Estimation of the annual field generations of *Parlatoria blanchardii* and prediction of its expected peaks using thermal units accumulation under Luxor governorate condition, Egypt.

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ABSTRACT

Key words: Parlatoria blanchardii, annual generation, age structure, seasonal abundance, heat units, predicting, date palm trees, control.

The date palm scale, *Parlatoria blanchardii* (Targioni-Tozzetti) is a target pest of date palm trees causing severe damage resulting in early leaves drop and yield reduction. In the current study, the approximated numbers, occurrence date, size of the generations and their peaks of *P. blanchardii* were determined during two succesive seasons (2010/2011 & 2011/2012) in order to predict the degree day's units and annual generation peaks using the relationship between the accumulated thermal heat units expressed as degree-days (DD's) and the population fluctuations of insect that help to find out a proper controlling time. The obtained results revealed that the date palm scale has four field generations under the climatic conditions in Luxor Governorate. The winter generation in the two studies seasons was the longest and biggest one than the other three generations. A discrepancy average of -24.8 and -28.5 days between observed and expected peaks was recorded for the two studied seasons, respectively. The general deviation average indicated delay in the expected peaks compared to the observed peaks with an average of 26.6 days. Based on the obtained results, four periods (beginning of October, mid-November to mid of December, mid –April & beginning to mid-June) could be recommended as ideal time for the chemical control of this pest.

INTRODUCTION

The white date palm scale, *Parlatoria blanchardii* (Targioni-Tozzetti) is considered as target pest of date palm trees causing remarkable damage by sucking the plant sap that give low rates of photosynthesis and respiration which leads to curling, yellowing, dropping to leaves and subsequently, cause considerable qualitative and quantitive yield losses and also affecting the marketing value of the fruits **(El-Said, 2000)**. A characteristic symptom of infestation by *P. blanchardi* is the appearance and accumulation of its scales on attacked palm parts **(El-Sherif *et al*., 2001 and Blumberg, 2008).** Most authors indicated three or four generations per year for *P. blanchardii* depending on the area, environmental conditions and the host plant world wide. in Iraq**, Abdel-Ahad and Jassim (1983)**, reported five overlapping generations a year on date-palm trees. In Damietta Governorate, Egypt**, Abdel-Kareim and Awadalla (1998)** observed three complete generations of *P. blanchardii* with a partial fourth generation annually. **El-Said (2000)** and **El-Sherif *et al*. (2001)** in North Sinai, Egypt, reported that the *P. blanchardii* had four annual peaks corresponding to the four annual generations. Peaks were recorded in mid-May, mid-July, mid-September and mid-November in the first season and early May, mid-July, mid-September and early December in the second seasons. **Elwan and El-Said (2009)** in Egypt, indicated that *P. blanchardii* had four annual overlapping generations per year. Degree-days can be defined as the units combining between time and temperature, used to measure the development of an organism from one

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point to another in its life cycle **(Wilson and Barnett 1983).** So, using degree-days allows for predicting pest occurrence, also can be an aid tool for scheduling sprays and beneficial insect releases at the optimum time to insure the best results, and helpful in monitoring pest activity. As the appearance of *P. blanchardii* varies greatly from year to another, it can be predicted by the standard degree-days method.

The current study was carried out for predicting and monitoring population systems based on the seasonal fluctuations and the annual generations of the *P. blanchardii* and to predict the annual generation peaks of *P. blanchardii* in the field using the relationship between the accumulated thermal heat units expressed as degree-days (DD's) and the population fluctuation of *P. blanchardii* at Esna district, Luxor Governorate.

MATERIALS AND METHODS

1- Seasonal abundance of *P. blanchardii*:

The seasonal abundance of *P. blanchardii* at Esna district, Luxor Governorate was observed during the two successive seasons (2010/2011 and 2011/2012). An orchard about one feddan was selected for sampling and four palms of the White variety that are almost similar and as uniform as possible in size, age (5 years), shape, height and vegetative growth were selected. The selected trees received the normal agricultural practices without pruning the fronds and application of any chemical before and during the period of investigation. Sampling was conducted at half-monthly intervals with a sample size of 12 leaflets from each palm at a rate of (3 leaflets) from all directions. Regular half-monthly samples were collected and immediately transferred to laboratory in polyethylene bags for inspection by the aid of stereo-microscope. the alive individuals on the upper and lower surfaces of the leaflets were individually sorted into immature stages (first instar nymphs and second instar nymphs) and mature stages (adult females and gravid females) and then were counted and recorded together opposite to each inspected date.

2-Age structure and number of annual generations of *P. blanchardii* in the field:

To calculate the age structure per sample, the mean number of each stage was divided by the total and multiplied by 100. This way gave each stage a percent proportion of the total per sample regardless the total number of presented insect (i.e. population density). The number of generations was determined using the obtained data throughout the two successive seasons using the age-structure technique per sample over the season.

3- Predicting of *P. blanchardii* annual generation peaks using thermal units accumulations:

Prediction of *P. blanchardii* annual generations was carried out by determining the relationship between the thermal heat units expressed as degree-days (DD's) and the percent of first instar nymphs of the total population of the insect during the two studied seasons. The half-monthly mean counts of age structure of first instar a whole were graphically illustrated to determine the population peaks (actual observed peaks). Then, observed peaks were compared with the expected ones as a tool to estimate heat requirements for predicting the *P. blanchardii* annual generations.

Generations of *P. blanchardii* expressed as the real peaks (actual observed peaks) that occurred in the field, were recorded based on the age structure of the first instar nymphs. The time at which the mean maximum percent of first instar nymphs has been attained was considerd as a peak for a generation.

