

**Biological Aspects of the Aphid Parasitoid *Aphelinus albipodus* (Hayat & Fatima)
(Hymenoptera: Aphelinidae) Parasitizing Mealy Plum Aphid
Hyalopterus pruni (Geoffroy) (Homoptera, Aphidoidea)**

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ABSTRACT

The aphid parasitoid, *Aphelinus albipodus* Hayat & Fatima (Hym.: Aphelinidae) is one of the common aphid parasitoid species in Egypt. Some of the biological aspects of the parasitoid when parasitizing the mealy plum aphid *Hyalopterus pruni* (Geoffroy) (Homoptera: Aphidoidea) were studied under laboratory conditions. The parasitoid female started parasitizing its host 6 hrs post emergence. Highest activity of the females was recorded at 25°C. Percentage of emergence attained 89.44±4.52%, when the parasitoid females aged 1-4 days. Developmental time of the parasitoid immatures ranged 11-13 days from mummy's formation to adult. The parasitoid adults emerged from the all nymphal instars but with the lowest numbers (57.59±31.25) from the 4th instar, while the highest (90.03±7.66) was from 3rd instar. The mean sex ratio was 1♂:1.06♀.

Key words: *Aphelinus albipodus*, *Hyalopterus pruni*, Biological aspects.

INTRODUCTION

In Egypt, aphids comprise one of the numerous insect groups of which the economic importance increases with the development of agriculture (Stary, 1976). Aphids are serious pests attacking several host plants (Kindler *et al.*, 1991). The aphid species, *Hyalopterus pruni* (Geoffroy) feeds on *Prunus* trees as primary host and on the gramineous plants; *Arundo donax* L. and *Phragmites australis* (Cav.) as secondary hosts (Jerraya, 2003).

Hymenopterous parasitoids of aphids have provided spectacular success in biological control (Stary *et al.*, 1988 and Sahand *et al.*, 2014). The genus *Aphelinus* (Hymenoptera: Aphelinidae) comprises 84 recognized species (Noyes, 2011). The species, *Aphelinus albipodus* Hayat & Fatima [formerly *Aphelinus* sp. nr. *varipes*; Hayat & Fatima (1992)] was collected from the Russian wheat aphid, *Diuraphis noxia* in the vicinity of Tahcheng, People's Republic of China and imported to the USA in 1992 for biological control of the latter pest species and then introduced to Egypt in 2001 for the biological control of cereal aphids (Adly *et al.*, 2006).

Knowledge of thermal constants and lower development thresholds provides essential information to determine the development rate of a particular species of arthropods (Jarošik *et al.*, 2002). Thermal constants are frequently used to create predictive models of pest development in various environments greenhouses and orchards (Graf *et al.*, 1996). Many studies have focused on *A. albipodus* fecundity and searching behavior (Bai and Mackauer, 1990 and Tatsumi and Takada, 2005) and some others (Bueno and van Cleave, 1997 and Adly *et al.* 2006) studied the effect of temperature, host age, density and parasitoid female age on development, parasitism and biological aspects of *A. albipodus*.

The present study aimed to evaluate the effect of temperature, host stage, parasitic female age and density on biological aspects of the parasitoid, *A. albipodus* i.e. parasitism rate, emergency rate, longevity and sex ratio.

MATERIALS AND METHODS

Rearing of the aphid and its parasitoid

A start colony of the mealy plum aphid, *Hyalopterus pruni* (Geoffroy) was collected from giant the cane weed *Arundo donax*, located at wastewater bodies. Collected aphid was reared on the same host under the laboratory conditions of 25±2°C and R.H. 65±5%. Fresh *A. donax* weed seedlings were grown in a laboratory cage (1x1x3 m) and then infested with *H. pruni*. The parasitoid *A. albipodus* was collected from the same area of the host and was identified according to (Stary *et al.*, 1997). The parasitoid was reared on the aphid culture under the same laboratory conditions in separate cage.

Effect of temperature and parasitoid female age

To evaluate some of the biological aspects of *A. albipodus*, 3rd instar nymphs of the aphid (in three

replicates) were exposed to female parasitoid aged 6hr, 12hr, 1, 2, 3, 4, 5 and 6 days after emergence. Each treatment was carried out at three different temperatures; 20, 25 and 30°C. Newly parasitized nymphs of each treatment were kept individually in small glass vials under the same temperature till adult emergence. Parasitism rate, emergency rate, sex ratio and longevity of the parasitoid male and female were estimated under the tested thermal conditions.

