SEASONAL FLUCTUATION OF THE SEYCHELLES FLUTED SCALE, *ICERYA SEYCHELLARUM* (WESTWOOD) ON FOUR MANGO CULTIVARS IN EGYPT

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Abstract

The seychelles fluted scale, *Icerya seychellarum* Westwood (Margarodidae: Homoptera) is a serious pest of mango in Egypt. As a basic study for developing future management of this scale species seasonal fluctuation of different stages and total population density within mango trees were monitored in a private mango orchards of mixed cultivars located in El-Saff, Giza Governorate, Egypt throughout two years started from January 2003 to December 2004. Seasonal fluctuation of total population on different mango cultivars was also studied. Under the climatic conditions of Giza Governorate, population of *I. seychellarum* showed four annual generations and four activity peaks; a small peak in March, intermediate peak in June, and two large peaks in August and September/October. The overall population trends were similar among the two studied years. Population density showed significant positive correlation with temperature and insignificant negative correlation with relative humidity. Of the four studied mango cultivars the highest population density was recorded on the cultivar 'Sultani' followed by Baladi and Hendi while Ewaisi had the lowest annual population density during both 2003 and 2004 seasons. Differences in annual population density of *I. seychellarum* between the four mango cultivars were significant at 0.05 % level.

Key words: *Icerya seychellarum,* Ecology, *Mangifera indica,* Cultivars,

INTRODUCTION

Mango, *Mangifera indica*, is one of the most popular and economic fruit trees in Egypt, where many cultivars such as Alphonso, Baladi, Ewaisi, Hendi and Sultani, are successfully grown (El-Zohgbi and Mostafa, 2002). According to the latest survey of Egyptian Ministry of Agriculture in 2002, mango orchards occupy 1.1 million feddan and commercially occupied the third degree after grapes and citrus (El-Masry, 2004).

Mango trees are liable to be infested with several serious insect pests during their growth stages including the seychelles fluted scale, *Icerya seychellarum* (Westwood) (Elwan, 1990). *I. seychellarum* is a polyphagous phloem-feeding coccid belongs to the family Margarodidae, order Homoptera. This insect feeds on the underside of leaves

sucking out plant sap. At high infestation levels, serious damage resulting in early leaf drop and yield reduction is caused by the feeding of this insect, but the major damage is caused by the production of large amounts of honeydew upon which saprophytic fungi develop, which interferes with photosynthesis and respiration (Assem, 1990) and otherwise reduces the quality of the plant causing considerable economic injury. Moreover, high populations of *I. seychellarum* can reduce the vigor of the plant, making it susceptible to other pests (Osman, 2005).

Despite its importance, little information is available on the seasonal occurrence and occurrence patterns of *I. seychellarum* in mango orchards. Data on the population fluctuations and the possible impact of weathering conditions and cultivar types on population density are essential in developing effective management strategies for this pest in mango orchards. Accordingly, this study was initiated to monitor the seasonal abundance of *I. seychellarum* on the four main Egyptian mango cultivars (Sultani, Baladi, Hendi and Ewaisi) during two successive years (2003 and 2004). The effects of temperature and relative humidity on the population density of this pest were also studied.

MATERIALS AND METHODS

Study area:

This two year-study was conducted in a private mango orchard (called Fisher orchards) located at El-Saff, Giza Governorate, Egypt, started from January 2003 to December 2004. This 200-feddan orchard contains. 2000 trees of more than 10 mango cultivars, grow next to each other. Most trees were planted in 1935 and were more than 4 m high at the time of the study.

Sampling:

Four local important mango cultivars were chosen (Sultani, Baladi, Hendi, and Ewaisi). Three trees from each cultivar were chosen at random and marked. The marked trees and four trees adjacent to each of them were excluded from any chemical treatment applied to the rest of the orchard. Samplings were done at two-week intervals during the study period. A sample comprising 20 leaves was collected randomly from the four cardinal directions of the middle crown parts from each of the three marked trees for each cultivar. Leaves of each tree were packed separately in plastic bags with a minute holes, labeled, and transported to the laboratory for examination and counting in the same day. In the laboratory, *I. seychellarum* different stages were identified according to all available descriptions, keys and criterion that described in details by Mohammad (1998). Total numbers of alive pre-adults, and adults on each leaf were counted and their combined numbers for each cultivar were

calculated. The number of generations was estimated from half monthly data of total nymphs according to the method mentioned by Assem (1990).

