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Population of the White Date Palm Scale Insect, *Parlatoria blanchardi* and Mortality Factors Acting their Population at New Damietta District

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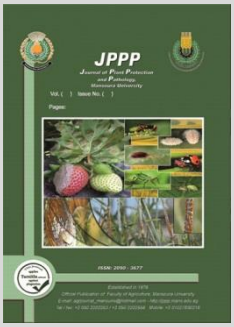

ABSTRACT

Population fluctuation of the total and living individuals of the white date palm scale insect, *Parlatoria blanchardi* was studied for two successive years, 2021 and 2022, in New Damietta district. The insect pest had six and seven peaks of abundance during the first and second years, respectively. The highest peaks of the total population occurred in the beginning of January, 2021 and Mid-November, 2022 and represented by 1520 and 1362 scales/100 leaflets, respectively. The highest peaks of living scales occurred in the beginning of December 2021 and Mid-November 2022 and represented by 778 and 968 scales/ 100 leaflets, respectively. The annual average number of total insect population was higher during the second year than the first year and represented by 686.1 ± 85.02 and 617.6 ± 114.42 scales/100 leaflets, respectively. Moreover, the annual average number of the living population was greater during the second year than the first year. The unknown mortality factors achieved the highest mortality in insect population during Winter season in the first year and during Autumn season during the second year. *Aphytis* spp. Contributed with the lowest performance in total population pest mortality during summer season, whereas both of *Encarsia citrina* and predators contributed less during Spring season of 2021 and Autumn season of 2022.

Keywords: Scale – *Parlatoria* - Predation- Parasitism.

INTRODUCTION

In the Arab countries, the date palm, *Phoenix dactylifera* L. (Family: Arecacea) is recognized as one of the oldest fruit trees and it is commonly cultivated as desirable edible sweet fruit (El-Shibli and Korelainen, 2009; Al Antary *et al*., 2015). Cultivation of date palms in Egypt comes back to thousands of years. The earliest confirmation of its presence comes from the drawing on the ancient Egyptian tombs, through some believe that it existed long before that time (El-Sherif *et al*., 1998 and Eraki, 1998). Egypt has about 15.5 million palm trees distributed in an area of 135,000 feddans. The top five producing regions of Egypt are Aswan, Beheira, Giza, New Valley, and Sharkia (AVIC, 2022). In season of 2021, 9.8 million tons of dates were produced worldwide; Egypt comes in the first rank worldwide as the largest producer of dates with 1.7 million tons of dates was produced in 2021 (FAO, 2021).

Date palm trees are subjected to attack by several insect pests specially the white date palm scale, *Parlatoria blanchardi* (Targioni-Tozzetti) (Hemiptera: Coccoidea, Diaspididae). Both immatures and adult females of this diaspidid insect attack most parts of the tree such as leaflets, leaves, tender shoots, offshoots, twigs and fruits (El-Said, 2000).

This insect sucks the sap with its mouth parts and secreting toxic saliva during feeding that causing malformed leaf and shoots, low photosynthesis and respiration rate. All of this lead to curling, yellowing and dropping of leaves, dwarfing of plant and subsequently cause considerable qualitative and quantities yield losses and eventually affect the marketing value of the fruits. Therefore, the presence of this insect weakens the infested plant itself (Saad, 1980, Gassouma, 2004 and Bakry *et al*., 2017). In the heavily infestation by *P. blanchardi*, it accumulates its scales on the infested part of the tree with secreting toxic saliva (El-Sherif *et al*., 1998, El-Said, 2000, Abivardi, 2001, Idris *et al*., 2006, Blumberg, 2008, Bakry *et al*., 2017 and Al-Shuraym and El Hadi Mohamed, 2020). These secretions affect the process of respiration, transpiration and photosynthesis of the leaves and thus leads to impeding the growth process and Several biotic and abiotic factors affect populations of scale insects. Parasitoids consider key biocontrol agents of scale insects. The species of genus *Aphytis* (Hymenoptera: Aphelinidae) are the most abundant and effective natural enemies of scale insects including *P. blanchardi*. Species of Aphytis grow exclusively as primary ectoparasitoids of armored scale insects (Hemiptera: Diaspididae) and have been successfully applied in biocontrol programs against several armored scale insects worldwide. The effectiveness and abundance of *Aphytis* species render them as an attracted subject for many researchers (El-Said, 2000, El-Sherif *et al*., 2001 and Bakry *et al*., 2017). Another an important natural enemy of the date palm scale is the coccinellid predator, *Chilocorus bipustulatus*. This predator considers one of the most successful predators in the classical biocontrol programs of scale insects. It considers also an effective predator of several species of Diaspididae, with an ability to colonize a wide range of tropical and sub-tropical regions. This species distinguishes with a rapid numerical response and an excellent ability to integrate with parasitoids in a stable relationship (Abdel-Kareim and Awadalla, 1998).