Effect of exposing period, host density and host stage

The experiments were carried out to evaluate the effect of host density (25, 50 and 100 3rd instar nymphs), host instar (2nd, 3rd, and 4th nymphal instars) and exposing periods (12, 24 and 48 hrs) to the parasitoid female. Each treatment was replicated three times with three female parasitoids. Interactions among the three factors were measured as parasitism rate, emergency rate, sex ratio and longevity of the parasitoid under the laboratory conditions of 25°C and 65% RH.

Statistical analysis

Data were analyzed using the General Linear Model (GLM) Procedure (SAS Institute, 1988) and using an analysis of variance (ANOVA) to test significant difference ($p < .005$) and estimate LSD among the treatments.

RESULTS AND DISCUSSION

Effect of temperature and parasitoid female age on parasitoid biological parameters

Results in table (1) indicate that both the temperature and the parasitoid female age affected the parasitoid biological parameters such as parasitism rate, longevity and sex ratio. At all the tested temperatures, *A. albipodus* females succeeded to parasitize their exposed hosts 6 hrs post emergence and the females could recognize between the parasitized and non-parasitized hosts. Parasitization rate increased gradually during the first four days, recording parasitized host numbers between 8.67 ± 2.08 and 23.56 ± 0.19 . The time from mummy's formation to adult emergence was correlated with temperature within the range of 20–30°C (Table 1). Highest activity of the parasitoid female was recorded at 25°C and average numbers of parasitoid emerged was recorded at the same table. However, the results also indicated that emergence rate attained $89.44 \pm 4.52\%$ at all the parasitized host individuals emerged when the parasitoid females' age ranged between 1 and 4 days.

Table (1) shows also that the life span from laying eggs to adults lasted a period ranged between 11 and 13 days. Longevity increased at 20°C and decreased at 30°C. Parasitoid female age and temperature affected the number of emerged parasitoids. Obtained data are in agreement with those of Adly *et al.* (2006) who reported that *A. albipodus* developmental time from egg to adult ranged between 12.45 and 13.55 days. Temperature is known to have a strong effect on these parameters (Steenis, 1994). In this respect, Bernal and Gonzalez (1996) stated that the total developmental time (from egg to adult) in *A. albipodus* increased from 10.1 days at 29.4°C to 27.9 days at 15.5°C and adult parasitoids did not emerge from mummies at 10°C. In Aphelinidae, ambient temperatures have been shown to have a significant effect on the offspring sex ratio (Stary, 1988). Fecundity of aphelinid females was known to vary with ambient temperatures and other factors. Julio *et al.* (1997) found that offspring sex ratio was highest at 21.1°C (although it was insignificantly different from that at 10°C). Moreover, King (1987) reported that the offspring sex ratio commonly declined with age in female parasitoids.

Effect of exposure period, host density and host stage on parasitoid biological parameters

Biological parameters are known to be affected by nymphal host instars, host density and exposure time. *A. albipodus* didn't develop successfully in the 1st nymphal instar as well in the adult of *H. pruni* as shown in table (2). The aphid as host was exposed to the females parasitoid for three periods of 12, 24, 48 hours and the results indicated that the mean numbers of mummies produced by an individual female at each instar was recorded in table (2). *A. albipodus* female could parasitize 14.78 ± 2.39 individuals from 25 exposed at the exposure period of 12hr. Female activity decreased when the exposed host number was increased from 25 to 50 and/or 100 nymphs. When the host was exposed for 24 and 48 hrs, *A. albipodus* preferred the 3rd nymphal instar for parasitism. The parasitoid female could increase its activity when the exposed host period increased.

Data in table (3) showed that the parasitoid immature stages lasted longer at the highest numbers of the host density and longevity decreased gradually when the number of the host was decreased. Parasitoid longevity ranged between 9.85 ± 4.71 and 12.05 ± 0.79 days at all the tested exposure times. In general, means at all the exposure times, parasitoid emergence rate did not reach 50%. The parasitoid emerged from the 2nd, 3rd and 4th nymphal instars spent shorter time than in 4th instar, with 9.89 ± 4.71 days. Highest numbers emerged were in 3rd instar recording 90.03 ± 7.66 . Moreover, *A. albipodus* general mean of the sex ratio was 7.27 ± 1.30 for female

