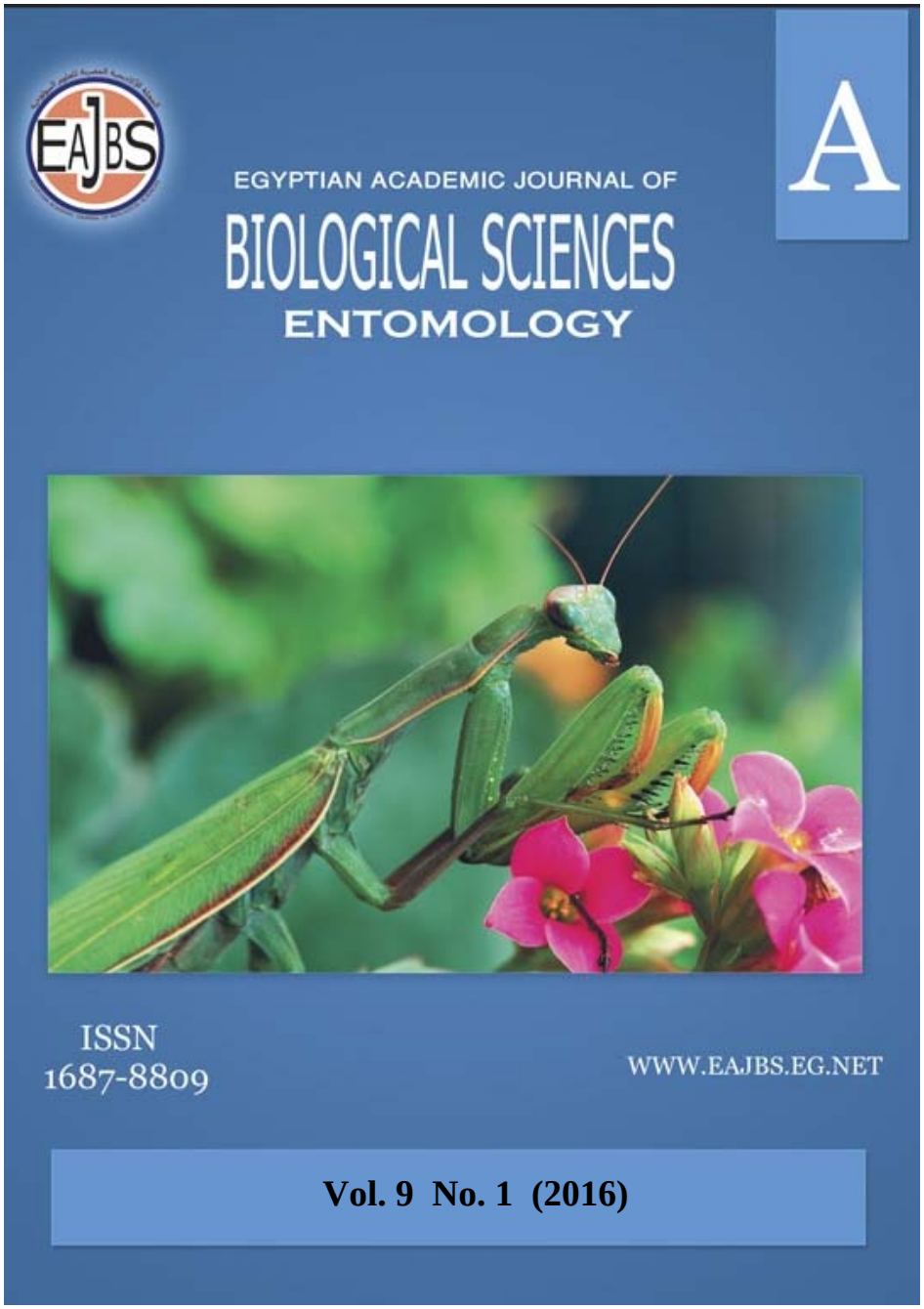

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Ecological Studies on Cottony Camellia Scale, *Pulvinaria floccifera* (Westwood) (Hemiptera: Coccidae) on Sago Palm Cycas *revoluta* Thunb in Relation to Biotic and Abiotic Factors.

