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Influence of Various Ecological Factors on Population Fluctuations of *Icerya Seychellarum* (Westwood) Infesting Guava Orchard in El-Behara Governorate.

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ABSTRACT: *Icerya seychellarum* (Westwood) (Homoptera: Monophelibidae) is the most important mealybug species in Egypt which attacking guava orchards. The purpose of this study was to observe the fluctuations in population of this insect pest in guava orchards throughout two seasons of 2020/ 2021 and 2021/ 2022 in Rashed region, El-Behara governorate. The obtained results indicated that, *I. seychellarum* had 2-3 peaks of population density during the first and second years of the study. There was a good synchronization between nymphal population of *I. seychellarum* and populations of the two predators *Rodalia cardinalis* (Mulsant) (r= 0.69 and0.78) and *Chrysoperla carnea* (Stephens) (r = 0.63 and 0.61) during the previous period. The impact of weather factors (temperature and relative humidity) on population of *I. seychellarum* and the associated predators (*R. cardinalis* and *C. carnea*) were examined.

Keywords: *Seychellarum mealybug, predators, synchronization,guava, weather factors.*

INTRODUCTION

There were various mealybugs species (Hemiptera: Margarodidae) were attacking the guava trees (*Psidium gaujava* L.) in Egypt, and the infestation by these species eventually causes losses in the crop's quantity and quality, (**Sayed, 2008; Attia, 2010; Awadalla, 2013; El-Sherbenie 2004; Abdel-Mageed 2005; Bakry and Arbab, 2020**). Because insect sap contains very little protein, the insect may have to suck a large amount of plant sap to get enough protein for growth and egg development. The insects can attack guava leaves, branches, and fruits as a result of a huge loss of plant sap, which in turn manifests as leaf loss, wilting of growing tips, early leaf drop, deformation of leaves and dwarfing **(Mangoud, 2000; El-Said, 2006; Reda *et al*., 2010).** As well as, honey dew, direct damage, which is secreted by these insect pests, enhances saprophytic fungal damage and decreases Plant metabolism and photosynthesis (**Mittler and Douglas, 2003; Zaki *et al*., 2013; El- Sayed, 2015 and Mohamed**, 2015). As well as, Mealybugs were difficult to kill because they live in protected areas, the mealybugs body walls on all developing stages are waxed, and most insecticides are ineffective. The immobility of Mealybugs, on the other hand, allows biocontrol chemicals to be successful. (**Mani *et al*. 2011**).

R.cardinalis (Coleoptera: Coccinellidae) is specialized on mealybugs. It had its important after its success in controlling *Icerya purchasi* Maskell in the citrus groves of California and many other countries (**Bennett *et al*., 1985; Caltagirone and Doutt, 1989 and Mohamed *et al*., 2013**). It became one of the most important predators that attack mealybug species in different areas in Egypt (**Hamed and Saad, 1989; Ibrahim, 2005; Awadalla, 2013**). The green lacewing, *C.carnea* (Neuroptera: Chrysopidae) is regarded as a common predator of *I. seychellarum* (**Carrillo and Elanov, 2004; El-Serafi *et al*., 2004**). It is regarded as one of the most significant predaceous species because, its extensive distribution, high relative frequency of occurrence, good hunting characteristics, and ease of rearing in the laboratory.

To achieve a good integrated pest management of any pest; ecological and biological aspects should be involved. As a result, the current work aimed to study the population fluctuations of *I. seychellarum* and its associated predaceous insects (*R.cardinalis* and *C. carnea*) and the synchronization between them as well as, the impact of some climatic factors (temperature and relative humidity) on their populations.

MATERIALS AND METHODS

This study was performed for two following years in heavy infested guava orchards with I. seychellarum during (2020/2021) and (2021/2022) at ELbhera, Governorate. The chosen trees did not receive to any chemical treatments throughout the period of this study. All trees received the same routine horticultural practices.

Sampling method and assessment

Five trees were similar in size, shape, height, vegetation and relatively homogenous in their infestation with *I. seychellarumm* were chosen to carry out this work. Samples of guava leaves were taken biweekly intervals throughout the investigation period from the four cardinal directions; East-West-North and South in addition to, the center of each selected tree. Sample size was 125 leaves represented 25 leaves for each direction. Samples were picked up randomly from each tree by using a garden scissors. The samples were packed instantly in polyethylene bags and transferred to the laboratory on the same day for assessment by using stereoscopic microscope (binocular) to record the number of *I.seychellarum* (as nymphs and adults). To investigate the population density of the two predators, the five trees were examined in the field and record the numbers of the observed predators which found.

