

**MORPHOLOGICAL CHARACTERISTICS OF THE APHID
PARASITOID, *APHELINUS ALBIPODUS*
HAYAT & FATIMA (HYMENOPTERA: APHELINIDAE)**

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INTRODUCTION

The hymenopteran parasitoids in the family Aphidiidae and Aphelinidae are important biological control agents of aphids' worldwide (Stary, 1970; Yasnosh, 1976; Chen, 1979 and Liu, 1989a). The aphelinids involve a small group of the primary parasitoids of aphids (Stary, 1976).

Aphelinus albipodus Hayat & Fatima (Hym.: Aphelinidae) was described from material earlier misidentified in India as *flavipes* by Ramaseshiah and Dharmadhikari (1969) and Hayat (1972). This species has also proved to be widely distributed. It has been recorded to be a parasitoid mainly on *Aphis gossypii* Glov., though several other aphid species are also parasitized, and may eventually prove to be of use in the control of these aphids (Hayat and Fatima, 1992). *A. albipodus* could be effective biological control agent because of its ability to parasitize several common aphids; *Rhopalosiphum padi* (L.), *Schizaphis graminum*, *R. maidis*, *Sitobion avenae*, *Diuraphis noxia*, *Aphis gossypii*, *Acyrtosiphon pisum*, *Lipaphis erysimi*, *Brevicoryne brassicae* and *Myzus persicae* (Hayat and Fatima, 1992 and Elliott, et al. 1999).

A. albipodus was collected from Tahcheng, PRC, by Gonzalez during 1992 and shipped to the Texas A & M University Quarantine Facility, College Station, Texas, USA, then exported to Egypt in 2001. The parasitoid culture was maintained at the Department of Biological Control (DBC), Agriculture Research Center (ARC), Giza, Egypt. Specimens of the native *Aphelinus* sp. emerged from cereal aphid species, collected from Egyptian wheat fields, were sent to Dr. M. Hayat (the author of the species), Department of Zoology, Aligarh Muslim University, Aligarh,

India for identification. The result showed that both the native and the exotic parasitoid species were the same *A. albipodus*.

The aim of this study was to describe morphological characteristics of the immature stages (egg, larval instars, pre-pupa and pupa) of *A. albipodus*.

MATERIAL AND METHODS

A. albipodus was reared on *R. padi* maintained on wheat (*Triticum aestivum*) seedlings. Colonies of both *A. albipodus* and *R. padi* were kept in the laboratory under controlled conditions ($23 \pm 1^\circ\text{C}$, 60-70% R.H. and photoperiod L: D 16: 8).

One hundred nymphs, almost 2nd and 3rd nymphal instars, were placed on wheat seedlings, cultivated in small pots and kept in small cages (15 replicates). In each cage, aphids were exposed to 10 parasitoid adults for one hour. Afterwards, parasitoid females were removed, and then the cages were placed inside the incubators at 15 °C. Parasitized aphids were dissected daily by a very fine needle, in a drop of Ringer's solution using a stereomicroscope.

The immature stages (egg, larval instars, pre-pupa and pupa) were measured and drawn by a square glass lens placed in a research microscope and then pictured using a video camera placed on a binocular stereomicroscope and transferred to the computer.

RESULTS AND DISCUSSION

Different immature stages and adult of the parasitoid species *A. albipodus* were morphologically characterized by the following:

Egg: *A. albipodus* females usually lay their eggs into the thorax or abdomen of the host aphid. The deposited egg of the parasitoid is hymenopteriform (Fig. 1a and b), translucent, with a very delicate chorion and consisted mostly of granular bodies. Before hatching, the embryo became clearly visible and characterized to head and body wall, but the segmentation was not apparent inside the egg (Fig. 1c). Hatching was mostly accomplished by the activity pressure and mandibles of the larva. Measurements of 15 newly deposited eggs averaged 1.7 ± 0.022 mm long and 0.59 ± 0.021 mm wide. There was no change in the egg size during the incubation period.

