

A NEW SPECIES OF *APHELINUS* (HYMENOPTERA: APHELINIDAE) FROM ISRAEL,
WITH NOTES ON THE *MALI* GROUP

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ABSTRACT

Aphelinus paramali n.sp. is described as one of 5 species comprising the *mali* group. Its distinctive characteristics are the elongate 3rd funicular segment and short ovipositor of the female. *A. paramali* and *A. mali* are sexually isolated and their host preferences are distinct.

KEY WORDS: Aphelinidae, *Aphelinus*, *A. mali*, *A. paramali* n.sp., Israel.

INTRODUCTION

Since the description of *Eriophilus* (= *Aphelinus*) *mali* by Haldeman (1851), several similar species have been described which share the following characteristics: Head, thorax and gaster black; base (and sometimes apex) of gaster yellow; middle femur dark, hind femur yellow; lineal calva of fore wing bordered proximally with only one complete row of hairs and open posteriorly.

This group presently includes the following species: *Aphelinus campestris* Jasnosh, *A. gossypii* Timberlake, *A. mali* (Haldeman) and *A. prociphili* Carver. Specimens of *gossypii*, *mali* and *prociphili* were available for study, whereas *campestris* is known to us only from the original description. A fifth species, *A. paramali* n.sp., is described herein. A synopsis of the species and a key for their identification are presented. A comparative biological study was undertaken with *A. mali* and *A. paramali*, the only two members of the group occurring in Israel.

KEY TO THE SPECIES OF THE *MALI* GROUP

(Slide-mounted specimens, in Hoyer's medium):

1. Triangular area at base of fore wing usually with 16 setae or more (excluding the complete row and the row parallel to marginal vein); male antenna with swollen scape, bearing more than 10 tuberculous sensilla *prociphili*
— Triangular area at base of fore wing usually with fewer than 15 setae; male scape narrow, bearing 3-6 sensilla 2
2. Ovipositor sheaths 0.25 length of ovipositor; triangular area at base of fore wing bare or bearing a few setae *campestris*
— Ovipositor sheaths 0.35-0.40 length of ovipositor; triangular area at base of fore wing bearing 3-14 setae 3
3. Ovipositor as long as middle tibia; third gastral segment usually pale *paramali*
— Ovipositor 1.5 times length of middle tibia; third gastral segment usually dark 4

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4. Antenna pale brown to yellowish. Male third funicular segment subquadrate (as in female) *gossypii*
- Scape and pedicel dark, subsequent antennal segments yellowish. Male third funicular segment ca 1.5 times as long as wide *mali*

SYNOPSIS OF THE SPECIES

Aphelinus campestris Jasnosh

Aphelinus campestris Jasnosh, 1963:183.

Distribution: Soviet Far East: Primorskiy Kray.

Hosts: Aphidoidea: undertermined aphids on *Polygonum* sp.

Aphelinus gossypii Timberlake

(Figs. 4-6)

Aphelinus gossypii Timberlake, 1924:408-411.

Distribution: Hawaii, Australia, India.

Hosts: Aphidoidea: Aphididae: *Aphis*, *Brachycaudus* and *Rhopalosiphum* spp.

For further references see Hayat (1986).

Aphelinus mali (Haldeman)

(Figs. 1-3, 12)

Eriophilus mali Haldeman, 1851:130-131.

Blastothrix rosae Ashmead, 1886:130.

Aphelinus varicornis Girault, 1909:29-31.

For further references see De Santis (1948), Peck (1963), Gordh (1979).

Distribution: North America. Introduced into numerous countries for the biological control of its main host, the woolly apple aphid, *Eriosoma lanigerum* (Hausmann) (Howard 1929, Clausen 1978).

Hosts: Aphidoidea: Eriosomatidae: Eriosomatinae: *Eriosoma lanigerum*, *Tetraneura graminis* Monell, *Colopha* sp. Other host records should be verified.

Aphelinus prociphili Carver

Aphelinus prociphili Carver, 1980:536-540.

Distribution: North America: U.S.A.: Iowa.

Hosts: Aphidoidea: Eriosomatidae: Pemphiginae: *Prociphilus fraxinifolii* (Riley).

