Journal of Plant Sciences and Crop Protection
Volume 3 | Issue 1
ISSN: 2639-3336

Research article Open Access

Seasonal Abundance of the Seychelles Scale, *Icerya Seychellarum* (Westwood) (Hemiptera: Monophlebidae) Infesting Guava Trees

Mohamed LHY and Bakry MMS*

Scale Insects and Mealybugs Research Department, Plant Protection Research Institute, A.R.C, Dokki, Giza, Egypt

***Corresponding author:** Bakry MMS, Scale Insects and Mealybugs Research Department, Plant Protection Research Institute, A.R.C, Dokki, Giza, Egypt, E-mail id: md.md_sabry@yahoo.com

Citation: Mohamed LHY, Bakry MMS (2020) Seasonal Abundance of the Seychelles Scale, Icerya Seychellarum (Westwood) (Hemiptera: Monophlebidae) Infesting Guava Trees. J Plant Sci Crop Protec 3(1): 104

Received Date: June 09, 2020 **Accepted Date:** December 21, 2020 **Published Date:** December 23, 2020

Abstract

The main objective of the present work was to study the population trend of the Seychelles scale, *Icerya seychellarum* (Westwood) (Hemiptera: Monophlebidae) on guava trees at Abu-Suwair district in Ismailia Governorate, Egypt during two consecutive years (2018-19). The results showed that insect population was recorded on guava trees all the year round and has three peaks of seasonal activity per year i.e., June, August/September and November. It indicates that the climatic conditions of autumn months during the two years were more critical based on total population density of *I. seychellarum*. Furthermore, the effect of climatic factors (daily mean maximum air temperature, minimum air temperature and mean relative humidity) on the total population of *I. seychellarum* varied during the years. The relative humidity was found the most effective variable for the changes in the insect population during both years. Also, the percentages of explained variance (E.V.) indicated that all tested variables were responsible for variability in the total insect population by 80.98 and 78.48% during the two years, respectively.

Keywords: *Psidium guajava*, Insect Pests, Scale Insect, *Icerya seychellarum*, Population Density, Honey Dew Secretion, Sooty Mould

Introduction

Guava trees, *Psidium guajava* (Myrtaceae), are subject to be infested by several pests, among which *Icerya seychellarum* (Westwood) (Hemiptera: Coccomorpha: Monophlebidae) is considered as one of the most destructive pests in Egypt (Sayed, 2008; Bakry and Arbab, 2020) [1,2]. This pest attacks the tender shoots, twigs, leaf veins, branches, and fruits by sucking the sap from the host tissues. The sap contains only a very low amount of protein; therefore, the insect may have to suck a great amount of sap to obtain an adequate quantity of protein for its growth and egg development. The high number of insects attacking the leaves, branches, and fruits of the tree result in a considerable loss of sap, which in turn manifests as leaf loss, wilting of growing tips, premature leaf drop, leaf malformation, and dwarfing. Nutrient deprivation of the trees ultimately has negative effects on the quality and quantity of fruit as well as on the general tree vigour (Mangoud, 2000; El-Said, 2006; Reda *et al*., 2010) [3-5]. Feeding by this pest species results in the excretion of large amounts of honey dew, which provides a good medium for the growth of sooty mould fungi. This, in turn, inhibits photosynthesis by the plant and may cause further leaf drop. In addition, toxic saliva secreted by the insects may result in malformed leaves and poor shoot growth (Osman, 2005) [6]. Therefore, the objective of this study was to estimate the seasonal activity and rate of monthly variation, and effect of main climatic factors on *I. seychellarum* activity to develop an effective program for its control.

Materials and Methods

The present study was carried out in private guava orchard (Abu Suwair district) at Ismailia Governorate during January 2018 to December 2019 to estimate the population density of the Seychelles scale, *Icerya seychellarum* (Westwood). This pest was identified by Dr. Fatma A. Moharum, Department of Scale Insect and Mealybugs, Plant Protection Research Institute, Agriculture Research Center, Egypt.