Meteorological data:

To reveal the relation between climate condition and fluctuation of *I. seychellarum* population, means of daily temperature and relative humidity at Giza Governorate were obtained from the Meteorological Station of the Agricultural Research Center, Egypt and the half monthly mean was calculated.

Statistical analysis

All parameters concerning *I. seychellarum* population density on mango leaves were reduced to three-specific means, and these means were used in statistical analysis. All data were evaluated statistically using ANOVA and means compared using Duncan's Multiple Range Test at $P<0.05$). The relationship between the population density of *I. seychellarum* and both temperature (T) and relative humidity (RH) were tested using simple correlation, and multiple regression analysis. All statistical analyses were done using the software package Costat (Costat, 1992).

RESULTS AND DISCUSSION

Figures (1 & 2) show the half-monthly means of pre-adults, adults and total population density of *I. seychellarum* infesting mango trees (mixed cultivars) throughout the two successive years of investigation (2003 and 2004). The figures also show the half monthly mean of temperature and relative humidity recorded during the same two years. In 2003, density of *I. seychellarum* pre-adults on mango leaves was low during January and February, then began to increase gradually to form a small significant peak on mid March (26.43 ± 5.2 nymphs/10 leaves). Intermediate peak of pre-adult was recorded on the beginning of June (64.2 ± 9.3 nymphs/10 leaves), then two large equal peaks occurred in August (123.5 ± 17.3 nymphs/10 leaves) and mid September (130.1 ± 16.5 nymphs/10 leaves). Also, four peaks of adult females were observed on mid March (13.6 ± 2.1 females/10 leaves), mid May (22.8 ± 3.5 females/10 leaves), August (41.2 ± 6.3 females/10 leaves) and the beginning of September (50.2 ± 7.0 females/10 leaves). Overall combined numbers of total population (pre-adults and adult females) on mango leaves indicated that activity of *I. seychellarum* extended from March to November with a small activity peak on mid March (40.0 ± 5.2 individuals/10 leaves). Intermediate peak of total population occurred during June (81.76.2 ± 9.3 individuals/10 leaves) and two approximately equal large peaks recorded in August (164.7 ± 22.0 individuals /10 leaves) and in mid September (180.3 ± 20.9 individuals /10 leaves) (Figure 1 and Table 1).

The results of the second year of investigation (2004) as represented in Figure (2) showed that population trends and number of peaks of pre-adults, adults and total population of *I. seychellarum* were nearly similar to those recorded in the previous season (2003). Considering the annual average of population density of *I. seychellarum* it is obvious from Table (1) that the effect of different seasons on the activity of pre-adults, adults and total population of *I. seychellarum* was insignificant (Table 2). Our results are in agreement with that obtained by Osman (2005) who reported four annually population peaks of *I. seychellarum* on mulberry trees at Giza Governorate, Egypt.

However, Table (1) shows that total population of *I. seychellarum* in June peak was significantly higher in 2004 than 2003. In addition, the two main activity peaks slightly shifted from the beginning of August and mid September in 2003 to mid-August and the beginning of October in 2004, respectively (Figures1&2; Table 1). This difference in *I. seychellarum* activity is possibly attributed to the differences in weathering condition between the two years. Ali (1980) and Osman (2005) considered weather to be important detrimental factor to *I. seychellarum* total population on palm and mulberry trees. Results of statistical analysis of the obtained data using simple correlations, and partial regression (Table 3) indicated significant and strong positive correlations between population densities of *I. seychellarum* on mango leaves and means of the half monthly temperature during 2003 season ($r = 0.٧4 \pm 0.1٤$). On the other hand, insignificant and negative correlations were computed between population densities and the mean of half monthly relative humidity during the same year ($r = -0.10 \pm 0.212$). In contrary, Assem (1990) mentioned that neither temperature nor relative humidity showed any significant correlation with population density of *I. seychellarum* on ornamental plants, while Ali (1980) reported that population density of *I. seychellarum* on palm trees showed significant positively correlation with temperature and significant negative correlation with relative humidity. However, our results are in agreement with that recorded by Osman (2005) who reported that population density of *I. seychellarum* on mulberry trees showed significant positive correlation with the temperature and insignificant correlation with the relative humidity.