There are approximately 50 genera in the family Aphelinidae (Viggiani, 1984). The egg of aphelinid species tended to be different in shape in many genera (Clausen, 1940). Clausen (1940) and Christiansen (1994) reported that, the eggs of the parasitoids; *A. mali* and *A. varipes* are hymenopteriform. Gerard (1989) and Christiansen (1994) mentioned that the egg of the aphelinids, *Centrodora scolypopae* and *A. varipes* did not enlarge during the developmental period of the embryo (incubation period). Schlinger and Hall, (1960) stated that hatching was mostly accomplished by the mandibles not by the growth and activity pressure of *Praon palitans* larva (Hymenoptera: Braconidae, Aphidiinae).

Larva: *A. albipodus* has three larval instars differ in their morphological shapes.

First larval instar: Newly hatched larva is elongate and transparent (Fig. 2 a and b). Body has an uneven integument and 13 segments. Mandibles narrow, triangular in shape and curved to inside (Fig. 2 c, d and e), measured 0.25 ± 0.005 mm long and 0.18 ± 0.0053 mm wide at the base. Larva measured 1.37 ± 0.04 mm long and 0.63 ± 0.02 mm at its greatest width; head capsule 0.35 ± 0.013 mm long and 0.45 ± 0.013 mm wide.

Second larval instar: Body at early stage, was similar in shape to that of first instar (Fig. 3a and b). At late stage, body started to be spherical in shape at thoracic and the beginning of the abdominal segments (Fig. 3c and d). Mandibles are invisible or absent. Feeding was done by pharyngeal pumping. Faint segmentation of the body began to show up. The gut in the first larval instar and early stage of the second larval instar was opaque but it tended to be yellow in the late stage of the instar. The larva averaged 2.72 ± 0.09 mm long and 2.42 ± 0.12 mm at its greatest width; head capsule 0.43 ± 0.027 mm long and 0.91 ± 0.077 mm wide.

Third larval instar: Body spherical in shape. Thoracic and abdominal segments are faintly visible. The gut was yellow and tended to black at the end of this instar. It occupied most of the body cavity (Fig. 4 a, b, c and d). Nervous and tracheal systems developed during this instar (observed during telescoping movement). The mandibles shaped like the beak of parrot (Fig. 4e and f), measured 0.39 ± 0.009 mm long and 0.42 ± 0.011 mm wide at the base. The larva averaged 5.35 ± 0.29 mm long and 4.67 ± 0.25 mm at its greatest width; head capsule 0.77 ± 0.046 mm long and 1.78 ± 0.036 mm wide.

The larval instars of aphelinid species tend to be similar in shape and structure in many genera (Viggiani, 1984). Several authors have described only three

larval instars (Nikol'skaya and Jasnosh (1966), Bar and Gerling (1971), Rosen and Eliraz (1978), Viggiani and Mazzone (1978), Gerard (1989) and Christiansen (1994).

O'Donnell (1987 b) stated that mandibles in first larval instar of Aphidiinae are not used for feeding, but may be used for a temporarily attachment during locomotion. Chow and Sullivan (1984) mentioned that they are used for fighting supernumerary larvae (Hymenoptera: Aphidiidae).

O'Donnell (1987a and b) reported that the second larval instar lacks mandibles, feeding largely on teratocytes and also any host embryos and other mobile cellular material that can be sucked into the oesophagus (Schlinger and Hall, 1960). The third instar is again equipped with mandibles; using them to cut a ventral slit in the host's skin after all its constants have been consumed.

Hafez *et al.* (1979) and Gerard (1989) observed faint segmentation of the second and third larval instars of *Eretmocerus mundus* Mercet and the gut was opaque white and occupied most of the body cavity in *Centrodora scolypopae* (both of them Hymenoptera: Aphelinidae).

Prepupa: The gut of prepupal is black in color because of existence of the meconium (Fig. 5a and b). The mandibles appeared transparent and tended to orange (Fig. 5 c and d), measured 0.83 ± 0.009 mm long and 0.38 ± 0.007 mm wide at the base. The prepupa averaged 9.11 ± 0.36 mm long and 7.27 ± 0.23 mm at its greatest width.