Table (3): Effect of exposed period, host stage and the host density on parasitoid longevity and offspring

Longevity										
Nymphal instar	Exposure period									Mean±SE
	12h			24h			48h			
Host Number	25±SE	50±SE	100±SE	25±SE	50±SE	100±SE	25±SE	50±SE	100±SE	
N2	11.67±0.50	11.56±0.53	11.67±0.71	11.67±0.71	11.44±0.53	11.78±0.67	11.44±0.73	11.56±0.53	11.44±0.73	11.58±0.62
N3	12.22±0.67	11.89±0.60	12.33±0.71	12.22±0.67	11.78±0.83	12.00±0.87	12.00±0.87	12.00±0.87	12.00±1.00	12.05±0.79
N4	9.44±5.39	9.67±5.50	12.00±0.87	7.63±6.35	10.89±4.14	11.00±4.18	8.22±6.18	9.56±5.43	10.63±4.34	9.89±4.71
General mean	6.67±1.31	6.62±1.33	7.20±0.46	6.30±1.54	6.82±1.10	6.96±1.14	6.33±1.55	6.62±1.37	6.81±1.21	6.70±1.22
LSD	1.83									
Male										
Nymphal instar	Exposure period									Mean±SE
	12h			24h			48h			
Host Number	25±SE	50±SE	100±SE	25±SE	50±SE	100±SE	25±SE	50±SE	100±SE	
N2	3.11±0.78	5.00±1.41	6.89±1.27	5.78±1.48	12.67±1.73	32.11±1.17	5.78±0.97	16.77±1.00	37.67±2.00	13.96±1.31
N3	6.56±0.88	8.68±1.30	10.00±2.00	7.89±1.62	16.56±1.59	36.98±2.62	9.22±1.64	21.67±2.04	42.00±3.04	17.73±1.90
N4	0.89±0.78	1.78±1.48	.22±1.56	2.13±2.17	3.22±1.56	4.68±2.68	2.33±2.06	3.78±2.73	3.36±2.07	2.75±1.90
General mean	2.11±0.49	3.11±0.84	3.82±0.97	3.16±1.05	6.49±0.98	14.76±1.29	3.47±0.93	8.42±1.23	16.66±1.42	6.89±1.02
LSD	1.12									
Female										
Nymphal instar	Exposure period									Mean±SE
	12h			24h			48h			
Host Number	25±SE	50±SE	100±SE	25±SE	50±SE	100±SE	25±SE	50±SE	100±SE	
N2	2.89±0.78	4.89±1.36	7.44±1.24	5.67±1.00	12.44±2.24	32.89±1.17	6.00±1.22	16.33±1.41	37.44±2.13	14.00±1.40
N3	6.56±1.24	8.56±1.01	11.00±3.46	7.44±2.07	17.22±1.79	36.56±2.40	8.56±1.81	21.56±2.88	40.56±2.01	17.56±2.07
N4	1.00±1.22	2.78±2.86	4.22±1.92	3.50±3.12	5.67±2.69	8.00±4.00	4.44±3.71	7.11±4.94	6.38±3.02	4.79±3.05
General mean	2.09±0.65	3.24±1.05	4.53±1.32	3.32±1.24	7.07±1.34	15.49±1.51	3.80±1.35	9.00±1.85	16.88±1.43	7.27±1.30
LSD	1.52									

and 6.89±1.02 for male (1.06♀: 1♂) at all tested factors, i.e., exposure time, host instar and density.

As shown in table (3), the parasitoid males emerged with an average rate of 6.89±1.02%, while it was 7.27±1.30% from the mummies emerged female parasitoids with a sex ratio of 1♂:1.06♀. Julio *et al.* (1997) reported that all *A. albipodus* females produced eggs which developed in hosts turned into mummies during the 1st day of adult life at 21.1 and 26.7°C. They developed also the life table and mentioned that the parasitoid fecundity was affected by a number of environmental factors and out of 202 parasitized mummies by *A. albipodus*, 93 emerged adults were females and 39 were males. In contrast to the present results, longevity of aphelinids depends on various factors among which are with special important of food and temperature (Jaroík *et al.* 2002). Zhishan *et al.* (2004) recorded that, from *Aphis glycines* parasitized host, a total of 21 females and 17 males (1.23♀: 1♂) of *A. albipodus* was produced from the collected mummies. On the contrary, Adly *et al.* (2006) reported that all the *A. albipodus* adults emerged were 100% females.

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