Journal of Nematology 45(2):106–111. 2013.


# *Deladenus cocophilus* n. sp. (Nematoda: Hexatylina): A Mycetophagous and Entomoparasitic Nematode in Infested Coconut Fruits from Balochistan, Pakistan

K. Nasira, F. Shahina, K. Firoza

*Abstract: Deladenus cocophilus* n. sp. was isolated from infested coconut fruits in Winder, Balochistan, Pakistan. Descriptions are given of the entomophagous (insect-parasitic females) and mycetophagous (fungus-feeding) free-living females, males, and juveniles. The new species *D. cocophilus* resembles those species in which the excretory pore is situated anterior to the hemizonid, namely, *D. apopkaetus* Chitambar, 1991; *D. leptosoma* Gagarin, 2001; *D. ipini* Massey, 1974; *D. laricis* (Blinova and Korentchenko, 1986) Ebsarry, 1991; *D.* (*siricidicola*) *canii* Bedding, 1974; *D.* (*s*) *imperialis* Bedding, 1974; *D. nevexii* Bedding, 1974; *D.* (*wilsoni*) *proximus* Bedding, 1974; *D.* (*s*) *rudyi* Bedding, 1974; *D.* (*s*) *siricidicola* Bedding, 1968; *D.* (*wilsoni*) *wilsoni* Bedding, 1968 and *D. minimus* Chizhov and Sturhan, 1998. The new species differs from *D. ipini* in the absence of a post uterine sac vs. present; a = 17 to 30 vs. 35 to 40; stylet = 8 to 10 vs. 11 to 12 μm and vulva-anus = 21 to 28 vs. 35 to 48 μm. From *D. apopkaetus* it differs in tail length in female 22 to 28 vs. 31 to 43 μm and in the male it is 24 to 32 vs. 30 to 46 μm. It differs from *D. leptosoma* in the c ratio in females, c = 21 to 37 vs. 16 to 22, presence of 6 lines in lateral field vs. 10 lines and slightly longer spicules 16 to 18 vs. 15 to 16 μm. From *D. laricis* it differs in a shorter stylet length 8 to 10 vs. 11 to 12 μm; in the c ratio in males 16 to 22 vs. 22 to 35 and hemizonid from anterior end 76 to 90 vs. 90 to 119 μm. It also differs from the following species: *D.* (*siricidicola*) *canii*; *D.* (*s*) *imperialis*; *D. nevexii; D.* (*wilsoni*) *proximus*; *D.* (*s*) *rudyi*; *D.* (*s*) *siricidicola*; *D.* (*wilsoni*) *wilsoni* and *D. minimus* in having shorter tail length, lower values of a,b,c ratios and a slightly anteriorly located vulva in females.

*Key words:* coconut, *Deladenus cocophilus*, Hexatylina, morphology, Nematoda, new species, Pakistan, taxonomy.

Thorne erected the genus *Deladenus* in 1941 to accommodate those species not possessing a valvular median oesophageal bulb. He differentiated *Deladenus* from other genera by the location of oesophageal-intestinal junction immediately behind the nerve ring. Two generations, entomoparasitic and free–living mycetophagous, were reported by Bedding (1967). Blinova and Korenchenko (1986) erected the genus *Beddingia* for the species with known free-living and insect parasitic forms under the family Phaenopsitylenchidae. The genus *Deladenus* was transferred to the family Allantonematidae by Fortuner and Raski (1987). The genus *Beddingia* is a junior synonym of *Deladenus* by Chitambar (1991). Presently there are 22 recognized species that are widely distributed and described from different regions of the world (Chizhov and Sturhan, 1998; Andrassy, 2007). The genus is characterized by the cephalic framework eight-sectored, dorsal oesophageal gland large, and subventral glands reduced. Bursa and gubernaculum are present. The free-living generation feeds on fungi. The parasitic generation lives in the haemocoel of Hymenoptera of Siricidae and Ichneumonidae (Andrassy, 2007).

During a survey of plant parasitic nematodes, specimens of an undescribed species belonging to the genus *Deladenus* Thorne, 1941 were encountered from coconut fruit from the vicinity of Winder, Balochistan, Pakistan. Detail examination revealed the presence of a number of mycetophagous nematodes including females, males, and juveniles as well as infective females, which were identified as *D. cocophilus* n. sp. and is described and illustrated herein. *D. pakistanensis* is the only reported species of the genus *Deladenus* in Pakistan (Shahina & Maqbool, 1992).

