

Seasonal Population Dynamics of *Parlatoria ziziphus* (Lucas) (Homoptera: Diaspididae) in Menoufia Governorate, Egypt

M.E. Tawfeek and Amany M.H. Abu-shall¹

ABSTRACT

The present work was conducted in the Experimental Farm of the Faculty of Agriculture in Shebin El-Kom to study seasonal population dynamics of *Parlatoria ziziphus* (Lucas). During the present investigation it was observed that it is often difficult to remove the scales of this insect especially as alive adult females from the citrus infested leaves. It was observed also, that the average numbers on upper surface of leaf were more abundant than that on lower surface.

Three annual peaks of abundance were encountered and recorded through both years of study (2008/2009 and 2009/2010) during April (in spring season), October (in autumn season) and December (in winter season). The highest one occurred in October in both years. Thus, the present results may help in planning a successful control program to check the ravages of *P. ziziphus* below economic injury level.

INTRODUCTION

The economic importance of scale insects is ascribed to their high reproductive potential. The number of generations per year varies by species. *Parlatoria ziziphus* (Lucas), (Black parlatoria scale insect OR ebony scale insect OR nabk scale insect) was originally recorded from Europe and later from particularly every tropical and subtropical part of the world on numerous hosts, especially on citrus. This insect pest did not attract attention until Ferris (1937) described it, as occurred on leaves and fruits of the hosts in America. Benassy and Soria (1964) studied briefly its ecology in Tunisia.

P. ziziphus was not a key insect pest of citrus in Egypt until the seventies of the last century. The first published studies in Egypt on the life history and population fluctuations of *P. ziziphus* were conducted by Darwish (1976) who reared this insect on the seedlings of mandarin; *Citrus reticulata*, while Amin and Salem (1978) studied the population abundance. However, little is known about the identity and seasonal population dynamics of this insect.

The ebony scale insect, *P. ziziphus* was discovered infesting citrus in southern Florida in 1985. It is considered a major pest in countries bordering the Mediterranean, Tropical Asia, Parts of South America, and the Caribbean. Scales infest leaves, twigs, and fruits

and because they adhere so strongly, cause rejection of fresh fruit in markets. Large populations cause chlorosis and early drop of leaves, dieback of twigs and branches, and distortion of fruit (Capinera, 2008).

Unfortunately, the studies of relationships among biotic potential factors of black parlatoria scale insects', dispersal and population dynamics have been greatly hampered due to the lack of modern reference works. Consequently, not much information is available. However, this great lack stimulated our attentions to launch these studies. Therefore, the scope of the present study was contributed towards a better knowledge to study the population fluctuations of the black parlatoria scale insect on naval orange trees.

MATERIALS AND METHODS

Naval orange trees *Citrus sinenses* (Rutaceae) relatively homogenous in size, height and age (about 40 years old) were chosen for the present study from the Experimental Farm of Faculty of Agriculture in Shebin El-Kom, Menoufia Governorate. The trees at this orchard were not exposed to any chemical pesticide treatment before or during the periods of the present investigation. Seasonal variations in the population of the ebony scale insect were determined from March 2008 through February 2010.

Samples of 30 infested leaves representing three replicates (each of 10 leaves) were picked up from the cardinal directions as well as from the central core of the labeled trees at a height of about 1.5 - 2 meters from the ground level. These samples were monthly taken and kept in polyethylene bags and transported in the same day, to the laboratory of Applied Entomology Department, Faculty of Agriculture, Alexandria University. Tap water was used to remove the dead scales. The living insects (adult females, adult males and immature stages other than crawlers) were counted on the whole leaf in both upper and lower surfaces using hand lens and binocular microscope. The average numbers of living insects per one leaf were considered as the population index for each month. The monthly variation (M.V.) in the population density was calculated as follows:

¹Applied Entomology Dept., Faculty of Agric. El-Shatby, Alexandria University
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$$M.V. = \frac{\text{Average count given at a month}}{\text{Average count in a preceding month}}$$

As a matter of fact, during the present work it was often difficult to remove the scales of this insect especially as alive adult females from the infested leaves.

