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# Discrimination among Aphid Parasitoids Through Characteristics of their Mummies

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## ABSTRACT

Aphid parasitoid species of family Aphidiidae form the major group of the primary parasitoid spectrum of aphids. As well, the species of family Aphelinidae form another small group. A trial to discriminate and / or classify the primary parasitoid species through the characteristics of the open empty mummies and the form and number of pellets of the meconium, the texture of the mummies, the form and position of the emergence holes made by the adult parasitoids of the five primary parasitoid species; *Aphidius matricariae* Haliday, *A. colemani* Viereck, *Diaeretiella rapae* M'Intosh, *Lysiphlebus testaceipes* Cresson (Aphidiidae) and *Aphelinus albipodus* Hayat & Fatima (Aphelinidae) was carried out.

**Key words:** Discrimination, mummies, morphological characteristics, aphid parasitoids.

## INTRODUCTION

Aphids are one of the insect groups whose economic importance increases with the development of agriculture (Stary, 1976). They are widespread in temperate and to a lesser degree tropical regions and attack a wide range of plants, including herbs, trees and even some mosses. Many species form dense colonies on the aerial parts of plants, while others attack roots. Nearly all species reproduce parthenogenetically (Dixon, 1998).

In general, aphids tend to have three groups of natural enemies; parasitoids, predators, and fungal diseases (Hagen and Van Den Bosch, 1968). Parasitoid species are mostly specific on a single or certain group of insect hosts. Aphid parasitoids are one of the groups of which utilization in biological control has given significant results in many countries of the world. Aphidiids form the major part of the primary parasitoid spectrum of aphids. As well, the aphelinids form another small group of the primary parasitoids of aphids (Stary, 1976).

Aphid parasitoids such as; *Aphidius* spp., *Diaeretiella rapae, Lysiphlebus* spp. (Aphidiidae) and *Aphelinus* spp. (Aphelinidae) are among the common and widely distributed primary aphid parasitoids that have wide ranges of hosts in agro-ecosystems. These parasitoid species are oligophagous, solitary and endoparasitoids of aphid species (Stary, 1976).

The objective of the present work is to highlight visual characteristics of the empty mummies of some primary aphid parasitoid species in a trial to differentiate among them as a contribution for classification of some common aphid parasitoid species.

## MATERIALS AND METHODS

*Aphidius matricariae* Haliday, *A. colemani* Viereck, *Diaeretiella rapae* M'Intosh, *Lysiphlebus testaceipes* Cresson (Aphidiidae) and *Aphelinus albipodus* Hayat & Fatima (Aphelinidae) were the primary aphid parasitoid species used in this study. They were chosen because they have different levels of specificity with aphid species and were relatively easy to obtain. Form and dimension of emergence operculum, shape of meconium and number of pellets were used as characteristics for classification.

**Laboratory Host and Parasitoids Stock Cultures:**

The Bird Cherry-Oat Aphid species, *Rhopalosiphum padi* L. and its parasitoid species, *Aphidius matricariae*, *A. colemani* and *A. albipodus* were collected from wheat fields, *D. rapae* was collected from mummies of *Brevicoryne brassicae* L. in cabbage fields, while *L. testaceipes* was obtained through a personal contact with Dr. P. Stary. Detailed rearing methods and conditions for the laboratory stock cultures of the host, *R. padi* and different aphid parasitoid species followed those described by Adly, 2002.

**Morphological Studies:**

Formed mummies of each of the five primary parasitoid species were placed individually in small glass vials until adults' emergence (20 replicates/ treatment). After emergence, mummies of each parasitoid species were dissected by a fine needle, in a drop of Ringer's solution using a stereomicroscope to determine shapes and dimensions of emergence holes and their covers as well numbers of meconium pellets inside the mummies. Mummies' emergence holes, their covers and meconia were pictured using a video camera placed on a binocular microscope and transferred to the computer. Major characteristics of the forewings of the parasitoid

species and relatively their measurements were also used as parameters for classification (El-Heneidy *et al.* 2003).

## RESULTS AND DISCUSSION

### Mummies' shape and color in relation to parasitoid species

Visual appearance of aphid mummies' shape depends on the parasitoid species not on the aphid species. When the aphids were parasitized by *A. matricariae, A. colemani, D. rapae* or *L. testaceipes* (Aphidiidae), mummies were almost spherical round and colored dark to light brown (Fig. 1 a, b, c and d) with some exceptions exist as in case of *D. rapae* when it parasitized *B. brassicae*, the mummies colour was white. In Aphelinidae, as in case of *A. albipodus*, the mummies were nearly oval in shape and colored black and this is a well known characteristic of the aphid parasitoids of family Aphelinidae (Fig. 1 e). Although mummies' shapes and colors are a species specific characteristic of the aphid parasitoid, but the mummies' color has a wide range and sometimes it may be influenced by host aphid species but so far it still an aphid parasitoid family characteristic (Stary *et al.* 1997).