The following three species appear to be related to the *mali* group but are not included in it because they differ in the pattern of pigmentation: *Aphelinus chaonia* Walker, 1839, has the gaster entirely black, without a yellow base. *Aphelinus kashmiriensis* Hayat, 1972, as described, has the hind femur brown rather than yellow. *Aphelinus humilis* Mercet, 1928, has the face and sometimes other parts of the head and gaster yellow.

Aphelinus paramali n.sp.
(Figs. 7-13)

Distinguishing characters: Third gastral segment pale; third funicular segment elongate; ovipositor short, only as long as middle tibia.

Female: Length about 1.2 mm (0.8-1.6); gaster a little shorter than head and thorax combined. Head: Compound eye with short inter-ommatidial setae. Maxillary palpus 2-segmented, labial palpus 1-segmented. Antennal scape (Fig. 7) 4.5 times as long as wide; pedicel twice as long as wide, about half length of scape; first 2 funicular segments short, subequal, 0.8 times as long as wide, slightly narrower than pedicel; 3rd segment 1.2-1.5 times as long as wide, about one-third length of scape, bearing one elongate sensillum; club 3 times as long as wide, 0.8 times length of scape, bearing 4-10 elongate sensilla. Thorax (Fig. 10) reticulate; mesoscutum 1.5 times as long as scutellum, bearing about 40 short setae, with 2 long setae at posterior margin; scutellum bearing 2 pairs of long setae; each axilla bearing 3-5 short setae; each parapsis bearing one long seta; metanotum about 0.2 times length of scutellum, 0.3 times length of propodeum. Mid-tibial spur 0.8 times length of the corresponding basitarsus. Fore wing (Fig. 9) 2.4 times as long as wide; triangle at base separated from linea calva by one complete row of setae, accompanied by 5-10 setae in incomplete rows. Gaster (Fig. 12A) finely reticulate. Ovipositor complex at rest 3 times as long as wide, as long as middle tibia; sheaths 0.35-0.40 of entire length of ovipositor.

Coloration: Head, thorax and propodeum black; gastral segments 1-3 yellow, others dark brown to black. Wings hyaline. Antennal scape and sometimes pedicel dark, other segments yellow. All coxae black; fore femur with varying amounts of dark centrally, pale on apices; middle femur dark (except apices); hind femur entirely yellow; fore tibia yellow, middle tibia with varying amounts of dark centrally; hind tibia dark except apices; all tarsi yellow, except dark hind basitarsus.

Male: Resembles the female, differing mainly in structure of antennae. Length about 0.9 mm (0.7-1.2). Antennal scape (Fig. 8) widened, 3-4 times as long as wide, bearing 3-5 tuberculous, truncate sensilla on its ventral aspect; 3rd funicular segment twice as long as wide, club as long as or slightly longer than scape. Mid-tibial spur slightly shorter than the corresponding basitarsus. Aedeagus 0.8 times length of middle tibia.

MATERIAL EXAMINED: Described from numerous specimens, reared from the melon aphid, *Aphis gossypii* Glover, and the pomegranate aphid, *Aphis punicae* Passerini (Aphidoidea: Aphididae) in Israel.

Holotype, ♀, Israel: ex *Aphis gossypii* Glover on cotton, Coastal Plain, Bet-Dagan, 20.IV.1987 (Department of Entomology, Hebrew University, Faculty of Agriculture, Rehovot [HUAR]).

Paratypes, Israel: same data as holotype (4♀♀, 9♂♂) (British Museum, Natural History), London; National Museum of Natural History, Washington, D.C.; Israeli National Insect Collection, Tel-Aviv University; all other specimens are deposited in HUAR). Same host on *Hibiscus rosa-sinensis*, Rehovot (Coastal Plain), IX.1982 (1♀); same, XI.1983 (2♂♂); same, I.1984 (1♂); same host on apple, Mesilat Zion (Judean Hills), VI.1984 (2♀♀, 2♂♂); ex *Aphis punicae* Passerini on pomegranate, Mata (Judean Hills), VI.1975 (1♀); same host and host plant, Bet Dagan, V.1983 (2♀♀, 6♂♂); same, V.1984 (3♀♀); same host and host plant, Safed (Upper Galilee), IV.1987 (2♂♂).

