



A new species of *Hexacladia* Ashmead (Hymenoptera, Encyrtidae) and new record of *Hexacladia smithii* Ashmead as parasitoids of *Dichelops furcatus* (Fabricius) (Hemiptera, Pentatomidae) in Argentina

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Abstract

Pentatomid adults of the species *Dichelops furcatus* (F.), collected on stubble of soybean, *Glycine max* (Linnaeus) Merrill, in Santa Fe province of Argentina, were found parasitized by two encyrtid wasp species (Hymenoptera: Encyrtidae). One of the encyrtids is described as *Hexacladia dichelopsis* Torr ns & Fidalgo, **sp. n.**, from both sexes, and the other species *H. smithii* Ashmead, is recorded for the first time from *D. furcatus* in Argentina. Both species are gregarious endoparasitoids which carry out the whole development (larval and pupal) in their living hosts; they emerge as imagoes, by cutting their way out through the dorsal wall of the abdomen. Including the newly described *H. dichelopsis*, seven species of the genus are recorded from South America, and an identification key to separate them is presented.

Keywords

Hexacladia, new species, parasitoids, *Dichelops furcatus*

Introduction

Members of the genus *Hexacladia* Ashmead are gregarious parasitoids of the late nymphs or adult stages of Pentatomidae, Coreidae, Pyrrhocoridae and Scutelleridae (Hemiptera) (Burks 1972, Noyes 2010), emerging from the living host. *Hexacladia* is unique amongst Encyrtidae in having a relatively slender, distinct petiole; the very high placement of the antennae, a dome-like scutellum, characteristic infuscation and setation of the fore wing and branched antenna of the males makes the genus very easy to recognize (Noyes 2010).

Six species of *Hexacladia* have been recorded from South America: *H. blanchardi* De Santis (Argentina and Brazil), *H. linci* Rasplus (Peru), *H. smithii* Ashmead (Argentina, Brazil and Venezuela), *H. townsendi* (Crawford) (Peru, Ecuador and Venezuela), *H. supina* Noyes (Ecuador), *H. impiros* Noyes (Ecuador and Peru) (De Santis 1963, 1979, 1980, De Santis and Fidalgo 1994, Rasplus et al. 1990, Noyes 2010, 2017). *H. smithii* is the species with many hosts mentioned in the literature, and also the most widely distributed being found in Argentina, Brazil, Costa Rica, M xico, Nicaragua, Puerto Rico, Trinidad and Tobago, USA and Venezuela (Gordh 1979, Noyes 2010, 2017).

Dichelops furcatus (F.) known as “chinche furcada” or “chinche de los cuernos” is considered a corn pest because it injects toxins into the stem during feeding. These toxins damage the vigor of the seedlings producing a detention of its growth, malformations in some cases and even death by intense attacks in the most susceptible stages (Canale and Ferreira 2013). *D. furcatus* has been recorded as the primary host of two encyrtids, *Ooencyrtus submetallicus* (Noyes 2010), and *Hexacladia smithii* in Southern Brazil (Panizzi and Da Silva 2010).

Herein we describe *Hexacladia dichelopsis* sp. n. and provide a key to separate the seven species of *Hexacladia* now known from South America. We also present a new record of *H. smithii* as parasitoid of *D. furcatus* in Argentina.

Methods

Both species of *Hexacladia* emerged from diapausing adults of *D. furcatus* on soybean stubble. The material was collected in the Experimental field J. Villarino of the Faculty of Agronomic Sciences in Zavalla, province of Santa Fe (Argentina). The collection date was August 2015, March and May 2016. In total, 33 females and 2 males of *H. dichelopsis* sp. n. and 4 females and 4 males of *H. smithii* were collected. The material was preserved in alcohol and then mounted; some of them were slide-mounted in Canada balsam.

For morphological terms and species identification we followed Burks (1972), Noyes (2010) and Cuezzo and Fidalgo (1997). The abbreviations used are: Fn = flagellar segment n; LOL = shortest distance between posterior ocellus and anterior ocellus in frontal view, OOL = shortest distance between posterior ocellus and eye margin in dorsal view and POL = shortest distance between posterior ocelli in dorsal view.

Specimens are deposited in the Instituto Fundación Miguel Lillo, Tucumán, Argentina (IFML); Museo Argentino de Ciencias Naturales ‘Bernardino Rivadavia’, Buenos Aires, Argentina (MACN); and the Entomology collection of CRILAR, Anillaco, La Rioja (CRILAR-En).