## Materials and Methods

Specimens were recovered from infected coconut fruits by Cobb's sieving and decanting method followed by modified Baermann funnel method (Southey, 1986). The nematodes were gently heat killed, fixed in TAF, transferred to glycerin solution, allowed to dehydrate (Seinhorst, 1959), and permanently mounted in anhydrous glycerin. Observations of all nematode specimens were made using a light microscope. Measurements and illustrations were made using camera lucida attachment. For still photomicrography DS-L2 camera was used. Identification was made according to Siddiqi (2000).

## Description

*Deladenus cocophilus* n. sp.

(Fig. 1, A–G; Fig. 2, A–H; Fig. 3, A–G)

*Measurements:* Morphometrics of the holotype, paratype, mycetophagous females, males, and infective females of *Deladenus* species are given in Table 1.

*Comparative data:* Comparative data of morphometrics of *Deladenus* species having excretory pore anterior to hemizonid, taken from the original descriptions, is given in Table 2.

*Mycetophagous female:* Body varied from vermiform, cylindrical to robust, swollen in young to old female, respectively. Cuticle finely annulated, annules 0.62 to 1.25 μm at midbody. Lip region low, hemispherical, lateral field with narrow band 5 to 8 μm wide, with six incisures occupying about one-third of the body width. Stylet basal knobs 2.4 μm wide × 0.8 to 1.6 μm high, stylet shaft

Received for publication January 10, 2013.
National Nematological Research Centre, University of Karachi, Karachi-75270, Pakistan.
Email: shahinafayyaz@gmail.com
This paper was edited by David Shapiro-Ilan.