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ABSTRACT

The Sago palm infested with different scale insects, among them the cottony camellia scale, *Pulvinaria floccifera* (Westwood), is the most serious pest of Sago palm. This study was conducted to demonstrate the number of generations of this pest and the effect of parasitic and meteorological factor on its population. The present study was carried out in the Farm of Faculty of Agriculture, Assiut university, during two successive seasons of 2013/2014 and 2014/2015. The obtain results of both seasons showed that half monthly observation of this insect had one peak of seasonal activity per year, which was recorded in the 1st of March. The highest percentage of the total monthly mean count was also recorded during March. (20.69, 19.09 % out of the total year count). The pest has one generation in each of the tow studied seasons. Concerning, the monthly variation rate in the population (M.V.R), the obtained results showed that the favorable times for this insect were from November to May of the first year and October to June of the second year. One parasitoid species was only found *Microterys flavus* (Howard). The percentages of parasitism ranged from 5.81% in October to 17.65% in August and 6.01% in April to 12.99% in July during the first and the second season of study.

INTRODUCTION

Cycads are an ancient lineage of plants routinely referred to as ‘‘living fossils’’ (Norstog and Nicholls, 1997; Seward, 1917). The genus *Cycas* exhibits the most primitive features from among all cycad genera, and these charismatic plants possess ethno biological, evolutionary, ecological, and horticultural characteristics that attract the interest of biologists (Brenner et al., 2003; Norstog and Nicholls, 1997). The most popular *Cycas* species in the international horticulture industry is *Cycas revoluta* (Norstog and Nicholls, 1997). It is widely represented in commercial and residential landscapes, as containerized specimen plants, in bonsai applications, and in the floriculture industry as greenery. According to Convention on International Trade in Endangered Species data, the number of *C. revoluta* plants crossing international borders in legal trade from 1983 until 1999 greatly exceeded that of any other cycad species (Donaldson et al., 2003). These legal export–import events were theoretically accompanied by inspections by qualified agents, sometimes at both locations.

The genus *Pulvinaria* (Sternorrhyncha: Coccidae) contains more than 100 described species (Hodgson, 1994; Ben-Dov *et al.*, 2009) of which 25 species have been recorded from the New World (Ben-Dov *et al.*, 2009).

The cottony camellia scale, *Pulvinaria floccifera* (Westwood, 1870) is a species common in the Mediterranean region that has a world-wide distribution (Kosztarab and Kozar, 1988; Ulgenturk *et al.,* 2004). It is a polyphagous species associated with host plants from at least 34 families (Ben-Dov *et al.,* 2008), most frequently found on the leaves and branches of *Pittosporum spp*., *Euonymus spp., Ilex spp*., *Mahonia spp.* and *Taxus spp.* (Milek *et al.,* 2009). Feeding on leaves and twigs by nymphs and adult females results in production of large amounts of honeydew that encourages the growth of black sooty mold and can weaken the host plant, causing leaf loss and slow dieback of twigs and branches. Soft scales might be a vector of plant viruses, for example, *P. vitis* L. can transmit the economically important grapevine leaf roll virus (Elborolosy *et al.,* 1990).

There is clear evidence that climate change is altering the distribution, incidence and intensity of animal and plant pests (Rasekh *et al.,* 2011) For example, it has been reported a dramatic increase in enquires regarding to *P. floccifera*. This pest is frequently intercepted on imported plants, most often on Camellia from France, Italy, Netherlands and New Zealand. For many years this soft scale was restricted to Camellia and South of England but has now spread throughout England and has also been recorded on *Choisya, Citrus*, *Juniperus, Kalmia*, *Laurus, Pieris*, *Pyracantha, Magnolia*, *Rhododendron* and *Trachelospermum*. So, over the last decades, this insect has become a more damaging pest. In Sweden this species was previously only known as a greenhouse species, but is now established as an outdoor species (Gertsson, 2005).

In 1951, Cottony camellia scale was considered as one of the most important pest of citrus trees in Egypt. A study on biology of this species showed that female fecundity and generation time was 875 eggs and 134.4 days. Furthermore, the unmated females produce female offspring (Elborolosy *et al.,* 1990). In a study on spatial distribution of citrus whitefly, *Dialeurodes citri* (Ashmead) and *P. floccifera*, it has been shown that these two pests had the simultaneous peak abundance in Palestine (Ben-Dov *et al.,* 2001). The effect of season on growth rate and fecundity of *P. psidi* and *P. floccifera* was studied in Spain (Helyer *et al*., 2003).