Pupa: It is a free type (exarate). Newly formed pupa is dark yellow, attaining a brown color as development proceeds. Compound and simple eyes are visible. At the end of this stage, the appendages, antennae and wing pads were obviously fully formed (Fig.6 a, b, c, d, and e). Cocoon is black, so the developing parasitoid was not visible through the ventral surface and the black meconium was found in the cocoon. The adult did not emerge from the cocoon until the wings were fully expanded. The pupa averaged 10.39 ± 0.14 mm long and 5.13 ± 0.09 mm at its greatest width.

O'Donnell (1987a and b) stated that most genera of Aphidiinae spin a frail cocoon inside their hosts' skin, which hardens and darkens attaching this mummy. Christiansen (1994) observed that during the last instar of *A. varipes*, the host aphid developed into a mummy in which black pigments were incorporated into the exocuticle and the integument of the aphid became sclerotized. Schlinger and Hall (1960) found that the molt skin and the meconium of last larval instar of *P. palitans* (Aphidiinae) were found in the middle of the cocoon; occasionally they might be

found attached to the last abdominal segment. Gerard (1989) reported that the meconium of *C. scolyopae* (Hymenoptera: Aphelinidae) was orange meconial pellets which lied nearly alongside the abdomen and the pupa was exarate.

Adult: Length 0.82-1.06 mm (Holotype 0.97 mm). Head and thorax dark brown to nearly black, antennae pale yellow to nearly white, wings hyaline and ovipositor not or very slightly exerted (Hayat and Fatima, 1992) (Fig. 6 f).

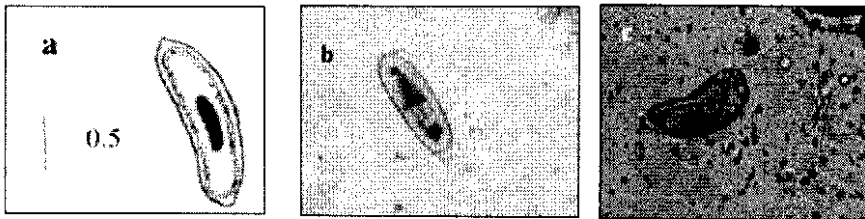


Fig. (1): Egg of *Aphelinus albipodus*: a: drawn, b: photographed (100 x), c: photographed before hatching (100 x)

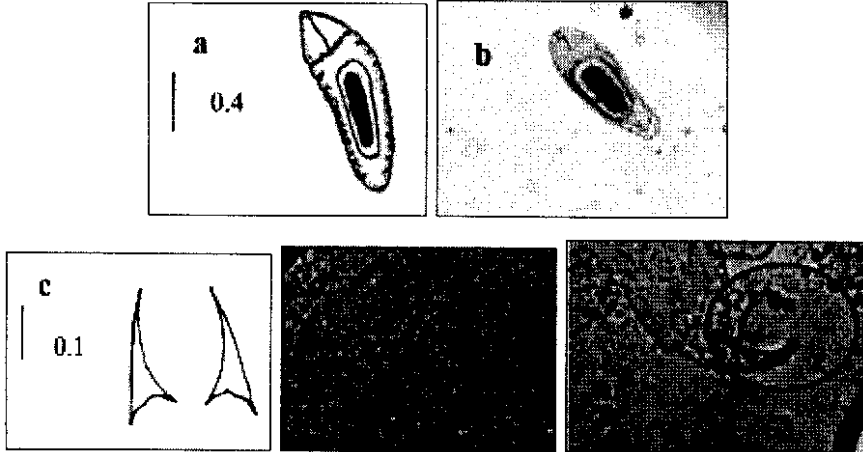


Fig. (2): *Aphelinus albipodus*, 1st larval instar. a: drawn, b: photographed (100 x), c: mandible (drawn), d: picture of left mandible (400 x), e: right mandible (400 x) (photographed).