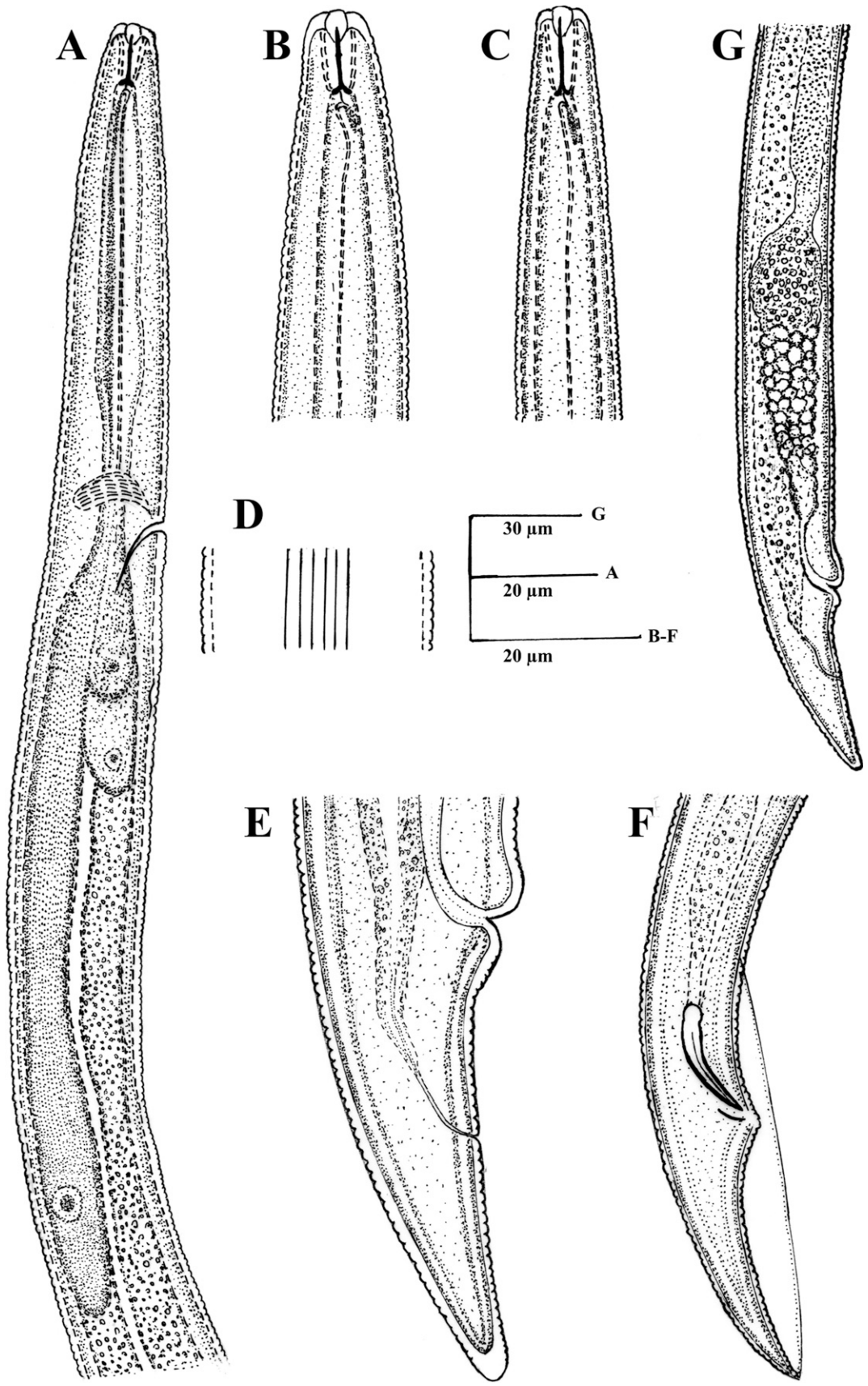


FIG. 1. *Deladenus cocophilus* n. sp.: A. Oesophageal region of mycetophagous female. B. Anterior region of mycetophagous female. C. Anterior region of mycetophagous male. D. Lateral field at mid body. E. Posterior region of mycetophagous female. F. Posterior region of mycetophagous male. G. Part of female gonad.