The hymenopteran superfamily Chalcidoidea is one of the largest groups of insects, yet one of the most poorly known. The vast majorities of included species are parasitoids of other insects and play an important role in their regulation. *Microterys flavus* (Howard) (Hymenoptera: Encyrtidae) which are synonyms of *M. nietneri* (Motschulsky) is one of the most efficient parasitoid of soft scale insects (Hemiptera: Coccidae) of world and Egypt (Hart, 1972; Abd-Rabou, 2006). It is recorded associated with a wide range of host insects and plants (Xu and Chen, 2000; Noyes, 2010). Abd-Rabou (2001) recorded this primary parasitoid species associated with *Ceroplastes floridensis* Comstock from Egypt. Hendaway (1999) recorded *Pulvinaria psidii* Maskell adults parasitized by *M. flavus* (Howard).Morsi (1999) recorded *Ceroplastes rusci* (L.) as a host of this parasitoid in Egypt. World data base of *M. flavus* reported by Noyes (2011). Abd-Rabou (2012) recorded this parasitoid species associated with *P. floccifera* (Westwood) from Egypt.

The present work was planned out to study the seasonal fluctuations of Cottony camellia scale pest on Sago palms in Assiut Governorate with aim to improve the available knowledge on the effects of climatic and biotic factors on its seasonal abundance. The results can be employed to optimize the monitoring methods for establishing Integrated Pest Management (IPM) strategies against the pest.

MATERIAL AND METHODS

The population fluctuations of cottony camellia scale found infesting Sago palms trees were carried out in the Farm of Faculty of Agriculture, Assiut university during two successive years (2013/2014 and 2014/2015). Four Sago palms trees of almost similar and as uniform as possible in size, age (7years), shape, height, vegetative growth and received the normal agricultural practices without application any chemical control measures before and during the period of investigation, were randomly chosen for sampling which was practiced at half-monthly intervals were selected for carrying out this study. The sample size (12 leaflets) was taken from every palm at a rate of (3 leaflets) from each of the north, east, south and west directions. Regular half-monthly samples were collected and immediately transferred to laboratory in polyethylene bags for inspection by the aid of stereo-microscope. The numbers of nymphs and adults of each inspected date were recorded.

To calculate the age structure per sample, the mean number of each stage (Adult) was divided by the total and multiplied by 100. This way gave each stage (Adult) a percent proportion of the total per sample regardless the total number of insects presents (i.e. population density).

To facilate the comparisons within the each studied season and among the two seasons, the half-monthly counts were accumulated monthly. These monthly counts were estimated in percentages out of the year total.

Also, the monthly variation rate (MVR) of population density of each studied insect was calculated according the following formula prescribed by Abdel-Fattah *et al*., 1978 and Serag-El-Din, 1998

$$\text{MVR} = \frac{\text{A.v. count of insect at a month}}{\text{A.v. count given at the precding month}}$$

The meteorological data of temperature and relative humidity were recorded at each inspection date. Records were obtained from the Meteorological Station located at the University of Assiut Experimental Farm.

To identify the pest parasitoid, each plant sample (5 leaflets) form each plant (4 plants), after the examination of plant leaves in the laboratory for counting the nymphs and adults of the pest. Then, the leaves were stored in one – pound glass Jar (4 glasses jars weekly). The jar was furnished with a suitable disc of filter paper on its bottom to absorb condensed humidity. Jars were covered with a piece of polyethylene with minute holes held by means of rubber band. Apiece of cotton-wool soaked in 10% sucrose solution was placed in a small plastic container and placed inside the jar for feeding the emerged parasitoides. The emerged parasitoids were then collected and kept in a well-ventilated small tubes containing alcohol 70% for identification.

During the half-monthly examination of the plant leaflets for counting the alive insects, the numbers of the dead insects as a result of parasitoids were also counted (the bodies of these dead insects have a minute holes as a result of emerging parasitoids).

The meaning of "Percent Parasitism" (%PA) in studies of insect parasitoids was described by Van Driesche (1983) and calculated as follows:

$$\%\text{PA} = \frac{\text{EMP} + \text{LP}}{\text{EMP} + \text{LP} + \text{UMH}}$$

Where EMP = emerged parasitoids, LP = all live parasitoids and UMH = unparasitized mealybug hosts. To simplify the formula EMP + LP= total parasitized

hosts, EMP + LP + UMH= total cottony camellia scale cottony camellia scale hosts.