Additional collections: ex *Aphis epilobiaria* Theobald on *Epilobium hirsutum*, Abu Ghosh (Judean Hills), XI.1975 (1♀, 2♂♂); same, XII.1976 (4♀♀); ex *Aphis fabae* Scopoli on Chenopodiaceae, Hula, V.1975 (2♀♀, 1♂); ex *Aphis hederae* Kaltenbach on *Hedera helix*, Jerusalem, XII.1975 (1♀); ex *Aphis ruborum* (Börner) on *Rubus sanctus*, Kfar Liman (Coastal Plain), VIII.1976 (1♂); ex *Aphis ziziphi* Theobald on *Ziziphus spina-christi*, Migdal (Kinneret Valley), V.1975 (1♀); ex *Myzus persicae* (Sulzer) on *Erodium* sp., Rehovot (Coastal Plain), II.1976 (1♀).

Morphologic differences between Aphelinus paramali and A. mali: When live specimens are compared, *A. mali* appears larger and generally darker than *A. paramali*. In cleared specimens, the color of the third gastral segment is yellow as the preceding segments in *paramali*, whereas in *mali* it is black as the following segments (Fig. 12). This difference in coloration was consistent throughout the year. In all microscopic slides of *paramali*, gastral segments 5-7 overlap to a much greater extent than in *mali*, although the sclerites seem to be of the same relative length. This appears to be the case also in live insects. Consequently, the yellow band at the base of the gaster appears much larger in *paramali*. The ovipositor complex is elongate in *mali* (in resting position, length:width = 5 and 1.5 times longer than the middle tibia), short in *paramali* (length:width = 3 and subequal to the middle tibia). Presumably, the shorter ovipositor of *paramali* enables the gastral segments to telescope more deeply one into the other than in *mali*. Both the absolute and relative dimensions of the ovipositor are hardly dependent on body size for a wide range of body lengths (Fig. 13). There is no overlap of these dimensions, making it a clear-cut differentiation between the two species.

The 3rd funicular segment of the female is elongate in *paramali*, subquadrate in *mali*; in the male, this segment is twice as long as wide in *paramali*, 1.5 times in *mali*. The mid-tibial spur of the female is shorter than the corresponding basitarsus in *paramali*, subequal in length in *mali*. The male aedeagus is shorter than the middle tibia in *paramali*, subequal in *mali*.

NOTES ON SOME BIOLOGICAL DIFFERENCES

Sexual isolation: This was examined for the two members of the *mali* group present in Israel, *A. mali* and *A. paramali*. Intraspecific courtship was found to be quite similar in these two species. Reciprocal interspecific courtship was observed for 96 pairs; 42 cases progressed to the stage of the male examining the female with his antennae. Of these, in only 3 cases did the male (*A. paramali*) mount the heterospecific female's back. His stay upon her — average 44 sec — was much longer than the conspecific average of 11.3 sec for *A. paramali*, 13.4 sec for *A. mali*. On these few occasions, the males attempted to copulate but the females terminated the courtship by a quick run. Successful copulation did not take place also when interspecific couples were confined in a petri dish for 24 h, as was verified by examining the spermathecae of the females.

Host preference: In 10 trials each with *A. paramali* and *A. mali*, the females never examined the typical aphid host of the other species (*Eriosoma lanigerum* and *Aphis gossypii*, respectively). The wasps moved very quickly over the aphid colony and left it after a few minutes. After occasional encounters with *E. lanigerum*, females of *A. paramali* were usually engaged for a while in cleaning their antennae and legs. *A. mali* females confined

with *A. gossypii* colonies for 24 h neither oviposited in nor host-fed upon these aphids, whereas with *E. lanigerum* oviposition and host feeding took place immediately.