During the present study the data of environmental factors, mainly temperature and relative humidity were recorded as obtained from the Meteorological Station in Shebin El-Kom, Menoufia region. Data were subjected to the analyses of variance test (ANOVA) with mean separation at 5% level of significance. Computer Program (IRRISTAT) and Duncan's Multiple range Tests and Correlation Coefficients were used to compare the averages of the treatments, according to the method of Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

1. Seasonal variations in the population of *P. ziziphus* on naval orange trees:-

Data concerning the average numbers of alive adult and immature stages per leaf (on both upper and lower surfaces of leaf) and monthly variations in the population densities of the black parlatoria scale insects during March 2008/February 2009 and March 2009 / February 2010 were recorded in Tables 1 and 2, respectively. Analyses of variances of the population densities of *P. ziziphus* as a total numbers revealed highly significant differences at 1% level of probability during both years of the present study.

1.1. Population density of *P. ziziphus* during 2008/2009:

The obtained data in Table 1 and illustrated in Figs. 1 and 2 indicated that the population densities of the ebony scale insect, *P.ziziphus* showed a sort of fluctuations from one month to another on naval orange leaves. As a total numbers, the population density of this insect species was noticed with three annual peaks of infestations. They were recorded in April 2008 (in spring season at an average temperature of 22.3°C and 49.4% R.H.), October 2008 (the highest peak in autumn season at an average temperature of 23.6°C and 61.3% R.H.) and December 2008 (in winter season at an average temperature of 17.2°C and 58.8% R.H.), successively and ranked the 2nd, 1st and 5th, respectively among the twelve months of the first year of study.

Statistical analyses showed significant differences between the population density either in April or October 2008 and the population density of each in June, July, November 2008 and February 2009, while

no significant differences were found among the remained months of the first year of study.

The present investigation and observation assured that the average numbers of scales on the upper surface of leaf were more abundant than that on lower surface. The occurrence percentages of *P. ziziphus* per leaf were 85.8% for the upper surface and 14.2% for the lower surface. However, the percentages of adult females, adult males and immature stages on the upper surface of leaf represented 48.9, 19.0 and 17.9%, respectively from the total numbers. Meanwhile, on the lower surface of leaf they represented 6.7, 2.5 and 5.0%, consecutively from the total numbers. Sex ratio for adult males to adult females was 1: 2.6 on upper surface of the leaves and 1: 2.7 on the lower surface of the leaves. The percentage of immature stage and adult stage were 20.9% and 79.1%, respectively on the upper surface, while these percentages represented 35.2% and 64.8%, successively on the lower surface.

1.2. Population density of *P. ziziphus* during 2009/2010:

Data shown in Table 2 and illustrated in Figs. 1 and 3 indicated that the population densities of the ebony scale insect, *P. ziziphus* fluctuated from one month to another on naval orange leaves. As a total numbers the population density of this insect species were found with three annual peaks of infestations occurred similar to those of the first year of study also in April 2009 (in spring season at an average temperature of 22.0°C and 49.5% R.H.), October 2009 (the highest one in autumn season at an average temperature of 25.5°C and 57.5% R.H.) and December 2009 (in winter season at an average temperature of 17.5°C and 55.6% R.H.), respectively and ranked the 3rd, 1st and 4th, respectively among the twelve months of study.

Statistical analyses showed significant differences between the population density in October 2009 and the population densities of all remained months, except with the population density of April 2009, where no significant difference was found during the second season of study.

The data of this year of study as the preceding one assured that the average numbers of insects on upper surface of leaf were more abundant than that on lower surface of leaf. The occurrence percentages of *P.ziziphus* per leaf were 83.1% for the upper surface and 16.9% for the lower surface. However, the percentages of adult females, adult males and immature stages on the upper surface of leaf represented 45.3, 16.8 and 21.0%, respectively from the total numbers. Meanwhile, on the lower surface of leaf they represented 8.5, 2.6 and 5.8%, consecutively from the total numbers.

