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Population Dynamics of the Olive Whitefly, *Aleurolobus olivinus* (Silvestri) (Homoptera: Aleyrodidae) and its Parasitoids in Middle Egypt

Morsi*, G. A.; S. F. M. Moussa and A. M. Serag****

* Biological Control Research Department

**Scale Insects and Mealybugs Res. Depar.., Plant Protection Res. Inst., Agric. Res. Center, Giza, Egypt

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ABSTRACT

Seasonal fluctuation of the olive whitefly, *Aleurolobus olivinus* (Silvestri) (Homoptera: Aleyrodidae) was studied throughout the two successive years from March 2006 to February 2008. This study was conducted in an olive grove at Beni-Suif district, Beni- Suif Governorate, Egypt. Half-monthly samples of 100 olive leaves were collected at random. Peaks of the pest numbers were recorded by early April, June, November 2006 and January 2007. In the second year, the peaks were observed by early April, July, November 2007 and January 2008. Three species of Aphelinidae; *Encarsia elegans* Masi, *E. olivina* (Masi), and *Ertmocerus* sp. emerged from *A. olivinus*. Percentage of parasitism on the olive whitefly peaked by early March, mid-May, mid-August, early October, mid-November and mid-December 2006. In the second year, peaks of the parasitism were recorded by early April, mid-July, early September, early October, early November and early December 2007. Correlation between the climatic factors and the population of *A. olivinus* and its parasitoids was statistically analyzed.

Key words: *Aleurolobus olivinus*, Ecology, Seasonal fluctuations, Parasitoids, Egypt.

INTRODUCTION

The olive tree, *Olea europeae* L. is one of the oldest fruit trees grown successfully in many parts of the world such as in Spain, Italy, Tunisia, Greece, Syria, Lebanon, Palestine, Egypt, Morocco, Libya, Iraq, and Sudan. It is grown successfully in many parts of Egypt such as Sinai, Behera, Matrouh, Giza, El- Fayoum and Beni-Suif. Areas cultivated with olive trees have increased especially in the newly reclaimed lands due to its tolerance to unsuitable environmental conditions such as; salinity, drought, water scarcity and adverse climatic factors.

Olive trees are subjected to attack by several insect and a mite pest, one of them is the olive whitefly, *Aleurolobus olivinus* (Silvestri) (Homoptera: Aleyrodidae). El-Khawas (2000) reported that Tunisia recorded the olive whitefly for the first time in 1929. However, it was recorded for the first time in Egypt by Abd-Rabou, (1996).

The olive whitefly mainly attacks olive trees, *Olea eauropeae*, *Phyllyrea augustifolia, P. latifolia* and *Erica arboria* and causes considerable damage (Bink-Moenen, 1989).

Few aphelinid parasitoids, (Hymenoptera) have been reported from *A. olivinus*, including *Encarsia elegans* Masi, *E. olivina* (Masi) and *Eretmocerus* sp. (Viggiani; 1982, 1987 and Abd-Rabou, 1997a, b, c, 2000 and 2006).

Regarding role of the parasitoids in regulating the abundance of the olive whitefly, *A. olivinus* has not been studied in Egypt. Therefore, the present work declaring the following aspects:

1- Seasonal abundance in the population dynamics of the olive whitefly insect in Beni-Suif Governorate,
2- Survey of the parasitoid species of *A. olivinus*, and role of the parasitoids in suppressing population of the pest.

MATERIALS AND METHODS

I: Seasonal fluctuation of *A. olivinus* the population of at Beni-Suif Governorate

A grove about 5 feddans, cultivated with about 15 year old trees (Agyzy and Tophahy varieties) at Beni-Suif district, Beni-Suif Governorate, Egypt was selected to carry out the study. The trees were heavily infested with the olive whitefly, *A. olivinus*. The grove was not exposed to any chemical pesticides during the period of investigation. Half-monthly samples each of 100 olive leaves were taken at random from different locations of the area. The leaves represented different sides, peripheral, inner zones, lower and middle strata of the tree. Obtained samples were kept in polyethylene bags and transferred to the laboratory to be examined by a binocular dissecting stereomicroscope. Numbers of eggs, nymphs and pupae of the olive whitefly, *A. olivinus* were recorded.