Heat units or degree days for *P. blanchardii* was calculated for each generation by using the lower thermal threshold for the development (t_0) of 10ºC with an average (1212.25 DD's) for generation development according to **El-Amir (2002) and Zadan *et al.* (2002)**. Degree-days were calculated by using the equations reported by **Richmond *et al.* (1983)** under fluctuating temperatures as follows:

H = Σ H J (Where: H = number of degree-days units)

H J = {(max + min)/2} – C (If max. > C and min. > C)

H J = {(max. – C)^2 / 2 (max.-min.)} (If max. > C and min. < C)

H J = Zero (If max. < C and min. < C)

C = t_0

The application used the maximum and minimum temperatures per day to calculate degree-days and its accumulation over a period of time by using the above mentioned equations.

RESULTS AND DISCUSSION

1-Seasonal abundance of *P. blanchardii*:

The half-monthly counts of *P. blanchardii* different stages infested date palm trees at Esna district, Luxor Governorate were recorded through the two successive years (2010/2011 and 2011/2012). Also, means of the half-monthly records of temperature, relative humidity and dew point throughout the two years of investigations. The obtained results (Table1 & 2) revealed 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 (2010/2011) and during the mid-October, mid- December, mid-April and mid-June in the 2nd year (2011/2012).The autumn and spring months during the 1st year (2010/2011) and autumn and summer during the 2nd year (2011/2012) were the most favourable period for *P. blanchardii* activity under the climatic conditions.

2- Age structure and generations determination:

2.1- Estimation of insect age-structure population for the white date palm scale insect infesting leaflets of the date palm trees:

Figure (1 & 2) present the age – frequency data for *P. blanchardii* population on date palm trees during the two successive seasons (2010/2011 and 2011/2012), respectively.

The age-structure population of *P. blanchardii* showed a total population of 2117.5 and 2101.9 individuals in 2010-2011 and 2011-2012, respectively. The 1st instar nymphs were represented by 705.1 and 679.6 individuals per leaflet (33.3 % and 32.3% of the total population) during the two years of study. On the other hand, the 2nd instar nymphs were represented by 508.6 and 495.7 individuals per leaflet (24.0 % and 23.6 % of the total population) in 2010-2011 and 2011-2012, respectively. While, the adult females were represented by 429.9 and 442.1 individuals per leaflet (20.3 % and 21.0 % of the total population) during the two seasons of the study, respectively. However, the gravid females were represented by 473.9 and 484.5 individuals per leaflet (22.4 and 23.0% of the total population) in the two years of investigation, respectively. The percentages of the age-structure population of this insect species, during both years of study, were almost similar.

Concerning, the first year of (2010/2011), the highest percentage of the 1st instar nymphs (40.2%) was observed in mid- December, whereas, the lowest one (22.8%) was recorded during mid-February. while the highest percentage of the 2nd instar nymphs (35.1%) was recorded in mid - October, and the lowest percentage (15.4%) was recorded during mid-November. On other hand, the highest percentage of adult females (36%) was observed in mid-February, whereas, the lowest one (10.20%) was recorded during beginning of July. The highest percentage of the gravid females (31.7%) was shown in mid - April, whereas, the lowest one (12.5%) was observed during beginning of August (Fig. 1)

Regarding, the second year of study (2011/2012), the highest percentage of the 1st instar nymphs (37.45%) was recorded in mid-December, whereas, the lowest one (26.89%) was observed during mid-November. In case of the 2nd instar nymphs the highest percentage (35.79%) was observed in beginning of November, whereas, the lowest percentage (14.79%) was recorded during beginning of October. The highest percentage of adult females (30.04%) was recorded in beginning of June, whereas, the lowest one (12.17%) was recorded during mid-April. On other hand, the highest percentage of the gravid females (31.7%) was shown in mid - April, whereas, the lowest one (14.77%) was observed during mid – November (Fig. 2).

The age-structure population was considerably differed among between months ad between the two years of study. These results may be attributed to the differences of environmental factors that prevailing during the two years of study. **Metcalf and Luckmann (1975)** reported that certain environmental conditions may alter the physiology of the plant to the extent that it becomes suitable or unsuitable as a host for a certain pest. **Dent (1991)** stated that the seasonal phenology of insect numbers, the number of generations, and the level of insect abundance at any location are influenced by the environmental factors at that location.

2.2- Number of annual generations of *P. blanchardii* using the age-structure technique:

The results of applying the age-structure technique to the seasonal abundance data of *P. blanchardii* during the two years of study on date palm are represented in Tables (1 and 2).

Obtained trend over both years indicated the occurrence of four generations per years for *P. blanchardii* on date palm trees at Esna district, Luxor Governorate were recorded through the two successive years (2010/2011 and 2011/2012) (Table 3& Fig. 3).

In the first season (2010/2011), the first generation started during the early of September, 2010 (i.e. transformation of gravid females (egg) to first nymphal instar) and continued until beginning of November, 2010 with total duration of about 78 days and generation size of 179.99 individuals per leaflet during the 1st year of (2010/2011), while in the second year (2011/2012), the 1st generation appeared from the beginning of September, 2011 and continued until mid-November, 2012 (92 days) with the a total size of 182.86 individuals per leaflet. These periods during the two years of study (marked by maximum population of gravid females). The following count showed that most of these females were in ovipositing stage in a much synchronized fashion (which indicates the optimal conditions for the development of this insect).Therefore the date of beginning of November in the 1st year and mid-November in the 2nd year were considered as the end of this generation and the start point for the next generation.