Table 1. Mean numbers \pm S.E. of the black parlatoria scale insect, *P. ziziphus* infesting naval orange trees in Shebin El-Kom, Menoufia Governorate during March 2008 - February 2009

Date of Collection	Mean numbers of adult and immature stages of <i>P. ziziphus</i> per leaf											
	Upper surface					Lower surface						
	Adult and immature stages		Adult and immature stages		Total	Adult and immature stages		Adult and immature stages		Total	Grand mean	M.V.
Female	Imm.	Female	Imm.	Female		Imm.	Male	Imm.				
March 2008	145.5	85.9	102.1	34.1	19.6	14.8	68.5	402.0 ab	-	3		
April 2008	181.1	101.2	52.4	334.7	28.2	37.4	10.9	76.6	411.3 a	1.02	2	
May 2008	172.7	47.7	32.4	252.8	13.6	31.4	2.7	47.7	300.5 abcd	0.73	7	
June 2008	129.4	35.5	23.4	188.3	18.6	12.1	1.8	32.5	220.8 d	0.73	12	
July 2008	107.1	36.6	41.2	184.9	28.7	14.0	4.4	47.2	232.1 d	1.05	10	
August 2008	103.4	40.1	87.7	231.2	19.5	10.6	19.0	49.1	280.3 bcd	1.21	8	
September 2008	183.6	88.1	78.3	350.0	22.1	15.5	8.8	46.4	396.4 ab	1.41	4	
October 2008	223.8	94.5	69.7	388.0	28.1	20.6	9.4	58.1	446.1 a	1.13	1	
November 2008	151.8	33.2	37.5	222.6	18.8	5.1	5.3	29.2	251.8 cd	0.56	9	
December 2008	167.5	59.6	87.2	314.3	25.6	13.8	10.7	50.2	364.4 abc	1.45	5	
January 2009	180.7	35.3	73.3	289.3	10.0	5.1	4.1	28.2	317.5 abcd	0.87	6	
February 2009	128.8	30.4	43.1	202.3	10.6	6.9	3.6	21.1	223.4 d	0.70	11	
Total	1875.4	688.1	728.3	3291.9	257.9	192.1	95.5	545.5	3837.4			
Mean / leaf	156.3	57.3	60.7	274.3	21.5	16.0	8.0	45.5	319.8			
\pm	\pm	\pm	\pm	\pm	\pm	\pm	\pm	\pm	\pm			
S.E.	10.2	7.9	7.4	20.1	2.2	2.9	1.5	4.8	23.4			

Abbreviation: \pm S.E. = \pm Standard Error, Imm. = Immature and M.V. = Monthly variations.
 One-Way ANOVA, Completely randomized, Duncan's Multiple Rang Test, Sample based on three replicates each of 10 leaves.
 L.S.D. at 0.5 = 114.9
 In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Table 2. Mean numbers \pm S.E. of the black parlatoria scale insect, *P. ziziphus* infesting naval orange trees in Shebin El-Kom, Menoufia Governorate during March 2009 - February 2010

Date of Collection	Mean numbers of adult and immature stages of <i>P. ziziphus</i> per leaf											
	Upper surface					Lower surface					Grand mean	
	Adult and immature stages		Total		M.V.	Adult and immature stages		Total		Rank		
Female	Imm.	Male	Total	Female		Imm.	Male	Total				
March 2009	99.5	61.0	38.9	199.4	39.0	21.7	18.5	79.2	278.6	bcd	1.25	10
April 2009	185.2	99.8	29.7	314.7	51.7	30.9	5.5	88.1	402.8	ab	1.45	3
May 2009	167.5	104.6	43.7	315.8	41.9	23.7	7.6	73.2	389.0	bc	0.97	5
June 2009	95.0	35.4	44.9	175.3	13.9	9.3	3.9	27.1	202.4	d	0.52	12
July 2009	128.3	56.6	51.8	236.7	21.1	28.0	6.2	55.3	292.0	bcd	1.44	9
August 2009	134.1	74.0	74.4	282.5	30.1	18.4	13.6	62.1	344.6	bcd	1.18	7
September 2009	179.1	97.2	70.1	346.4	28.2	24.7	9.5	62.3	408.7	ab	1.19	2
October 2009	231.9	129.1	81.2	442.2	38.6	38.9	14.2	91.7	533.9	a	1.31	1
November 2009	184.3	38.2	40.3	262.8	25.1	8.5	10.5	44.1	306.9	bcd	0.57	8
December 2009	174.3	63.0	97.8	335.1	27.0	21.0	7.9	55.9	391.0	bc	1.27	4
January 2010	188.2	69.7	73.2	331.1	24.9	9.2	9.4	43.5	374.6	bc	0.96	6
February 2010	123.7	48.8	55.7	228.2	12.6	8.0	3.7	24.3	252.5	cd	0.67	11
Total	1891.1	877.4	701.7	3470.2	354.1	242.3	110.5	706.8	4177.0			
Mean / leaf	157.6	73.1	58.5	289.2	29.5	20.2	9.2	58.9	348.1			
\pm	\pm	\pm	\pm	\pm	\pm	\pm	\pm	\pm	\pm			
S.E.	11.9	8.3	5.9	21.3	3.3	2.9	1.3	6.3	25.4			

