

## Original Research Article

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**Biology of *Aenasius arizonensis* Hayat (Hymenoptera: Encyrtidae) a Nymphal Adult Parasitoid against Cotton Mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae)**

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### ABSTRACT

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The study on biology of nymphal adult parasitoid *Aenasius arizonensis* Hayat on cotton mealybug, *Phenacoccus solenopsis* Tinsley was conducted under laboratory conditions during February to April, 2016. Preliminary survey on host plants of *P. solenopsis* was conducted along with its natural enemies and *A. arizonensis* was found to be a commonly occurring natural enemy along with *Cryptolaemus montrouzieri*. The parasitoids were collected and reared on cotton mealybug for one generation, then allowed to mate. The parasitized mummies of mealybugs were taken separately for emergence of parasitoid and fed on 50% honey solution. The studies showed that the developmental period of parasitoid till formation of pupa was 10.31 days, pupal stage was 8.60 days. The longevity of adult female wasp was 70.20 days and male wasp was 53.30 days. The total average duration of life cycle was 89.10 days.

### Introduction

*Phenacoccus solenopsis* was found seriously infesting cotton plants during 2005 in the Punjab and Sindh regions of Pakistan (Arif *et al.*, 2007). Then, it had spread to a large number of cotton growing districts in India and by 2006. Biological control practices have been developed in recent years with the introduction promising parasitoid *Aenasius arizonensis* (Hayat, 2009), predators like *Cryptolaemus montrouzieri*, *Cheilomenes sexmaculatus*, *Brumoides suturalis* (Sattar *et al.*, 2007; Suroshe *et al.*, 2013) and entomopathogenic fungi like *Lecanicillium*

*lecani*, *Metarrhizium anisopliae*, *Beauveria bassiana* (Nagrare *et al.*, 2011). In India, the endoparasitoid, *Aenasius* sp., was reported to attack *P. solenopsis* on different host plants such as cotton, okra, *Parthenium hysterophorus*, *Achyranthes asper* etc. (Sharma, 2007; Tanwar *et al.*, 2008). The parasitoid was first identified as *Aenasius arizonensis* Hayat (Hymenoptera: Chalcidoidea: Encyrtidae) by Insect Identification Service, Division of Entomology, IARI, New Delhi (Hayat, 2009). *Promuscidea unfasciiventris* Girault (Hymenoptera: Chalcidoidea: Aphelinidae) was identified as another parasitoid (Tanwar *et*

*al.*, 2011), which was earlier identified as hyperparasitoid on *A. arizonensis* (Hayat, 1998).

Fand and Suroshe (2015) mentioned that *A. arizonensis* was effective in controlling the population of *P. solenopsis* upto 30 - 60% apart from 28 other species of natural enemies which include predators and parasitoids. This parasitoid was reported from USA, India, Pakistan, China and Iran (Girault, 1915; Hayat, 2009; Bodlah *et al.*, 2010; Chen Hua-Yan, *et al.*, 2010 and Fallahzadeh *et al.*, 2014). A recent report of the parasitization of the *P. solenopsis* by *A. arizonensis* was also reported on different host plants at Giza region in Egypt (Angel *et al.*, 2017).

The mean duration of development of *A. arizonensis* from egg laying to pupation was 8.85 days and pupation to adult emergence took 7.35 days in males and 7.00 in females. The mean total duration of development of *A. arizonensis* from egg laying to adult emergence was 16.10 days (range 14-18 days). The adult females survived for 70.95 days and males survived for 49.0 days when fed on 50% honey (Poorani *et al.*, 2009).

The developmental period of the parasitoid from 1<sup>st</sup> day of parasitization till emergence of adult wasp from mummies was recorded 12 - 17 days. Single parasitoid adult was emerged from each mummy of the host, giving evidence that female of parasitoid lay single egg in the host. Male wasp died within 7 - 10 days whereas female survived for 15 - 32 days. Female parasitoid parasitizes 30 - 165 mealybugs in its whole life (Abdin *et al.*, 2012).

The morphometrical observations recorded by Sangle *et al.*, (2013) were as follows. The mean length and width of the pupa were  $3.48 \pm 0.01$  mm and  $1.85 \pm 0.02$  mm respectively. The mean length and width of the adult female

were  $1.83 \pm 0.03$  mm and  $0.80 \pm 0.01$  mm respectively. The mean length and width of the adult male were  $1.04 \pm 0.04$  mm and  $0.38 \pm 0.01$  mm respectively.