Results

Key to the South American species of *Hexacladia* Ashmead (modified from Burks 1972)

- 1 Male; funicular segments of antenna with branches (Fig. 9).....2
- Female; funicular segments of antenna without branches (Fig. 10)5
- 2 Fore wings comparatively short, 1.3× as long as mesosoma (Figs 1, 2)3
- Fore wings normally developed, nearly 2.5× as long as mesosoma (Figs 11, 12).....4
- 3 Fore wings with marginal fringe uneven, largely or completely absent.....
..... ***linci* Rasplus**
- Fore wings with marginal fringe present and complete except perhaps for a short strip immediately distad of apex of venation or towards anal angle (Fig. 7).....***dichelopsis* sp. n.**
- 4 Branch of F6 extremely short, 0.1× length of segment itself. Female unknown***blanchardi* De Santis**
- Branch of F6 at least as long as segment itself***smithii* Ashmead**
- 5 Fore wings comparatively short, 1.3× as long as mesosoma6
- Fore wings normally developed, nearly 2.5× as long as mesosoma.....7
- 6 Fore wings with marginal fringe uneven, largely or completely absent.....
..... ***linci* Rasplus**
- Fore wings with marginal fringe present and complete except perhaps for a short strip immediately distad of apex of venation or towards anal angle (Fig. 8).....***dichelopsis* sp. n.**
- 7 Fore wings with marginal fringe uneven, largely or completely absent.....8
- Fore wings with marginal fringe present and complete except perhaps for a short strip immediately distad of apex of venation or towards anal angle.....9
- 8 Costal cell of fore wing dorsally naked, or virtually so; with at most only one seta ventrally. Male unknown..... ***supina* Noyes**
- Costal cell of fore wing with up to 9 setae dorsally and 7 ventrally.....
.....***smithii* Ashmead**
- 9 Each lateral projection of hypopygium broadened, flattened and rounded apically, paddle-like. Male unknown ***impiros* Noyes**
- Hypopygium apically with a pair of long, curved lateral processes either side of a deep, median invagination. Male unknown..... ***townsendi* (Crawford)**