Christiansen 1994 reported that the mummies of the parasitoid, *Aphelinus varipes* are oval and colored black but the mummies of *Aphidius* species are round and colored brown. Praslicka, *et al.* 2003 mentioned that the parasitoid genera were determined by coloration and shape of the aphid mummies. Species of genus *Aphidius* emerge from oval yellowish brown mummies, in genus *Ephedrus* the mummies are black, and in genus *Praon* the larvae make a white cocoon under the killed aphid. Legrand, *et al.* 2004 noticed a wide range of *Aphidius rhopalosiphi* mummy colorations, between dark and light. This range of coloration did not allow a clear-cut distinction between diapausing and non-diapausing individuals of this parasitoid. Raghuwinder and Marjorie 2007 found that the color of mummies induced by *Lysiphlebus oregmae* varied when reared in six aphid species on five plant hosts. These differences in the color of mummies made it difficult to use color as a method for identification of *L. oregmae* mummies. However, all mummies appeared similar in texture and size, even though they differed in color.

### Shape of aphid parasitoid emergence hole and its lid

Generally, the emergence hole in the aphidiid parasitoid species; *A. matricariae, A. colemani, D. rapae* and *L. testaceipes* was circular, without jagged edges and bear an emergence lid, easily broken and missing. In most of the aphidiid species, the hole was located in any part of the aphid's abdomen. In some species, it was in the apical part of the abdomen and the whole apex functions as a lid when the parasitoid emerged (Stary, 1974). In the aphelinids, the edge of the emergence hole of *A. albipodus* was irregular and no emergence lid was developed. Emerged adult parasitoids generally prefer the posterior part of the mummy for their exit. (Fig. 1 a, b, c, d and e).

The type of the emergence lid seems to be a genus characteristic. The emergence lid of the parasitoid *A. matricariae* was circular, measured an average of 2.11 ± 0.008 mm (2.05 - 2.15) long and 1.9 ± 0.02 mm (1.75 - 2) wide, *A. colemani* emergence lid also shaped like circular but had an extra part shaped like the beak of parrot, the lid averaged 2.15 ± 0.02 mm (2 - 2.25) long and 2.11 ± 0.02 mm (2- 2.2) wide, *D. rapae* emergence lid shaped like tear measured 2.13 ± 0.012 mm (2.05 - 2.2) long and 1.67 ± 0.01 mm (1.55 – 1.75 ) wide and *L. testaceipes* emergence lid was elongated and averaged 2.29 ± 0.009 mm (2.25 - 2.35) long and 1.8 ± 0.01 mm (1.75 – 1.85) wide (Fig. 2 a, b, c and d). The emergence lid might be sufficient and effective for distinction among the aphid parasitoid genera.

Hafez, 1965 pictured and reported that the emergence hole of the primary parasitoid *Diaeretiella (Aphidius) rapae* was more or less circular in shape with smooth edges and situated posterior on the dorsal surface of the mummy, usually between the cornicles. In case of *Charips* (secondary parasitoid species) the emergence hole was mostly circular but in some cases it was rather elongated, the edges were always coarse and dentate and mostly dorsal but it could be latero-dorsal or even latero-ventral.

### Meconia of the aphid primary parasitoid species:

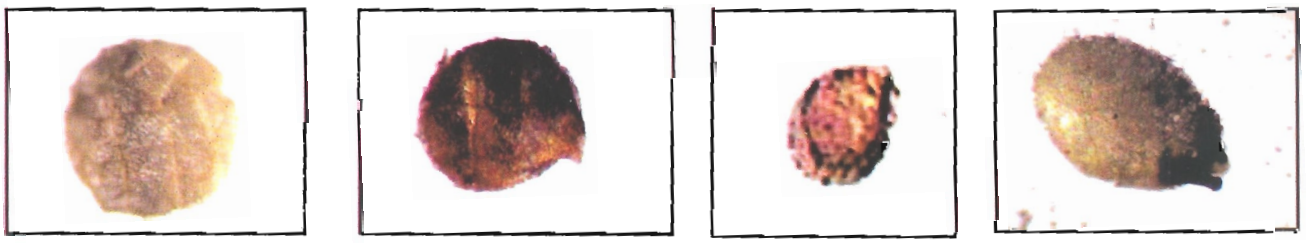
Pre-pupal stage begins with discharging of the meconium inside the aphid mummy. These pellets vary according to the parasitoid species (Hafez, 1965).