CONCLUDING REMARKS

Aphelinus mali was introduced and successfully established in Israel in 1935 (Bodenheimer, 1947). *A. paramali*, on the other hand, is apparently indigenous to Israel. It was found in most non-desert regions of the country, all year round and on different vegetation types – annuals, bushes and trees, attacking both polyphagous and host-specific aphids, totalling at present 8 definite host species. In addition, *Aphelinus* specimens reared ex *Toxoptera aurantii* (Boyer) on citrus, recorded by Rosen (1967) as *A. mali*, apparently were *A. paramali*. Specimens reared from various hosts, at various altitudes and in various seasons were remarkably consistent in coloration.

As pointed out by Michel (1969), records of *A. mali* from non-typical hosts in various parts of the world may be referable to other, perhaps undescribed, members of the *mali* group.

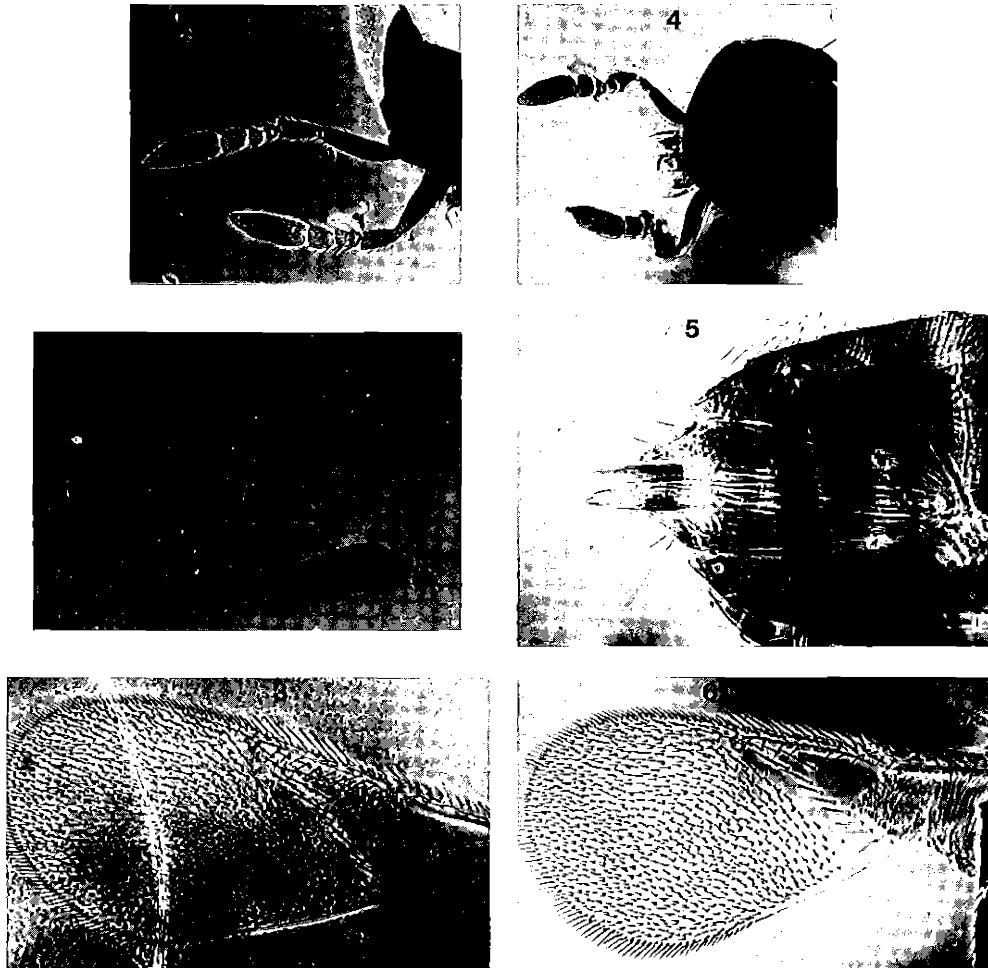
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REFERENCES