Results of regression analysis (Table 3) indicated that temperature significantly influence population density of *I. seychellarum* and could explain 60% of the population fluctuation during 2003 (the explained variance; $R^2 = 0.6$). The calculated partial regression coefficient for the effective factor (temperature) indicated that for every 1°C increase in temperature, population density increased by 6.35 individuals/10 leaves. Results of the fluctuation of *I. seychellarum* population density during 2004

supported these calculations and explain why June population peak of *I. seychellarum* in 2004 was significantly higher than that of 2003. The obtained metrological data during this activity peak indicated that the mean half monthly temperature increased from 27°C during May and June, 2003 to mean of 32°C during the same months in 2004. Consequently, the population density of June peak increased from 81.76 ± 9.3 in 2003 to 110.3 ± 9.5 individuals/10 leaves in 2004. This magnetite of increase in population density was close to that expected according to the calculated partial regression coefficient that determines the degree by which temperature affect population density of I. *seychellarum* and proves that the derived coefficients were predictable. Results of correlation and regression analysis of 2004 data (Table 3) added further support to the conclusion that temperature is strongly affect population density of I. *seychellarum* on mango trees. The calculated correlation coefficient, partial regression coefficient and R^2 values were 0.81±0.123, 5.46 and 0.67, respectively. These values are obviously close to those obtained during 2003.

The approximate number of generations of *I. seychellarum* on mango at Giza Governorate my be deduced from the fluctuation in the population of nymphs throughout the two seasons. Data in Table (4) illustrate that the number of generations in the two seasons was four overlapping generation per years.

Figure (3) shows that a trend of total population and number of annual activity peaks of *I. seychellarum* on different mango cultivars were similar among cultivars and years. However, average annual numbers of individuals differed significantly (P>0.05) among cultivars. Sultani cultivar had the highest average annual population density followed by Baladi, Hendi and then Ewaisi. (Figure 3; Table 5). Accordingly, it could be concluded that among the tested mango cultivars, Ewaisi was the most resistant cultivar while Sultani showed highest susceptibility to *I. seychellarum*. Differences in susceptibility of various mango cultivars to scale insects had reported by several investigators. Salama et al. (1970) studied the population density of the soft scale insect, *Lecanium acuminatum* Signoret in an orchard cultivated with nine Indian cultivars of *M. indica* throughout seven successive months. They mentioned that different cultivars of the mango trees vary in their susceptibility to infestation with *L. acuminatum*. Their results showed that Timour and Pairi cultivars were the most resistant to infestation. Zebda cultivar on the other hand was highly susceptible to insect infestation. Salem (1994) reported different in susceptibility of six Egyptian cultivars of mango to the pallid scale, *Insulaspis pallidula*, the acuminate scale, *Kilifia acuminate* and the plum scale, *Parlatoria olea*. Hendi and zebda cultivars were highly susceptible while Taimour and Alfonso were the least susceptible cultivars. Salama *et al.* (1970), Gallardo, (1983), Salem (1994) and Uddin *et al.* (2003) suggested that

differences in mango cultivar susceptibility to insect infestations might by relate to cultivar specific trait. Further studies to investigate trait responsible for such differences in mango cultivars susceptibility to *I. seychellarum* infestations are in progress.

El-Masry (2004) mentioned that due to the commercial value of mango fruits, areas cultivated with mango trees in Egypt are in contentious increase. Accordingly, this study suggests to cultivate mango cultivars that showed low susceptibility to *I. seychellarum* such as Alphonso, Ewaisi and Hendi in the candidate new mango orchards especially in areas heavily infected with such serious pest.

Table 1. Date and density of total population peaks of *I. seychellarum* in mango orchards of mixed cultivars during 2003 and 2004.

Population Peaks	(individuals /10 leaves)			
	2003		2004	
	Date	Population density	Date	Population density
1	15- March	40.0 ± 5.2 [a]	15- March	44.1 ± 6.0[a]
2	1-June	81.76.2 ± 9.3[b]	1-June	110.3 ± 9.5[c]
3	1-August	164.7 ± 22.0[d]	15-August	155.5 ± 15.7[d]
4	15-September	180.3 ± 20.9[e]	1-October	165.7 ± 13.5[c]

Means followed with the same letter do not differ significantly (ANOVA and Duncan's Multiple Range Test, P< 0.05).

Table 2. Annual mean of *I. seychellarum* total population infesting mango trees at El-Saff, Giza Governorate, Egypt.

