EVALUATION OF ECONOMIC THRESHOLD LEVEL OF THE SEYCHELLES FLUTED SCALE, *ICERYA SEYCHELLARUM* (WESTWOOD) (HEMIPTERA: MONOPHLEBIDAE) ON MANGO TREES IN GIZA GOVERNORATE

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Abstract

The seychelles fluted scale, *Icerya seychellarum* (Westwood) (Monophlebidae: Hemiptera) is a serious pest of mango in Egypt, while it causes yield loss in most of mango orchards all over the country. The economic threshold level is a key factor to start control program. Results of statistical analysis shown that, when population density of *I. seychellarum* were (27.24 & 27.22) pre-adult / leaf) in March and June infestation, respectively. These numbers could be regarded as economic threshold of infestation with *I. seychellarum* on mango trees, at this level sufficient time for initiation of control measures. Population of *I. seychellarum* showed four annual generations and four activity peaks; a small peak in mid-March, intermediate peak in June, the third peak in August and last peak in mid-September.

Key words: *Icerya seychellarum*, Economic Level, *Mangifera indica*.

INTRODUCTION

Mango, *Mangifera indica* (L.) (Anacardiaceae) is one of the most popular and economic fruit trees pests in Egypt, according to the latest survey of Egyptian Ministry of Agriculture in 2016. Mango orchards occupy 281.153 feddan and considered the third important fruit crop after grapes and citrus (Economic affairs Sector, 2016). Mango trees are liable to be infested with several serious insect pests during their growth stages including the seychelles fluted scale, *I. seychellarum* (Elwan, 1990). At high infestation levels, serious damage resulted 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 is 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). The economic threshold is fundamental integrated pest management (IPM) concepts. Also, decisions about control measures should be based upon the economic threshold

level, i.e., that population density at which control measures are necessary to prevent

eventual economic damage. The present work aims to evaluate of the economic threshold level of infestation with the seychelles fluted scale, *I. seychellarum* on mango trees in Giza Governorate.

MATERIALS AND METHODS

To estimate the economic threshold level of infestation with *I. schychellarum* to mango trees, mango orchard located at El-Saff, Giza Governorate 75 Km. south of Cairo was chosen for these purposes. The mango trees, *Mangifera indica* cv. *sultani* about 8-9 years old. These trees were received the same agricultural practices during the experimental period. From these trees twenty five trees of the same age, shape, size, vegetative growth and infest with *I. seychellarum* were selected for experimental purposes. The selected trees received no insecticidal application during experiment period. In order to determine the population density of the seychelles fluted scale, *I. seychellarum* on the selected trees, half-monthly samples each consisted of 20 leaves were picked at random of each tree from January to December, 2015. These samples were kept in special plastic boxes and transferred to laboratory for counting procedures by aid of stereoscopic microscope. This involved estimation of the average number of alive pre-adult and adult females per 20 leaves. To estimate the population density of this species, the selected trees were enumerated and mean number of alive pre-adults / leaves were recorded half-monthly intervals from the beginning of January to end of July, 2016 and the average of individuals were calculated for each tree. During the harvest season on August, 2016 total mango fruit yield of each tree was weighted and fruit yield Kgs. /tree was recorded. To estimate the economic threshold level of infestation due to infestation by *I. seychellarum*, it was found more convenient to use average number of pre-adults / leaves for each tree throughout March & June infestation as independent factor (x1 & x2), respectively. While, mango fruit weight in Kgs. /tree was used as dependent factor (y). When correlation coefficient value was significant regression coefficient (b) value was calculated using this formula according to (SAS Institute, 1989).

$$\grave{y} = a \pm bx$$

Where:

ỳ : Expected value

a : Constant

b : Regression coefficient

x : Mean number of pre-adult / tree

This value was calculated at this stage to determine the slope of straight regression line. But since the yield population relationship found to be more or less curved than linear thus a curved regression line had to be fitted. The obtained values of (ỳ) for each tree were arranged in descending order, while average numbers of pre-adults / leaves for each tree were arranged in ascending order. To achieve the point which the weight started to show a significant drop in the yield, the method of Chi-square analysis termed "r x 2 contingency tables with no exception" was applied to the (ỳ) data. The following model elucidates this procedure according to (SAS Institute, 1989):

$$\chi^2 = \Sigma \frac{(ni - ei)^2}{ei}$$

Where:

χ^2: Chi-square.

ni : Observed yield.

ei : Expected yield.