The meconia of the aphid parasitoid species; *A. matricariae, A. colemani, D. rapae* and *L. testaceipes* were elongated, shiny black or dark brown. Average pellet numbers of the aphid parasitoid species were 19.9±0.85 (12-26), 24.4±1.25 (16-34), 13.6±0.69 (10-19) and 26.9±0.76 (22- 3), respectively. The meconium of the parasitoid *A. albipodus* was circular, flattened and black. Pellets number averaged 4.7 ±0.27 (3-7), (Fig. 3 a, b, c, d and e) and (Fig. 4, a and b).

The meconia were identical in shape among the parasitoid species of the same family. The number of

a b c d e

Fig. (1): Form of the mummies and emergence hole of the aphid parasitoid species after emergence of the adult parasitoid: a= *A. matricariae,* b= *A. colemani*, c= *D. rapae*, d= *L. testaceipes*, e= *A. albipodus*.

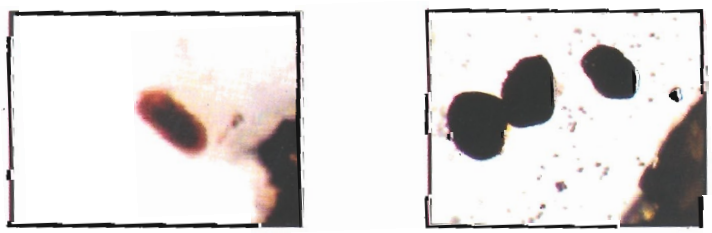


a b c d

Fig. (2): The type of the emergence lid of the aphid parasitoid species:
a= *A. matricariae,* b= *A. colemani,* c= *D. rapae*, d= *L. testaceipes.*

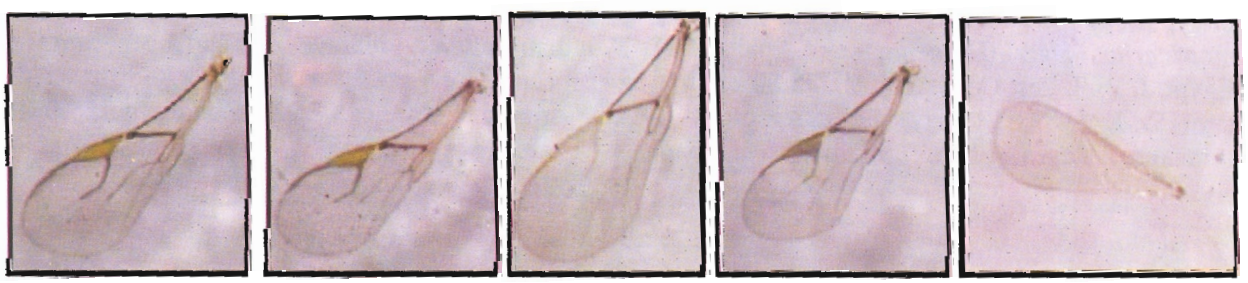
a b c d e

Fig. (3): The meconium of the aphid parasitoid species:
a= *A. matricariae*, b= *A. colemani*, c= *D. rapae*, d= *L. testaceipes*, e= *A. albipodus*.



a b

Fig. (4): The nearly view of the meconium of the aphid parasitoid species:
a= Aphidiidae, b= *Aphelinus*.



a b c d e

Fig. (5): Forewing of the aphid parasitoid species:
a= *A. matricariae,* b= *A. colemani*, c= *D. rapae*, d= *L. testaceipes*, e= *A. albipodus.*

the meconium pellets was not constant and varied according to the host aphid's age. Therefore, they could not be used as clear characteristics for identifying the aphid parasitoid species.

Schlinger and Hall (1960) found that the last larval instar of *Praon palitans* (Aphidiinae) molt skin and the meconia were found in the middle of the cocoon; occasionally be attached to the last abdominal segment. Hafez, (1965) reported that the meconium of *D. rapae* composed of about 10 to 20 shiny black almost cigar shaped pellets and that for *Charips* sp. were about 4 to 6 comparatively large flattened bodies mostly compacted together or attached with their strands. Their color was also black or very dark brown. Gerard, 1989 reported that the meconium of the aphelinid, *Centrodura scolypopae* was orange and lied nearly alongside the abdomen.

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