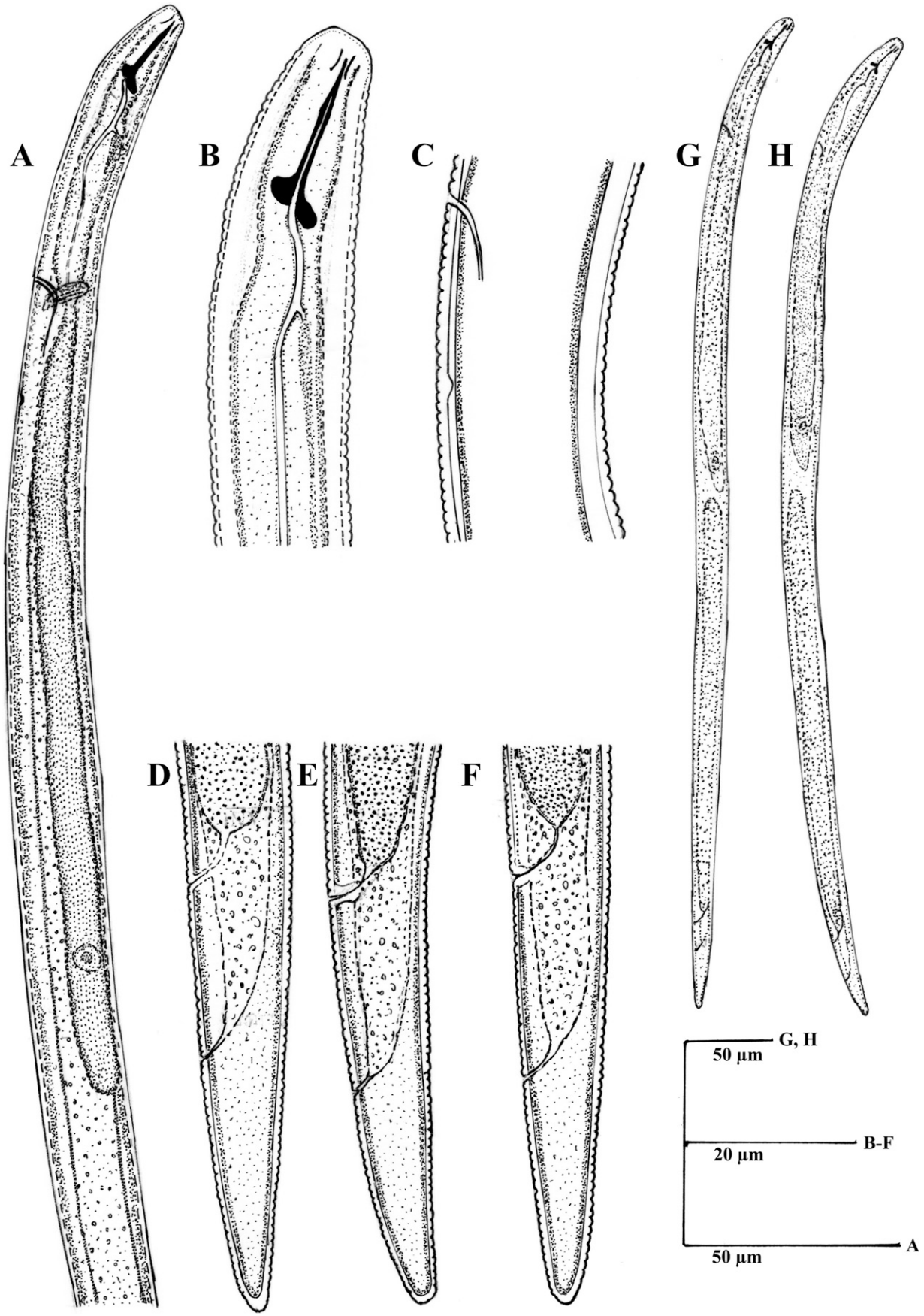


Fig. 2. *Deladenus cocophilus* n. sp. Infective female: A. Oesophageal region. B. Anterior region. C. Excretory pore and hemizonid. D–F. Posterior region. G–H. Whole body.