The selected orchard received the normal agricultural practices without application any chemical control measures before and during the period of study. Five guava trees, Balady variety, of approximately the similar age (about 10 years old), size, height, and vegetative growth were selected at random. Sample (five leaves) from the terminal shoots of each of the five trees and in each of the four wind directions were selected at fortnightly intervals (20 leaves *i.e.* 5 samples per tree).

Regular fortnightly samples were picked at random from the different directions and strata of the tree in polyethylene bags. The samples were immediately transported to the laboratory of Plant Protection Department, Agriculture Research Station at Ismailia

Governorate for inspection and were examined using a stereo-microscope. The total numbers of live insects on the upper and lower surfaces of the guava tree leaves were individually sorted into immature stages (nymphs) and mature stages (adult females) and then were counted and recorded, linked to the inspection date, and presented as mean number of individuals per sample (5 leaves) ± standard error (SE) was considered in this study to express the population size of pest.

All sampling was conducted from 4800 leaves on 48 dates over a 2-year period, *i.e.* 5 trees × 4 directions × 5 leaves × 48 dates. Also, the rate monthly variation in the population (R.M.V.P) was calculated according to the formula reported by Serag-El-Din (1998) [7].

$$\text{(R.M.V.P)} = \frac{\text{Av. count of insect at a month}}{\text{Av. count given at the preceding month}}$$

Concerning, the effect of the main weather factors on the total *I. seychellarum* population. The climatic factors data (daily mean maximum air temperature, daily mean minimum air temperature and daily mean of % relative humidity) for conditions of Ismailia Governorate were obtained from the Egypt Weather Underground site, https://www.wunderground.com/global/EG.html.

According to the results of the simple correlation, regression coefficient and the partial regression formula which was adopted to find out the simultaneous effects of tested main weather factors on *I. seychellarum*. The partial regression method termed the C-multipliers was adopted according to Fisher (1950) [8]. Averages of different stages of insect population and climatic factors was calculated and shown graphically by Excel sheets. Statistical analysis in the present work was carried out with Computer using MSTATC Program software (1980) [9] to determine the preferable time for the insect activity and the proper time for its control.

Results and Discussion

Seasonal Activity of *I. seychellarum* on Guava Trees

The monthly counts of *I. seychellarum* different stages in infested guava trees were recorded for two successive years (2018-19). Also, means of the monthly records of temperature and relative humidity throughout the two years of investigations and are represented in Tables 1 and 2 and graphically illustrated in Figure 1. To discuss the seasonal activity of different stages of *I. seychellarum* based on average number of immature and mature stages counts per sample were discussed through monthly records.

Month of inspection	Mean number of individuals per sample			R.M.V.P for total population	Climatic factors		
	Nymphs	Adult females	Total		Max. temp. (°C)	Min. temp. (°C)	R.H. (%)
Jan.	20.63 ± 0.53	6.75 ± 0.90	27.38 ± 0.66	____	17.72	12.62	62.10
Feb.	18.00 ± 1.04	11.67 ± 0.99	29.67 ± 0.57	1.08	17.69	12.39	60.30
Mar.	20.83 ± 1.32	14.67 ± 1.92	35.50 ± 1.63	1.20	23.98	14.91	60.17
Apr.	25.67 ± 1.59	17.00 ± 1.56	42.67 ± 1.99	1.20	26.13	17.95	57.75
May	32.00 ± 2.13	12.00 ± 1.10	44.00 ± 1.91	1.03	29.38	21.45	54.58
Jun.	59.33 ± 4.21	23.33 ± 1.01	82.67 ±3.64	1.88	30.65	22.78	58.26
Jul.	57.33 ± 4.02	17.17 ± 1.07	74.50 ± 4.52	0.90	32.25	22.87	62.39
Aug.	74.90 ± 8.30	19.95 ± 2.55	94.85 ± 10.69	1.27	31.85	22.70	62.58
Sept.	32.83 ± 3.15	13.50 ± 0.75	46.33 ± 3.80	0.49	29.58	23.51	49.91
Oct.	55.10 ± 3.69	17.50 ± 1.11	72.60 ± 4.26	1.57	26.94	21.59	57.53
Nov.	54.67 ± 4.50	28.40 ± 1.10	83.07 ± 4.81	1.14	22.60	18.85	59.69
Dec.	37.00 ± 1.81	8.83 ± 1.44	45.83 ± 3.00	0.55	20.41	17.03	62.32
Total	488.29	190.77	679.06				
General average	40.69 ± 2.10	15.90 ± 0.71	59.59 ± 2.58		25.77	19.06	58.96
%	71.91	28.09	100.00				