***Hexacladia dichelopsis* Torrén & Fidalgo, sp. n.**

<http://zoobank.org/83FD4672-A94D-437C-8F6E-68F4673E84E6>

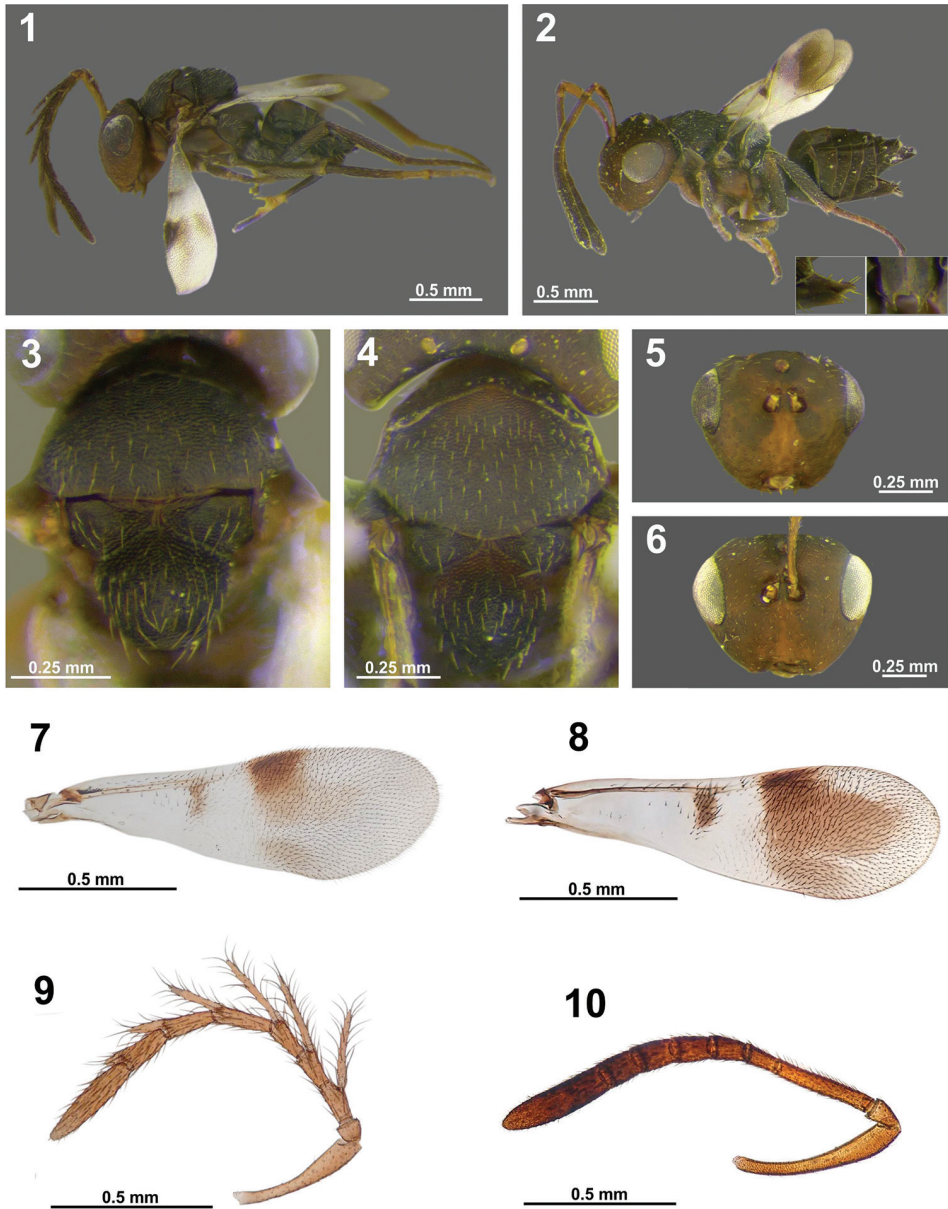
Figs 1–10

Diagnosis. Distinguished from other species by the following combination of characters: general body color dark brown to black (Figs 1, 2); small wings, fore wing 1.3× as long as length of mesosoma (Figs 1, 2); female with costal cell with four or five setae, distal third of the upper margin without marginal setae, dark areas of the wing disc well evident; male with costal cell with abundant setae (25 to 27), basal third with eight to nine setae, distal third of the upper margin with marginal setae and dark areas of the wing disc poorly defined; male with F7 2.0× as long as F6, branch of F6 0.5× length of F6.

Description. Female (holotype): length, 2.3mm. General body color dark brown to black dorsally, being paler toward head, scape and pedicel, axilla, metanotum, apex of tibiae and tarsi, propodeum and base of first tergite of gaster; entire body lighter ventrally, femora and metasoma slightly darker than the rest; setae on dorsum of mesosoma translucent (Figs 2, 6). Wings largely hyaline, but fore wing with two brown areas, the first and smaller behind base of parastigma, with about 40 strong dark brown setae, the distal area is most extensive, begins behind marginal vein and occupies most of wing apex, alar disc between the two brown areas with light setae (Fig 8).

Head 1.3× as broad as high. POL 2.1× LOL; POL 1.3× OOL. Head with fine, raised, imbricate-reticulate sculpture, well-marked and moderately deep on frons and vertex, and slightly marked and irregular on face and gena; anterior ocellus connected to toruli by a shallow groove; interantennal area narrow and smooth; frontovertex and face with inconspicuous, decumbent setae, each slightly shorter than diameter of anterior ocellus (Fig. 6). Eyes separated by 1.7× their height. Malar space 0.9× height of eye. Antenna 9-segmented, flagellar segments cylindrical. Flagellum 1.6× as long as head height; length of F1 0.6× length of scape, and 2.8× as long as broad; clava 3.4× as long as broad. Antenna (Fig. 10) apically with slightly curved setae in all segments, more dense on funicle; funicle with linear sensilla only on F3–F6 (Fig. 10).

Mesosoma with fine, raised, polygonally-reticulate to imbricate-reticulate sculpture on mesoscutum (Figs 2, 4). Pronotum with small and decumbent setae, head overlapping the pronotum. Mesoscutum 1.7× as broad as long, with small and decumbent setae (Fig. 4). Scutellum 1.1× as long as maximum width; axilla and scutellum with coarse reticulate sculpture slightly deeper than that on mesoscutum, and with semi-erect and longer setae than the mesoscutum; scutellum humped, strongly and fairly evenly curved in profile (Fig. 4); propodeum with a group of about 11–14 setae outside spiracle. Fore wing 3.1× as long as broad, costal cell with seven or eight setae dorsally, lineae calvae broad and open posteriorly, basal cell with five to eight setae, submarginal vein with 11 bristle-like setae, postmarginal vein slightly shorter than stigmal vein, marginal fringe present, stigmal vein without uncus and with three or four placoid sensilla; hind wing 3.7× as long as broad.