Effect of ecological factors on population fluctuations of *I.seychellarum*and its associated predators:

Meteorological Central Laboratory, Agricultural Research Center, and Ministry of Agriculture provided us with the data of temperatures, as well as average daily relative humidity, for the seasons 2020/2021 and 2021/2022.We investigated the simple correlation and regression values to study the relationships between the tested weather factors and the population density of the *I.seychellarum* and its associated predators. Also, multi regression analysis was done to estimate the combined effects of the abiotic factors of *I.seychellarum* and its associated predators as well as, estimated the combined effects of abiotic and biotic factors on population of seychellarum scale. Correlation also, the regression analyses were done by using SAS program (**SAS Instue, 1998**).

RESULTS AND DISCUSSION

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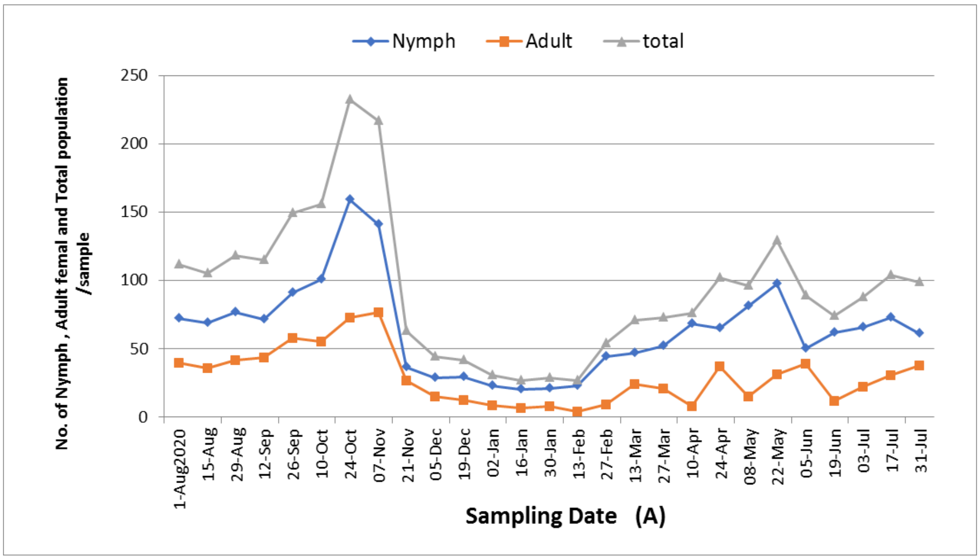
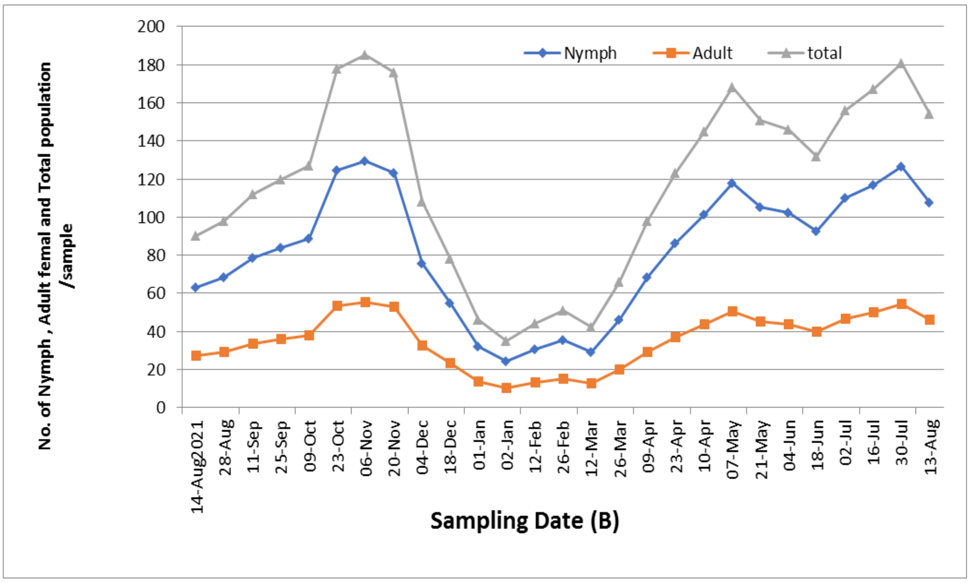




(Fig.1) Population fluctuations of *I.seychellarum*infesting guava trees during 2020/2021 (A) and 2021/2022 (B) in El-Behara governorate.