Table 1: Monthly mean number of different stages and rate of monthly variation in I. seychellarum (Westwood) population on guava trees, with climatic factors affecting in Ismailia Governorate during 2018

Month of inspection	Mean number of individuals per sample			R.M.V.P for total population	Climatic factors		
	Nymphs	Adult females	Total		Max. temp. (°C)	Min. temp. (°C)	R.H. (%)
Jan.	15.50 ± 1.24	9.17 ± 0.79	24.67 ± 0.90	____	18.63	13.89	62.29
Feb.	17.83 ± 0.72	12.67 ± 1.10	30.50 ± 0.78	1.24	15.85	13.62	60.06
Mar.	22.67 ± 0.85	11.67 ± 1.36	34.33 ± 1.59	1.13	21.10	16.41	52.92

Month of inspection	Mean number of individuals per sample			R.M.V.P for total population	Climatic factors		
	Nymphs	Adult females	Total		Max. temp. (°C)	Min. temp. (°C)	R.H. (%)
Apr.	27.83 ± 1.57	19.83 ± 1.73	47.67 ± 1.01	1.39	25.17	19.74	50.61
May	43.67 ± 1.49	10.17 ± 0.52	53.83 ± 1.27	1.13	28.76	23.60	48.42
Jun.	63.00 ± 2.00	9.80 ± 1.36	72.80 ± 1.39	1.35	30.62	25.06	49.96
Jul.	43.67 ± 1.44	16.17 ± 1.39	59.83 ± 1.79	0.82	32.20	25.16	54.09
Aug.	61.83 ± 1.64	22.00 ± 1.75	83.83 ± 1.65	1.24	31.86	24.97	54.26
Sept.	52.17 ± 2.90	25.33 ± 2.24	77.50 ± 4.16	1.18	36.02	25.86	61.09
Oct.	67.33 ± 2.43	12.17 ± 1.33	79.50 ± 2.20	0.91	34.22	23.75	67.21
Nov.	87.00 ± 2.79	24.17 ± 2.82	111.17 ± 1.75	1.40	21.96	19.74	57.98
Dec.	63.00 ± 5.01	11.67 ± 3.16	74.67 ± 7.42	0.67	22.94	18.74	62.47
Total	565.50	184.80	750.30				
General average	47.13 ± 2.30	15.40 ± 0.76	62.53 ± 2.62		28.49	22.30	55.90
%	75.37	24.63	100.00				

Table 2: Monthly mean number of different stages and rate of monthly variation in I. seychellarum (Westwood) population on guava trees, with climatic factors affecting in Ismailia Governorate during 2019