There for the present work was carried out to study some ecological aspects of this scale insect. It is hoped that

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the achieved information may lead to helpful recommendations for the management of this pest on date palm. The scope of this study included the following objectives:

MATERIALS AND METHODS

The present study was conducted throughout two successive years (from January 1, 2021 until December 15, 2022) on the date palm trees, *Phoenix dactylifera* L. (Family: Arecacea) in two districts New-Damietta and Faraskour, Damietta governorate, Egypt. This was to study the population fluctuations of the date palm scale insect, *P. blanchardi* and its natural enemies. The selected trees have been received the normal agricultural practices, without any application of chemical insecticides during the period of investigation.

Sampling:

Five palm trees approximately similar as possible as in their age (Ca. 6 years), size, and height were selected randomly. Samples were collected biweekly during the investigation period. A sample size of 20 leaflets was collected from each tree in the four directions (north, east, south, and west) with five leaflets from each side.

Examination:

Biweekly samples were regularly collected and transferred to the laboratory in polyethylene bags for investigation by the aid of binocular microscope. The numbers of living, unknown dead, parasitized, and consumed individuals on each leaflet of the sample were determined and recorded in each sampling date.

The parasitized scales were determined and recorded, the collected parasitoids were identified, and the percentage of parasitism were calculated. Specimens of the scale insect were collected in glass jars and kept at 21-25°C and 60-65% R.H. for observing any parasitoids could be emerged. The emerged parasitoid species were identified by the aid of specialists in the Department of Biological Control, Plant Protection Research Institute, Egypt.

The number of consumed individuals were identified and recorded. The observed predators were identified by the aid of specialists in the same place as previously described for insect parasitoids.

Statistical analysis:

One-way ANOVA and regression analyses were performed using SPSS software program and in case of significant, means separated by using Duncan's Multiple Range test (1955).

RESULTS AND DISCUSSION

Population fluctuation of the white date palm scale insect, *P. blanchardi*:

Data obtained in Figure (1) show the population fluctuation of total and living populations of *P. blanchardi* in the New Damietta district throughout the first year 2021. During the first year of 2021, the population of total scale individuals demonstrated six peaks of abundance. The highest peak occurred at the start of January 2021, followed by the peak in the start of December 2021, and was represented by 1520 and 1442 scales / 100 leaflets, respectively. In terms of the scale insect's living population, it showed six abundance peaks over the first year of 2021. The biggest peak, which was represented by 778 and 748 scales/100 leaflets, respectively, occurred at the beginning of December 2021, followed by the peak, which occurred on the 15th of January 2021.

Data arranged in Figure (2) show the fluctuations in population of *P. blanchardi* during the second year of 2022 in the New Damietta district. There were seven peaks of the total scale individuals throughout the second year 2022. The highest peak occurred in the 15^{th} of November 2022 followed by the peak occurred in the 15^{th} of October 2022 and presented by 1362 and 1242 scales / 100 leaflets, respectively. In respect to the living population of the scale insect, it also had seven peaks of abundance during the second year 2022. The highest population occurred in Mid-November 2022 followed by the peak occurred in Mid-December and both represented by 968 and 940 scales/100 leaflets, respectively.

