

## Full Length Research

# Factors affecting distribution patterns of the white date palm scale insect, *Parlatoria blanchardii* (Targioni-tozzetti), on date palm trees at Esna district, Luxor governorate, Egypt

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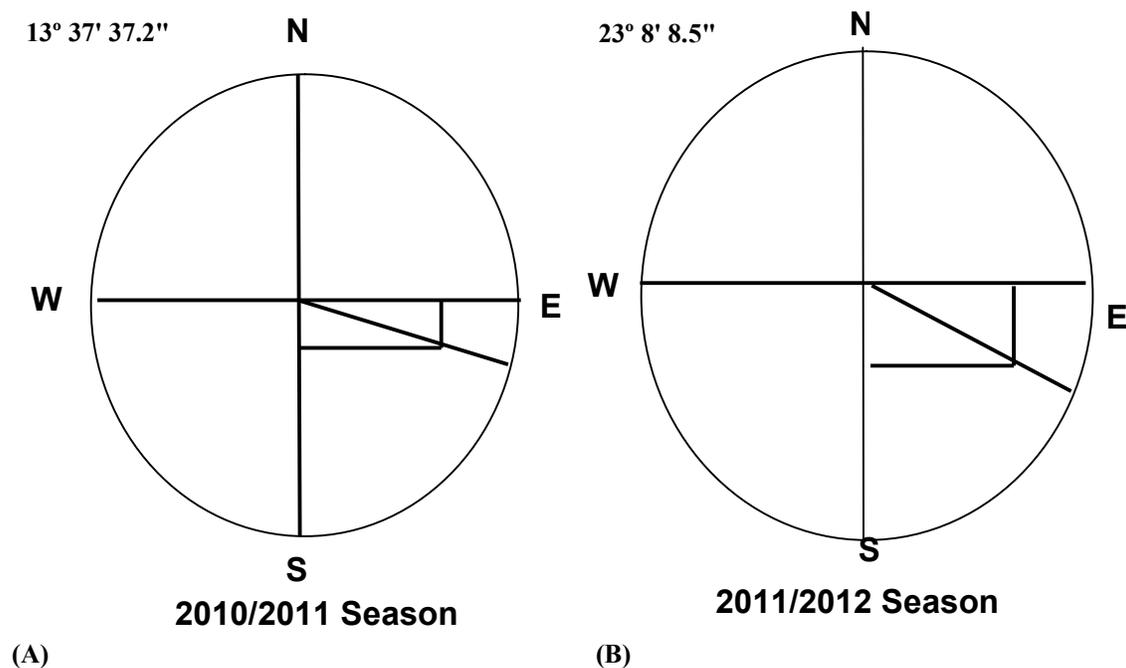
*The present work was carried out throughout two successive years (2010/2011 and 2011/2012) to determine effect of different tree cardinal directions, leaflet parts, leaflet surfaces and frond stratum of date palm trees on distribution of *Parlatoria blanchardii* at Esna district, Luxor Governorate. The obtained results showed a highly significant and significant differences between the population means at the four cardinal directions during the two years of study (2010/2011 and 2011/2012), respectively. However, the grand means were relatively higher at the east direction (102.8 and 94.03 individuals per leaflet), followed by south site (96.26 and 88.79 individuals per leaflet). In contrast, west direction was the least infested by insect (66.43 and 83.03 individuals per leaflet). While, the north direction was moderately infested with this insect as mean (87.48 and 84.12 individuals per leaflet) for the two years of study, respectively. Also, the basal parts of leaflet was the most preference parts and highest infestation to this insect with mean (12.25 and 11.86 of scale per inch<sup>2</sup>), followed by the middle parts of the leaflets with mean (10.25 and 10.05 of scale per inch<sup>2</sup>) for two years of study, respectively. While, the apical parts of leaflet was the least affected by insect with mean (7.10 and 6.93 of scale per inch<sup>2</sup>) during the 2010/2011 and 2011/2012, respectively. As regarding the leaflet surfaces, the upper surface were heavily infested than the lower ones. The percentages of the pest population on the upper and lower leaflet surface were 71.36 and 28.64% during the 1st year (2010/2011). While, in the 2nd year of (2011/2012) were 71.19 and 28.81%, respectively. Concerning the distribution of infestation on frond, the basal stratum of fronds received the highest population as mean (11.38 and 10.21 of scale per inch<sup>2</sup>) were determined depended on the upper basal surface of leaflets, followed by the middle stratum of the frond as mean (7.99 and 7.79 of scale per one inch<sup>2</sup>) for two years of study, respectively. Infestation on the apical stratum of the frond was least population of this insect (6.62 and 6.46 individuals per inch<sup>2</sup>) during 2010/2011 and 2011/2012, respectively. Generally, it can be concluded from the current investigation that the insect population occurred on different tree directions and all parts and stratum of date palm trees on the all year round during the two years of investigation. *P. blanchardii* prefers south eastern sides and upper basal surface of leaflets where its population was always abundant all over the year.*