II: Survey of the parasitoids

A survey of the olive whitefly parasitoids was carried out in the selected farm throughout a period of two successive years, from March 2006 until February 2008. Samples of the infested leaves were randomly collected from different grove. Specimens were examined and a needle was used to remove all

the insects except the olive whitefly to survey its parasitoids. The examined leaves were enclosed in plastic jars of 15 cm diameter and 20 cm. height covered with muslin held in its position by a rubber band and kept under laboratory conditions for securing any emergence of parasitoids.

The parasitoids were collected, classified into species and preserved in vials containing 70% Ethanol and Glycerin, plus slide mounting specimens. The parasitoids were identified at the Biological Control Res. Dept., Plant Prot. Res. Inst., Agric. Res. Center, Giza, Egypt.

III: Rate of parasitism upon *A. olivinus*

Heavily infested leaves from the olive trees were selected at random from the cardinal directions and central cores of the trees. Half-monthly samples (100 randomly selected nymphal and pupal stages) were chosen. This sample represented the second and third nympal instars and pupae. This sample was divided into 4 replicates each with 25 nymphs or pupae, each nymph or pupa was removed, transferred and mulched on a slide in a water film and classified as follows: alive un-parasitized, parasitized insects having (larvae, pupae and emergence holes). The total percentage of parasitism of the olive whitefly insect was estimated.

Statistical analysis

Simple correlation and regression values between the population of the insect and the weather factors were calculated to obtain information about the relationship between the mean number of individuals/ leaf and the mean records of the three tested weather factors considered in the analysis (daily max., min. temperatures and daily mean RH%). Half-monthly mean counts were considered as the dependent variable (y), while the corresponding mean weather readings represented the independent variable (x). Simple correlation values helped in detecting any relationship between the (y) and any of the (x) variables. In addition, partial regression analysis was used to determine the relative importance of each factor, analysis of variance (F-test) and the percentage of explained variance (E. V. %) were estimated by applying "the C- multipliers formula" as described by Fisher (1950). The calculations and statistical analysis of the data were carried out by using (MSTAT-C& SPSS Computer Programs).

RESULTS AND DISCUSSION

I: Seasonal abundance of the olive whitefly, *A. olivinus*:

Obtained results of seasonal fluctuation were illustrated in Fig. (1). Number of eggs of the pest, recorded by early March 2006 was 125 eggs, increased to reach 983 eggs by early April and fluctuated to reach 1235 eggs by mid-May. However, the number of eggs fluctuated during the period from June until November 2006, when the number reached 2210 eggs. 2587 eggs were recorded by early January 2007.

Regarding the number of nymphs, 676 nymphs were recorded by early March 2006, decreased to reach 99 nymphs by early April 2006. 530 and 598 nymphs were recorded by early May and June 2006, respectively. The number decreased to reach 215 and 265 nymphs by early and mid-July 2006, respectively. Then, the number fluctuated and recorded 365, 200, 300, 185, 190 and 325 nymphs every fifteen days, respectively. 100, 115 and 100 nymphs were recorded at the next three sampling dates. The number increased gradually to reach 1420 nymphs by mid-January 2007.

Concerning the number of pupae, 295 pupae were recorded by early March 2006, decreased to 123 pupae by early April 2006. Two hundreds forty-five pupae were recorded by mid-April 2006. Fifty pupae were recoded by early June 2006. Thereafter, the number increased to 200 pupae by early July 2006, followed by 45, 90, 65, 55 and 175 pupae by mid-July and early and mid-August, early and mid-September 2006. The number fluctuated during the period extended from October 2006 to February 2007.

Figure (1) represents the total population of the olive whitefly, *A. olivinus* per 100 leaves of olive at Beni-Suef Governorate in the first year of investigation. The results demonstrated that there were four peaks; the first occurred by early April 2006, when the total number of all stages of the olive whitefly per 100 leaves was 1205, the second by mid-May (1458 insects), the third (2340 insects) by early November 2006, and the fourth (3116 insects) by early January 2007.