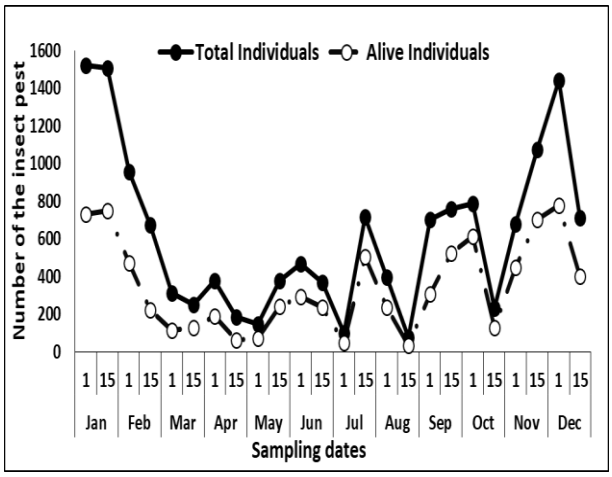

Fig. 1. Seasonal fuctuations in the total and living populations of the white date palm scale insect, *Parlatoria blanchardi* during the first year 2021 at New Damietta district.

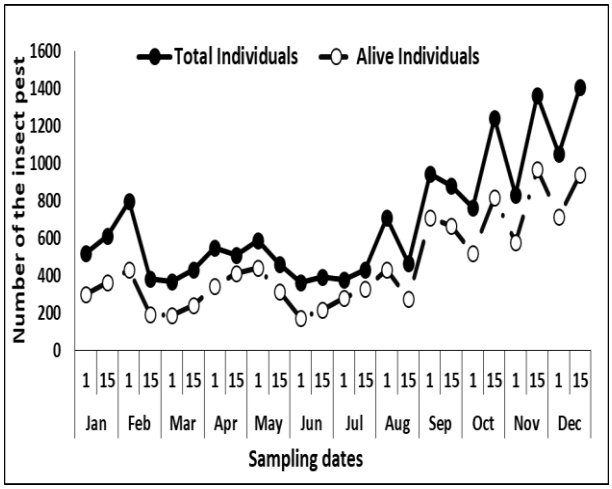

Fig. 2. Seasonal fuctuations in the total and living populations of the white date palm scale insect, *Parlatoria blanchardi* during the second year 2022 at New Damietta district.

The results in Table (1) show the annual average number of the white date palm scale insect *P. blanchardi* (Total and living scale populations, and their percentage) during the two years of the study 2021 and 2022 in New Damietta district. During the first year 2021, January and

December were found to be the highest average number of the total individuals and presented by 1514 and 1077 scales / 100 leaflets, respectively. Meanwhile, August was found to be the lowest average number (235 scales / leaflets). In respect to to the living scales, it can be noticed that January and December of the first year had the highest average number and presented by 739 and 589 scales / 100 leaflets, respectively. While, March had the lowest average number (120 scales / 100 leaflets).

During the second year 2022, December and November were found to be the highest average number of the total individuals and presented by 1231 and 1098 scales / 100 leaflets, respectively. Meanwhile, June found to be the lowest average number (379 scales / leaflets). On the other hand, according to the alive scales during the second year, it can be noticed that December and November had the highest average number and presented by 828 and 773 scales / 100 leaflets, respectively. While June had the lowest average number (197 scales / 100 leaflets).

Table 1. The monthly and annual average number of the total individuals, alive individuals, and the percentage of the white date palm scale insect, *P. blanchardi* during the two successive years 2021 and 2022 at New Damietta district.

Months	The first Year 2021			The second Year 2022		
	Total No. individuals	Alive No. individuals	%	Total No. individuals	Alive No. individuals	%
Jan	1514	739	48.81	566	334	59.01
Feb	815	348	42.70	590	312	52.88
Mar	280	120	42.86	401	217	54.11
Apr	282	124	43.97	530	379	71.48
May	263	157	59.81	526	380	72.22
Jun	417	266	63.79	379	197	52.05
Jul	409	275	67.24	407	306	75.18
Aug	235	134	57.02	590	353	59.83
Sep	731	415	56.77	912	690	75.60
Oct	510	370	72.55	1002	669	66.77
Nov	878	575	65.49	1098	773	70.40
Dec	1077	589	54.69	1231	828	67.25
Average	617.6	342.7	56.3	686.1	453.2	64.7
±SE	±114.42	±59.26	±2.90	±85.02	±64.17	±2.53