**Key words:** *Parlatoria blanchardii*, distribution patterns, directional preference, date palm trees.

## INTRODUCTION

The date palm tree, *Phoenix dactylifera* L. is one of the oldest domesticated fruit crops (El-Shibli and Korelainen, 2009).

Among several agricultural pests infesting date palm trees is the white date palm scale, *Parlatoria blanchardii* (Targioni-



**Figure 1.** Directional preference of *P. blanchardii* nymphs and adults on date palm leaflets, Esna district, Luxor Governorate, Egypt, over a two year period from autumn 2010 to summer 2012.

Tozzetti). Adults and nymphs feed on sap from the leaves that contain sugars and macro- and micro-elements. High infestations of the date palm scale produce remarkable damage that results in early leaf drop and yield reduction (El-Said, 2000). Damage to the date palm leaves also reduces photosynthesis and respiration that leads to curling, yellowing, and dropping of leaves. Characteristic of white date palm infestations is the appearance and accumulation of scales on selected regions of the date palm leaves (El-Said, 2000; El-Sherif et al., 2001; Blumberg, 2008).

The objective of this study is to identify the distribution of *P. blanchardii* based on tree cardinal directions, leaflet parts, leaflet surfaces, and frond parts of date palm trees over a period of two successive years (2010/2011 and 2011/2012) at Esna district, Luxor Governorate.

## MATERIALS AND METHODS

A date palm orchard of about one acre (4,200 m<sup>2</sup>) in size was selected for sampling over two successive years (2010 to 2012). Four white variety palms were selected based on uniform size, age (5 years), shape, height, and vegetative growth. The orchard was farmed under normal agricultural practices without pruning the fronds and application of chemical control measures before and during the period of investigation. Bimonthly surveys consisted of removing 12 leaflets (3 leaflets from each direction) which were removed from each palm tree

and transporting them to our laboratory in polyethylene bags. The leaflets were examined under a stereo-microscope, and the numbers of live white palm scales per leaflet were recorded. Directional preference was determined by applying the following formula (Mahmoud, 1981) (Figure 1):