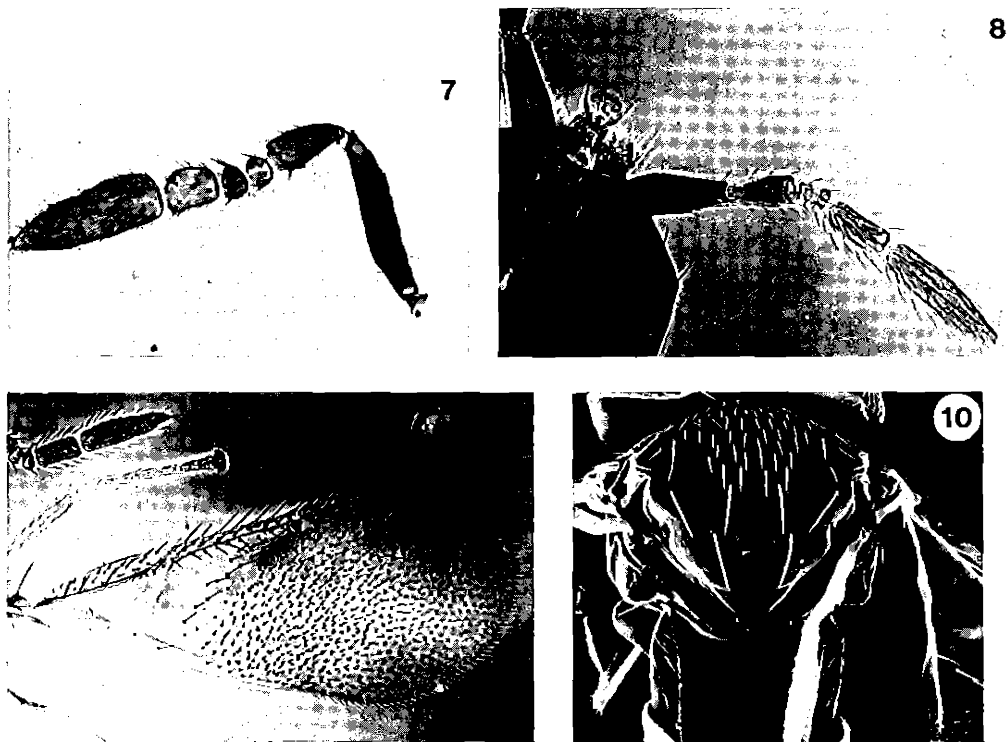
- Bodenheimer, F.S. 1947. Studies on the physical ecology of the woolly apple aphid (*Eriosoma lanigerum*) and its parasite *Aphelinus mali* in Palestine. *Agricultural Research Station, Rehovot Bulletin* 41, 20 pp.
- Carver, M. 1980. A new species of *Aphelinus* Dalman (Hymenoptera: Chalcidoidea: Encyrtidae). *Proceedings of the Entomological Society of Washington* 82:536-540.
- Clausen, C.P. 1978. Introduced Parasites and Predators of Arthropod Pests and Weeds: a World Review. Agriculture Handbook 480, USDA, Washington, D.C., 545 pp.
- De Santis, L. 1948. Estudio monográfico de los Aphelinidos de la Republica Argentina (Hymenoptera, Chalcidoidea). *Revista del Museo de La Plata (N.S.)* 5 (Zool.):103-112.
- Gordh, G. 1979. Chalcidoidea. Pages 890-967 in: Catalog of Hymenoptera in America North of Mexico (K.V. Krombein, P.D. Hurd Jr., D.R. Smith & B.D. Burks, ed.). Smithsonian Institution Press, Washington.
- Haldeman, S.S. 1851. *Eriophilus*. *Pennsylvania Farm Journal* 1:130-131.
- Hayat, M. 1986. Family Aphelinidae. Pages 143-171 in: The Chalcidoidea (Insecta: Hymenoptera) of India and the Adjacent Countries (B.R. Subba Rao & M. Hayat, ed.). Part II. A Catalogue of Chalcidoidea of India and the Adjacent Countries. *Oriental Insects*, Vol. 20.
- Howard, L.O. 1929. *Aphelinus mali* and its travels. *Annals of the Entomological Society of America* 22:341-368.
- Jasnosh, V.A. 1963. New species of the genus *Aphelinus* Dalm. (Hymenoptera, Chalcidoidea) in the fauna of the USSR. *Entomologicheskoye Obozreniye* 42:178-185 (in Russian; English translation: *Entomological Review* 42:98-101).
- Michel, M.F. 1969. Contribution à l'étude des Aphelinidae aphidiphage et de leurs hôtes en France (Hymn. Chalcidoidea). *Entomophaga* 14:439-446.

