soft scale insects.

Table (1): Effect of weather factors on the main periods of seasonal activity of *P. psidii* on mulberry trees at Qalubyia Governorate during the both studied years (2005/2006 & 2006/2007).

Year	Activity period	Duration of the seasonal activity		Weather Factors	Simple correlation and regression values			Partial regression values		ANOVA	
		From	To		r	b.reg.± s.e.	t	P. reg. ± s.e.	t	F value	E.V. %
20058/2006	1st Period	Mid September	Early January	Mean max. temp.	0.786**	1.11 ± 0.29	3.82**	1.24 ± 0.13	0.98	4.47*	65.7
				Mean min. temp.	0.751**	1.10 ± 0.32	3.41**	-3.31 ± 1.28	-2.28**		
				Mean R.H.%	0.599	0.59 ± 0.26	2.45	2.31 ± 0.27	0.87		
	2nd period	Early May	Mid August	Mean max. temp.	-0.939**	-0.77 ± 0.13	6.13**	-1.16 ± 0.91	-1.28	8.44*	89.4
				Mean min. temp.	-0.915**	-0.97 ± 0.19	5.10**	4.80 ± 1.13	0.42		
				Mean R.H.%	0.133	0.27 ± 0.91	0.30	-2.34 ± 0.44	-0.54		
2006/2007	1st Period	Mid September	Early January	Mean max. temp.	0.676*	1.60 ± 0.58	2.75*	-1.55 ± 0.13	-1.20	6.88*	74.7
				Mean min. temp.	0.811**	2.04 ± 0.49	4.16**	3.99 ± 1.41	2.82**		
				Mean R.H.%	0.413	1.84 ± 1.35	1.36	-1.10 ± 0.12	-0.92		
	2nd period	Early May	Mid August	Mean max. temp	0.439	1.25 ± 0.85	1.47	-3.81 ± 1.55	-1.07	5.16*	68.9
				Mean min. temp.	0.471	1.67 ± 1.04	1.60	6.36 ± 2.43	1.44		
				Mean R.H.%	-0.646*	-2.04 ± 0.80	2.54*	-2.12 ± 0.67	-3.17**		

b. reg. = Simple regression coefficient.
P. reg. = Partial regression coefficient.
E.V. = Explained variance.

REFERENCES

Butani, D.K. (1978): Insect pests of fruit crops and their control. Pesticides, 12(8):53-59.

El-Minshawy, A.M. and K. Moursi (1976): Biological studies on some soft scale insects (Hom., Coccidae) attacking guava trees in Egypt. Z. ang. Ent., 81(4):363-371.

El-Serafi, H. A.; A. A. Ghanim; A. H. El-Heneidy and M. K. El-Sherbenie (2004): Ecological studies on certain insects infesting guava orchards and their predatory insects at Mansoura District. Egypt. J. Biol. Cont., 14(1):77-85.

Elwan, E. A. (2000): Ecological studies on the green shield scale, *Chloropulvinaria psidii* (Mask.)(Homoptera: Cocoidea: Coccidae) on mango trees, Qalubyia Governorate, Egypt. Egypt. J. Appl. Sci., 15(7):603-616.

Ghanim, N. M. G. (2003): Studies on some natural enemies associated with some soft scale insects. M. SC. Thesis, Fac. Agric., Mansoura Univ.

Hassan, N. A. (2003): Ecological studies on the scale insect *Pulvinaria psidii* (Mask) infesting coffee trees (*Coffea arabica*) at Qalubyia Governorate, Egypt. J. Agric. Sci. Mansoura Univ., 28(8): 6385-6391.

Hosny, A.; I. A. El-Karasky and M. E. El-Sayed (1995): Effect of defoliant materials on mulberry trees and silk production of silkworm *Bombyx mori* L. Z. ang. Zoo., 81 (2):279-284.

Radwan, S. G. (2003): Toxicological studies on some scale insects infesting mango and guava trees Ph.D. Thesis, Fac. Agric., Cairo Univ., 211pp.