The second generation occurred during a period extended from the beginning of November to the mid - February, 2011. This generation lasted 106 days with total size of 257.96 individuals per leaflet for the first year. But, in the second year, the second generation extended from mid-November to the beginning of March, 2012 (106 days) with a total size reached 211 individuals/ leaflet. Hence the date of mid of February, 2011 in the 1st year and beginning of March, 2012 during the 2nd year were considered as the end of this generation and the start point for the next generation. The third generation lasted 106 days extended from mid-February to beginning of June, with total size 159.06 individuals per leaflet in the first year. While, this generation was started at beginning of March and continued until to beginning of June (92 days) with a total size was 156.49 individuals per leaflet in the second year. Whereas, the date of beginning of June for two years of study was considered as the end of this generation and the start point for the fourth generation. The fourth generation for this insect continued to the end year which lasted about 75 days appeared from beginning of June to the end of August, with total size 173.39 and 176.39 individuals per leaflet during the first and second seasons, respectively.

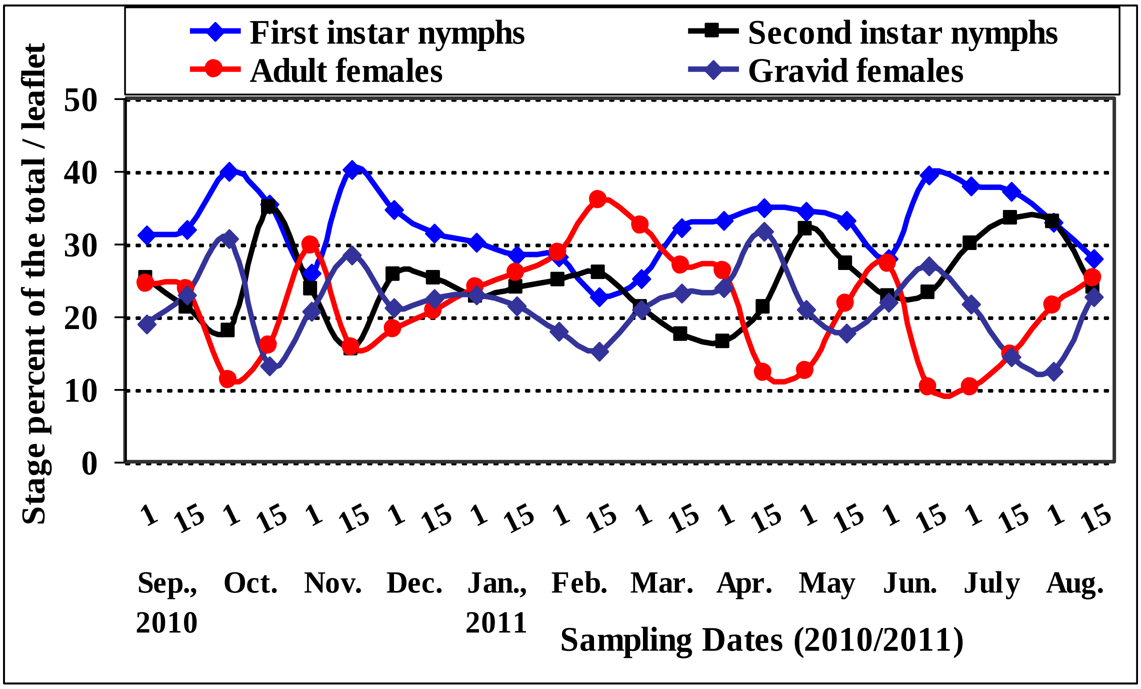

Fig. (1). The age structure of *P. blanchardii* stages on date palm trees at Esna district, Luxor Governorate during (2010/ 2011).