$$F_1 = E - W$$

$$F_2 = N - S$$

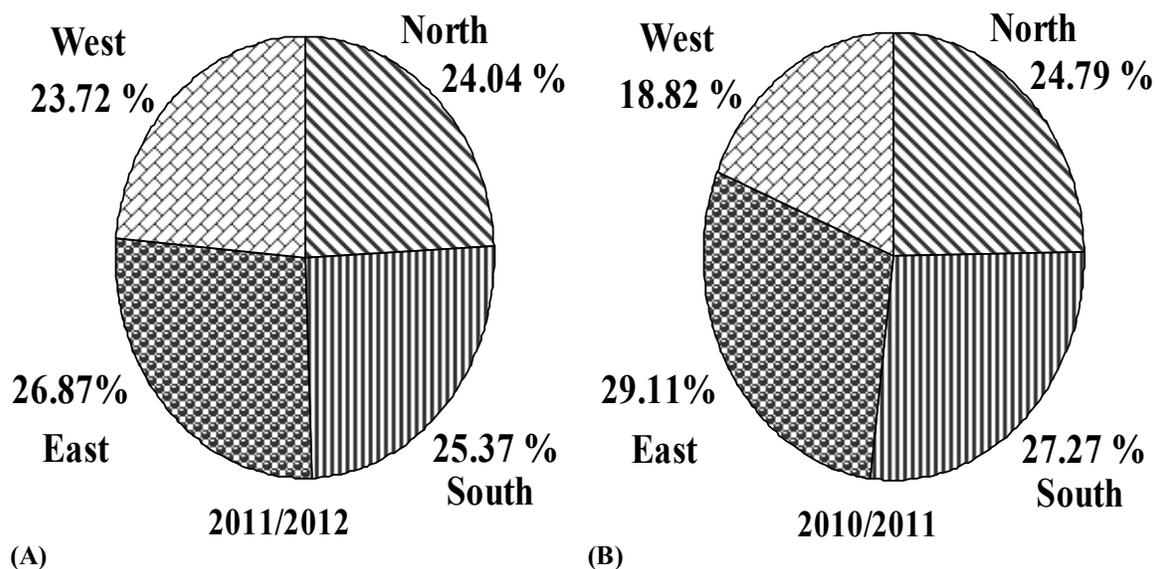
$$\tan.Q = F_2 / F_1$$

**F<sub>1</sub>:** Mean number of insects in the east direction minus insect numbers in west direction, if the former is higher, and the reverse if the latter is higher.

**F<sub>2</sub>:** Mean number of insects in the north direction minus insect numbers in south direction, if the former is higher, and the reverse applies if the insect number in south direction is higher. The figure obtained represents the tangent: the corresponding values of which was obtained from the mathematical table.

**tan.Q:** Tan of the angle between the two forces.

*P. blanchardii* population distributions on the different parts of date palm leaflet (i.e. basal, middle and apical parts) were determined by dividing leaflets into three equal sections (basal, middle and apical). The numbers of *P. blanchardii* were recorded, by leaf section, for both upper and lower leaf surfaces. Bimonthly samples were calculated as the mean numbers of *P.*



**Figure 2.** Cardinal distribution of nymphs and adult stages of *P. blanchardii* on date palm at Esna district, Luxor Governorate , Egypt, over a two year period from autumn 2010 to summer 2012).

*blanchardii* per inch<sup>2</sup> of leaflet. The distributions of *P. blanchardii* infestations for different stratum on fronds were determined by dividing each of the 12 frond leaflet samples into three equal stratum of 4 leaflets, each (*i.e.* basal, middle and apical stratum). The numbers of scale insects were counted and mean numbers per inch<sup>2</sup> determined. Data were analyzed using analysis of variance (ANOVA) at significance levels of  $P \leq 0.05$  using LSD values (MSTATC Program software, 1980).

## RESULTS AND DISCUSSION

### Distribution patterns of *P. blanchardii* on the cardinal directions of date palm trees

The bi-monthly mean cardinal distribution of *P. blanchardii* (average no. of scale insect per leaflet) at Esna district, Luxor Governorate, Egypt, for years 2010-2012 were determined (Tables 1 and 2, Figure 2). Analysis of variance demonstrated significant differences between the population means of the four cardinal directions. The means for each of the 12 month periods (2010/11 and 2011/12) were higher for the eastern direction (102.8 and 94.03/leaflet), followed by southern site (96.26 and 88.79/leaflet). In contrast, west direction was the least infested by insect (66.43 and 83.03/leaflet). While, the north site were moderately infested with this insect as mean (87.48 and 84.12/leaflet). Overall mean populations *P. blanchardii* per leaflet were highest for each of the years during the autumn (117.57 and 98.23), followed by winter (87.02 and 92.45), summer (83.88 and 90.84), and spring (64.45 and 68.46).