The present results are in the same trend with those of Hussain (1996) in Egypt, found that *P. blanchardi* had three peaks in October, March, and July at Bahria Oases, whereas had three peaks in November, February, and May in Giza. While Abdel-Kareim and Awadalla (1998) studied the population dynamics of *P. blanchardi* for two successive years (1996 and 1997) on date palm trees. They discovered three full generations of *P. blanchardi*, with an annual partial fourth generation. The pest had seven generations during the two years of study. Partial population curves for egg stage showed four peaks during the first year and, during the second year. The partial population curves for the 1st instar nymph showed four peaks during the first year and three peaks during the second year. Moreover, El-Said (2000) recorded that *P. blanchardi* had four generations in the year. Peaks were recorded in mid-May, mid-July, mid-September, and mid-November in the first year and early May, mid-July, mid-September, and early December in the second year. While Bakry *et al.* (2015) reported that, data of total population of insect, four peaks were recorded in April, June, September, and November in all studied years except 2009. The total population of insects had three peaks in 2009, which was recorded in April, June, and October. In addition, the presence of a simple significant positive correlation between the mean temperature and different stages of *P. blanchardii* and total population of insect. Meanwhile, Salman *et al.* (2016) stated that, this insect had four peaks of seasonal activity per year, which were recorded during mid-October, mid-November, mid-April and mid-June in the first year (2010/11) and during the mid-October, mid- December, mid-April and mid-June in the second year (2011/12).The autumn and spring months during the first year (2010/11) and autumn and summer during the second year (2011/12) were the most favorable period for *P. blanchardii* activity under the climatic conditions. According to Chebaani *et al.* (2021) in Algeria, studied the population dynamics of *P. blanchardi* during one year in the variety of Deglet Nour in the region of Biskra. The results showed that the *P. blanchardi* had three annual generations, spring, summer and fall further, preferred the south and west orientation of date palm, with proportions ranging from 28.42% and 27.5%. It preferred places protected from sunstroke to thrive.

The seasonal mortality and its contribution in total population mortality of *P. blanchardi*:

Data in Table (2) show the seasonal mortality and its contribution in the total population mortality of *P. blanchardi* by different mortality factors during the first year 2021. It can be noticed that the highest population mortality and its contribution for all mortality factors acting the population density of the white date palm scale insect, *P. blanchardi* was during winter season of the first year, 2021 in New Damietta district. The highest average number of dead scales and its contribution by *Aphytis spp., E. citrina,* predators and unknown mortality factors were 33.3±8.54 (50.26%), 23.3±6.92 (42.83%), 11.3±2.11 (33.24%) and 399.3±96.98 individuals. (42.27%), respectively during winter 2021.

Data arranged in Table (3) showed the seasonal activity and its contribution for each season by the different mortality factors during the second year 2022. It can be noticed that the Winter season 2022 was the highest average number and its contribution for *Aphytis spp., E. citrina* and predators acting the population density of the white date palm scale insect, *P. blanchardi* during the second year 2022 in New Damietta district. The highest average number and its contribution were 18.3±3.71 (39.87%), 11.3±1.89 (32.01%) and 20.7±2.23 indiv. (39.28%) in winter 2022. While the unknown mortality factors were the highest average number and its contribution in Autumn 2022 and presented by 325.7±35.20 indiv. (40.85%).

Statistical analysis indicates that there are significant differences in mortality rates resulting from various factors in winter compared to the other seasons. On the other hand, it was found that there are significant differences between mortality rates resulting from unknown mortality factors and other known factors and that was during the two years of study.

Table 2. The seasonal population mortality and its contribution by different mortality factors acting population of *Parlatoria blanchardi* on date palm tree during the first year 2021 at new Damietta district.