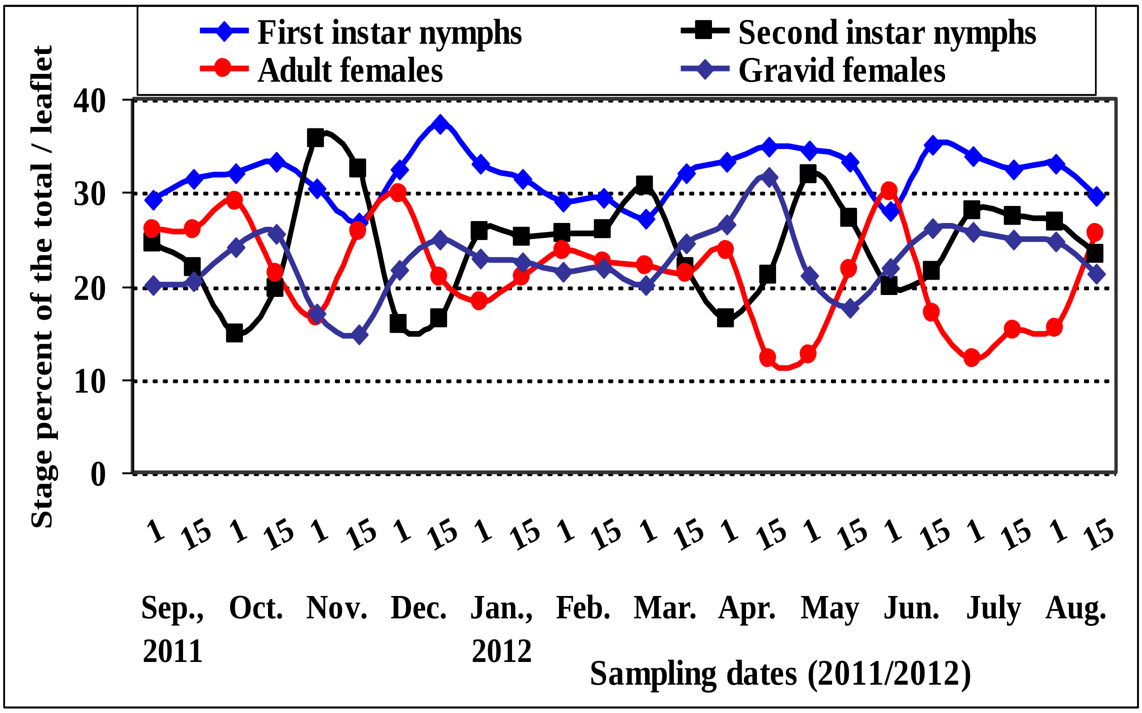

Fig. (2). The age structure of *P. blanchardii* stages on date palm trees at Esna district, Luxor Governorate during (2011 / 2012).

Table (1). The half monthly mean numbers of *P. blanchardii* first instar nymphs at Esna district, Luxor Governorate during (2010/ 2011).

Inspection date		Mean number of individuals /leaflet	Climatic factors						Heat units calculation	
			Max. temp.°C	Min. temp.°C	Range temp.°C	Mean temp.°C	% R.H.	Dew point° C	Degree days (DD's)	Accumulated heat unit (AHU)
September, 2010	1	21.0	42.1	27.5	14.59	34.8	21.7	34.8	24.8	444.5
	15	32.8	40.3	24.4	15.86	32.4	23.6	32.4	22.4	753.5
October	1	55.7	39.7	23.8	15.88	31.8	25.5	31.8	21.8	1106.0
	15	37.7	38.6	22.6	15.93	30.6	25.6	30.6	20.6	1392.0
November	1	32.8	37.6	21.1	16.47	29.4	26.9	29.4	19.4	1712.5
	15	65.8	33.0	17.0	16.00	25.0	33.6	25.0	15.0	1925.0
December	1	45.7	31.7	16.1	15.56	23.9	35.9	23.9	13.9	2142.5
	15	34.9	25.6	10.6	15.07	18.1	38.5	18.1	8.2	2251.2
January, 2011	1	28.2	25.2	8.9	16.29	17.1	39.8	17.1	7.3	2375.7
	15	23.9	22.1	7.4	14.71	14.7	48.3	14.7	5.0	2445.9
February	1	17.7	23.3	8.2	15.06	15.8	45.9	15.8	5.9	2548.9
	15	9.1	26.6	12.6	14.00	19.6	44.4	19.6	9.6	2683.7
March	1	12.2	25.9	12.1	13.79	19.0	41.4	19.0	9.0	2809.2
	15	20.6	27.2	11.4	15.79	19.3	30.1	19.3	9.3	2940.9
April	1	25.1	28.8	15.3	13.53	22.1	32.4	22.1	12.1	3151.4
	15	30.4	30.3	16.4	13.86	23.4	25.1	23.4	13.4	3335.9
May	1	22.1	34.1	18.1	15.94	26.1	19.2	26.1	16.1	3596.4
	15	16.1	35.9	20.5	15.36	28.2	18.1	28.2	18.2	3848.4
June	1	23.4	38.4	22.1	16.29	30.3	18.3	30.3	20.3	4200.9
	15	44.6	41.1	25.6	15.50	33.3	17.2	33.3	23.3	4523.4
July	1	35.5	39.3	24.5	14.75	31.9	19.6	31.9	21.9	4876.9
	15	27.8	41.7	25.3	16.40	33.5	19.8	33.5	23.5	5209.4
August	1	22.2	41.8	28.2	13.65	35.0	20.1	35.0	25.0	5634.9
	15	19.9	40.9	27.7	13.20	34.3	20.9	34.3	24.3	5971.9

Table (2). The half monthly mean numbers of *P. blanchardii* first instar nymphs at Esna district, Luxor Governorate during (2011/2012).

Inspection date		Mean number of individuals /leaflet	Climatic factors						Heat units calculation	
			Max. temp.°C	Min. temp.°C	Range temp.°C	Mean temp.°C	% R.H.	Dew point° C	Degree days (DD's)	Accumulated heat units (AHU)
September, 2011	1	26.95	39.82	24.82	15.00	32.32	20.88	12.82	22.3	6349.9
	15	34.83	38.50	24.57	13.93	31.54	24.64	13.57	21.5	6652.4
October	1	38.44	37.69	22.50	15.19	30.09	26.31	13.31	20.1	6972.4
	15	41.63	36.36	20.64	15.71	28.50	26.71	12.21	18.5	7229.9
November	1	23.97	33.00	18.41	14.59	25.71	33.71	12.12	15.7	7489.9
	15	17.05	29.07	12.71	16.36	20.89	34.00	7.71	10.9	7640.4
December	1	25.92	24.13	10.25	13.88	17.19	40.56	6.63	7.2	7751.7
	15	50.92	24.64	7.29	17.36	15.96	43.00	5.79	6.2	7839.5
January, 2012	1	42.07	23.47	7.71	15.76	15.59	45.65	5.88	5.9	7938.0
	15	31.25	19.71	5.36	14.36	12.54	44.57	3.29	3.4	7983.8
February	1	18.28	21.82	6.06	15.76	13.94	42.41	3.65	4.6	8063.8
	15	15.29	24.79	9.29	15.50	17.04	29.57	2.57	7.2	8173.5
March	1	10.23	25.33	9.87	15.47	17.60	33.40	4.80	7.7	8280.2
	15	13.30	27.07	11.00	16.07	19.04	21.07	0.64	9.1	8412.5
April	1	25.84	27.47	11.29	16.18	19.38	18.76	-0.18	9.4	8579.4
	15	31.39	34.93	17.86	17.07	26.39	11.57	0.71	16.4	8811.4
May	1	30.37	36.44	18.38	18.06	27.41	8.50	-1.44	17.4	9089.9
	15	25.46	37.79	21.00	16.79	29.39	9.14	1.57	19.4	9364.4
June	1	19.89	39.88	24.47	15.41	32.18	9.82	4.29	22.2	9743.4
	15	40.74	41.43	24.50	16.93	32.96	14.14	8.36	23.0	10065.4
July	1	33.97	42.06	27.13	14.94	34.59	18.81	13.69	24.6	10458.9
	15	29.18	40.71	26.07	14.64	33.39	20.93	14.29	23.4	10788.4
August	1	27.12	42.65	27.18	15.47	34.91	21.65	15.41	24.9	11212.4
	15	25.49	41.64	26.43	15.21	34.04	21.07	14.29	24.0	11522.9