Life form *	(individuals /10 leaves)	
	Season 2003	Season 2004
Pre-adults	45.2 ± 3.4[a]	50.0 ± 4.1[a]
Adults	19.8 ± 3.2[b]	18.5 ± 3.0[b]
Total population	65.1 ± 6.2[c]	68.2 ± 6.6[c]

* Annual mean of individual of the three trees ± SE

Means within the same raw followed with the same letter do not differ significantly (ANOVA and Duncan's Multiple Range Test, P< 0.05).

Table 3. Effect of both temperature and relative humidity on *I. seychellarum* total population on mango leaves at El-Saff, Giza Governorate, Egypt during the two studied years.

Statistical	First year (2003)		Second year (2004)	
parameters	Temperature	R.H.%	Temperature	R.H.%
Simple correlation				
Corr. Coef. (r)	0.٧4 ± 0.1٤	-0.10 ± 0.212	0.81±0.123	- 0.23±0.20
Probability (p)	0.00٠٢ ***	0.66 ns	0.0001 ***	0.11 ns
Partial Regression				
Partial Regres. Coef (b)	6.35	1.15	5.46	0.48
F-value	27.51	1.63	42.42	0.67
Probability (p)	0.0001***	0.21 ns	0.0001***	0.41 ns
	Temperature + R.H.%		Temperature + R.H.%	
R^2 (%)	0.6		0.67	
F-value	14.57		21.55	
Probability (p)	0.0001***		0.0001 ***	

R^2 = Multiple regression coefficient (Explained variance)

*** Highly significant

Table 4. Number and duration of *I. seychellarum* generations under field condition in mango orchards at El-Saff, Giza Governorate, Egypt during the two studied years.

Generation number	Duration of each generation
	2003 and 2004
First	February-April
Second	April-July
Third	July-September
Fourth	September-November

Table 5. Susceptibility of different mango cultivars to *I. seychellarum* infestation during the two studied years.

Population Peaks	(individuals /10 leaves)							
	Season 2003				Season 2004			
	Sultani	Baladi	Hendi	Ewaisi	Sultani	Baladi	Hendi	Ewaisi
1	53.22^{a} ± 4.5	38.83^{b} ± 4.2	41.95^{b} ± 3.9	25.95^{c} ± 2.3	50.64^{a} ± 4.6	37.81^{b} ± 4.1	45.29^{a} ± 4.3	42.71^{b} ± 3.6b
2	117.50^{a} ± 7.8	87.62^{b} ± 6.2	89.52^{b} ± 6.6	32.00^{c} ± 2.5	141.7^{a} ± 8.3	136.1^{a} ± 7.6	101.3^{b} ± 7.0	62.00^{c} ± 4.7
3	285.4^{a} ± 12	148.4^{b} ± 9.3	140.0^{b} ± 7.7	84.82^{c} ± 6.5c	240.3^{a} ± 11	137.3^{b} ± 6.1	138.7^{b} ± 6.5b	105.7^{c} ± 9.5c
4	219.0^{a} ± 10	205.8^{a} ± 9.5a	158.8^{c} ± 7.9	137.5^{d} ± 6.6	220.2^{a} ± 11	186.2^{b} ± 8.2	141.7^{c} ± 7.2	114.5^{d} ± 6.3d
Average annual population	87.01^{a} ± 4.2	73.37^{b} ± 3.5	62.13^{c} ± 3.6	37.79^{d} ± 2.5	89.86^{a} ± 4.5	75.25^{b} ± 3.3	63.35^{c} ± 3.1	44.41^{d} ±2.7

Means within the same raw Means followed with the same letter do not differ significantly (ANOVA and Duncan's Multiple Range Test, $P < 0.05$).