The statistical analysis of data was carried out with computer (SAS Institute).

RESULTS AND DISCUSSION

Data on the half-monthly counts of *I. schychellarum* on mango trees during, 2015 were shown in Table (1) and illustrated in Fig. (1), it shown that the seychelles fluted scale recorded 4 annual generations per year, the first peak was in mid-March and the second one was in June, the third one in August and the fourth one in mid-September. The mango fruit yield of variety (*sultani*) was harvested during August. This means that the first generation started from mid-February to end of April and peaked in mid-March and the second generation started in April to July and peaked in June is effective on mango yield. So, the present work, data of insect counts during the first and second peaks of abundance were analyzed statistically and correlated with the yield of mango fruits.

Table 1. Half-monthly counts of *I. schychellarum* represented by means of alive individuals on 20 leaves of mango at El Saff, Giza Governorate from January to December, 2015.

Sampling dates	Pre-adults	Adults	Population
01-Jan., 2015	16.20	10.30	26.50
15-Jan., 2015	16.70	11.20	27.90
01-Feb., 2015	13.10	10.70	23.80
15-Feb., 2015	10.50	9.50	20.00
01-Mar., 2015	20.00	10.40	30.40
15-Mar., 2015	26.30	14.00	40.30
01-Apr., 2015	12.20	9.90	22.10
15-Apr., 2015	17.60	12.70	30.30
01-May, 2015	36.30	19.40	55.70
15-May, 2015	53.60	23.30	76.90
01-Jun., 2015	64.20	18.80	83.00
15-Jun., 2015	55.70	15.10	70.80
01-Jul., 2015	31.90	13.80	45.70
15-Jul., 2015	51.40	19.30	70.70
01-Aug., 2015	124.10	41.20	165.30
15-Aug., 2015	53.60	28.30	81.90
01-Sep., 2015	111.60	34.70	146.30
15-Sep., 2015	130.40	50.00	180.40
01-Oct., 2015	81.50	28.40	109.90
15-Oct., 2015	59.70	22.20	81.90
01-Nov., 2015	39.10	21.20	60.30
15-Nov., 2015	20.00	20.90	40.90
01-Dec., 2015	23.90	20.70	44.60
15-Dec., 2015	23.30	19.40	42.70

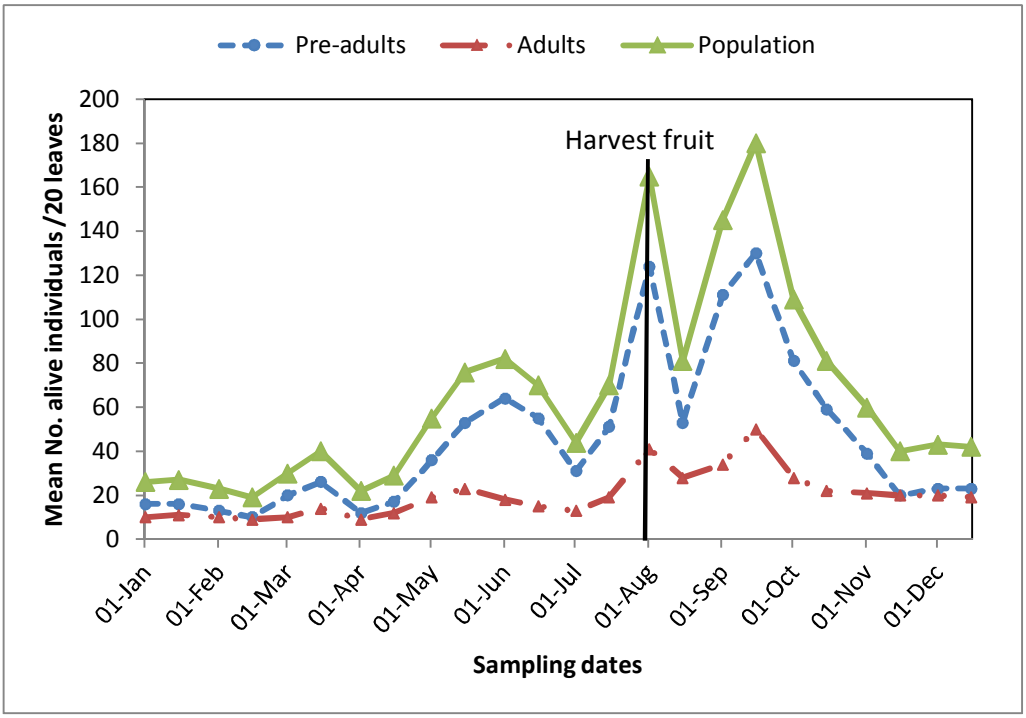

Fig.1. Half-monthly fluctuation of *I. seychellarum* on mango trees under field conditions in Giza Governorate, 2015.