Table (3): Approximated number, duration and size of *P. blanchardii* generations recorded based on the first nymphal instar on date palm trees under field conditions at Esna district, Luxor Governorate during the two seasons of (2010/2011and 2011/2012).

Season	Generation	Date	Duration in days	Population size of first instar nymphs per leaflet	Means Climatic factors						Mean daily degree days (DD's) per generation
					Max. temp. °C	Min. temp. °C	Range temp. ° C	Mean temp. ° C	R.H.%	Dew point °C	
2010/2011	1st	Early September to beginning of November	78	179.99	39.64	23.89	15.74	31.77	24.69	13.74	22.4
	2nd	Beginning of November to Mid February	106	257.96	28.14	12.74	15.40	20.44	39.16	8.26	10.7
	3rd	Mid February to Early of June	106	159.06	30.89	16.07	14.82	23.48	28.61	6.42	12.5
	4th	Early of June to Mid-August	75	173.39	40.53	25.56	14.97	33.04	19.30	12.06	23.0
2011/2012	1st	Early September to Mid November	92	182.86	35.74	20.61	15.13	28.18	27.71	11.96	19.6
	2nd	Mid November to Early of March	106	211.00	24.12	8.57	15.56	16.34	39.15	5.04	6.5
	3rd	Early of March to Early of June	92	156.49	32.70	16.27	16.44	24.48	16.04	1.49	13.2
	4th	Early of June to Mid-August	75	176.39	41.40	25.96	15.43	33.68	17.74	11.72	23.7

Mean ±STD of daily heat units = 16.5 ± 6.6 DD's.