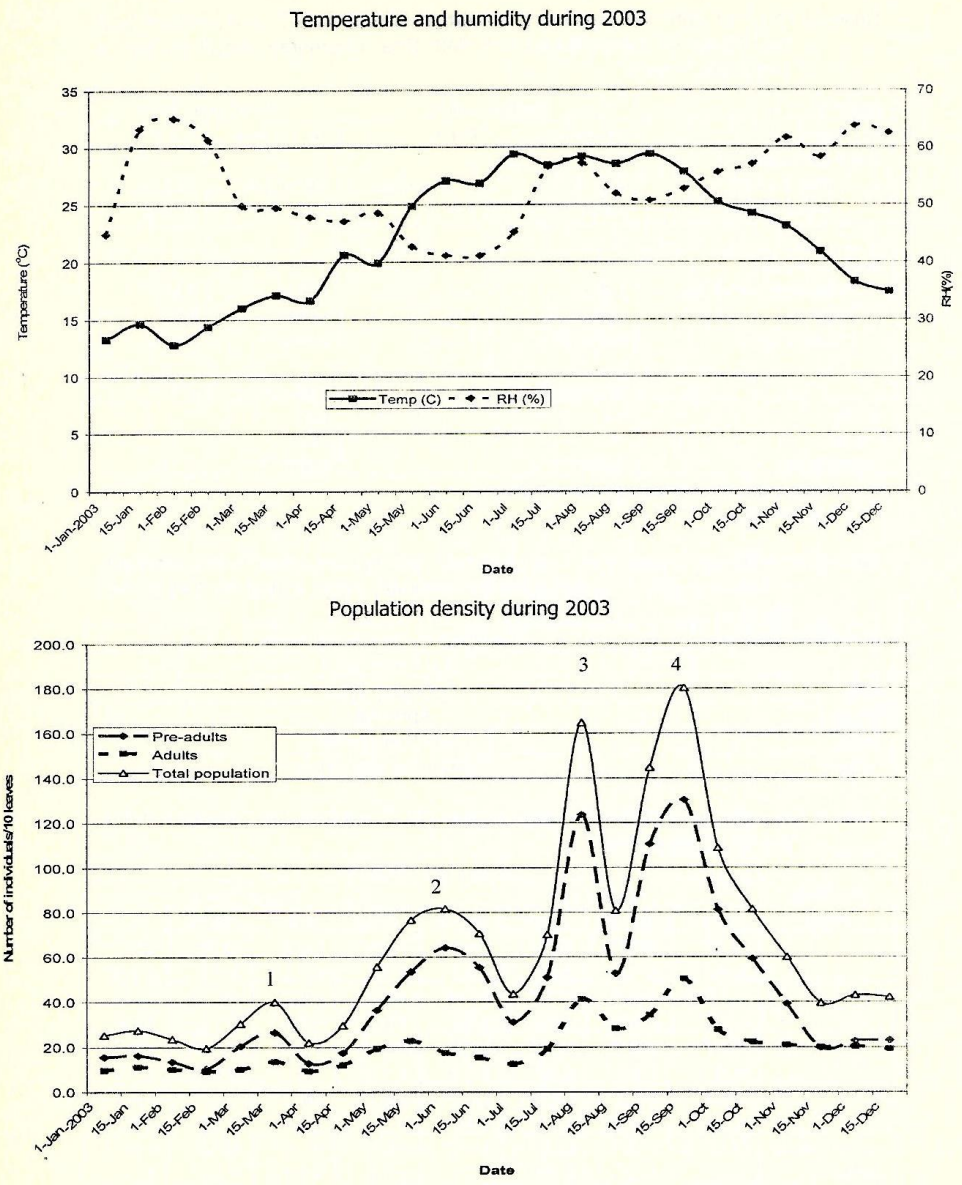
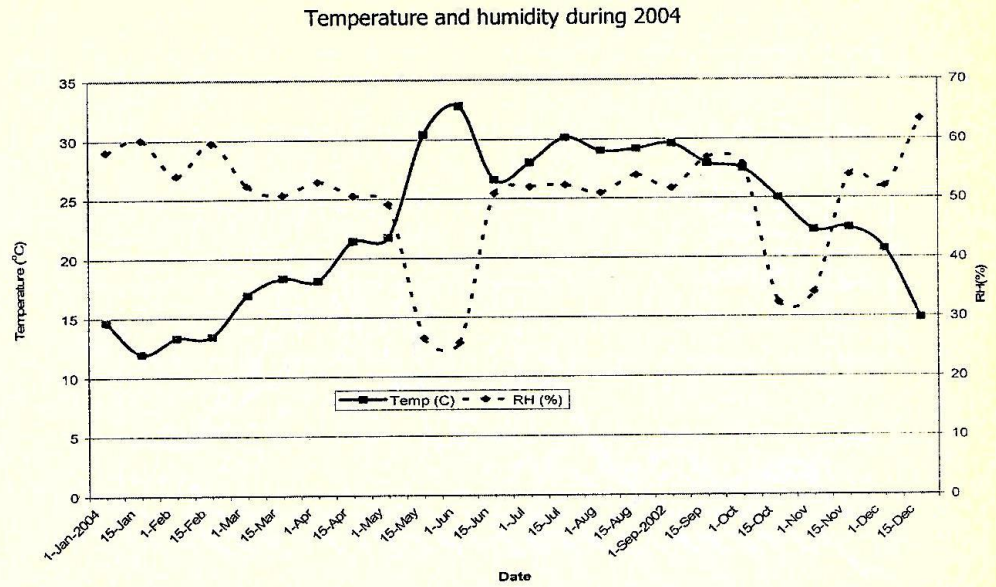