The relationships between the population size of each insect species (The pest and its parasitoid) and the meteorological factors were studied by using multiple regression analysis.

RESULT AND DISCUSSION

Seasonal fluctuation in population:

The half-monthly count of *P. floccifera* different stages infested *C.revoluta* at the Farm of Faculty of Agriculture, Assiut university were recorded through the successive years (2013/2014 and 2014/2015). Also, mean of the half-monthly records to temperature and relative humidity throughout the two years of investigation are illustrated in Tables (1, 2 and 3).

The first year (2013/2014):

Results in Table 1 and Figure (1) show that the scale population started the season with high population level of 75 and 31 individuals /48 leaflets for nymphs and adults during the 1st week of October .The population increased gradually from the mid-October to reach its highest level of 401 and 111 individuals/48 leaflets for nymphs and adults during the 1st week of March. After that the population decreased slightly till the end of April and a steep decline occurred from May to reach its lowest level of 7 and 4 individuals /48 leaflets during the mid-September. From the beginning of 1st October, 2014 the population started its gradually increase.

Table 1: Fortnightly number of different developing stages of *Pulvinaria floccifera* on *Cycas revolute* during the two successive years, at Assiut governorate:

1 st Season				2 nd Season			
Investigation Date	Total population	Adult-female	Nymphs	Investigation date	Total population	Adult-female	Nymphs
01/10/2013	106	31	75	01/10/2014	72	27	45
15/10/2013	135	54	81	15/10/2014	147	44	103
01/11/2013	146	43	103	01/11/2014	202	61	141
15/11/2013	170	51	119	15/11/2014	182	42	140
01/12/2013	231	50	181	01/12/2014	245	47	198
15/12/2013	263	56	207	15/12/2014	273	64	209
01/01/2014	288	88	200	01/01/2015	325	52	273
15/01/2014	286	83	203	15/01/2015	366	86	280
01/02/2014	402	94	308	01/02/2015	393	75	318
15/02/2014	455	97	358	15/02/2015	501	108	393
01/03/2014	512	111	401	01/03/2015	467	97	370
15/03/2014	446	92	354	15/03/2015	524	109	415
01/04/ 2014	460	110	350	01/04/2015	391	73	318
15/04/2014	281	75	206	15/04/2015	339	74	265
01/05/2014	92	31	61	01/05/2015	281	60	221
15/05/2014	66	24	42	15/05/2015	185	35	150
01/06/2014	67	21	46	01/06/2015	112	38	74
15/06/2014	59	21	38	15/06/2015	44	11	33
01/07/2014	47	17	30	01/07/2015	43	13	30
15/07/2014	35	10	25	15/07/2015	34	7	27
01/08/2014	28	11	17	01/08/2015	28	6	22
15/08/2014	23	10	13	15/08/2015	19	4	15
01/09/2014	22	7	15	01/09/2015	11	4	7
15/09/2014	11	4	7	15/09/2015	7	3	4

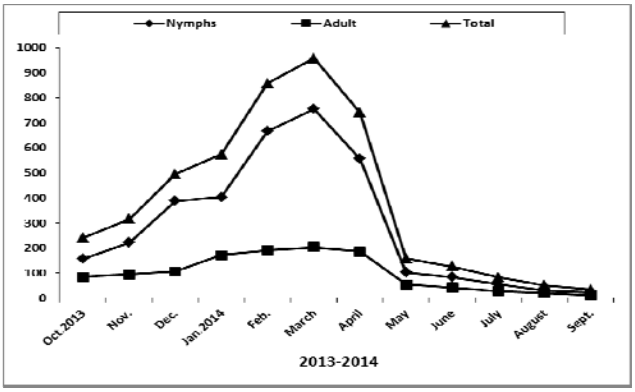

Fig. 1: Total number of different developmental stages of *Pulvinaria floccifera* on 48 leaflets of 4 *Cycas revolute* trees at Assiut district, 2013/2014.

Concerning the total monthly mean for the pest population, the highest percentages of the pest population ranged from 10.67 to 20.69 % of the total mean count during the period from December to April and the highest one (20.96%) was recorded during March, while the lowest one (0.71 %) was recorded during September. (Table 2).

Table 2: Population fluctuations of cottony camellia scale, *Pulvinaria floccifera* and its parasitoid, *Microterys flavus* on during 2013/2014, at Assiut district.