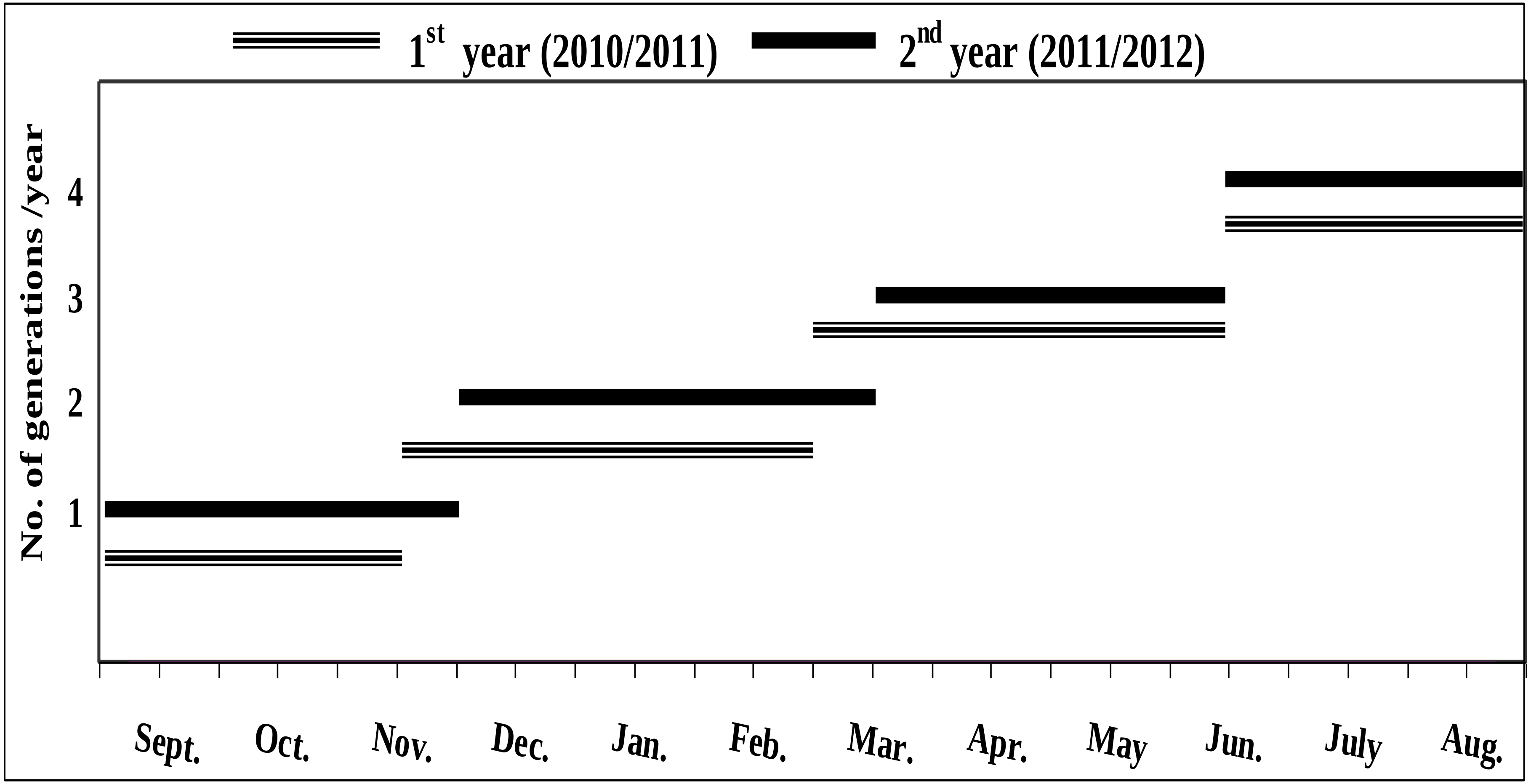

Fig. (3): Duration of the four successive annual generations of *P. blanchardii* recorded on date palm trees at Esna, Luxor Governorate during (2010/2011) and (2011/2012) seasons.

From the previously mentioned results, it could be concluded that the population of this insect during the first year was higher in size as compared with the second year. In general the winter generation in the two years was the longest one and biggest in size than the other three generations. This evidence may be due to the different fluctuations of climatic factors. In both years, the four generations could be arranged according to their size in the following order as follows:

First < second > third < fourth generation.

The above mentioned results are in agreement with those obtained by **Bénassy (1990)** in Iran, found that female development ranged from 85 to 100 days in the spring and 120 to 150 days for the winter generation. The life cycle of *P. blanchardii* duration as about 75 days in summer to 150-180 days in winter. In Egypt, **Eraki (1998)**, **El-Said (2000), El-Sherif *et al*. (2001)** and **Elwan and El-Said (2009)** reported that the *P. blanchardii* had four annual generations per year**.**

3- Heat units of each generation:

The summary of applying heat units to determine *P. blanchardii* generations are presented in Table (3). For the fourth generation (summer generation) of *P. blanchardii* started during beginning of June and continued until mid of August, mean daily heat units per generation = degree-days (DD's) was estimated to be 23.0 and 23.7 (DD's) during the first and second years of study, respectively which was higher compared to the other generations, because the highest increasing in the temperature during this generation.

On the contrary, the second generation (winter generation) during the both two years of study was the lowest generation at mean daily heat units of (10.7 and 6.5 DD's) as compared to the other generations during the first and second (Table 3).

The winter generation occurred during a period from the November to the February with the gradual decrease in temperature during the fall season and dormancy of the trees during winter time which is expected to effect dramatically the insect behavior other than the scale effect of temperature on rate of growth. Most of the scales spend the period of January to late February, 2011 as adult females calculation of DD's for this generation would meaning less.

Using available meteorological data provided for Luxor area, the mean ± STD daily heat units for each of *P. blanchardii* for the two years were estimated to be 16.5 ± 6.6 DD's.

As a general trend applying the accumulated heat units was rather successful in explaining these insect generations than using changes of ambient temperatures. Results obtained from these may provide important information for predicting the field population of *P. blanchardii* or predicting the timing of a barrier chemical treatment against this insect in the field. These results are almost in agreement with those of **El-Amir (2002) and Zadan *et al.* (2002).**

Heat units calculation for *P. blanchardii* (field studies) has not been reported before in the literature except the study of **El-Amir (2002) and Zadan *et al.* (2002)** who studied the accumulated heat units calculations for *P. oleae* (field studies). This study could be a starting point in this direction and hopefully would serve in future studies concerning the prediction of seasonal fluctuations of *P. blanchardii* on date palm trees in relation to temperature change.

4- Predicting of *P. blanchardii* annual generation peaks using thermal units accumulations:

Concerning, the prediction of the annual generations of *P. blanchardii* was carried out by determining the relationship between the thermal heat units expressed as degree-days (DD's) and the percent of thew first instar nymphs from the total population of insect during the two seasons of (2010/2011 and 2011/2012). Depending on the thermal units average which required for completion generation (1212.25 DD's), that estimated by **El-Amir (2002) and Zadan *et al.* (2002)**, and by comparison between observed peaks (that occurred in the field) and respective peaks (which calculated by the formula of **Richmond *et al.*, 1983**), the following results could be revealed;

Concerning, the first generation, the prospective peak of 2010/2011 year were detected in Oct., 06th at 1220 DD's, while the actual peaks (Oct., 01st) was attained 5 days earlier than the expected peak. On the other hand, the possible peak of 2011/2012 year (Oct., 11th) took place 4 days earlier than the field peak (Oct., 15th) ats 1212 degree days.

While, the observed peak for the second generation attained 59 and 63 days earlier than the expected one in the first and second seasons, respectively. The probable peak achieved in Jan., 13th and Feb., 16th was coincided with 1215.7 and 1220 degree days of two years of 2010/2011 and 2011/2012, respectively. While, the exact peak was attained in Nov., 15th and Dec., 15th through the two successive years, respectively.

Considering data of the third generation, it was clearly evident that the expected peaks took place 19 and 32 days (May, 4th and May, 17th) were detected later than the actual peak (Apr., 15th) at 1216.2 and 1220.9 degree days for the two seasonss of 2010/2011 and 2011/2012, respectively.

On the other hand, the field observed peaks for the fourth generation (Jun., 15th) were attained 16-23 days before the occurrence of probable peak at 1225 and 1214 degree for (2010/2011) and (2011/2012) seasons, respectively.