Figures 1–10. *Hexacladia dichelopsis* sp. n.: **1** habitus (male) **2** habitus (female) (magnified apex of hypopygium, lateral and ventral view) **3** mesosoma (male, dorsal) **4** mesosoma (female, dorsal) **5** head (male, frontal) **6** head (female, frontal) **7** fore wing (male, lateral) **8** fore wing (female, lateral) **9** antenna (male, lateral) **10** antenna (female, lateral).

Metasoma 1.5× as long as broad. Hypopygium very nearly reaching apex of metasoma; apically with a pair of short lateral processes either side of a wide, shallow, median invagination; with about 6 hypopygial hairs (Fig. 2). Ovipositor not observed.

Variation. The length of the female varies between 2.2–2.6 mm. The coloration in some specimens are darker than holotype, otherwise very little variation in material examined.

Male. Similar to female except for following: The length of the male varies 1.7–1.9 mm. General body color and head darker than female (Figs 1, 3, 5), fore wing with areas paler, with costal cell with abundant setae (25 to 27), basal third with eight to nine setae, stigmal vein with four or five placoid sensilla (Fig. 7) ; antenna with funicle segments longer than broad and with a elongate dorsal branch (Fig. 9); F1 a little longer than F2 and F3; F4 longer than F5 and F6; F7 is the longest flagellomere; branch of F1 2.0× as long as F1 and as long as F1 and F2 together; branch of F6 0.5× length of F6. Length:width of the antennal segments in the following relationship: scape (48:7), pedicel (9:8), F1 and branch of F1 (14:5 and 29:3), F2 and branch of F2 (13:5 and 31: 2,5), F3 and branch of F3 (13:5 and 30:2), F4 and branch of F4 (19:5 and 20:2), F5 and branch of F5 (16:5 and 14:2), F6 and branch of F6 (16:6 and 9:2), F7 (35:7).

Material examined. Holotype ♀: ARGENTINA, Santa F , Zavalla, Campo experimental Villarino, Fac. Cs. Agrarias, 2.v.2016., E. Punschke, ex. diapausing adult of *Dichelops furcatus* on soybean stubble (MACN). Paratypes (11 ♀♀ and 23 ♂♂): same locality as holotype, 2.viii.2015 (MACN, 11 ♀ and 2 ♂), 2.v.2016 (IFML, 11♀♀, IFML; CRILAR-En, 10 ♀♀).