Months	Nymphs	Adult	Total	%Out of year total	M.V.R.	Parasites	%Parasitism	R.H.%	Mean Temp.˚C
Oct.2013	156	85	241	5.20		14	2.82	57.76	23.94
Nov.	222	94	316	6.82	1.31	21	4.23	60.95	21.11
Dec.	388	106	494	10.67	1.56	34	6.85	63.87	15.47
Jan.2014	403	171	574	12.39	1.16	83	16.73	55.77	15.42
Feb.	666	191	857	18.51	1.49	97	19.56	62.16	16.28
March	755	203	958	20.69	1.12	101	20.36	55.75	19.92
April	556	185	741	16.00	0.77	82	16.53	45.57	25.23
May	103	55	158	3.41	0.21	23	4.64	40.26	28.5
June	84	42	126	2.72	0.80	17	3.43	38.3	31.17
July	55	27	82	1.77	0.65	11	2.22	43.13	31.4
August	30	21	51	1.10	0.62	9	1.81	52.15	31.03
Sept.	22	11	33	0.71	0.65	4	0.81	49.13	26.63
Total	3440	1191	4631	100		496	100.00		

The second year (2014/2015):

Concerning, the data during the second year of (2014/2015) as recorded in Tables (1 and 3) and Figure (2) it was cleared that the total population of this insect was bigger in comparison to the first year of investigation, which may due to the influence of favourable factors (such as environmental conditions,…etc.) and the abundance of the natural enemies.

Data in Table 1 show that the insect population half-monthly counts started with 45 and 27 individuals /48 leaflets for nymphs and adults. Then, the population increased in fluctuated manner to reach its highest level (524 individuals/48 leaflets) a half-monthly later than that of the first season. The highest month total count (nymph + adults) was 524 individuals /48 leaflets occurred during of March as the same in the first season. After the population reached its highest level, it decreased slightly during May and sharply during June and July and reaching its lowest level (7 individuals each/48 leaflets for nymphs + adults) during the mid of September. Then, like the first season, the population started increase gradually.

Data in Table 3 show that the five months from December to April contained

(73.66%) of the pest total year count and the highest percentage (19.09%) was recorded during March. The four months from June to September contained (5.75%) of the insect total year count and the lowest percentage (0.35%) was recorded during September.

Data of both seasons clearly indicated that the pest population was concentrated during the period from December to April. At this period, 78.26 and 73.66% of the pest population was recorded during the 1st and 2nd seasons. The highest percentage of the pest population was recorded during March in the 1st and 2nd seasons (20.69% and 19.09%). The period from June to September contained the lowest percentages (6.3 and 5.75%) of the pest population during both seasons, respectively. September contained the lowest population numbers during both seasons.

Results obtained by some authors are in partial agreement with those findings. Rosen (1967) in Israel, found that *P. floccifera* on citrus were the most abundance in April. Jansen (2000**)** in Netherlands, stated that the populations of *P. floccifera* on ornamental plants were found to increase substantially in spring. Malumphy and Badmin (2007) in British, showed that the population density of *P. floccifera* on ornamental Yew, *Taxus baccata* had three peaks in October, March and July. Elborolosy *et al*. (1990) in Egypt, found that a significant difference in the population density of *P. psidi* Maskell on the rice paper ornamental plant, *Aralla paprifera* Hook during winter and spring. Other results of some other authors were somewhat different**.** Hallaji-Sani et al. (2012) in Iran, found that *P. floccifera* on Thomson navel orange trees, *Citrus sinensis* L. were the most abundance in August. The differences in our results and their results are may be due to the differences in geographical region and consequently the differences in climatic elements.

Number of field generations:

Data present in Figures (1 and 2) and Tables (2 and 3) indicated that the cottony camellia scale, *P. floccifera* has one annual generation, and these results were ensured throughout the two years of study of the insect population under field condition at Assiut governorate. The number of generations was taken from the annual number of peaks of nymphs.

Table 3: Population fluctuations of cottony camellia scale, *Pulvinaria floccifera* and its parasitoid, *Microterys flavus* on during 2014/2015, at Assiut district.