Abbreviation: \pm S.E. = \pm Standard Error, Imm. = Immature and M.V. = Monthly variations.
 One Way ANOVA, Completely randomized, Duncan's Multiple Rang Test. Sample based on three replicates each of 10 leaves.
 L.S.D. at 0.5 = 129.9
 In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

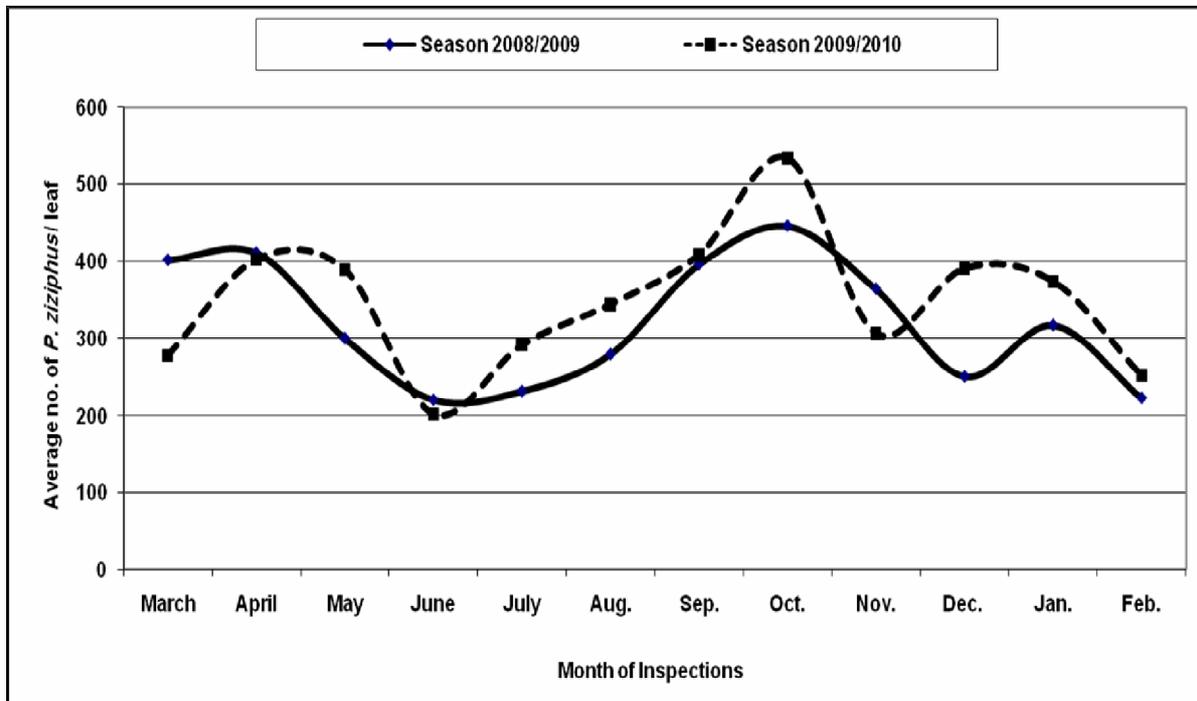


Fig.1. Comparison between the population density of the black parlatoria, *Parlatoria ziziphus* (Lucas) on naval orange leaves in Menoufia during the two growing seasons of 2008/2009 and 2009/2010