In the second year of study, number of eggs recorded 175 eggs by early March 2007, followed by 2225 eggs by early April 2007. It decreased to 470 eggs by early May 2007, 2290 eggs were recorded by mid-May 2007. The number of eggs fluctuated and recorded 383, 420, 1145, 285, 140, 705, 489, 600 eggs at each fortnightly, respectively. Then, it increased from 1305 eggs by early October 2007 to reach 2175 eggs by early November 2007. In addition, 3158 eggs were recorded by early January 2008 and decreased to 470 eggs by mid-February 2008.

Results of the second year are illustrated in

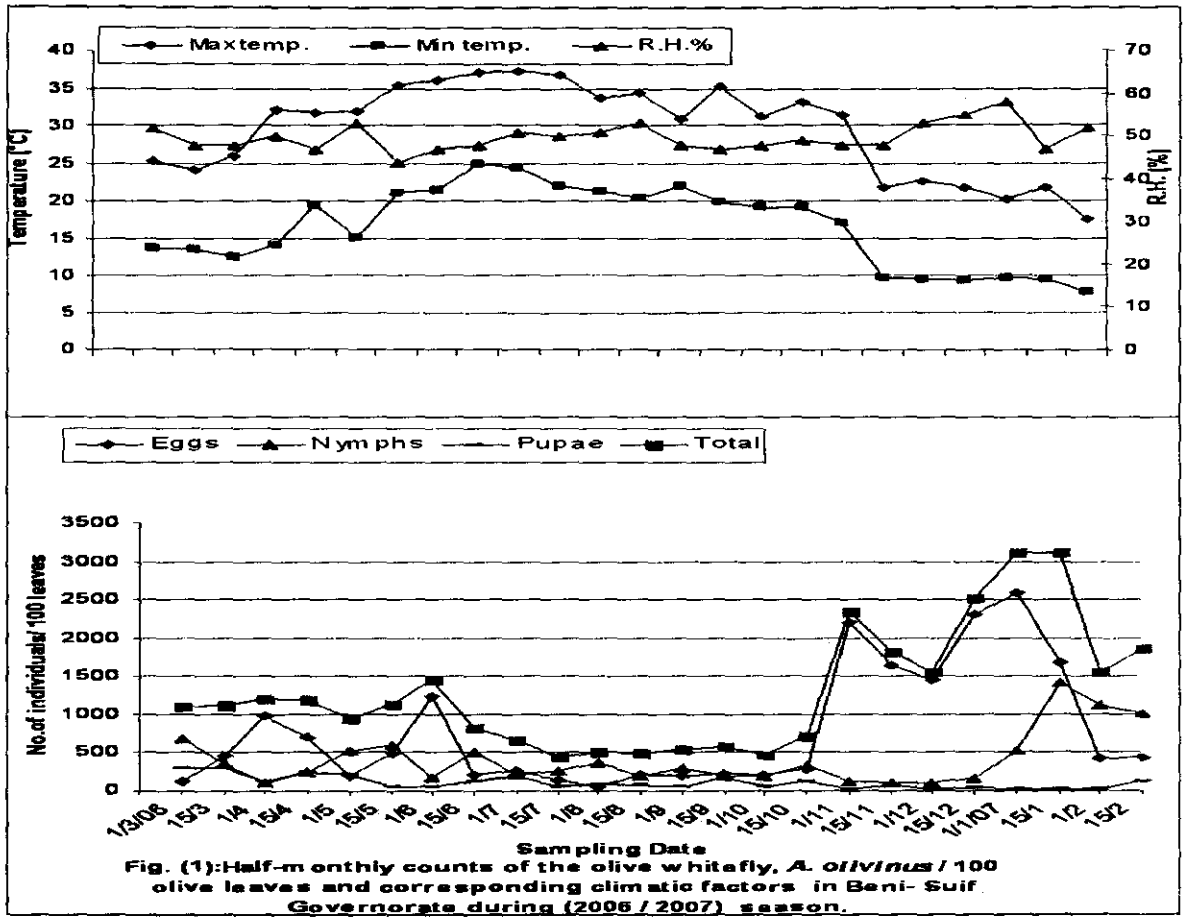

Fig. (1):Half-monthly counts of the olive whitefly, *A. olivinus* / 100 olive leaves and corresponding climatic factors in Beni- Suif Governorate during (2006 / 2007) season.