Mortality Factors	Estimate	Seasons				
		Winter	Spring	summer	Autumn	Total
Aphytis spp.	Average ± SE	33.3 ± 8.54 A b	11.3 ± 2.83 B b	7.3 ± 1.85 B b	14.3 ± 5.93 B b	…..
	Contribution%	50.26	17.06	11.03	21.61	100
Encarsia citrina	Average ± SE	23.3 ± 6.92 A b	5.5 ± 1.27 B b	13.3 ± 3.81 AB b	12.3 ± 4.31 AB b	…..
	Contribution%	42.83	10.11	24.45	22.61	100
predation	Average ± SE	11.3 ± 2.11 A b	6.7 ± 1.12 B b	8.3 ± 1.09 AB b	7.7 ± 1.58 AB b	…..
	Contribution%	33.24	19.71	24.41	22.65	100
Unknown mortality	Average ± SE	399.3 ± 96.98 A a	114.7 ± 15.65 B a	154.7 ± 49.47 B a	276.0 ± 72.57 AB a	…..
	Contribution%	42.27	12.14	16.38	29.22	100

Average followed by the same capital letters in the rows among different seasons and the same small letters in the columns are not significantly differences at the level of 5 % probability (Duncan's Multiple Rang Test).

Table 3. The seasonal population mortality and its contribution by different mortality factors acting population of *P. blanchardi* on date palm tree during the second year 2022 at new Damietta district.

Mortality Factors	Estimate	Seasons				
		Winter	Spring	summer	Autumn	Total
Aphytis spp.	Average ± SE	18.3 ± 3.71 A b	7.3 ± 1.96 B b	7.0 ± 2.56 B b	13.3 ± 2.94 AB b	…..
	Contribution%	39.87	15.90	15.25	28.98	100
Encarsia citrina	Average ± SE	11.3 ± 1.89 A b	8.7±1.62 A b	8.0 ± 1.66 A b	7.3 ± 1.74 A b	…..
	Contribution%	32.01	24.65	22.66	20.68	100
Predation	Average ± SE	20.7 ± 2.23 A b	13.7 ± 2.28 B b	11.0 ± 1.53 BC b	7.3 ± 0.99 C b	…..
	Contribution%	39.28	26.00	20.87	13.85	100
Unknown mortality	Average ± SE	181.0 ± 27.34 B a	129.8 ± 14.33 B a	160.8 ± 28.02 B a	325.7 ± 35.20 A a	…..
	Contribution%	22.7	16.28	20.17	40.85	100

Average followed by the same capital letters in the rows among different seasons and the same small letters in the columns are not significantly differences at the level of 5 % probability (Duncan's Multiple Rang Test).

The annual mortality activity and its contribution of the different mortality factors:

The obtained results in Table (4) show the annual average number of the different mortality factors and its contribution during the two successive years 2021 and 2022. It can be noticed that the unknown mortality factors were the highest average numbers and percentages during the two years 2021 and 2022 and presented by 236.2 ± 38.51 indiv. (85.92%) and 199.3 ± 20.19 indiv. (85.61%), respectively. The ectoparasitoid *Aphytis spp*. was the highest average number and percentage 16.6 ± 3.16 indiv. (6.04%) and 11.5 ± 1.50 indiv. (4.94%) than the endoparasitoid *E. citrina* 13.6 ± 2.38 indiv. (4.95%) and 8.8 ± 0.76 indiv. (3.78%) during the two years 2021 and 2022, respectively. The lowest average numbers and percentages were recorded by the predatism mortality factor during the first year 2021 and by the endoparasitoid *E. citrina* during the second year 2022 and presented by 8.5 ± 0.80 indiv. (3.09%) and 8.8 ± 0.76 indiv. (3.78%), respectively.

Table 4. The annual average number of the different mortality factors and its contribution during the two successive years 2021 and 2022.