During the first year (2010/2011) of the study, there were significant differences between cardinal directions for each of the seasons. Also, significant differences were observed between cardinal directions for comparisons of combined effect for the whole year. Data show that leaflets collected from the east side of the palm trees accounted for 26.87 to 29.11% of the total scale insect population, followed by the south (25.37 to 27.27%), north (24.79 to 29.04%), and the west (18.82 to 23.72%) (Table 2 and Figure 2). These results show that the preferred site of infestation of scale insects are the east and south sides of palm trees and were similar to those of Al-Hafidh et al. (1981) and Swaminathan and Verma (1991). Aly (1984) and Eraki (1998) in Egypt, also reported significant differences between the four cardinal directions of date palm trees, while El-Said (2000) and El-Sherif et al. (2001) reported that *P. blanchardii* infestations on date palm leaflets were highest for south facing leaflets. These differences in their distributions might be attributed to the pooled effect of the wind direction and the duration of leaflets exposure to the sun rays (Eraki, 1998). Such deduction seems to be logic in the light of the fact that in the study area the main wind direction was north-west and thus drifts more newly emerged crawlers southeastwards where they may aggregate for feeding and growth (El-Said, 2000). These results are important in the development of pest control programs.

### Relative distribution of infestation on the different parts of leaflet and its surfaces

The mean numbers of scale insects per square inch were signifi-

**Table 1.** Seasonal mean number of nymphs and adult stage *P. blanchardii* on date palm leaflets for years 2010-11 and 2011-12 at Esna district, Luxor Governorate, Egypt.

Seasons	Date palm tree directions				Mean	L.S.D. at %5
	North	South	East	West		
<b>Average no. of scale insect per leaflet</b>						
<b>2012/2011</b>						
Autumn	117.17	129.46	137.38	86.29	117.57	13.06**
Winter	86.29	94.87	100.54	66.38	87.02	11.49**
Spring	63.66	70.55	75.85	47.71	64.45	5.34**
Summer	82.81	90.14	97.23	65.33	83.88	22.57*
Mean	87.48	96.26	102.75	66.43	88.23	8.28**
<b>2012/2011</b>						
Autumn	92.6	100.8	106.5	93.1	98.23	N.S
Winter	90.4	93.8	98.4	87.1	92.45	N.S
Spring	65.2	69.8	74.6	64.3	68.46	6.93*
Summer	88.2	90.8	96.7	87.6	90.84	N.S
Mean	84.12	88.79	94.03	83.03	87.49	7.92*

<sup>1</sup> L.S.D.: Least significant difference; \* significant for P<0.05; \*\* significant for P<0.01; N.S. = Not Significant.

**Table 2.** Percentages of *P. blanchardii* population on date palm occurred in different sites at Esna district, Luxor Governorate during the two years of study.

Directions	Mean no. of scale insects/ leaflet			Annual % of scale insect populations		
	2010/2011 year	2011/2012 year	Mean	2010/2011	2011/2012	Mean
North	87.48	84.12	85.80	24.79	24.04	24.41
South	96.26	88.79	92.52	27.27	25.37	26.33
East	102.75	94.03	98.39	29.11	26.87	28.00
West	66.43	83.03	74.73	18.82	23.72	21.26
Total	352.91	349.98	351.45	100	100	100

cantly higher for the basal parts of the leaflets (mean 12.25 and 11.86 of scale), followed by the medial (10.25 and 10.05 of scale) and apical (7.10 and 6.93) parts of the leaflet over the two years, respectively (Table 3). Concerning, the seasons of year, the highest average of insect population occurred in autumn at the basal part of leaflet (16.27 and 13.81 individuals per inch<sup>2</sup>) followed dissentingly by the apical and medial parts of leaflet. The respective scale densities reported that the average of insect per inch<sup>2</sup> of such parts were (12.80 and 11.13) and (8.86 and 7.71 individuals per inch<sup>2</sup> of leaflet) in the two years of investigation, respectively (Table 3). Overall, mean population densities of scale insects for each of the two years were similar which may be due to the fact that the environmental condition was nearly similar. Overall, the mean

numbers of scale insects per square inch were significantly higher both the basal and medial (leaflet parts) than for the apical leaflet part and accounted for 41.39, 34.62 and 24.00% for 2010 to 2011, respectively and 41.12, 34.84 and 24.04% for 2011-2012, respectively (Table 4 and Figure 3).