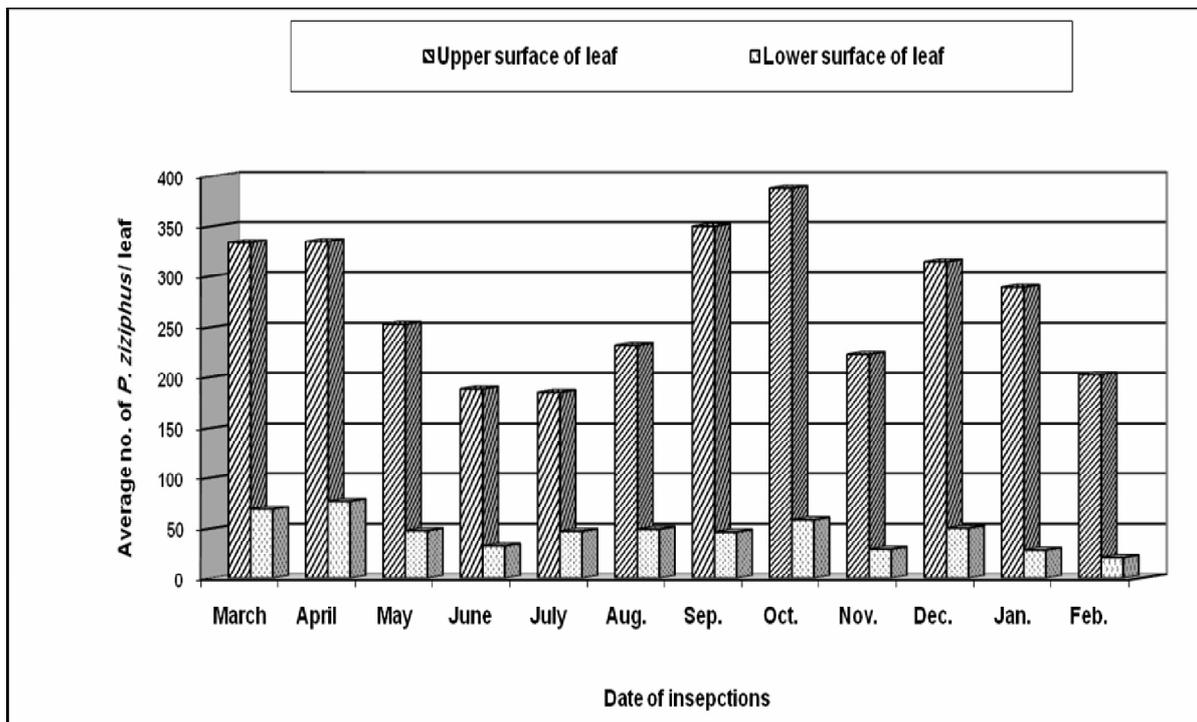


Fig.2. Relative abundance of *P. ziziphus* on upper and lower surfaces of naval orange leaves during March 2008/ February 2009