1. Effect of mean number of pre-adult on mango fruit yield

Results obtained and statistical analysis are given in Table (2) and graphically illustrated in Fig. (2) showed that the relationship between mean number of pre-adults / leaf in March and June generations and mango fruit yield were negative and very highly significant. The correlation coefficient value in March and June generations were (-0.9746 & -0.9412), respectively. Also, a regression coefficient value were (-2.1324 & -1.9076), respectively. Thus means that when population density of the seychelles fluted scale increased mango fruit yield was decreased.

Table 2. Relationship between different levels of mean numbers of pre-adults of *I. schychellarum* throughout activity period and mango fruit yield of 25 mango trees in Giza Governorate during, 2016.

Tree No.	Yield in Kg. / tree	Average number of pre-adults / leaf	
		March	June
1	45.93	21.74	22.92
2	28.43	30.14	30.22
3	39.13	24.84	24.32
4	13.93	36.14	36.42
5	28.23	30.24	31.12
6	29.93	29.04	28.92
7	33.73	27.24	27.22
8	47.13	21.64	18.92
9	41.63	23.74	23.02
10	9.73	38.34	39.12
11	12.23	36.94	35.12
12	26.93	30.24	28.52
13	24.13	31.64	31.82
14	19.23	33.74	33.52
15	27.13	29.94	30.02
16	21.93	32.54	32.52
17	27.03	28.24	29.42
18	21.93	32.44	32.72
19	31.53	28.24	30.82
20	11.93	36.94	38.32
21	15.13	35.64	36.22
22	26.43	26.04	25.42
23	29.93	29.84	32.72
24	22.13	32.44	32.82
25	27.63	29.94	30.02
Simple correlation (r)		-0.9746	-0.9412
Simple regression (b)		-2.1324	-1.9076

From the aforementioned results, it could be stated that population density of *I. schychellarum* during main period of activity found to be greatly affected on fruits yield. The injury caused by this pest found to cause great damages to mango fruit yield.

2. Estimation of economic threshold level of infestation

Result of statistical analysis showed that population density of this pest was highly significant correlated with fruit yield. Therefore, losses assessment must be depend on mango fruit yield losses. Estimation of "Economic Levels of Infestation" will be based on correlation different levels of population density of *I. schychellarum* and mango fruit yield per tree in order to take correct decision for control measures. In found more convenience to illustrate definition of some terms about "Economic Threshold Level of Infestation" according Pedigo *et al.* (1986) and Pedigo and Higley (1992). To achieve this, the method of Chi-square termed "r x 2 contingency tables" was applied to determine (ỳ) data. Results of statistical analysis are given in Table (3) and graphically illustrated in Fig. (2).

Table 3. Chi square analysis of mango yield with different levels of average number of pre-adults of *I. seychellarum on* mango trees in Giza Governorate during, 2016.