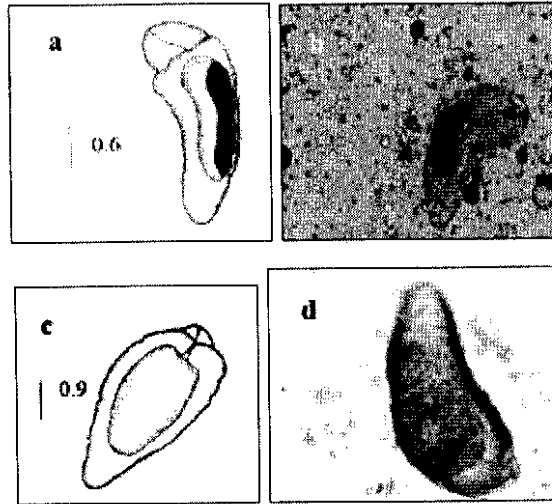


Fig. (3): *Aphelinus albipodus*, 2nd larval instar, a: drawn, b: early stage of larva (100 x) photographed, c: late stage of larva (drawn), d: late stage of larva (100 x) photographed.

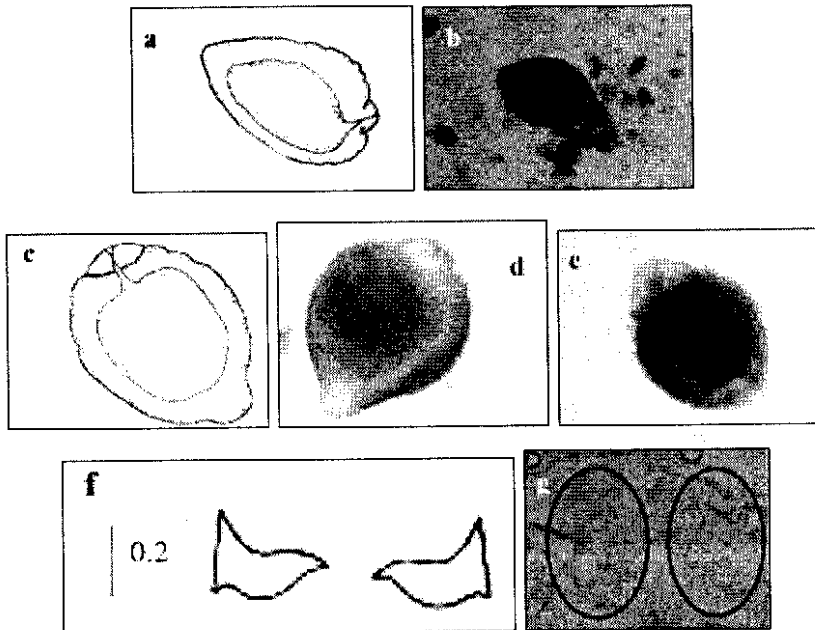


Fig. (4): *Aphelinus albipodus*, 3rd larval instar. a: early stage of larva (drawn), b: early stage of larva (100 x) photographed, c: late stage of larva (drawn), d: late stage of larva (100 x) photographed, e: at the end of the instar (photographed), f: mandible (drawn), g: mandible (400 x) photographed.