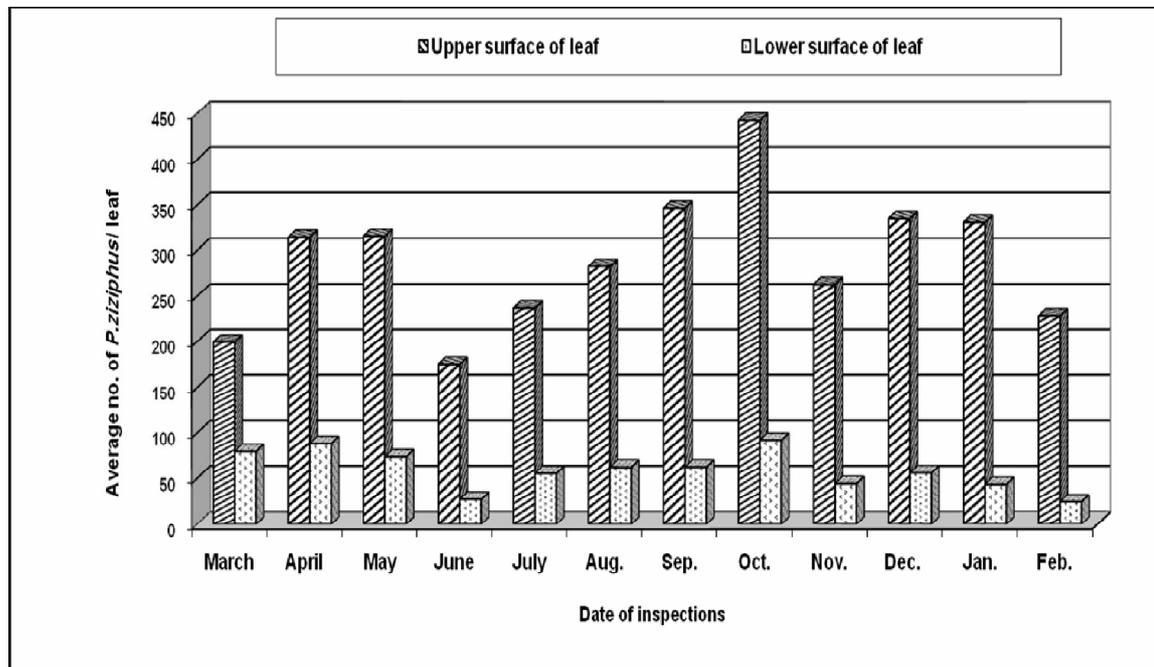


Fig. 3. Relative abundance of *P. ziziphus* on upper and lower surfaces of naval orange leaves during March 2009/ February 2010

Sex ratio for adult males to adult females was 1: 2.7 on the upper surface of the leaves and 1: 3.2 on the lower surface of the leaves. The percentage of immature stages and adult stage were 25.3% and 74.7%, respectively on the upper surface, while these percentages represented 34.3% and 65.7%, successively on the lower surface.

Three annual peaks of abundance were encountered during both seasons 2008/2009 and 2009/2010, the highest ones occurred in October.

It is worthily to mention that during the last fifty years, as a result of interspecific competition, the black parlatoria scale insect (*P. ziziphus*) became the most dominant species on citrus in Shebin El-Kom, Menoufia (Tawfeek, 2010). However, Darwish (1976) stated that the purple scale insects, *Lepidosaphes beckii* (Newman) was the most abundant species infested citrus trees in this area during 1974 and 1975 grown seasons. While *Chrysomphalus ficus* Ashm., was found with the highest numbers of scale insect species on citrus plants in the same farm (El-Keiy, 1964).

In addition, because it is often difficult to remove these insects from products such as fruits they may be considered to be cosmetically damaging (Miller *et al.*, 2005).

In Egypt, Tawfeek (2007) found that *P. ziziphus*, The nabk or ziziphus scale insect is wide spread on citrus trees (Rutaceae) in Egypt. It was collected from citrus in Alexandria and Menoufia.

Thus, the present results may help in planning a successful control program to check the ravages of Black parlatoria scale insect, *P. ziziphus* below economic injury level.

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الملخص العربي

الوفرة الموسمية لحشرة *Parlatoria ziziphus* (Lucas)

(متشابهة الأجنحة: عائلة الحشرات القشرية المسلحة) في محافظة المنوفية - مصر

محمد السيد توفيق، أمانى مصطفى حسن أبو شال

- تم دراسة الوفرة الموسمية لحشرة *Parlatoria ziziphus* (Lucas) على أشجار الموالح بمزرعة كلية الزراعة بشبين الكوم بمحافظة المنوفية وذلك لمدة سنتين متتاليتين (مارس ٢٠٠٨ حتى فبراير ٢٠٠٩ ومارس ٢٠٠٩ حتى فبراير ٢٠١٠) وخلال الدراسة تم الحصول على النتائج التالية:-
- سجل ثلاثة قمم لمنحنى تعداد الحشرة *Parlatoria ziziphus* (Lucas) خلال موسمي الدراسة وهي في الربيع (شهر ابريل)
- وفي الخريف (شهر أكتوبر) وفي الشتاء (شهر ديسمبر) وكان أعلاهم في شهر أكتوبر.
- الكثافة النسبية لأعداد الحشرة على السطح العلوى أعلى منها عن السطح السفلى لجميع أطوار الحشرة.
- وهكذا تساعد نتائج هذه الدراسة في عمل توصية لبرنامج مكافحة ناجح يجد من الأصابة بحشرة *Parlatoria ziziphus* (Lucas) ومنع وصولها الى مستويات ضارة اقتصاديا.