Salama, H. S. and M. R. Saleh (1970): Distribution of the scale insect *Pulvinaria psidii* Maskel (Coccoidea) on orchard trees in relation to environmental factors. Z. ang. Ent., 66(4):380-385.

Sengonca, C. ; N. Uygun ; U. Kersting and M. R. Ulusoy (1998): Population dynamics of *Parabemisia myricae* (Kuwana) (Homoptera: Aleyroididae) and its parasitoid *Eretmocerus debachi* Rose and Rosen (Hymenoptera, Aphelinidae) on non-citrus host plant. Zeitschrift für Pflanzenkreiten und Pflanzenschutz, 105(2):149-156.

دراسات بيئية على حشرة البلفيناريا القشرية الرخوة *Pulvinaria psidii* (Mask.) على أشجار التوت بمحافظة القليوبـــــية.

سوسن جاب الله رضوان و نجوى على حسن
قسم الحشرات القشرية والبق الدقيقي - معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - جيزة.

تعتبر حشرة البلفيناريا القشرية الرخوة من الحشرات الهامة التى تصيب اشجار الفاكهة المستديمة الخضرة ، وفى السنوات الاخيرة بدأت الحشرة فى مهاجمة أشجار الفاكهة المتساقطة الاوراق وأهمها أشجار التوت المنزرعة فى محافظة القليوبية حيث وجد ان الإصابة الشديدة بالحشرة تؤدى الى حدوث نقص كبير في كمية الأوراق الصالحة لتغذية دودة القز (الحرير).

أجريت الدراسة الحالية في محافظة القليوبية لمدة عامين متتاليين (٢٠٠٥- ٢٠٠٧) على أشجار توت مصابة بالحشرة بغرض تحديد فترات نشاطها وعدد أجيالها وتأثير بعض عوامل الطقس السائدة فى محافظة القليوبية على نشاطها حتى يمكن وضع بروتوكول مناسب لمكافحتها والحد من اضرارها.

وتبين من نتائج الدراسة وجود فترتين لنشاط الحشرة على مدار العام .

١- الفترة الاولى لنشاط للحشرة توجد فى فصل الخريف من منتصف سبتمبر وحتى اوائل ديسمبر حيث يوجد لها جيل واحد فى تلك الفترة يصل الى اقصى نشاطه فى منتصف نوفمبر أو اوائل ديسمبر (٢٦,٥ - ٦٩,٦ حشرة/ورقة).

٢- اما الفترة الثانية لنشاط الحشرة فتوجد فى فصل الصيف من اوائل مايو وحتى منتصف اغسطس حيث يوجد لها جيلين متداخلين خلال هذه الفترة ، الجيل الاول يصل الى اقصى نشاطه فى اوائل يونيو (٢١,٤ - ٣١,٦٢ حشرة/ورقة) ، اما الجيل الثانى فيصل الى اقصى نشاط فى منتصف يوليو أو اوائل اغسطس (٣٤ - ٥١,٧٧ حشرة/ورقة).

٣- انخفض نشاط الحشرة الى ادنى مستوى له فى الفترة من منتصف يناير وحتى منتصف ابريل وهذا راجع الى تساقط الاوراق فى فصل الشتاء وعدم ملائمة الظروف البيئة لنشاط الحشرة بالاضافة الى خروج النمولت الجديدة لأوراق التوت فى فصل الربيع.

٤- اتضح من نتائج الدراسة ايضا ان عوامل الطقس السائدة (درجة الحراة العظمي والدنيا والرطوبة النسبية) فى محافظة القليوبية كان لها تأثير واضح على نشاط الحشرة فى فصلى الخريف والصيف ، حيث تساهم هذه العوامل بـــ ٦٥,٨٧ - ٧٤,٧% (فى فصل الخريف) و ٦٨,٩- ٨٩,٤% (فى فصل الصيف) من اجمالي التغيرات الكلية في التعداد.