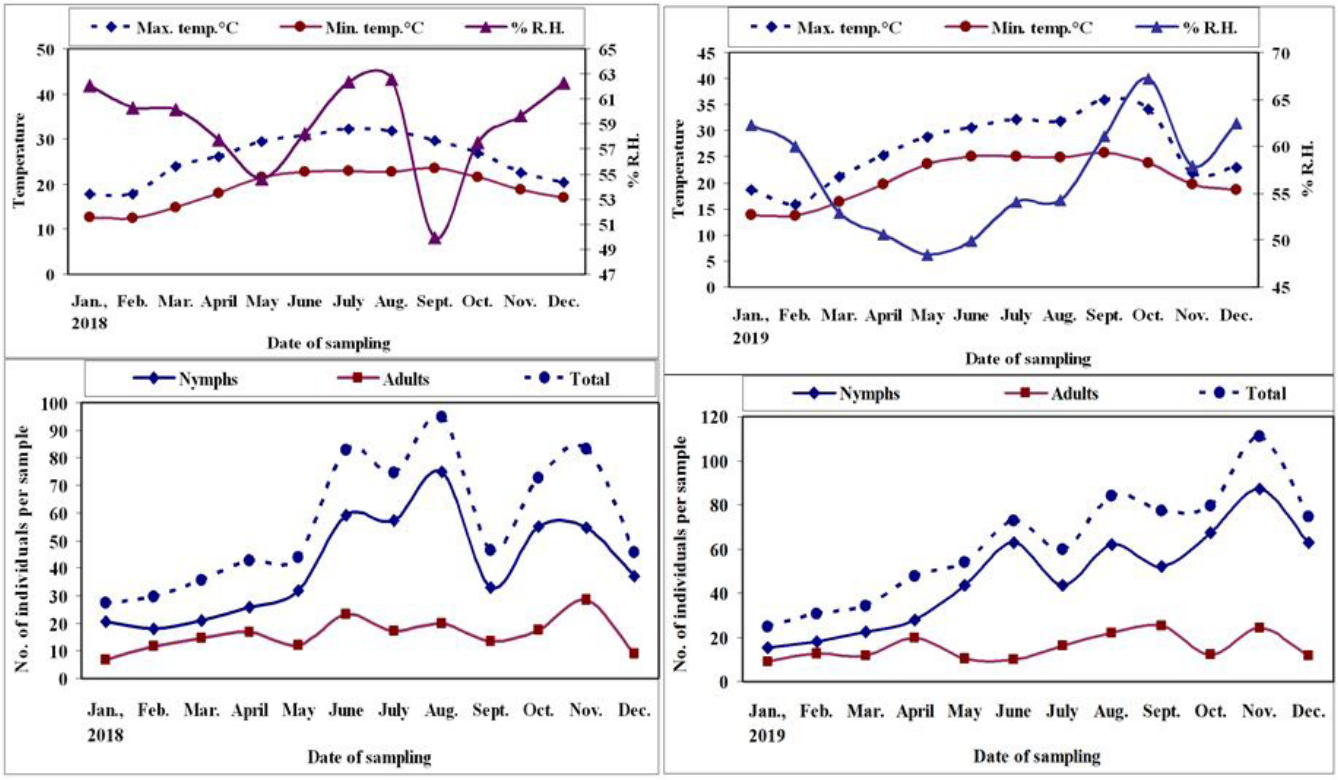

Figure 1: Means of monthly counts of different stages of *I. seychellarum* (Westwood) on guava trees, with climatic factors affecting in Ismailia Governorate during 2018-19

The first year (2018): Data represented in Table 1 and illustrated in Figure 1 showed that the mean population size was 40.69 ± 2.10, 15.90 ± 0.71 and 59.59 ± 2.58 individuals per sample for nymphs, adult females and total alive population of *I. seychellarum*, respectively.

The seasonal abundance of total alive population of insect was recorded. Three peaks of activity were observed in June, August and November when the mean total population density was 82.67 ±3 .64, 94.85 ± 10.69 and 83.07 ± 4.81 individuals per sample, respectively.

A similar trend in the seasonal abundance of nymphs was observed. Three peaks of activity were recorded in June, August and October when the mean population density was 59.33 ± 4.21, 74.90 ± 8.30 and 55.10 ± 3.69 individuals per sample, respectively. However, with different values the adult females had four peaks recorded in April, June, August and November when the mean population density was 17.00 ± 1.56, 23.33 ± 1.01, 19.95 ± 2.55 and 28.40 ± 1.10 individuals per sample, respectively.