Months	Nymphs	Adult	Total	%Out of year total	M.V.R.	Parasites	% Parasitism	R.H.%	Mean Temp.˚C
Oct.2014	148	71	219	4.22		17	3.66	50.85	25.01
Nov.	281	103	384	7.40	1.75	31	6.68	58.92	20.72
Dec.	407	111	518	9.98	1.35	57	12.28	64.61	17.26
Jan.2015	553	138	691	13.31	1.33	64	13.79	58.08	13.81
Feb.	711	183	894	17.22	1.29	78	16.81	60.63	16.55
March	785	206	991	19.09	1.11	84	18.10	56.92	20.64
April	583	147	730	14.06	0.74	70	15.09	51.02	22.52
May	371	95	466	8.98	0.64	28	6.03	40.32	28.73
June	107	49	156	3.01	0.33	17	3.66	40.25	30.01
July	57	20	77	1.48	0.49	10	2.16	46.55	31.31
August	37	10	47	0.91	0.61	6	1.29	55.14	32.23
Sept.	11	7	18	0.35	0.38	2	0.43	52.22	28.33
Total	4051	1140	5191	100		464	100.00		

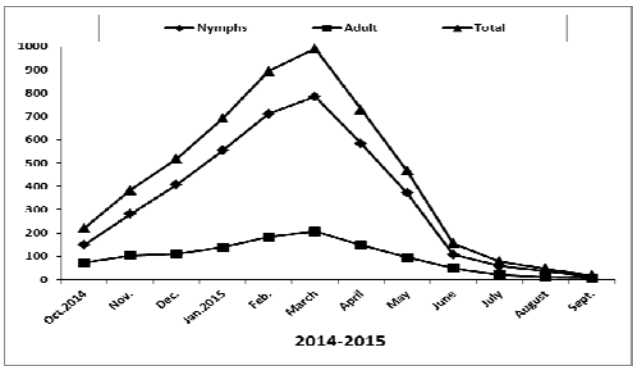

Fig. 2: Total number of different developmental stages of *Pulvinaria floccifera* on 48 leaflets of 4 *Cycas revolute* trees at Assiut district, 2014/2015.

During the first year of investigation, the percentage of nymph population recorded 78.81%of the total population through March. Almost similar trend has been obtained in the 2nd (2014/2015), where one annual generation existed. Nymphs population peaked in March (79.21%) also. This agreed with Hallaji-Sani *et al.* (2012) findings in Iran *P. floccifera* has one annual generation per year and hibernates as an adult insect. In a study in Croatia, overwintering stage has been as the second nymphal instar Milek *et al.,* 2009.The female overwinters on stems and migrates to leaves in spring where an ovisac is produced for egg deposition. These results and other author's results also were in conflict concerning each generation period. This is also because of the differences in climatic conditions of each district in which the experiments conducted.

Monthly Variation Rate (M.V.R.):

2013/2014 season:

The estimated monthly variation rate (M.V.R.) was intimated in Table 2. The monthly variation rate of the population density of the cottony camellia scale demonstrate that the favourable periods for the insect development and increasing found to be from November to March. The prevailing environmental conditions during these months were ranged from 15.42 to 21.11°C and from 55.75 to 63.87% R.H., which seem to be suitable for the pest multiplication. The highest value of (M.V.R.)was recorded on December (1.56), which mean that the conditions of 15.47°C and 63.87%R.H. are seemed to be the optimal for *P.floccifera* population to growth and build up.

2014/2015 season:

Table 3 a trend of the first season has been obtained similarly on the second one. The highest monthly variation rates (M.V.R.) were 1.75, 1.35, 1.33, 1.29 and 1.11 occurred during November, December, January, February and March, respectively. The prevailing weather conditions during these months are seemed to be favourable for the insect multiplication (temperature ranged from 13.81 to 20.72°C and relative humidity ranged from 58.08 to 64.61%). The optimal conditions for the population growth and build up were achieved during November (20.72°C and 58.92% R.H.), since the highest (M.V.R) value was achieved (1.75).

Generally, it is clear that the highest M.V.R. values were achieved during November and March of both seasons. The results of the insect seasonal abundance confirmed this, which showed that the pest population started its gradually increase during November and March (Tables 1, 2 and 3).

Factors affecting the cottony camellia scale *Pulvinaria floccifera*: *Microterys flavus* (Howard) (Hymenoptera: Encyrtidae) parasitoid:

Survey, seasonal abundance and percentages of parasitism:

2013/2014 season:

Survey of the cottony camellia scale parasitoids resulted by only one parasitoid species identified as, *Microterys flavus* during this season.