***Hexacladia smithii* Ashmead, 1891**

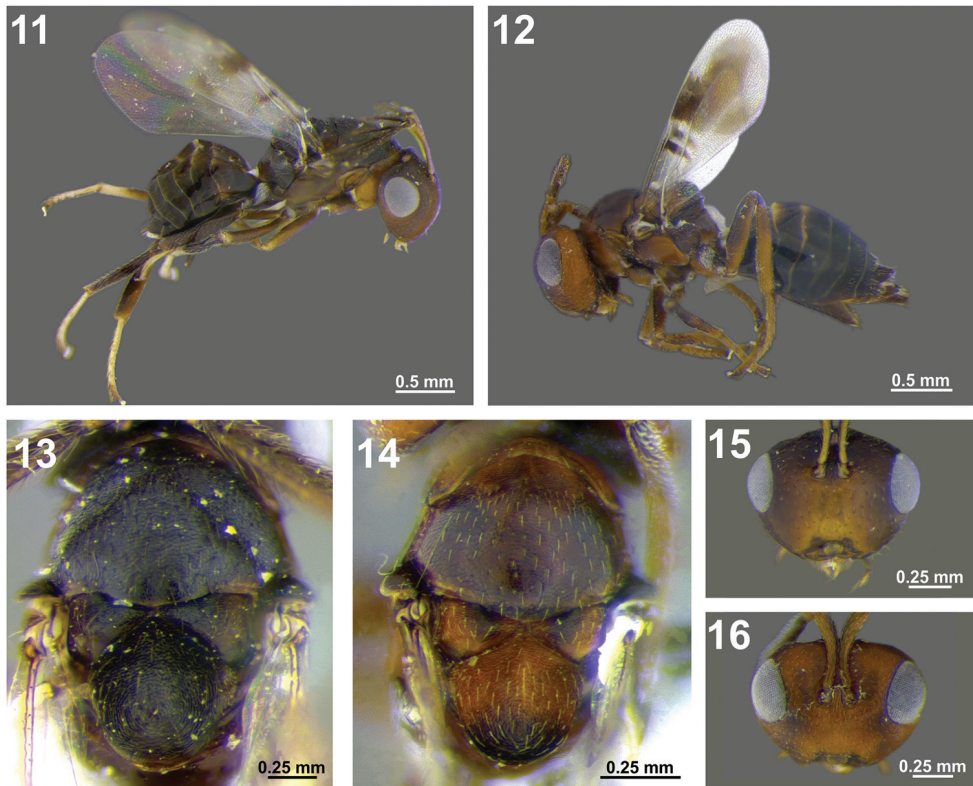
Figs 11–16

Hexacladia smithii Ashmead, 1891:457, lectotype designated by Burks (1972).

Hexacladia mexicana Girault, 1917, lectotype designated by Cuezzo and Fidalgo (1997). Synonymized under *smithii* by Cuezzo and Fidalgo (1997).

Diagnosis. Distinguished from other species by the following combination of characters: female with general body color and head mostly dark, reddish brown (Figs 12, 14, 16); presence of subapically curved and slightly flattened setae dorsally on F1; fore wing fully developed, reaching apex of gaster, with marginal fringe absent, dark areas of the wing disc well evident; costal cell dorsally with fewer than 10 setae and ventrally with at least 2 or 3; hypopygium apically with a pair of short lateral processes either side of wide, shallow, median invagination. Male similar to female but body color mostly dark brown (Figs 11, 13, 15); antenna with all funicle segments branched, branch of F6 at least as long as segment itself; fore wing with marginal fringe present, although occasionally slightly reduced.

Material examined. ARGENTINA, Santa F , Zavalla, Campo experimental Villarino, Fac. Cs. Agrarias, 2.viii.2015, E. Punschke, ex. diapausing adult of *Dichelops furcatus* on soybean stubble (CRILAR-En, 1♀ and 1♂; MACN, 1♀ and 1♂; IFML, 2♀♀ and 2♂♂). ARGENTINA, Tucum n, S. M. de Tucum n, 3.v.1993, P. Fidalgo (IFML, 1♀).



Figures 11–16. *Hexacladia smithii*: **11** habitus (male) **12** habitus (female) **13** mesosoma (male, dorsal) **14** mesosoma (female, dorsal) **15** head (male, frontal) **16** head (female, frontal).

Discussion

Hexacladia dichelopsis sp. n. differs from *H. linci* (morphologically the closest species) in: general body color dark brown to black, including head; funicle including clava and scape dark brown (versus general body color brown, pleura yellowish to brown, yellowish face and funicle, the first two flagellomeres and scape dorsally darker, apex of clava black); antenna of the female with F1 as long as following three segments, with slightly curved setae (versus F1 almost as long as following four segments, with straight setae), antenna of the male with branch of F6 0.5× length of F6 (branch of F6 as long as F6 or longer than the flagellomere); fore wing with continuous marginal fringe (versus absent or discontinuous marginal fringe), basal third of wings with setae present (versus basal third of wings without setae). Following the description of Rasplus et al. (1990) the shape of distal margin of hypopygium is similar in both species. What about shape of distal margin of hypopygium.

Two species were previously recorded from Argentina, *Hexacladia smithii* and *H. blanchardi*; *H. dichelopsis* differ from *H. smithii* mainly by its coloration, length and setation of fore wing. While the male differ from that of *H. blanchardi* in: antenna of

male with branch of F1 two times longer than the F1 and branch of F6 0.5× length of the F6 (versus branch of F1 11 to 12 times longer than F1 and branch of F6 rudimentary); F7 two times longer than F6 (versus F7 1.2× longer than F6); fore wings 1.1–1.2 mm, reaching half of metasoma (versus 1.9 mm, reaching to the apex of metasoma); basal third of wings with eight to nine setae (versus basal third of wings densely setose).

Concerning the parasitoidism data, it was not possible to separate the parasitoidism of both species; there were few occasions when the host were found so the rate of parasitoidism is only an estimation and correspond to both species combined: five to eight adults per diapausing *Dichelops furcatus* emerged and reached up to 10% during 2015 and up to 7.5% in 2016. The development from collection of parasitized host to emergency of adult parasitoids took approximately 30 days.

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