Effect of some weather factors on the seasonal activity of *I. seychellarum* on guava trees.

Table 1: Simple correlation and regression coefficients between the tested weather factors and each of nymphs, adult females and total populations of *I. seychellarum* on guava during 2020/2021.

Pre-stage	Weather factors	Simple correlation & partial regression				Multi regression	
		r	P	b	R^2	b	E.V
Nymph	T. MAX	0.58	0.0016	3.29	0.3350	0.8163	37.34
	T. MIN	0.58	0.0016	4.01	0.3329	0.3136	
	RH%	-0.45	0.0198	-3.31	0.1985	0.3077	
Adult	T. MAX	0.55	0.0033	2.00	0.3577	0.2186	50.19
	T. MIN	0.59	0.0012	2.79	0.4672	0.0193	
	RH%	-0.38	0.0505	-1.39	0.1010	0.4157	
Total	T. MAX	0.62	0.0006	5.29	0.3694	0.5430	43.45
	T. MIN	0.63	0.0004	6.80	0.4089	0.1200	
	RH%	-0.46	0.0168	-4.70	0.1707	0.3201	

Impact of temperatures (maximum, minimum) and relative humidity on the totality of population of *I. seychellarum* during the two studied years were illustrated in Tables (1 & 2). During the first year (Table, 1), there were slow positive relationship between the nymph density of the *I. seychellarum* (r =0.58) with maximum and minimum temperatures; while, with relative humidity it was negative (r =- 0.45). Multi regression show that the combined effect of weather factors had low effect (E.V. = 37.34 %).

There were slow positive relationship between the adult female population of the *I. seychellarum* (r = 0.55 & 0.59) with maximum and minimum temperatures; while, with relative humidity it was negative (r = - 0.38). Multi regression show that the combined effect of weather factors had 50.19 % of the total factors affecting adult female population (Table, 1).

There were significant effects of maximum and minimum temperatures on *I. Seychellarum* total population during the first year (r =0.62 & 0.63) and there were insignificant effects of relative humidity during (r =- 0.46). Multi regression show that the effect combined of weather factors exhibited 43.45% of the total factors affecting total population (Table,1).

In the second year (Table, 2), there were positive relationship between the nymph population of the *I. seychellarum* (r =0.70 & 0.63) with maximum and minimum temperatures; while, with relative humidity it was negative (r =- 0.68). Multi regression show that the effect combined of weather factors reached 56.32%.

There were positive relationship between the adult female population of the *I. seychellarum* with maximum and minimum temperatures (r = 0.69 & 0.63); while, with relative humidity there was a negative coloration (r = - 0.68). Multi regression show that the combined effect of weather factors had 56.37 % of the total factors affecting adult female population (Table,2). There were significant positive effects of maximum and minimum temperatures on *I. seychellarum* total population during the second year (r =0.70 & 0.63). Significant negative effects of relative humidity (r =- 0.68). Multiregression showed that, the influence of weather factors reached 56.37 % (Table, 2).

Table 2: The simple correlation and regression coefficients between the tested weather factors and each of nymph, females and total population of *I. seychellarum* on guava trees during 2021/2022.