Figure 1. Mean half monthly temperature, relative humidity and Population fluctuation of *I. seychellarum* on leaves of mango trees at El-Saff, Giza Governorate, throughout season 2003.



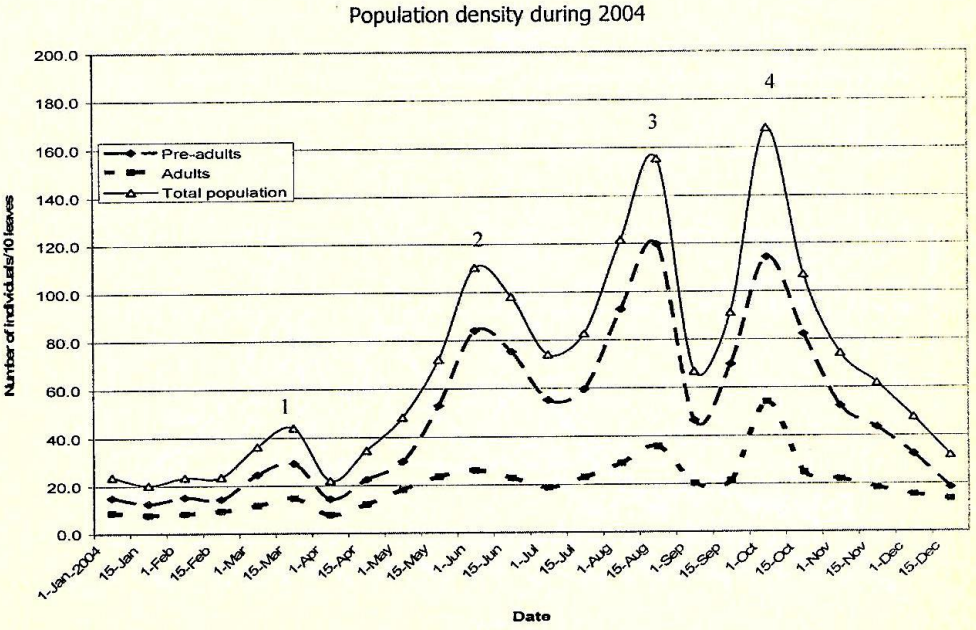


Figure 2. Mean half monthly temperature, relative humidity and Population fluctuation of *I. seychellarum* on leaves of mango trees at El-Saff, Giza Governorate, throughout season 2004.