The differences in distribution pattern of insect on the different parts of leaflet, may be due to the differences in the environmental conditions, wind direction, sunlight and other factors. Also, the basal part of leaflet provided good shelter for insect especially in the sensitive developmental stages and feeding and growth of insect. Previous studies show that *P. blanchardii* demonstrates a preference for the basal parts of date palm leaflets (Al-Hafidh et al., 1981; Eraki, 1998; El-Said, 2000; El-Sherif et al., 2001; Youssef, 2002). Conversely,

**Table 3.** Mean numbers of *P. blanchardii* nymphs and adults for the basal, medial, and apical portion of the date palm leaflets collected from date palms at Esna district, Luxor Governorate, Egypt, over a two year period from autumn 2010 to summer 2012).

Seasons	Date palm tree leaflets			Mean	L.S.D
	Basal	Medial	Apical		
Average no. of scale insect per inch <sup>2</sup> on leaflet					
<b>2010/2011</b>					
Autumn	16.27	12.80	8.86	12.64	0.54**
Winter	11.86	9.32	7.39	9.52	0.48**
Spring	8.59	7.97	5.35	7.30	0.47**
Summer	12.27	10.90	6.80	9.99	0.61**
Mean	12.25	10.25	7.10	9.86	0.29**
<b>2011/2012</b>					
Autumn	13.81	11.13	7.71	10.88	0.55**
Winter	12.53	9.87	7.64	10.01	0.73**
Spring	9.35	8.83	5.92	8.03	0.61**
Summer	11.76	10.37	6.48	9.54	0.63**
Mean	11.86	10.05	6.93	9.61	0.29**

<sup>1</sup>L.S.D.: Least significant difference; \* significant for P<0.05; \*\* significant for P<0.01; N.S. = not significant.

**Table 4.** Percentages of *P. blanchardii* population on date palm occurred in the different parts of date palm leaflet at Esna district, Luxor Governorate during the two years of (2010/2011 and 2011/2012).

Different parts of leaflets	Average no. of scale insect per inch <sup>2</sup> on leaflet			% of total insect population		
	2010/2011 year	2011/2012 year	Average	2010/2011	2011/2012	Average
Basal	12.25	11.86	12.1	41.39	41.12	41.25
Medial	10.25	10.05	10.2	34.63	34.85	34.74
Apical	7.10	6.93	7.0	23.99	24.03	24.01
Total	29.60	28.84	29.2	100	100	100

Hussain (1974) in Iraq and Dabbour (1981) in Saudi Arabia, reported that the scale insects were observed in higher numbers on the lower leaflet surfaces at the lowest part of the canopy. This contradiction may be due to very high temperatures of the scorching sun under environmental climatic conditions prevailing in Iraq and Saudi Arabia.