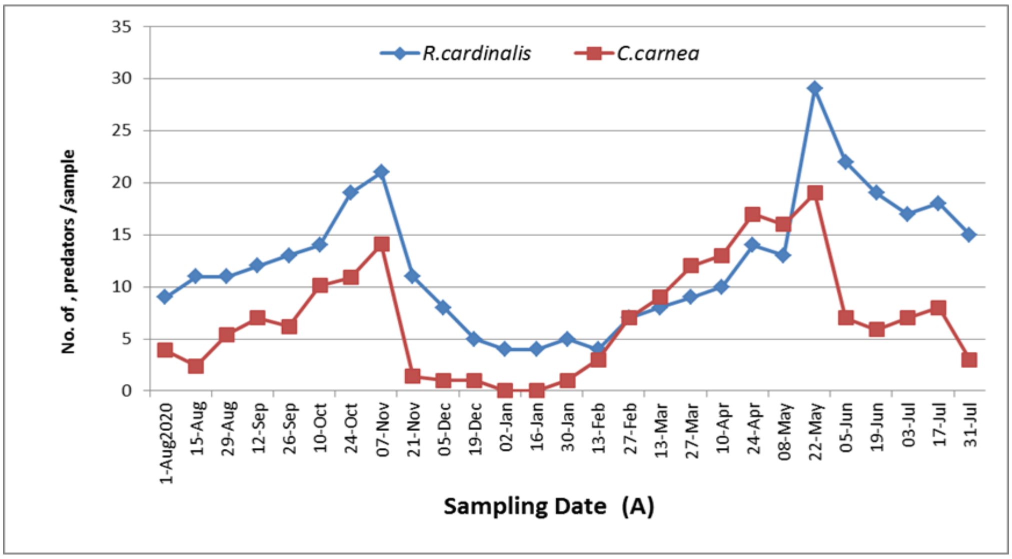
Pre-stage	Weather factors	Simple correlation & partial regression				Multi regression	
		r	P	b	R^2	b	E.V
Nymph	T. MAX	0.70	<.0001	3.44	0.4833	0.6239	56.32
	T. MIN	0.63	0.0004	3.81842	0.3971	0.8854	
	RH%	-0.68	<.0001	-4.69	0.4680	0.0835	
Adult	T. MAX	0.69	0.0001	1.47	0.4836	0.6231	56.37
	T. MIN	0.63	0.0004	1.64	0.3972	0.8864	
	RH%	-0.68	0.0001	-2.01	0.4687	0.0829	
Total	T. MAX	0.70	0.0001	4.91	0.4834	0.6236	56.37
	T. MIN	0.63	0.0004	5.46	0.3971	0.8857	
	RH%	-0.68	0.0001	-6.71	0.4682	0.0833	

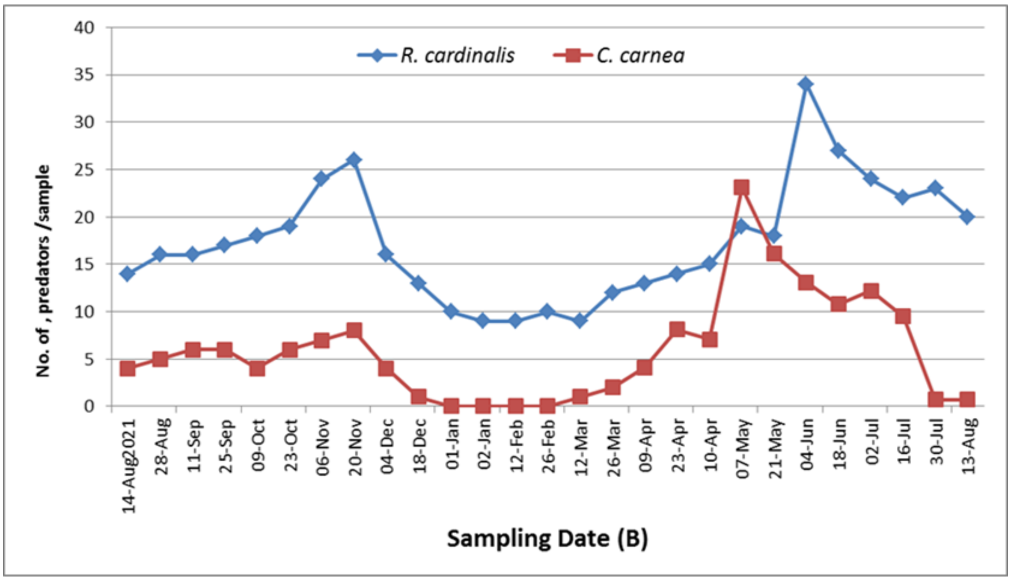
3- Seasonal activity of *R. cardinalis* and *C.carnea* on guava trees:

Data presented in Fig. (2 A&B) illustrated that seasonal activity of *R. cardinalis* and *C.carnea* had two peaks on guava trees during first and second years.

Population of *R. Cardinalis* recorded its first peak on the 24th of October and 20th of November (with 31 and 26 individuals /sample), throughout the first and second year, respectively. The second peak was recorded on the 22th of May and 4th of June with 23 and 34 individuals / sample, respectively (Fig., 2).