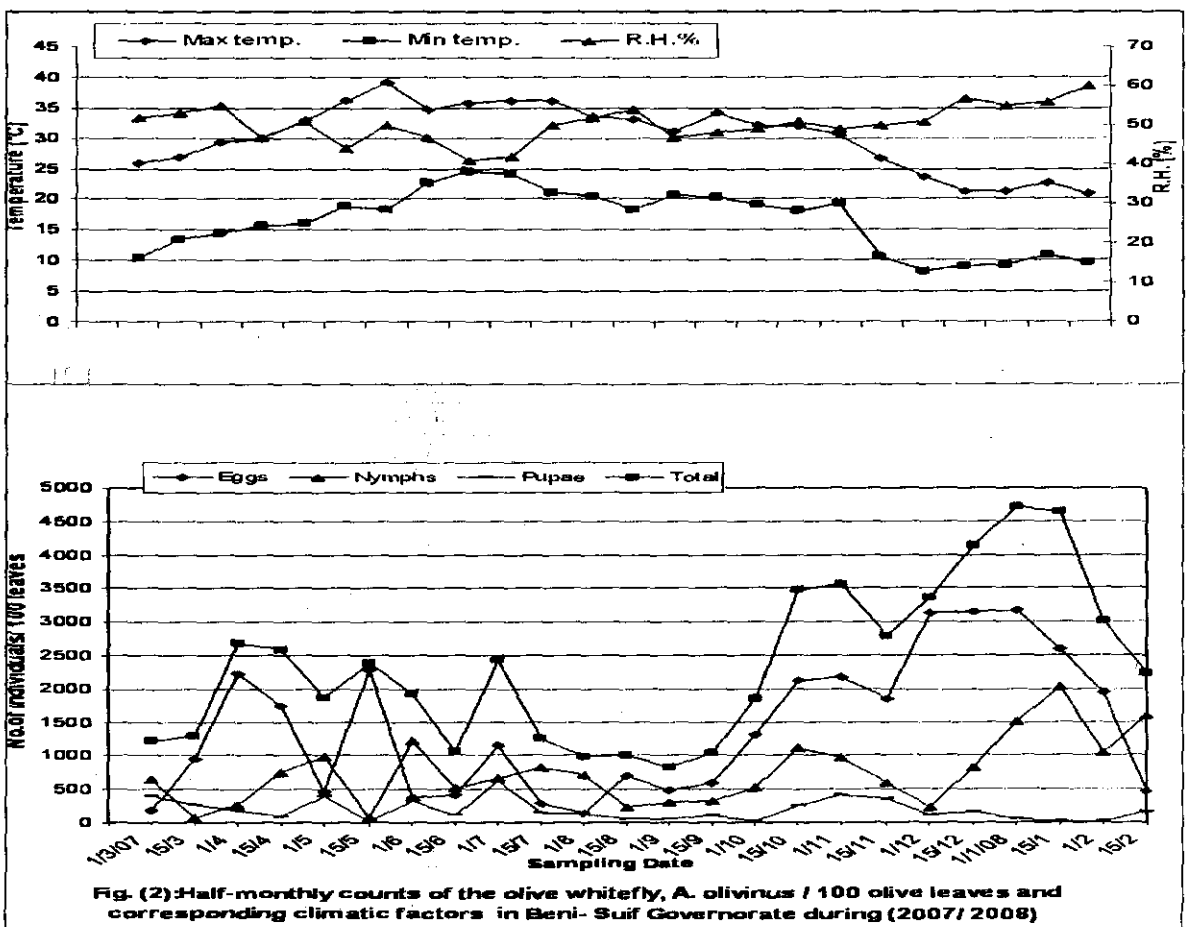

Fig. (2):Half-monthly counts of the olive whitefly, A. olivinus / 100 olive leaves and corresponding climatic factors in Beni- Suif Governorate during (2007/ 2008) season.

fig. (2). Number of nymphs decreased to reach 80 by mid-March-, 2007. Then, it increased from 275 nymphs by early April 2007 to 995 nymphs by early May 2007. 1220 nymphs were recorded by early June 2007. By mid-July 2007, 835 nymphs were recorded. The number fluctuated during the period from August to October 2007. However, 1115 nymphs were recorded by mid-October 2007. Then, the number decreased gradually to reach 325 nymphs by early December 2007 and 2032 nymphs by mid-January 2008, followed by 1600 nymphs by mid- February 2008. Number of pupae in the second year increased to reach 389 pupae by early March 2007, and decreased to reach 95 pupae by mid-April. 400 pupae were recorded by early May. By early June 2007, 319 pupae were recorded. Low numbers of pupae were recorded during the period from August until October 2007. By early November 2007, 420 pupae were recorded. The number decreased at the following period. By mid-February 2008, 163 pupae were recorded.