Data presented in Table 2 indicated that the number of parasitized *P. floccifera* adults (as *M. flavus* number) started with 14 individuals/48 leaflets on October and increased in fluctuated manner to reach its maximum level of abundance 101 individuals/48 leaflets on March. Then, the population decreased slightly during April and sharply after that to reach its lowest level of abundance 4 individual/48 leaflets during September. The parasitoid started its gradually increase during October, 2014. The percentages of parasitism ranged from0.81% during September to 20.36% during March (Table 2). Data presented in Table 4 show that the simple correlation coefficient among mean temperature and the population of the parasitoid insect was negative highly significant, while the effect of relative humidity on the parasitoid population was positive highly significant. Multiple-regression analysis show that the two weather elements are responsible for 93.44% of the changes of *M. flavus* population. The efficiencies of each variable on the parasitoid population changes were 80.17 and 13.28 % for mean temperature and relative humidity respectively.

2014/2015 season:

During this season, there is no more parasitoid species were recorded than that during the first one.

Data of Table 3 show that *M. flavus* started its population with 17 individuals/48 leaflets on October and increased gradually to reach its highest level of abundance 84 individuals/48 leaflets during March. After the parasitoid population reached its highest level, it decreased very slightly during April. Then, a dramatic decline in the parasite population, during 1st of September. The population of *M. flavus* started its gradually increase after 15, September.

Data of Table 3 revealed that the percentages of parasitism ranged from 0 .43% during September to 18.10% during March.

Data presented in Table 4 indicated that the simple correlation between mean temperature and relative humidity, and the population of *M. flavus* was approximately similar to that of the first season. Multiple-regression analysis revealed that the efficiency of mean temperature occupied the same site (83.49%), whereas, the relative humidity recorded (0.83%).

Data of both seasons, concerning the population dynamic of *M. flavus* revealed that the population of this parasitoid species was approximately synchronized with the pest population. The lowest population of *M. flavus* was recorded during summer months during both seasons. This may be because of high temperature and low humidity during this period (Tables 2 and 3) and, the ornamental plants are not well foliaged, because of its small size, as fruit trees in order to provide enough protection from direct sun. Also, the pest population during that time was in its lowest numbers and this may be makes the suitable pest stage for parsiting is not available. Abd-Rabou and Badary (2004) recorded *M. flavus* associated with the cottony camellia scale, *P. floccifera* in Egypt. Morsi (2010) mentioned that *M. flavus* has three peaks of parasitism on *Saissetia coffeae* (Walker) in March, June and September. Schneider et al., 1983 stated that *M. flavus* reached its maximum level of abundance on the Florida wax scale, *Ceroplastes floridensis* Comstock during spring in Israel.

Data of both seasons, concerning the low parasitism percentages, many authors

arrived to the same results. Arnold and Sengonca (2003) recorded a low population of the parasitoid *M. flavus* on ornamental trees during the two years of their study with an average rate of parasitism of 19.6%. Abd-Rabou (2011) showed that the maximum rate of parasitism reached 0.8 and 1.4% in October 2009 and 2010 respectively. The percentages of parasitism ranged from 1.1 to 1.4% in the first year and from 0.8 to 1.4% in the second year.

The author think that this parasitoid species may not established yet at Assiut district or the insect pest under this investigation is not preferred as a host for this parasitoid species. Data of both seasons concerning the effects of weather elements on the parasitoid population revealed clearly that the changeable weather element which responsible for the most changes in *M. flavus* population was mean temperature and mean relative humidity has the same sites from season to another.

Weather elements

2013/2014 season:

Data of Table 4 show that simple correlation was highly significant. The negative highly significant values were calculated for the effects of mean temperature, while the positive highly significant value was calculated for the effect of relative humidity on the population of *P. floccifera*. The multiple-regression analysis revealed that the two studied variables were responsible for 94.12% of the changes in *P. floccifera* population .Most of the changes (84.82%) were due to mean temperature followed by mean relative humidity (9.30%).

Table (4): Multiple regression analysis between the total number of the cottony camellia scale, *P. floccifera* and its parasitoid,*M.flavus* and some weather element prevailing during 2013/2014 and 2014/2015 seasons,at Assiut.