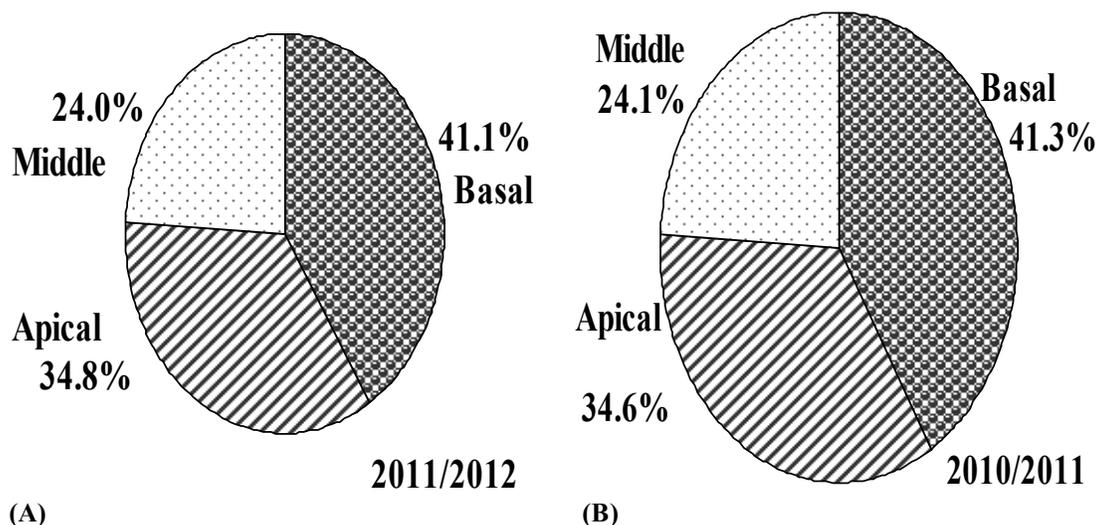
The distribution pattern of the total population of *P. blanchardii* showed that upper basal surfaces of leaflets were more heavily infested than the lower ones (Table 5 and Figure 4). The overall mean number of scale insects per inch<sup>2</sup> on the upper basal surface of leaflet was 8.74 and 8.44 over the 2 year period, respectively, while overall mean number of scale insects per inch<sup>2</sup> on the lower basal surfaces of leaflets were 3.51 and 3.42, respectively. Insect population on upper basal surface of leaflet comprised (71.36 and 71.19%) of the total number of insects, while these values ranged between (28.64

and 28.81%) on the lower basal surface of leaflet for two years, respectively. This means that the insect behaves as photopositive and the upper surface of leaflet were exposed to more sunlight than the lower ones.

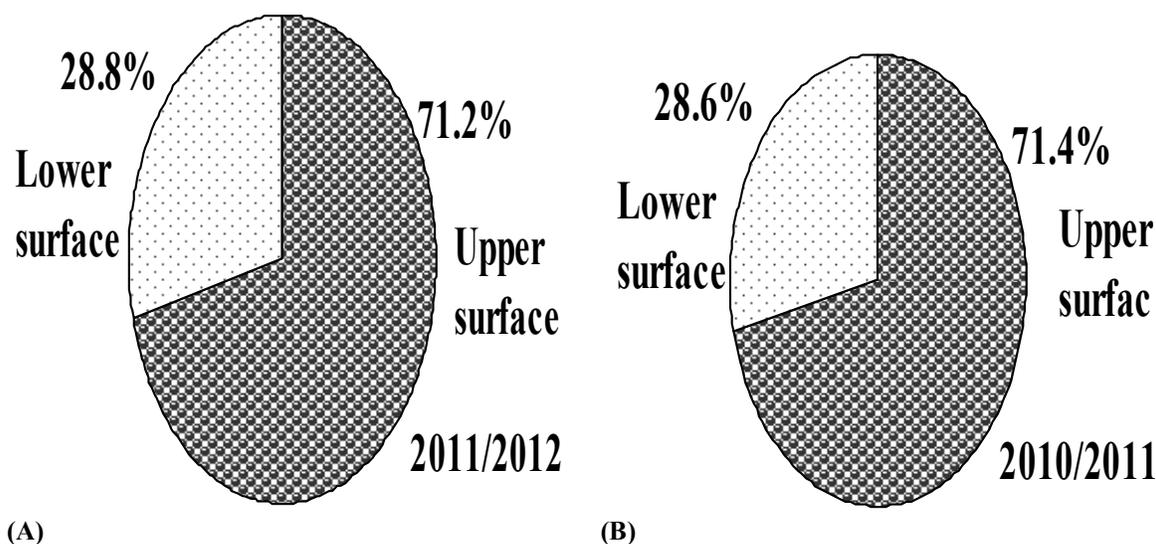
The aforementioned results emphasize that *P. blanchardii* prefers the upper basal surface of date palm leaflet than the lower ones. These results were agreeable with Mourad and Zanucio (1998) and Youssef (2002) in Egypt, they reported that the scale preferred the upper surface of leaflets.