The second year (2019): Data tabulated in Table 2 and illustrated in Figure 1, showed that the mean population density was 47.13 ± 2.30, 15.40 ± 0.76 and 62.53 ± 2.62 individuals per sample for nymphs, adult females and total alive population, respectively. The seasonal activity of nymphs of insect was recorded established three peaks of activity in June, August and November. The mean population density recorded was 63.00 ± 2.00 (June), 61.83 ± 1.64 (August) and 87.00 ± 2.79 (November) individuals per sample.

A similar trend in the seasonal activity of adult females was observed. Three peaks of activity were recorded in April, September and November when the mean population density was 19.83 ± 1.73, 25.33 ± 2.24 and 24.17 ± 2.82 individuals per sample, respectively. The variance in different stages abundance reflected based on the total mixed population per sample had three peaks of activity during June (72.80±1.39), August (83.83±1.65) and November (111.17±1.75) per sample.

The results depicted that the nymphal population was relatively higher than the adult female population during the two successive years. The nymphs were represented by 71.91 and 75.37% of the total population during 2018 and 2019, respectively. On the other hand, the adult females were represented by 28.09 and 24.63% of the total population in 2018 and 2019, respectively.

The lowest population density of different stages and total population of *I. seychellarum* was recorded during January, both years, which may be attributed to the high relative humidity, gradual decrease in temperature and dormancy of the trees during winter. When crawlers emerged after the egg laying period, their population decreased for several months due to mortality of nymphs in the winter which is expected to affect dramatically the insect behavior and on rate of growth and infestation.

In contrary, the maximum values of insect population were observed in November during the two years of study, which may be due to the influence of favorable factors (such as environmental conditions etc.). It appeared that, the annual fluctuations in the population density during the two years were affected by the variability in these physical factors. 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 of that location.

From the previously mentioned results, it could be concluded that insect population was present on guava trees all the year round and has three peaks of seasonal activity per year, which was recorded in June, August/September and November over the years. Also, the second year of study cleared that the total population density of this insect was higher in comparison to the first year of investigation, which may be due to the influence of environmental conditions or others factors. These results were coincided with those obtained by El-Borollosy *et al.* (1990), Mangoud (2000), Osman (2005), El-Said (2006), Abd-El-Rahman *et al.* (2007), Sayed (2008) and Bakry and Arbab (2020) [1-3,4,6,10,11] in Egypt; however, with different host plants, they reported that the *I. seychellarum* had three or four peaks per year.

Rate of Monthly Variation (R.M.V.P.) In the Population of the Seychelles Scale, *I. seychellarum:* The monthly variation rates in the population of *I. seychellarum* were calculated (Tables 1 and 2). The rate of monthly variation in the population is considered an indicator to the favourable month for insect activity throughout the year. When R.M.V.P. is >1, it means more activity, <1 means less activity and =1 means no change in the population density during the two successive months (Bakry, 2009) [12].

The favourable times of annual increase for total alive population appeared to be from February to June months and August, October and November months during the first year (2018), when the rates of monthly variation were ranged 1.03-1.88 (Table 1 and 2). During 2019, the rates of monthly variation for total mixed population showed that the favourable times for annual increase were February to June, August, September and November, which ranged from 1.13 to 1.40.

Previous studies by Mangoud (2000) [3] revealed that the population of this insect increased in summer and autumn. El-Said (2006) [4] found significant difference in the mealybug, *I. seychellarum* activity during summer and autumn.

Effect of the Main Weather Factors on the Total Insect Population of I. seychellarum:

Year	Tested counts	Simple correlation and regression values				Partial correlation and regression values			Analysis variance			
		r	b	SE	t	P. reg.	SE	t	F value	MR	R^2	E.V.%
2018	Max. temp.	0.64	2.86	1.08	2.65 *	-2.03	1.85	-1.10	11.35 **	0.90	0.81	80.98
	Min. temp.	0.72	4.15	1.26	3.30 **	8.03	2.49	3.22 *				
	R.H.%	0.16	0.99	1.95	0.51	3.73	1.08	3.45 **				
2019	Max. temp.	0.51	1.99	1.09	1.89	-9.77	2.73	-3.58 **	10.33 **	0.89	0.79	78.48
	Min. temp.	0.62	3.51	1.41	2.48 *	18.25	4.11	4.44 **				
	R.H.%	0.13	0.55	1.35	0.41	3.28	0.90	3.64 **				

r = Simple correlation; **b** = Simple regression; **MR** = Multiple correlation; **P. reg.**= Partial regression;
CV= Coefficient of Variation; **R^2**= Coefficient of determination; **E.V%** = Explained variance;
SE = Standard error; * Significant at P ≤ 0.05; ** Highly significant at P ≤ 0.01