## Materials and Methods

The host *P. solenopsis* was collected from infested fields and reared in laboratory on potato sprouts, to maintain culture. The parasitoids were collected from *P. solenopsis* infested field twigs of *Hibiscus rosa-sinensis* were allowed to rear on *P. solenopsis* for one generation. The parasitized mealybug mummies were collected and kept individually for emergence of parasitoids. Upon emergence, the parasitoids were allowed to mate and parasitize the mealybugs of 2<sup>nd</sup> instar and above. The parasitized mealybugs were kept separately in glass for observation. Observations on time taken from egg laying to pupation, pupation to adult emergence and adult longevity on 50% honey were recorded. The time taken from exposure to adult emergence was considered as the total duration of development. The above said procedure was followed as suggested by Poorani *et al.*, (2009). The different visual stages of parasitoids were observed for morphometrical readings for color and shape using stereoscopic microscope.

## Results and Discussion

The observation on life stages of parasitoid revealed that the time taken from parasitization to pupal stage ranged from 8 - 12 days with a mean of  $10.31 \pm 1.56$  days. The swelling of the host was observed after 3 - 4 days of parasitization and they are called mummies or mummified insects. The mummies were leathery brown structures. The parasitoid pupa inside the body of the mummies was hard, shiny and brown. The Duration of pupa ranged from 7 to 10 days with a mean of  $8.60 \pm 1.07$  days and the length

of pupa ranged from 2.70 to 3.70 mm with a mean of  $3.10 \pm 0.37$  mm whereas width ranged from 1.6 to 2.1 mm with a mean of  $1.80 \pm 0.20$  mm and only one parasitoid was emerged from one mummified insect.

The total duration from egg to adult emergence ranged from 15 to 20 days with a mean of  $18.91 \pm 1.90$  days. The longevity of adult females and males when reared on 50 % honey ranged from 49 to 84 (Av.  $70.20 \pm 12.39$ ) and 35 - 66 (Av.  $53.30 \pm 9.23$ ) days, respectively. The length and width were 1.60 - 2.60 (Av.  $2.06 \pm 0.03$  mm) and 0.70 - 0.95 (Av.  $0.80 \pm 0.01$  mm) for female and 0.90 - 1.60 (Av.  $1.26 \pm 0.02$  mm) and 0.35 - 0.60 (Av.  $0.45 \pm 0.01$  mm) for male. The total duration from egg laying to the adult mortality ranged from 64 to 105 days with a mean of  $89.10 \pm 13.90$  days (Table 1 and 2). The body

of the parasitoid is shiny black coloured with punctured like appearance of pronotum and the abdomen is dark brown. The male was smaller in size than the female. The wings were translucent, but in male wing length was longer than the body length and reverse was the case with the female. The female parasitoids were easily distinguished due to presence of pointed and long ovipositor at the end of the abdomen (Fig. 1–4). Poorani *et al.*, (2009) reported that the mean duration of development from egg laying to pupation was 8.85 days and pupation to adult emergence was 7.35 days in males and 7.00 in females. The mean total duration of development from egg laying to adult emergence was 16.10 days. The adult females survived for 70. 95 days and males survived for 49.0 days when fed on 50% honey, which supported the present findings.

**Table.1** Duration of life stages of *Aenasius arizonensis* on *Phenacoccus solenopsis* in laboratory under ambient conditions

Life stage	Duration (days)	
	Range	Mean $\pm$ SD
Egg + Larva	8 - 12	$10.310 \pm 1.567$
Pupa	7 - 10	$8.600 \pm 1.074$
Total	15 - 21	$18.910 \pm 1.969$
Female	49 - 84	$70.200 \pm 12.398$
Male	35 - 66	$53.300 \pm 9.238$

**Table.2** Morphometry of *A. arizonensis*

Life stage	Morphometry (mm)	
	Range	Mean $\pm$ SD
Pupa		
Length	2.7 - 3.7	$3.10 \pm 0.37$
Width	1.6 - 2.1	$1.80 \pm 0.20$
Adult Female		
Length	1.60 - 2.6	$2.06 \pm 0.03$
Width	0.70 - 0.95	$0.80 \pm 0.01$
Adult Male		
Length	0.90 - 1.60	$1.26 \pm 0.02$
Width	0.35 - 0.60	$0.45 \pm 0.01$

**Fig.1** *Aenasius arizonensis* parasitized mummies of *P. solenopsis* on China rose



**Fig.2** Pupae of *A. arizonensis*



**Fig.3** Adult male of *A. arizonensis*



**Fig.4** Adult female of *A. arizonensis*



Abdin *et al.*, (2012) reported the total development period from parasitization to emergence of adult ranged from 12 to 17 days. The longevity of adult male and female ranged from 7 to 10 days and 15 to 32 days respectively, which varied with present study.

The findings of the present study corroborates to the findings of Sangle *et al.*, (2013). The biology studies of the current research varied with the findings of Aga *et al.*, (2016), who mentioned the maximum longevity of the adult female and male to be 34 and 24 days

respectively. The morphometrical observations were in coincidence with the present findings.

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