#### Distribution of infestation on frond (leaf)

The relative distribution of the total population of *P. blanchardii* (as mean numbers of insect per inch<sup>2</sup> of leaflet were determined depended on upper basal surface of leaflet) on



**Figure 3.** Relative distribution of nymphs and adult stages of *P. blanchardii* on the different parts of date palm leaflets at Esna district, Luxor Governorate during the two years of 2010/2011 and 2011/2012.



**Figure 4.** Relative distribution of nymphs and adult stages of *P. blanchardii* on the surfaces of date palm leaflet at Esna district, Luxor Governorate during the two years of 2010/2011 and 2011/2012.

the different stratum (basal, middle and apical) on frond was counted and determined in Tables 6 and 7 and illustrated by pie-charts in Figure 5.

Data in Table 6 indicated that the statistical analysis of data revealed there were highly significant, differences between different stratum (basal, middle and apical) on frond in seasons of year were counted and recorded during the two years, when the comparison were directed for each season separately or for the combined effect on all seasons of the whole year. During the first year of 2010/2011, the highest average of insect population occurred in autumn months at the

basal stratum of frond as mean (14.61 individuals per inch<sup>2</sup>), followed dissentingly by the apical and medial stratum of frond. The respective scale densities reported that the average of insect per inch<sup>2</sup> of such stratum were 10.20 and 8.45 individuals per leaflet, respectively (Table 6). In contrary, in the winter season of the second year of the study (2011/2012) received the highest population density of insect than the other seasons, as mean (11.67, 8.88 and 7.36 individuals per inch<sup>2</sup>) for the basal, medial and apical stratum of frond, respectively.

As shown in Table 7 and illustrated by pie-charts in Figure 5, it indicated that the basal stratum of fronds received the highest

**Table 5.** Percentages of *P. blanchardii* population on date palm occurred on the surfaces of date palm leaflet at Esna district, Luxor Governorate during the two years of (2010/2011 and 2011/2012).

Surfaces of leaflet	Average no. of scale insect per inch <sup>2</sup> on leaflet			% of total insect population		
	2010/2011 year	2011/2012 year	Average	2010/2011	2011/2012	Average
Upper basal	8.74	8.44	8.60	71.36	71.19	71.26
Lower basal	3.51	3.42	3.47	28.64	28.81	28.74
Total	12.25	11.86	12.07	100	100	100

**Table 6.** Average numbers of nymphs and adult stages of *P. blanchardii* on the different stratum of date palm frond during seasons of year at Esna district, Luxor Governorate during the two year of (2010/2011 and 2011/2012).