- Peck, O. 1963. A Catalog of the Nearctic Chalcidoidea (Insecta: Hymenoptera). *Canadian Entomologist, Supplement* 30:1092 pp.
- Rosen, D. 1967. The hymenopterous parasites and hyperparasites of aphids on citrus in Israel. *Annals of the Entomological Society of America* 60:394-399.
- Timberlake, P.H. 1924. Description of new chalcid-flies from Hawaii and Mexico (Hymenoptera). *Proceedings of the Hawaiian Entomological Society* 3:395-449.



Figs. 1-3: *Aphelinus mali* (Haldeman). 1. ♀: antennae; 2. ♂: antenna; 3. ♀: fore wing.

Figs. 4-6: *Aphelinus gossypii* Timberlake. 4. ♀: antennae; 5. ♀: gaster and ovipositor; 6. ♂: fore wing.



Figs. 7-10: *Aphelinus paramali* n.sp. 7. ♀: antenna; 8. ♂: antenna; 9. ♂: fore wing; 10. ♂: thorax (SEM micrograph).

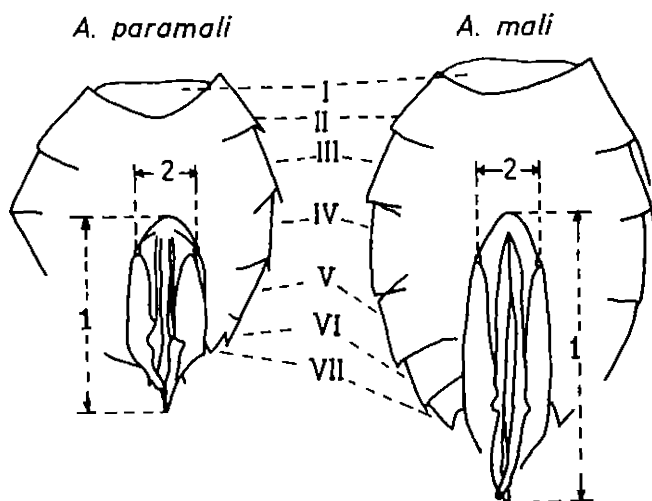


Fig. 11. Comparison of ovipositor complex of *Aphelinus paramali* and *A. mali*. 1,2 – length and width of complex, respectively as measured for Figs. 5,12,13.



Fig. 12. Gaster of *Aphelinus paramali* (A) and *A. mali* (B).

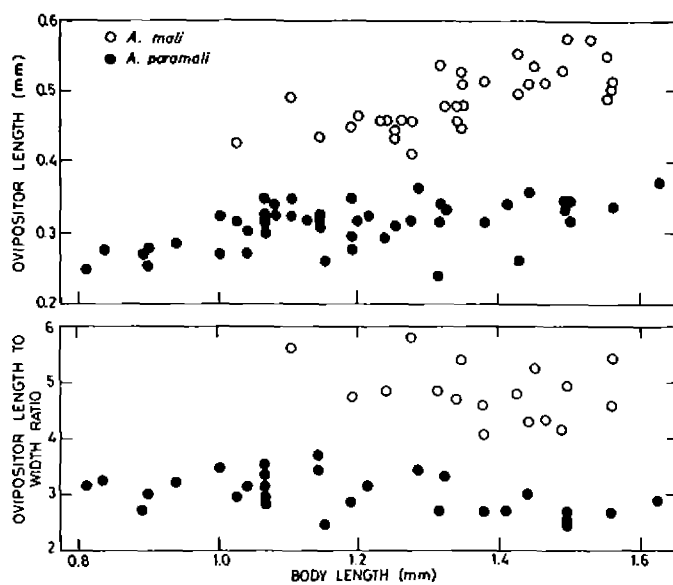


Fig. 13. Length of ovipositor complex and length-to-width ratio as related to body length of *Aphelinus paramali* and *A. mali*.