Results of the second year are illustrated in fig. (2). Total population of the olive whitefly started to increase from 1219 individuals recorded by early March 2007. The first peak of total population (2680 individuals) was recorded by early April. Then, the population fluctuated to reach the second peak by mid-May, when it recorded 2390 individuals. The third peak occurred by early July 2007 recording 2435 individuals. The total population fluctuated to reach 832 individuals by early September. The fourth peak appeared by 3560 individuals by early November. The fifth and highest peak (4721 individuals) of this pest was recorded by early January 2008. It decreased gradually to 2233 individuals by mid-February, 2008.

In this respect, Soliman, (2005) recorded four to six overlapping generations for the olive whitefly, *A. olivinus* in Egypt.

Data in table (1) summarized the simple correlation of immature stages of the pest and maximum and minimum temp. during the two years of study. Eggs and max. and min. temperatures in the first season was negative and significant at the 5% level of probability; and insignificant positive with relative humidity. The correlation between the nymphal stage and max. temperature was insignificant negative. With the min. temperature it was significant negative; and significant positive with % R. H. For the pupal stage, the simple correlation was insignificant negative between pupae and all tested factors; insignificant negative with max. temperature and % R.H. In the second season, the simple correlation was positive or negative insignificant for all stages, except with max. temperature,

Table (1): Simple correlations (r), simple regressions (b), partial regressions (P.reg.)and analysis of variance of *A. olivinus* counts as affected by max. temp. (M.T.), min. temp. (M.T.) and mean relative humidity (M.R.H.) altogether and the corresponding percentage of explained ``variance (E. V. %) throughout two successive years 2006/07 and 2007/08 at Beni-Suif Governorate

Year	Stage		Simple			Partial		Analysis of variance	
			r	b	t	P.reg	t	F.	E. V. %
2006/07	Eggs	Max.T.	-0.76	-1.47	5.45**	-2.65	4.78		
		Min. T.	-0.59	-1.33	4.34**	9.12	0.98	4.98**	71.21
		M.R.H.	0.58	2.45	3.36**	-0.59	-0.12		
	Nymphs	Max.T.	-0.71	-2.75	5.52*	-3.24	3.12		
		Min. T.	-0.66	-0.83	2.78*	-8.22	-1.76	3.84	56.56
		M.R.H.	0.35	0.09	1.87	5.31	1.87		
	Pupae	Max.T.	-0.63	-1.78	4.99	-1.98	2.19		
		Min. T.	-0.26	-1.57	0.67	-4.12	-2.11	1.23	61.00
		M.R.H.	-0.29	-2.34	0.89	0.07	0.09		
2007/08	Eggs	Max.T.	-0.67	-2.43	3.69*	-2.74	4.67		
		Min. T.	-0.56	-0.56	3.09**	-7.09	-1.09	4.51*	76.10
		M.R.H.	-0.03	-1.67	0.09	-2.65	-2.23		
	Nymphs	Max.T.	-0.63	-1.12	4.47	-2.12	3.39		
		Min. T.	-0.45	-0.56	2.45*	-4.78	-1.18	3.54	67.23
		M.R.H.	0.46	3.22	1.79	-1.56	-1.16		
	Pupae	Max.T.	-0.51	-3.08	4.52	-1.98	2.43		
		Min. T.	-0.61	-2.13	0.34	2.20	1.98	2.96	55.70
		M.R.H.	-0.16	-4.22	0.98	0.49	1.98		

*Significantly at the 5% level of probability **Highly significantly at the 1% level of probability

Table (2): Total percentages of parasitism among the olive whitefly, *A. olivinus* during the 2006/07 and 2007/08 seasons at Beni-Suif Governorate (Based on 100 dissected nymphs & pupae of olive whitefly).