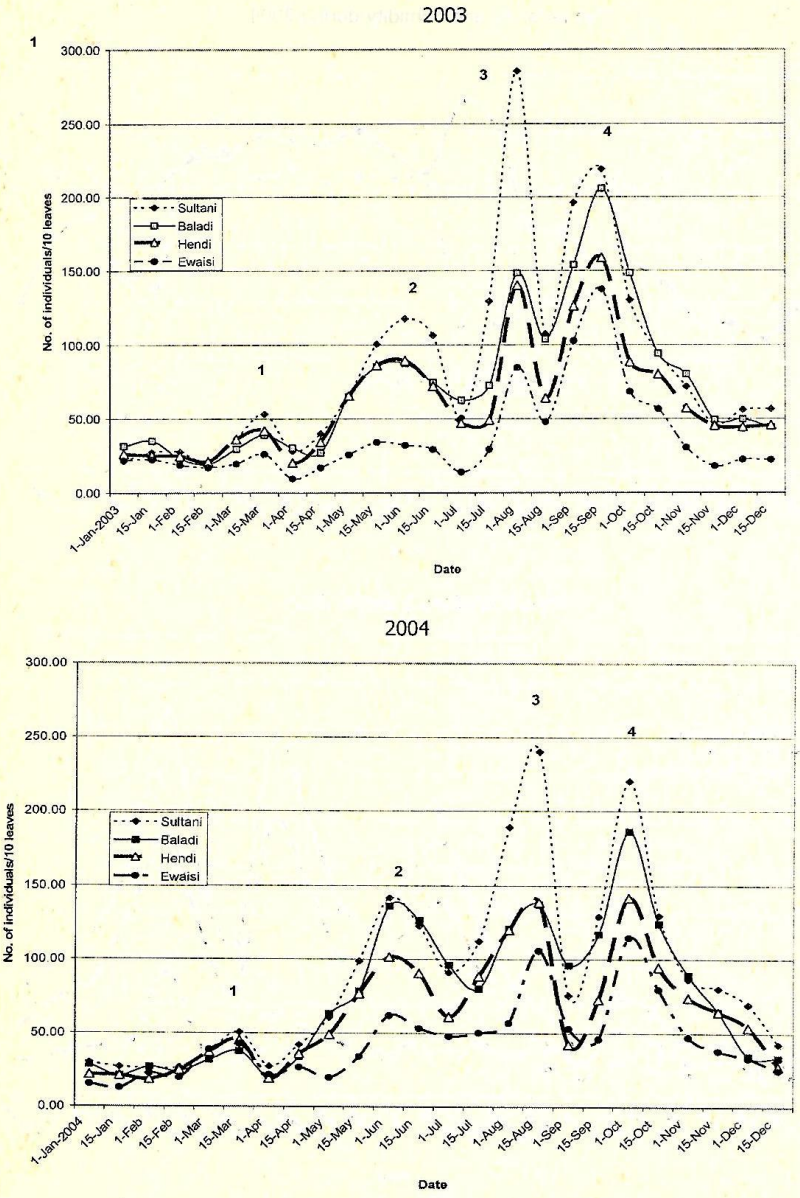


Figure 3. Population fluctuation of *I. seychellarum* on leaves of different mango cultivars at El-Saff, Giza Governorate, throughout two successive years (2003 and 2004)

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التغيرات الموسمية فى مستوى كثافة الحشرة القشرية *Icerya seychellarum* على أربعة أصناف من اشجار المانجو فى مصر

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الحشرة القشرية *Icerya seychellarum* تعتبر من الآفات الخطيرة التى تصيب أشجار المانجو فى مصر. وكدراسات لا غنى عنها يمكن الاعتماد عليها لتصميم برنامج مكافحة متكامل لهذه الآفة تم تحديد التغيرات الموسمية التى تطرأ على كثافة أفراد هذه الحشرة على اربعة أصناف من أشجار المانجو فى حديقة مانجو خاصة بمدينة الصف- محافظة الجيزة، خلال عامين متتابعين من يناير ٢٠٠٣ الى ديسمبر ٢٠٠٤. وقد أظهرت النتائج أن هناك أربعة ارتفاعات سنوية لتعداد هذه الآفة: زيادة صغيرة من حيث تعداد الافراد تظهر فى مارس يليها ارتفاع متوسط فى يونيو ثم ارتفاعين كبيرين متتاليين الأول فى اغسطس والثاني فى الفترة ما بين ١٥ سبتمر وأوائل أكتوبر. وقد لوحظ أن التغيرات العامة فى كثافة الآفة ومستوى الاصابة بها تبدو متماثلة خلال عامى الدراسة. وقد ظهر ارتباط معنوى قوى وموجب بين مستوى الاصابة بالآفة والتغير فى درجة حرارة الجو خلال العام وارتباط ضئيل غير معنوى سالب مع الرطوبة النسبية. وقد سجلت اعلى كثافة لتعداد الآفة على أشجار المانجو من صنف "السلطانى" تليها صنف "البلدى" ثم "الهندى" بينما سجلت أقل كثافة سنوية لتعداد الآفة على أشجار المانجو من نوعية "عويسى" خلال عامى الدراسة، وقد أظهر التحليل الاحصائى أن الاختلافات فى تعداد هذه الآفة على الاربعة أصناف من أشجار المانجو اختلافات معنوية. ويقترح البحث أن تولى الاصناف الاقل قابلية للاصابة بتلك الآفة مثل الفونس والعويسى والهندى فى المناطق الجديدة المرشحة لزراعة المانجو خاصة تلك المناطق المعروفة بانتشار تلك الآفة بها.