Results in Table (4) revealed that there was a discrepancy ranged between observed and expected peaks with an average of -24.8 and -28.5 days for both successive years, respectively. The predicted peaks of generations could be detected when the accumulated thermal units reached 1212.25 degree days. For both years as a whole, the general deviation average indicated that the actual observed peak was detected earlier than the expected peak with an average of 26.6 days. The accuracy of prediction that depends on DD’s and population of *P. blanchardii* - enabling the growers and pest control advisors to reduce the monitoring period to make a true decision for pest control in the proper time, which minimize costs and the hazard of chemical control. This technique could be considered as one of the most important factor of pest management programs. Finally, it could be concluded that the prediction of *P. blanchardii* field activities is based on lower threshold of development, degree days for complete generation, maximum temperature, minimum temperature and percentage of first instar nymphs.

From the above results, four periods can be recommended for control of this insect population depending on scouting and population determination where the relative abundance of first instar nymphs was the most. The first period is during beginning of October to reduce the population in the autumn. The second timing is mid -November to mid of December before the formation of over wintering females. The third timing is mid –April. This would reduce the population in the summer and would protect the blooming period and the new formed fruits. The fourth timing is from the beginning to mid of June that help to reduce the population while most of it at the pre-adults stage. Applying of any insecticide could be guided by population determination and continues scouting. Spraying after nearly all eggs have hatched and first nymphal instar are most abundance should achieve good control.

Table (4): Comparison between the actual observed and the expected peaks of *P. blanchardii* annual generations on date palm trees and accumulated thermal units under field conditions at Esna district, Luxor Governorate during (2010/2011) and (2011/2012) seasons.

Year	Generation	Generation period		Peak		Deviation (days)	Accumulated heat units (AHU)
		From	To	Observed	Expected		
2010/2011	1st	Sept., 01st	Nov., 01st	Oct., 01st	Oct., 06th	- 5	1220
	2nd	Nov., 01st	Feb., 15th	Nov., 15th	Jan., 13th	- 59	1215.7
	3rd	Feb., 15th	Jun., 01st	Apr., 15th	May, 4th	- 19	1216.2
	4th	Jun., 01st	Aug., 15th	Jun., 15th	Jul., 01st	- 16	1225
	Average					- 24.8	1219.2
2011/2012	1st	Sept., 01st	Nov., 15th	Oct., 15th	Oct., 11th	+ 4	1212
	2nd	Nov., 15th	Mar., 01st	Dec., 15th	Feb., 16th	- 63	1220
	3rd	Mar., 01st	Jun., 01st	Apr., 15th	May, 17th	- 32	1220.9
	4th	Jun., 01st	Aug., 15th	Jun., 15th	Jul., 8th	- 23	1214
	Average					- 28.5	1216.7
General average						- 26.6	1218

(+) mean ahead of the actual observed peak, (-) mean behind the actual observed peak.