Mortality factors	First year 2021		Second year 2022	
	Average ± SE	%	Average ± SE	%
Aphytis spp.	16.6 ± 3.16	6.04	11.5 ± 1.50	4.94
Encarsia citrina	13.6 ± 2.38	4.95	8.8 ± 0.76	3.78
Predation	8.5 ± 0.80	3.09	13.2 ± 1.33	5.67
Unknown mortality	236.2 ± 38.51	85.92	199.3 ± 20.19	85.61
Total	----	100	----	100

The present data are in agreement with the finding of those Abdel-Kareim and Awadalla (1998) in Egypt, reported that the aphelinid parasitoid, *Aspidiotiphagus lounsburni* and the coccinellid predator, *C. bipustulatus* were the dominant natural enemies on *P. blanchardii*. The quantity of parasitoids and predators peaked in the autumn and decreased in the winter. The endoparasitoid, *A. lounsburni* induced relatively considerable mortality of *P. blanchardii* adult females. The mortality percentage caused by the predators was very low and Mourad and Zanuncio (1998) stated that the parasitization by the aphelinid parasitoid *Aphytis sp.* (Hymenoptera: Aphelinidae) had an important role in regulating the population dynamics of the white date palm scale insect, *P. blanchardi*. Moreover, El-Said (2000) recorded that the aphelinid parasitoid *A. phoenicis* was active and effective on the nymphs and adult females of *P. blanchardii* particularly in summer and autumn. The parasitism rate ranged from 21.4 to 33.6% in the spring, 21.3 to 36.7% in the summer, 35.3 to 46.8% in the autumn, and 18.5 to 39.1% in the winter. While Al-Megrin (2007) in Saudi Arabia, reported that the hymenopterous parasitoid, *Encarsia lounsburyi* an important parasitoid of *P. blanchardi*, helps to reduce the population density of the white date palm scale insect, *P. blanchardi*, on date palms. Also, Achoura and Belhamra (2016) studied the predation rates to allow assessment of predatory activity that can contribute to the destruction of the white scale insect. They noted a decrease in predation rates during the month of January. From February, they noticed an increase in the number of parasitized females until reaching the peak of 24 individuals/cm2 in March. The results showed that predatory activity was very marked in the spring when conditions were favourable to the proliferation of predators.

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التذبذبات العددية لحشرة النخيل القشرية البيضاء *Parlatoria blanchardi* وعوامل الموت المختلفة التي تؤثر علي تعداد الحشرة

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[٢]قسم وقاية النبات – كلية الزراعة – جامعة دمياط

الملخص

تمت دراسة التذبذبات العددية للتعداد الكلي والأفراد الحية لحشرة النخيل القشرية البيضاء *P. blanchardi* خلال عامين متتاليين ٢٠٢١ و٢٠٢٢ في منطقة دمياط الجديدة. حيث سجلت الحشرة ستة قمم من الوفرة خلال العام الأول وسبعة قمم خلال العام الثانيلكلاً من التعداد الكلي والأفراد الحية. ظهرت أعلى القمم في بداية يناير ٢٠٢١ ومنتصف نوفمبر ٢٠٢٢ للتعداد الكلي ومُثّلت بـ (١٥٢٠ و١٣٦٢ حشرة / ١٠٠ وريقة) على التوالي. فيما يتعلق بالأفراد الحية حدثت أعلى القمم في بداية ديسمبر ٢٠٢١ ومنتصف نوفمبر ٢٠٢٢ ومُثّلت بـ (٧٧٨ و٩٦٨ حشرة / ١٠٠ وريقة) على التوالي. سجل المتوسط السنوي للتعداد الكلي أعلى معدل خلال العام الثاني مقارنة بالعام الأول ومُثّل بـ (٦٨٦,١ ± 85.02 و٦١٧,٦ ± ١١٤,٤٢حشرة / ١٠٠ وريقة) على التوالي. علاوة على ذلك سجل المتوسط السنوي للأفراد الحية أعلى معدل خلال العام الثاني عن العام الأول .تسببت عوامل الموت الغير معروفة في أعلى متوسط ونسبة مئوية في موسم الشتاء خلال العام الأول وفي موسم الخريف خلال العام الثاني. بينما كان أدنى متوسط ونسبة مئوية في مواسم الصيف للطفيل الخارجي *Aphytis spp.* وفقاً للطفيل الداخلي *E. citrina* والافتراس كان أقل متوسط ونسبة مئوية في موسم الربيع خلال العام الأول وموسم الخريف خلال العام الثاني.