2006/2007					2007/2008				
Sampling date	Larvae	pupae	Emergence holes	Total (%Parasitism)	Sampling date	Larvae	pupae	Emergence holes	Total (%Parasitism)
1/3/2006	10	12	7	29	1/3/2007	3	4	12	19
15/3	2	3	5	10	15/3	6	4	15	25
1/4	2	5	7	14	1/4	5	7	20	32
15/4	4	5	12	21	15/4	2	2	10	14
1/5	5	6	12	23	1/5	3	6	5	14
15/5	11	12	8	31	15/5	5	3	2	10
1/6	1	7	0	8	1/6	3	1	1	5
15/6	3	2	2	7	15/6	2	1	0	2
1/7	3	5	4	12	1/7	5	2	3	10
15/7	3	2	2	7	15/7	15	10	11	36
1/8	4	2	4	10	1/8	7	3	4	14
15/8	10	10	5	25	15/8	8	7	6	21
1/9	9	6	5	20	1/9	20	10	15	45
15/9	8	7	6	21	15/9	7	3	21	21
1/10	18	10	13	41	1/10	21	12	48	48
15/10	11	7	10	28	15/10	12	6	27	27
1/11	22	8	10	40	1/11	15	18	44	44
15/11	25	10	7	42	15/11	3	4	27	27
1/12	18	11	7	36	1/12	22	13	53	53
15/12	30	8	10	58	15/12	3	5	18	18
1/1/2007	11	5	6	22	1/1/2008	4	6	13	13
15/1	3	5	7	15	15/1	1	1	10	10
1/2	2	4	6	12	1/2	4	3	12	12
15/2	3	5	11	19	15/2	2	3	9	9

where it was significant negative for eggs and nymphs.

The partial regression indicated that the effect of max. temperature was significant negative for eggs and insignificant positive for nymphs and pupae in the first year. In the second year, the effect was insignificant negative. Concerning min. temperature, the effect was insignificant negative in the first and second years, except for nymphs and pupae in the first year, where it was significant positive. For % RH, it was found that the effect of this factor was insignificant negative on the egg stage in both seasons, while it was insignificant positive for nymphal and pupal stages in the first year and for the pupal stage in the second year.

The combined effect of the three weather factors was presented in table (1). The effect of these factors on the activity of eggs was significant in both years (F=4.98 and 4.51), respectively. For nymphal and pupal stages, the effect was insignificant in both years (F= 3.84, 1.23 and 3.54, 2.96) for the first and second seasons, respectively. The variance explained percentage by the three factors combined was significant in the three tested stages. The explained variance of the combined effect of these factors was, 71.21, 56.56 and 61.00% in the first year of study, respectively. However, these values were 76.10, 67.23 and 55.70 in the second year of study, respectively.

II: Survey of the parasitoids

Obtained results showed that three species of Aphelinidae; *Encarsia elegans* Masi, *E. olivine* (Masi), and *Eretmocerus* sp. were recovered from *A. olivinus*. These results are in agreement with those obtained by Viggiani (1982 and 1987) in Italy and Abd-Rabou and Hassan (2005) and Abd-Rabou (2006) in Egypt.

III: Rate of parasitism

Percentages of parasitism of the parasitoids on the olive whitefly, *A. olivimus* during the period started from early March 2006 until mid-February 2007 are presented in table (2). The first peak (29 %) was recorded by early March 2006 and then decreased to 10% by mid-March. Rate of parasitism increased gradually to reach the second peak (31%) by mid-May. The percentage of parasitism fluctuated during the period June to August. By mid-August, the third peak (25%) was recorded. By early September, it recorded 20 %. The fourth peak (41%) was recorded by early October. The fifth peak (42%)

occurred by mid-November. The sixth peak (58%) showed up by mid-December, representing the highest peak of parasitism. Afterwards, the percentage of parasitism decreased to reach 12% by early February 2007 and started to increase again to record 19% by mid-February 2007.

Results of the second year of investigation (Table 2) indicated that there were six peaks recorded by early April, mid-July, early September, early October, early November and early December 2007 recording 32, 36, 45, 48, 44 and 53%, respectively.

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