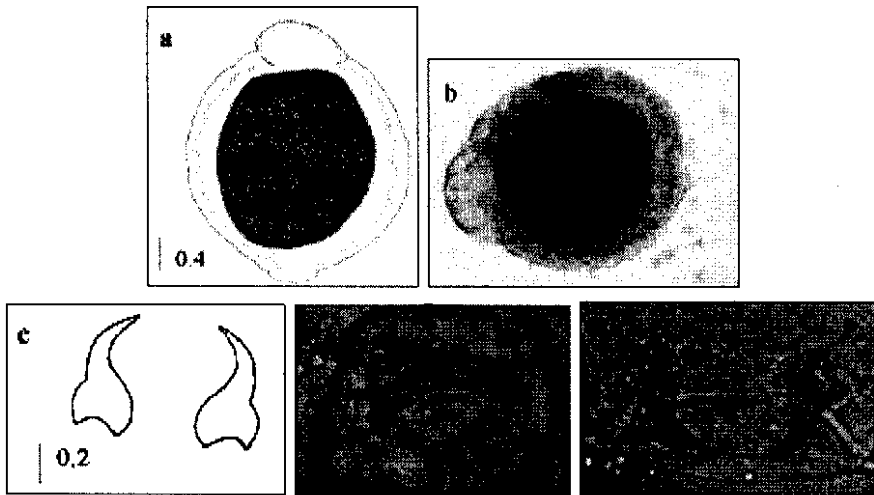


Fig. 5: *Aphelinus albipodus*, pre-pupa: a: drawn, b: pre-pupa (40 x) photographed, c: mandible of pre-pupa (drawn), d: mandible (400 x) photographed.

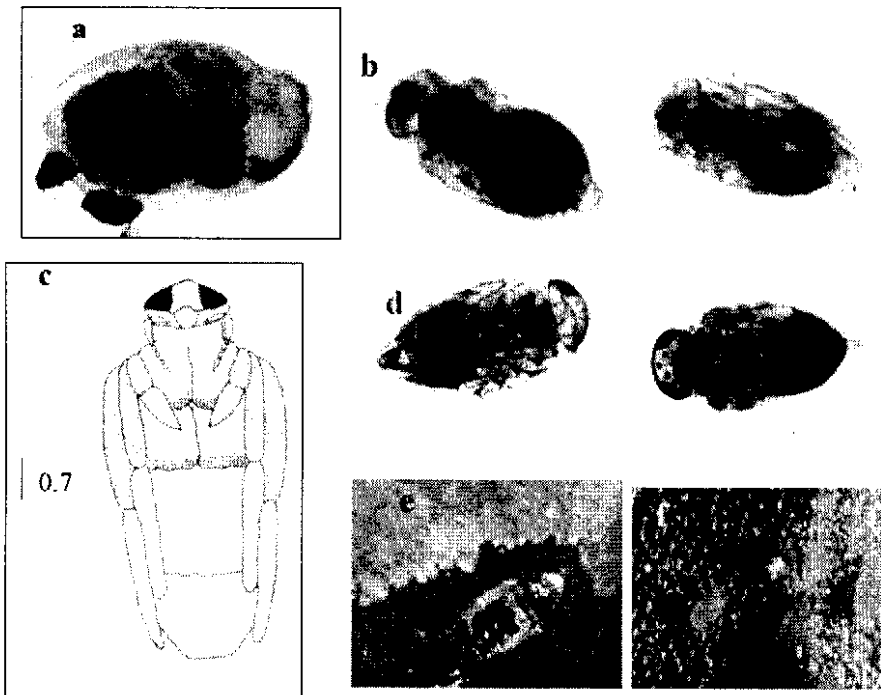


Fig. (6): *Aphelinus albipodus*, pupa: a, b, c, d, e: developmental stages of pupa, f: adult female deposits egg in the host (40 x)

SUMMARY

Different immature stages and adult of the parasitoid species, *Aphelinus albipodus* Hayat & Fatima (Hymenoptera: Aphelinidae) were morphologically characterized. Deposited egg is hymenopteriform, translucent, with a very delicate chorion and consisted mostly of granular bodies. Larva has three instars differed in their morphological shapes. Newly hatched larva is elongate and transparent. Mandibles narrow, triangular in shape and curved. Body at early stage of second larval instar, is similar in shape to the first instar. Late stage of this instar is spherical in shape at thoracic and fore-abdominal segments. Mandibles were invisible or absent. Last instar larva spherical in shape. Thoracic and abdominal segments were faintly visible. The gut of prepupa appeared black in color because of existence of meconium. Mandibles were transparent and tended to orange. Pupa is of a free type (exarate). Newly formed pupa dark yellow and attained brown as development proceeded.

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