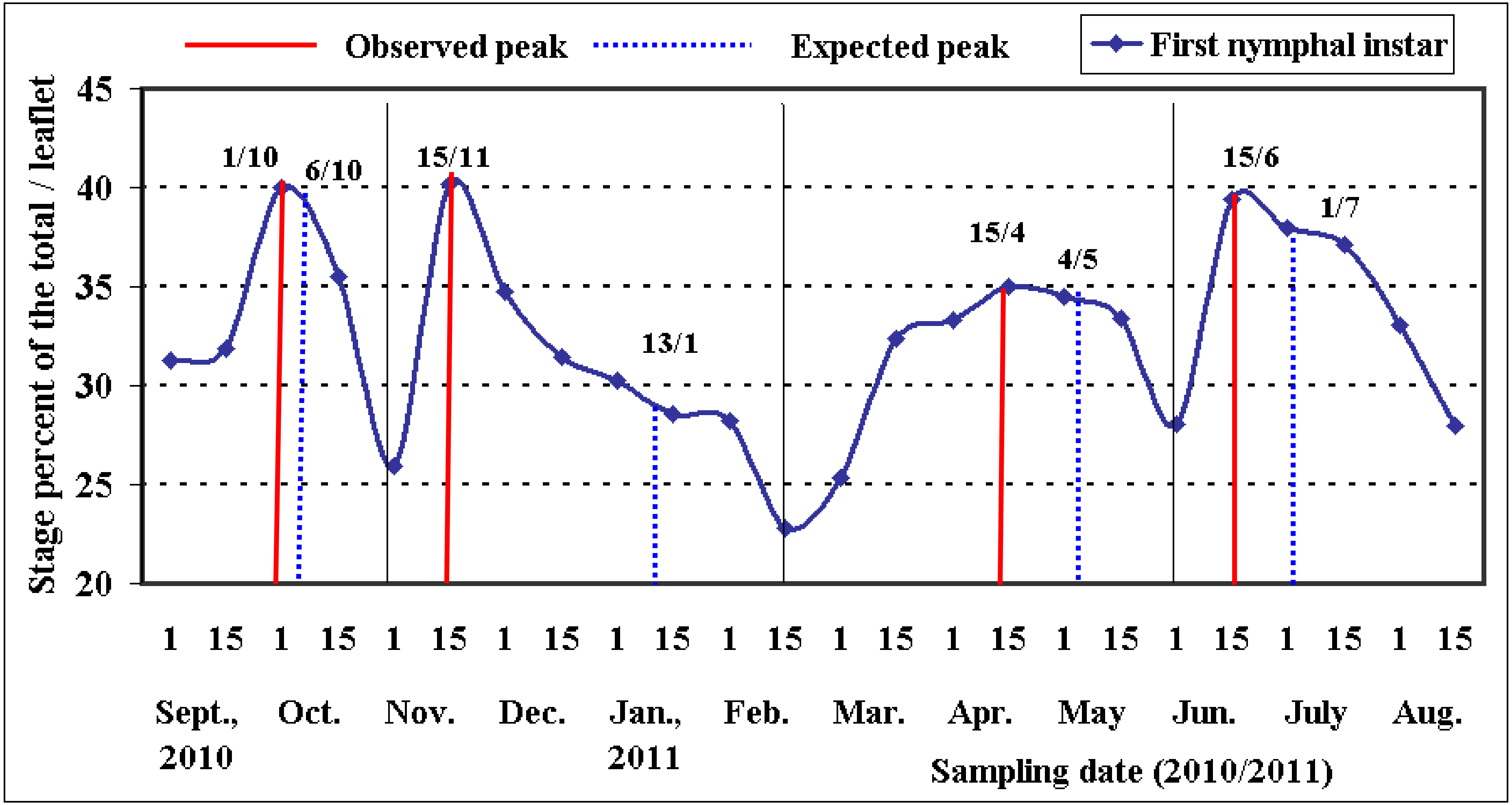

Fig. (4): Deviation between observed and expected peaks of the annual generations of *P. blanchardii* at Esna district, Luxor Governorate during (2010 / 2011).

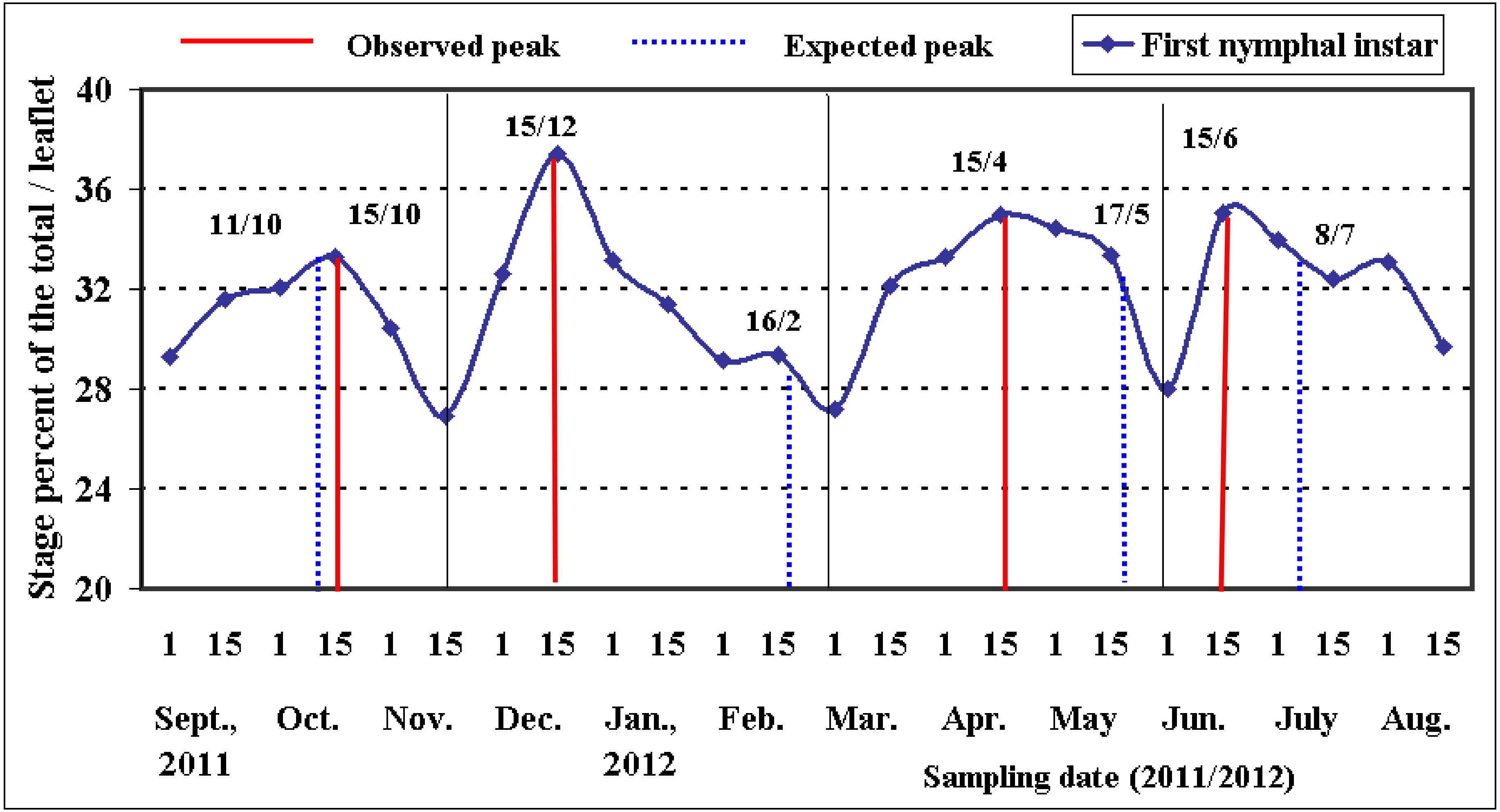

Fig. (5): Deviation between observed and expected peaks of annual generations of *P. blanchardii* at Esna district, Luxor Governorate during (2011/ 2012).

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