March infestation (x1)				**June infestation (x2)**			
Average No. of pre-adults / leaf	observed yield (Kg.)	Expected Yield (Kg.)	χ^2	Average No. of pre-adults / leaf	observed yield (Kg.)	Expected Yield (Kg.)	χ^2
21.64	47.13	48.77	1.3787	18.92	47.13	48.31	0.7206
21.74	45.93	47.57	1.4135	22.92	45.93	47.11	0.7389
23.74	41.63	43.27	1.5540	23.02	41.63	42.81	0.8131
24.84	39.13	40.77	1.6493	24.32	39.13	40.31	0.8636
26.04	33.73	35.37	1.9010	25.42	33.73	34.91	0.9971
27.24	31.53	33.17	2.0271	27.22	31.53	32.71	1.0642
28.24	29.93	31.57	2.1299	28.52	29.93	31.11	1.1189
28.24	29.93	31.57	2.1299	28.92	29.93	31.11	1.1189
29.04	28.43	30.07	2.2361	29.42	28.43	29.61	1.1756
29.84	28.23	29.87	2.2511	30.02	28.23	29.41	1.1836
29.94	27.63	29.27	2.2972	30.02	27.63	28.81	1.2083
29.94	27.13	28.77	2.3372	30.22	27.13	28.31	1.2296
30.14	27.03	28.67	2.3453	30.82	27.03	28.21	1.2340
30.24	26.93	28.57	2.3535	31.12	26.93	28.11	1.2383
30.24	26.43	28.07	2.3954	31.82	26.43	27.61	1.2608
31.64	24.13	25.77	2.6092	32.52	24.13	25.31	1.3753
32.44	22.13	23.77	2.8288	32.72	22.13	23.31	1.4934
32.44	21.93	23.57	2.8528	32.72	21.93	23.11	1.5063
32.54	21.93	23.57	2.8528	32.82	21.93	23.11	1.5063
33.74	19.23	20.87	3.2218	33.52	19.23	20.41	1.7055
35.64	15.13	16.77	4.0095	35.12	15.13	16.31	2.1343
36.14	13.93	15.57	4.3186	36.22	13.93	15.11	2.3038
36.94	12.23	13.87	4.8479	36.42	12.23	13.41	2.5958
36.94	11.93	13.57	4.9550	38.32	11.93	13.11	2.6552
38.34	9.73	11.37	5.9138	39.12	9.73	10.91	3.1907