Table 3: Different models of correlation and regression analyses for describing the relationship between total population of *I. seychellarum* (Westwood) and three weather variables on guava trees at Ismailia Governorate during 2018-19

Effect of Daily Mean Maximum Temperature: The results of statistical analysis of simple correlation (Table 3) showed significantly positive correlation between the daily maximum mean temperature and total population of *I. seychellarum*; r value was (+0.64) during the first year (2018) and insignificantly positive relation (r value +0.51). The unit effect regression coefficient (b) indicates that an increase of 1oC in the daily mean maximum temperature, would increase the population by 2.86 and 1.99 individuals per sample for the years 2018 and 2019, respectively.

The partial regression values presented in Table 3 accentuated an insignificant negative relation (P. reg. -2.03) during 2018 and highly significant negative effect (-9.77) during 2019. The values of t-test were -1.10 and -3.58 for the first and second years, respectively. The obtained results revealed that daily mean maximum temperature was around the optimum range for total population of *I. seychellarum* activity during the first year, and was entirely above the optimum range during the second year.

Effect of Daily Mean Minimum Temperature: The correlation coefficient (r) between daily mean minimum temperature and the total population of pest was highly significant positive (r value +0.72) for the first year and significant positive relation (r value +0.62) for second year (Table 3). The calculated regression coefficient (b) for the effect of this factor indicated that for every 1oC increase, the population would increase by 4.15 and 3.51 individuals per sample for the two years, respectively.

The exact effect of this factor on insect population revealed that it was significant positive from the partial regression (P. reg. value +8.03) during 2018 and highly significant positive effect (P. reg. value +18.25) during 2019. The t-test values were +3.22 and +4.44 during the two years, respectively, when the daily mean maximum temperature and relative humidity become around their means (Table 3). The results also revealed that mean minimum temperature was under the optimum range for total population activity in the first year and was entirely under the optimum range for total population activity during the second year (Table 3).

Effect of the Mean Relative Humidity: Data obtained are represented in Table 3, which shows that the mean relative humidity had insignificant positive effect on total population activity, since the correlation coefficient was r=+0.16 and r=+0.13 for the first and second years, respectively. The unit effect (regression coefficient) indicates that an increase of 1% in the mean relative humidity, would increase the total population density by 0.99 and 0.55 individuals per sample for the two years, respectively.

The real effect of this climatic factor appeared from the partial regression (P. reg.) values (Table 4) shows that it has highly significant positive effects (P. reg. values +3.73 and +3.28) and t-test values were +3.45 and +3.64, for the two years, respectively. The obtained results revealed that, mean relative humidity was entirely under the optimum range for total population activity during the two years (Table 3).

The Combined Effect of the Tested Climatic Factors on the Total Population Activity: The combined effect of climatic factors on the total population was highly significant where the F values were 11.35 and 10.33 during the first and second years, respectively (Table 3). The percentage of variability that could be attributed to the combined effect of these tested factors on the insect population, were 80.98 and 78.48% for the two years, respectively. The remaining unexplained variances are assumed to be due to the influence of other unconsidered and undetermined factors that were not included in this study in addition to the experimental error.