Growing season	Weather element	Insect species									
		P. floccifera					*M. flavus*				
		r	R	r^2 ×100	Decrease in R^2 ×100	Efficienc	r	R	R^2 ×100	Decreas in R^2×100	Efficienc
2013/2014	Non	–	0.9701	94.12	–	–	–	0.9667	93.45	–	–
	Mean. temp.	-1.7222 **	1.7795	159.6	28.67	84.8228	-1.6693**	1.7601	156.37	30.53	80.1678
	mean. R.H.%	0.4725**	0.9538	90.98	3.14	9.30010	0.4144**	0.9402	88.4	5.05	13.276
2014/2015	Non	–	0.8888	79.01	–	–	–	0.9182	84.31	–	–
	Mean. temp.	-1.4364**	1.5214	118.73	39.29	78.0044	-1.5301**	1.5975	130.28	38.34	83.491
	mean. R.H.%	0.3540**	0.886	78.5	0.51	1.0078	0.4055**	0.9161	83.93	0.38	0.8273

2014/2015season:

Concerning the simple correlation, the effects of mean temperature and mean relative humidity on the pest population found to be similar to that of the previous season. The multiple regression analysis shows that the effects of these variables on the changes of *P. floccifera* population were (79.01%). Most of these changes were due to mean temperature (78%) while mean relative humidity recorded 1.01%.

Data of both seasons revealed that the changeable variable of weather elements which responsible for the most changes in *P. floccifera* population was temperature. Hallaji-Sani *et al.*, (2012) stated that reduction of *P. floccifera* had happened by exposure the scale to sun light, and temperature. Abd-Rabou *et al.,* (2012) found that the incidence of the scale *P. floccifera* is closely related to temperature, the dispersion of the variable number of insects differentiated on different plant organs are jointly

represented against the variable temperature.

CONCLUSION

From the results it was found that the cottony camellia scale, *Pulvinaria floccifera* active throughout the year on *Cycas revolute* trees. Its activity was at the peak during the months of December, January, March and April. Population of *P. floccifera* was maximum on *C.revolute* during spring season. The cottony camellia scale had one generation in each of the two years of investigation at Assiut governorate. The effect of biotic and abiotic factors revealed that the population of this parasitoid, *Microterys flavus* species was approximately synchronized with the pest population. Concerning the effects of abiotic factor, the changeable variable of weather elements which responsible for the most changes in *P. floccifera* population was temperature in the two years of this investigation.

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ARABIC SUMMERY

دراسات بيئية على حشرة الكاميليا القشرية الرخوة على نخيل السيكاس وعلاقتها بالعوامل الحيوية و العوامل غير الحيوية

غادة صلاح محمد

قسم وقاية النباتات– كلية الزراعة – جامعة جنوب الوادى – قنا

تم إجراء هذه الدراسة فى المزرعة البحثية التابعة لكلية الزراعة بجامعة اسيوط خلال موسمى 2014/2013 و2015/2014 و ذلك لدراسة الوفرة الموسمية لتعداد حشرة الكاميليا القشرية الرخوة و أعدائها الحيوية و تأثير العوامل الجوية المحيطة من حرارة و رطوبة نسبية وكانت النتائج المتحصل عليها كما يلى:-

خلال موسمى الدراسة وجد أن أكبر عدد من الحوريات ومجموع الآفة يظهر فى شهر مارس . كما تظهر أعلى نسبة مئوية من التعداد الكلى السنوى في شهر مارس (20,69 ، 19,09٪) خلال سنتى الدراسة . بالنسبة لمعدل التغير الشهرى أظهرت النتائج أن الوقت الملائم لنمو تعداد هذه الحشرة كان من نوفمبر إلى شهر مايو من السنة الأولى و من شهر أكتوبر إلى يونيو من السنة الثانية. فيما يختص بعدد الاجيال ، فقد وجد ان لهذه الحشرة جيل واحد فى السنة خلال موسمى الدراسة .

وقد تم دراسة تأثير العوامل الحيوية وغير الحيوية على تعداد هذه الآفة. كما تم تصنيف نوع واحد من الطفيليات وهو *Microterys flavus*. وقد بلغت أعلى نسبة للتطفل 20,36٪ خلال العام الأول من الدراسة، كما تم دراسة التعداد الموسمى لهذا الطفيل ومدى تاثير بعض العوامل الجوية عليه وكذا تأثير هذه العوامل الجوية على الآفه قد تم ايضاً دراسته .