With respect to *C. carnea* population (Fig., 2), it recorded its first peak on the 7th and 20th of November of first and second year (14.1 and 8 individuals /sample, respectively). The second peak was recorded on the 22th and 7th of May of first and second year (19 and 23.1 individuals/ sample, respectively).





(Fig.2) Seasonal activity of *R.cardinalis*and *C.carnea* on guava trees infested with *I. seychellarum* during 2020/2021 (A) and 2021/2022 (B) in El-Behara governorate.

Impact of some climatic factors on the seasonal activities of *R. cardinalis* and *C.carnea* on guava trees.

Impact of temperatures (maximum & minimum) and (R.H %) on the populations of *R. cardinalis* and *C. carnea* throughout the two years of study were illustrated in Tables (3 and 4).

There were positive relationship between the *R. cardinalis* and both of maximum & minimum temperatures (r =0.68 and 0.66) during the first year; while, with relative humidity it was negative (r =- 0.56). Multi regression show that the combined effect of weather factors 51.81% of total factors affecting *R. cardinalis* (Table, 3).

There were no relationship between the *C. carnea* population and both of maximum & minimum temperatures (r = 0.19 and 0.01) during the first year; while, with relative humidity it was significantly negative (r = - 0.49). Multi regression show that the combined effect of weather factors had a moderate effect (E. V = 35.51%) (Table,3).

Table 3: The simple correlation and regression coefficients between the tested weather factors and populations of *R. carinalis* and *C. carnea*during 2020/2021.

Tested factors		Simple correlation & partial regression				Multi regression	
		r	P	b	R^2	b	E.V
R. cardinalis	**T. MAX**	0.68	<.0001	0.87	0.4607	0.8298	51.81
	T. MIN	0.66	0.0002	1.03	0.4362	0.2427	
	RH%	-0.56	0.0023	-0.94	0.3155	0.2427	
C. carnea	**T. MAX**	0.19	0.3453	0.17	0.0357	0.1958	35.51
	T. MIN	0.01	0.9552	0.01	0.0001	0.0952	
	RH%	-0.49	0.0090	-0.59	0.2429	0.1356	

There were positive relationship between the *R. cardinals* and temperatures (maximum and minimum where r-values were 0.66 and 0.63) during the second year; while, with relative humidity it was negative (r =-0.49). Multi regression show that the combined effect of weather factors contributed 44.25% of the total factors affecting *R. cardinalis* (Table, 4).

There were relatively low effect of maximum and minimum temperatures on *C. Carnea* population during the second year (r = 0.42 and 0.27); while, with relative humidity it was significant (r = - 0.57). Multi regression show that the combined effect of weather factors had moderate effect (E.V. = 44.12%) (Table, 4).

Table 4: Simple correlation and regression coefficients between the tested weather factors and populations of *R. cardinalis* and *C. carnea* during 2021/2022.

Tested factors		Simple correlation & partial regression				Multi regression	
		r	P	b	R^2	b	E.V
R. cardinalis	**T. MAX**	0.66	0.0002	0.61	0.4406	0.3852	44.25
	T. MIN	0.63	0.0004	0.71	0.3952	0.9504	
	RH%	-0.49	0.0096	-0.63	0.2394	0.8454	
C. carnea	**T. MAX**	0.42	0.0281	0.35	0.1786	0.0467	44.12
	T. MIN	0.27	0.1750	0.27	0.0723	0.0445	
	RH%	-0.57	0.0017	-0.66	0.3301	0.3319	

Synchronization between *I.seychellarum* and its predators.

Correlation coefficient values between predators (*R. cardinalis* and *C. carnea*) populations and each of the nymphs, females and totality of population of *I. Seychellarum* during the two studied years are represented in Table (5). There were positive relationship between the *R. cardinalis* and each of nymphs (r =0.69 and 0.78), adult females (r =0.62 and 0.76) and total population (r =0.72 and 0.77) during the first and second year, respectively.

As it was noticed with *R. cardinalis*, the was a good synchronization between *C. Carnea* population and each of nymphs (r =0.63 and 0.61), adult females (r =0.29 and 0.56) and total population of *I. seychellarum* (r =0.54 and 0.57) throughout 1st and 2nd seasons, respectively (Table, 5).

Table 5: The correlation coefficient values between denisities of predators(*R. cardinalis* and *C. carnea*) and each of nymphs, adult females and total populations of *I. seychellarum*in guava orchard during 2020/2021 & 2021/2022.