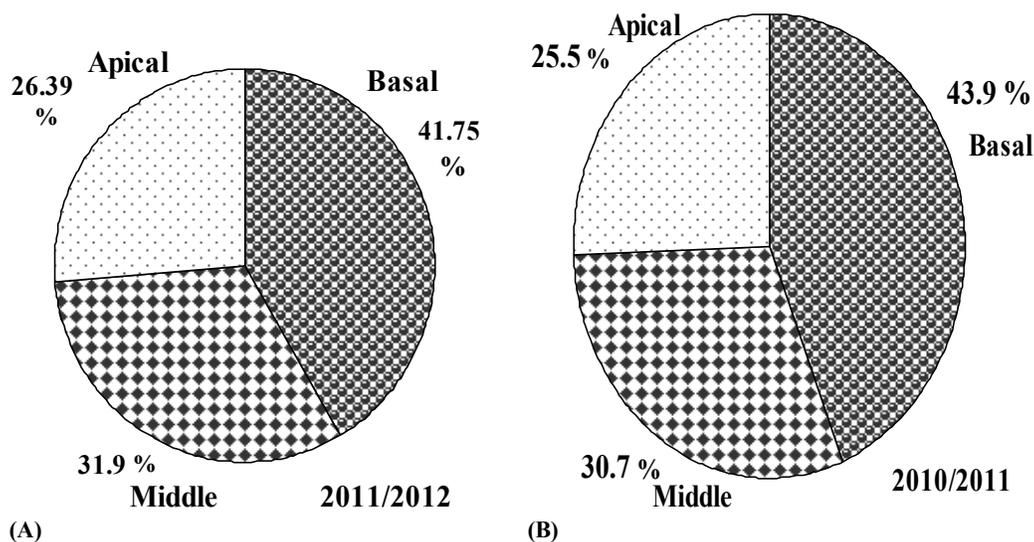
Seasons	Date palm tree fronds			Mean	L.S.D. %5
	Basal	Medial	Apical		
Average no. of scale insect per inch <sup>2</sup> of frond					
<b>2010/2011</b>					
Autumn	14.61	10.20	8.45	11.08	0.40**
Winter	11.83	8.28	6.86	8.99	0.41**
Spring	7.72	5.52	4.58	5.94	0.24**
Summer	11.38	7.96	6.60	8.65	0.28**
Mean	11.38	7.99	6.62	8.66	0.18**
<b>2011/2012</b>					
Autumn	11.41	8.64	7.16	9.07	0.36**
Winter	11.67	8.88	7.36	9.31	0.48**
Spring	7.75	6.02	4.99	6.25	0.37**
Summer	10.03	7.63	6.32	7.99	0.27**
Mean	10.21	7.79	6.46	8.16	0.20**

**Table 7.** Percentages of *P. blanchardii* population on date palm occurred on the different stratum of date palm frond at Esna district, Luxor Governorate during the two years of (2010/2011 and 2011/2012).

Different stratum of frond	Average no. of scale insect per inch <sup>2</sup> on frond			% of total insect population		
	2010/2011 year	2011/2012 year	Average	2010/2011	2011/2012	Average
Basal	11.38	10.21	10.80	43.79	41.74	42.76
Medial	7.99	7.79	7.89	30.74	31.86	31.3
Apical	6.62	6.46	6.54	25.47	26.39	25.94
Total	25.99	24.46	25.23	100	100	100

infestation (43.79 and 41.75%) in 2010/2011 and 2011/2012, respectively and the apical stratum of frond was the least infested by insect (25.47 and 26.39%) for two years. Infestation on the middle stratum of the frond was moderately infested by

this pest (30.74 and 31.86%) in 2010/2011 and 2011/2012, respectively. In addition, the basal stratum of frond was the most preference stratum to this pest as mean (11.38 and 10.21 of scale per inch<sup>2</sup>), followed by the middle stratum of the frond



**Figure 5.** Relative distribution of nymphs and adult stages of *P. blanchardii* on the different strata of date palm frond at Esna district, Luxor Governorate during the two years of 2010/2011 and 2011/2012.

as mean (7.99 and 7.79 of scale per inch<sup>2</sup>) for two years, respectively, while the apical stratum was the least infestation by insect as mean (6.62 and 6.46 individuals) in 2010/2011 and 2011/2012, respectively.

In general, it could be concluded that the basal stratum on fronds in the all seasons of year during the two years of study, received the highest population density of insect than the other strata. The differences in distribution pattern of insect on the different strata of frond, which may be due to the differences in the environmental conditions and other factors and the old leaflets of the date palm trees become accumulated by *P. blanchardii*.

The aforementioned results emphasize that; *P. blanchardii* prefers the basal stratum of date palm frond than the middle or apical ones. These results were disagreeable with Eraki (1998) who reported that a non significant difference between the population densities on the three stratum of the frond throughout the year.

### Conflict of interest

Authors declare that there are no conflicts of interest.

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