Current study revealed that activity of *I. seychellarum* was mostly related to the simultaneous effect of these selected weather factors rather than the effect of an individual factor. Previous studies conducted by Fisher (1950) [8] revealed that the method of partial regression was the best way for dealing with uncontrolled variables such as physical factors in the ecosystem. Pervious study by El-Said (2006) [4] in Egypt stated that the effect of temperature on insect activity was strongly positive and significant and the effect of daily mean relative humidity was insignificantly negative for both years of investigation. Also, the percentage of explained variance by these factors was 60 and 76% for the 2003 and 2004 seasons. In addition, Abd-El-Rahman *et al.* (2007) [11] found significant positive correlation with temperature and insignificant negative correlation with the relative humidity. Also, Sayed (2008) [1] stated that the four tested factors i.e. maximum temperature, minimum temperature, mean temperature and percentage of relative humidity were simultaneously responsible for about 32.8-65% of *I. seychellarum* activity. Selim (2012) [13,14] reported that *I. seychellarum* generations had an affirmative respond with both day maximum temperature and night minimum temperature.

References

1. Sayed AMM (2008) Studies on the mealybugs infesting some fruits trees and its natural enemies. Faculty of Agriculture, Al-Azhar University, Egypt.

2. Bakry MMS, Arbab A (2020) Monitoring of the scale insect, *Icerya seychellarum* (Westwood) infesting guava. Indian J Entomol 82: 1-12.

3. Mangoud AAH (2000) Integrated pest management of apple trees. Faculty Agriculture, Cairo University, Egypt.

4. El-Said MI (2006) Studies on some eco-physiological factors affecting resistance of five mango cultivars to the Margarodid mealybugs, *Icerya seychellarum* (Westwood). Faculty of Agriculture, Cairo University, Egypt.

5. Bakr RFA, Badawy RM, Mousa SM, Hamooda LS, Atteia SA (2010) Ecological and taxonomic studies on the scale insects that infest mango trees at Qaliobiya governorate. Egypt Acad J Biol Sci 2: 69-89.

6. Osman EA (2005) Studies on some homopterous insect pests infesting mulberry tree in relation with *Bombyx mori* L. (Bombycidae: Lepidoptera) silk production. Faculty of Agriculture, Cairo University, Egypt.

7. El-Din AMS (1998) Ecological and biological studies on the *Chrysomphalus dictyospermi* and *Coccus hesperidium* L. Faculty of Agriculture, Cairo University, Egypt.

8. Fisher RA (1950) Statistical Methods for Research Workers (12th Edn) Oliver and Boyd Ltd., Edinburgh, London, UK.

9. MSTATC (1980) A Microcomputer Program of the Design Management and Analysis of Agronomic Research Experiments. Michigan State University, USA.

10. El-Borollosy FM, El-bolok MM, Shadia MA, Ezz AI (1990) Ecological studies on the ornamental palm Mealybug, *Icerya seychellarum* (Westwood) (Margarodidae, Homoptera) on *Cycus revolute* Thumb (Cycadaceae). Bull Soc Ent Egypte 69: 257-69.

11. El-Rahman A, Salem MS, Moussa SFM, Nour ME, El-Said MI (2007) Seasonal fluctuation of the Seychelles Fluted scale mealybugs, *Icerya seychellarum* (Westwood) on four mango cultivars in Egypt. Egypt J Agric Res 85: 77-88.

12. Bakry MMS (2009) Studies on some scale insects and mealybugs infesting mango trees in Qena Governorate. Faculty of Agriculture, Minia University, Egypt.

13. Selim AA (2012) Population dynamics of *Icerya seychellarum* (Hemiptera: Monophlebidae) and *Rodalia cardinalis* (Coleoptera: Coccinellidae) on grape at Dakahlia Governorate. Egypt J Agric Res 90: 119-32.

14. Dent D (1991) Insect Pest Management (2nd Edn) CAB International, UK.

Submit your next manuscript to Annex Publishers and benefit from:

- Easy online submission process
- Rapid peer review process
- Online article availability soon after acceptance for Publication
- Open access: articles available free online
- More accessibility of the articles to the readers/researchers within the field
- Better discount on subsequent article submission

Submit your manuscript at
http://www.annexpublishers.com/paper-submission.php