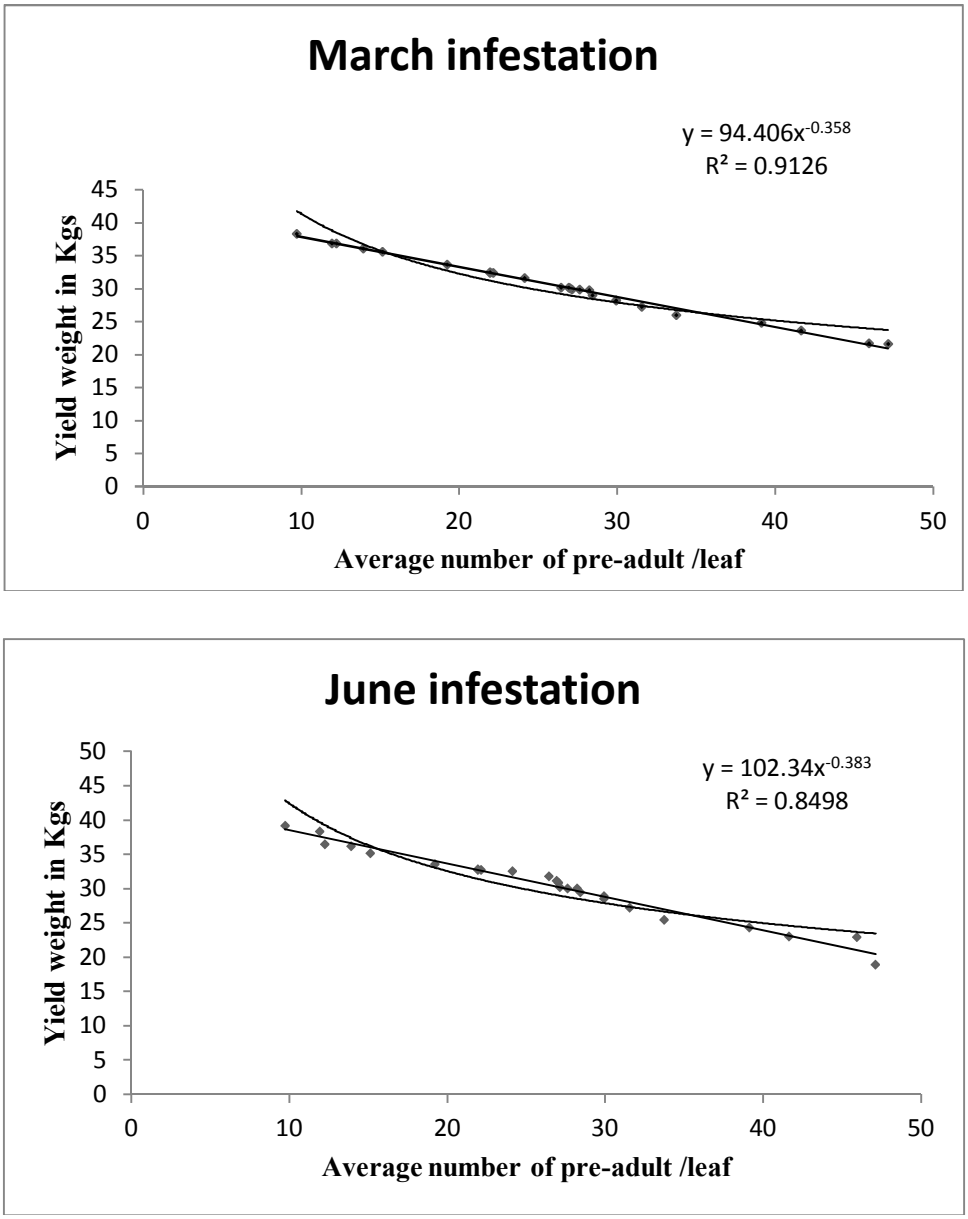

Fig. 2. The corrected average change in mango fruit yield / unit (ỳ) change with *I. seychellarum* infestation in March and June infestation (x1 & x2) during, 2016, on mango trees in Giza Governorate.

For the part of the population density of *I. seychellarum* during March period of seasonal activity ranging between (0.0 to 26.04) alive pre-adult / leaf, the chi-square value for the yield (1.901) was insignificant, denoting that the corresponding reduction in the yield could be due to chance only. However, for figures from (27.24) alive pre-adults / leaf and up, the chi-square value (2.027) indicated a significant drop in the yield. Thus, the increase of insect number to an average of 27.24 / leaf could be re-garded as the economic threshold for the March infestation.

For June period the increase of infestation from (0.0 to 25.42) alive pre-adult / leaf decreased the mango yield insignificantly. At the range from (27.22) alive pre-adults /leaf and up, there was a significant decrease in the yield, Chi-square value was (1.0642). Therefore, (27.24 & 27.22) pre-adult / leaf could be regarded as economic threshold of March & June infestation with *I. seychellarum* on mango trees under weather conditions of Giza Governorate, respectively.

These results are related to those obtained by (Abd El-Rahman *et al.,*2007) recorded combined numbers of individuals (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 , peak of intermediate population density during June and two approximately equal large peaks on August and mid-September (Salem *et al.,* 2006) found that susceptibility of five mango cultivars to infestation with *I. seychellarum* that *sultani* variety is the most susceptible to infestation (Selim and Badary, 2013) stated that the economic threshold for *Lepidosaphes pallida* on mango trees 3.1 adult females / leaf in April infestation while, 10.1 adult female/leaf in July infestation.(Hosny *et al.,* 1972) determined the economic damage threshold for the different infestation densities of *A. aurantii* (Maskell) on mandarin trees. He found that more than 0.24, 0.18 adult females / leaf during June and October respectively decreased the yield of fruit significantly.

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تقدير الحد الأقتصادى الحرج لحشرة بق السيشيلارم الدقيقى على أشجارالمانجو فى محافظة الجيزة

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تعتبر حشرة بق السيشيلارم الدقيقى من الآفات الخطيرة التى تصيب أشجار المانجو ، حيث تسبب فقد فى محصول المانجو فى معظم البساتين فى مصر ، وتهدف الدراسة الحالية تحديد الحد الحرج للأصابة بالحشرة لإتخاذ قرار بدء المكافحة فى التوقيت المناسب ولتفعيل أحد الركائز الأساسية لبرنامج المكافحة المتكاملة .

أجريت الدراسة فى أحد مزارع المانجو الخاصة على مانجو صنف سلطانى بمحافظة الجيزة خلال عامى 2015 & 2016 .

أوضحت نتائج التحليل الأحصائى عندما كانت الكثافة العددية للحشرة (٢٧,٢٤ أطوار غير كاملة / ورقة خلال شهر مارس ، ٢٧,٢٢ أطوار غير كاملة خلال شهر يونيه) يمكن أعتبارهما يمثلا الحد الاقتصادى الحرج حيث تبدأ عند هذا الحد إتخاذ أجراءات المكافحة لمنع زيادة الكثافة العددية للحشرة من الوصول لحد الضرر الأقتصادى. كما أوضحت النتائج أن للحشرة أربعة فترات للنشاط للعام الأولى خلال شهر مارس والثانية خلال شهر يونيه والثالثة خلال شهر أغسطس والرابعة خلال شهر سبتمبر. تعتبر فترتى النشاط خلال شهرى مارس ويونيه هما المؤثرتين على كمية محصول المانجو حيث يتم قطف ثمار الصنف سلطانى فى بداية شهر أغسطس قبل بداية الجيل الثالث.