Prey Stage	2020 - 2021				2021 - 2022			
	R. Cardinalis		***C. carnea***		***R. Cardinalis***		***C. carnea***	
Nymph	0.69	<.0001	0.63	0.0004	0.78	<.0001	0.61	0.0098
Adult	0.62	0.0006	0.29	0.1373	0.76	<.0001	0.56	0.0099
Total	0.72	<.0001	0.54	0.0039	0.77	<.0001	0.57	0.0008

Combined effect of ecological factors on *I.seychellarum* population:

The combined effect of abiotic (maximum, minimum temperatures and relative humidity) and biotic factors (*R. cardinalis* and *C. carnea*) represented by R^2 (0.90, 0.87 and 0.91) of the total factors affecting nymphs, adult females of *I. seychellarum* throughout the 1st season. On the other hand, throughout 2nd season these effects recorded R^2 (0.79,0.71 and 0.77) of the total factors affecting nymphs, adult females, respectively. The mathematical relationships between *I. seychellarum* populations (nymphs, adult females and total) and abiotic & biotic factors are represented as follows:

During the first year:

Nymph = -55.23-1.95 TMax +3.24 Tmin +0.88RH +3.28*R.cardinalis* +1.92*C. C. carnea*

Adult = -32.68 - 2.12TMax +3.08 Tmin +0.54 RH +2.32*R.cardinalis* -0.04*C. C. carnea*

Total = -87.91-4.07 TMax +6.33 Tmin +1.42RH +5.60*R.cardinalis* +1.89*C. C. carnea*

During the second year:

Nymph = -55.23-1.95 TMax +3.24 Tmin +0.88 RH +3.28 R. cardinalis +1.92C. carnea

Adult = -32.68-2.12TMax +3.08 Tmin +0.54 RH +2.32R.cardinalis -0.03900C. carnea

Total = -87.91-4.07 TMax +6.33 Tmin +1.42RH +5.60R.cardinalis +1.88 C. carnea

These results were agreed with those obtained by (**Abdel-Rahman *et al.* 2007**), who reported, there were significant positive correlations with temperature degrees and insignificant negative correlations with relative humidity on mango orchards which infested by *I. seychellarum.* **Moustafa (2012)** indicated, there were positively high significant correlations between *I. seychellarum* population and the mean of temperatures and relative humidity at Damietta governorate.

Also, the current results were agreed with those obtained by **Ghanim *et al.* (2013) and Mohamed (2013)**; they indicated that, the predator, *R. cardinalis* is the most predator of *I. seychellarum* on citrus and grapevine orchards in Dakahlia governorate. Also, the above results were agreed with those obtained by **El-Sherbenie(2004)**; who recorded that, the predator *R. cardinalis* is the most widespread predator on *I. seychellarum* in guava orchards. **Abdel-**

Mageed (2005), **Abdel-Aleem (2008) and Moustafa (2012)** added that, *R. cardinalis* was the dominant insect predator associated with*I. Seychellarum*, **Hamid and Hassanian(1991)**, *R. cardinalis* associated with *Icerya* spp..

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الملخص العربى

تأثير العوامل البيئيه المختلفة علي تعداد بق السيشيلارم الدقيقي علي أشجار الجوافة في محافظه البحيرة

وفاء محمد البرادعي، السيد عبد الحميد رفاعي، مروة السيد سند عامر

معهد بحوث وقاية النبات- مركز البحوث الزراعية-الجيزة- مصر.

يعتبر بق السيشيلارم من أهم أنواع البق الدقيقي في مصر و التي تهاجم بساتين الجوافة . وقد أجريت هذه الدراسة لمعرفة تعداد هذه الأفة في منطقة رشيد بمحافظة البحيرة خلال الموسمين 2020\2021 و 2021\2022. أظهرت النتائج أن للحشرة ثلاث ذروات في العام الأول وذروتين في العام الثاني. كان هناك تزامن جيد بين حوريات *I. Seychellarum* والمفترسين الروداليا و أسد المن (r =0.63 & 0.61) و (r=0.69 & 0.78) خلال عاميين الدراسة الأول والثاني على التوالي. تم دراسة تأثير بعض العوامل البيئية (درجة الحرارة والرطوبة النسبية) على تعداد *I. Seychellarum* والمفترسات المرتبطة به وهي الروداليا وأسد المن.