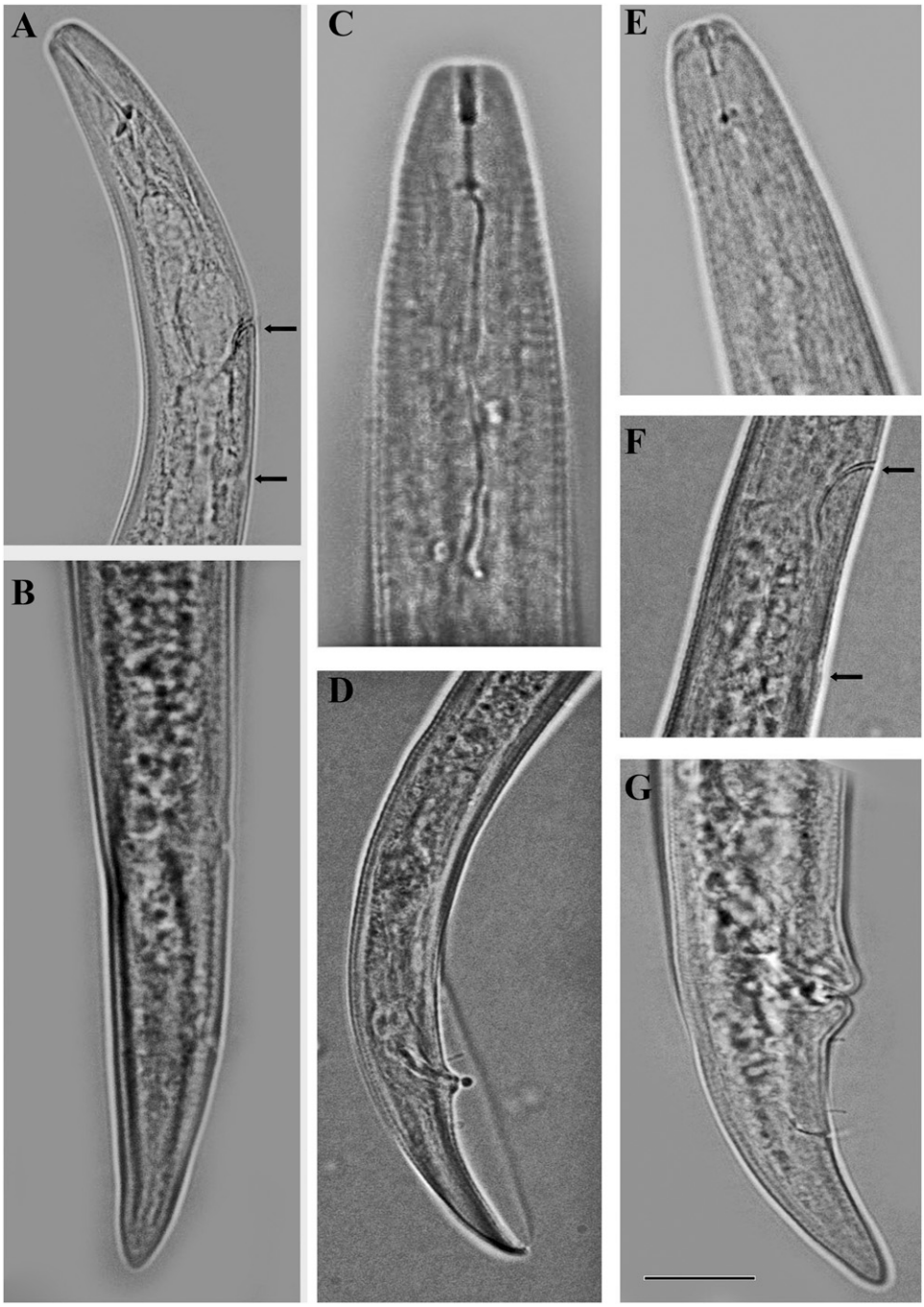


Fig. 3. Light micrographs of *Deladenus cocophilus* n. sp.: A. Anterior region of infective female arrow showing excretory pore and hemizonid. B. Posterior region of infective female. C. Anterior region of mycetophagous male. D. Posterior region of mycetophagous male. E. Anterior region of mycetophagous female. F. Female showing excretory pore and hemizonid. G. Posterior region of mycetophagous female. (Scale: A–G = 20 μm.)

slightly longer (4.8 μm) than spear cone (4 μm). The opening of the dorsal oesophageal gland is 0.8 to 1.2 μm behind the stylet base. Oesophagus corpus cylindrical, slightly swollen in midregion, median chamber absent. Oesophageal glands overlapping anterior end of intestine, subventral glands reduced, dorsal oesophageal gland elongate, gland nuclei distinct. Excretory pore sclerotized, present at 65.6 to 84 μm from the anterior end. Hemizonid 13.6 to 29 μm posterior to excretory pore, 3 to 5 μm long, posterior to nerve ring. Nerve ring 61.6 to 80.8 μm from anterior end. Ovary outstretched, oocytes arranged in a single row, vulval lips protuberant with sharply posterior constriction of the body. Vagina short muscular oblique, thick-walled. Post uterine sac absent. Tail conoid with narrowly rounded terminus, length equal to vulva-anus distance.

*Male:* Similar to female, slightly smaller; nerve ring 72 to 92 μm from anterior end. Excretory pore 60 to 74 μm

TABLE 1. Morphometrics of mycetophagous females, males, and infective females of *Deladenus cocophilus* n. sp. (Measurements are in μm except L).

| Measurements | Mycetophagous females (n = 20) | | Mycetophagous males (n = 11) | | Infective females (n = 11) |
|---|---|---|---|---|---|
| | Holotype | Paratype Mean ± SD (range) | Allotype | Paratype Mean ± SD (range) | Mean ± SD (range) |
| L | 0.74 | 0.74 ± 0.1 (0.55-0.93) | 0.56 | 0.55 ± 0.05 (0.5-0.6) | 0.57 ± 0.03 (0.5-0.6) |
| a | 28.3 | 24.3 ± 4.3 (16.6-30) | 31.8 | 33.5 ± 3.4 (26-38.8) | 30.0 ± 2.3 (27-33.5) |
| b | 3.6 | 5.1 ± 1.85 (4.1-11.3) | 3.7 | 3.9 ± 0.39 (3.5-4) | 2.0 ± 0.54 (1.9-2.5) |
| c | 26.6 | 28.1 ± 4.3 (21-32.7) | 18.9 | 19.6 ± 2.0 (16.6-22.6) | 21.3 ± 3.1 (16-27.9) |
| c' | 2.0 | 2.3 ± 0.3 (1.6-3.5) | 2.4 | 2.4 ± 0.29 (2.1-3.1) | 2.7 ± 0.36 (2.1-3.0) |
| V | 93.1 | 92.8 ± 0.92 (90.3-94.4) | – | – | 91.6 ± 0.84 (90-92.4) |
| Stylet | 9.6 | 8.9 ± 0.53 (8-10) | 8.8 | 19.3 ± 0.50 (8.8-10) | 20.2 ± 1.46 (19-21.6) |
| Excretory pore from ant. end | 77.6 | 75.4 ± 5.3 (65.6-84) | 68 | 65.0 ± 4.2 (60-74) | 71.9 ± 1.82 (68.8-73.6) |
| Hemizonid from ant. end | 87.6 | 101.1 ± 10.3 (77.6-109.6) | 77.6 | 83.0 ± 4.56 (76.5-90.4) | 89.0 ± 3.93 (83-94) |
| Excretory pore to hemizonid | 24.8 | 24.6 ± 5.45 (13.6-29) | 19.2 | 19.7 ± 2.0 (16-22.2) | 18.3 ± 3.26 (16-24) |
| Body width | 28.8 | 27.4 ± 5.1 (21.6-38.4) | 14.4 | 16.3 ± 4.2 (13.8-22) | 19.1 ± 1.59 (15-21) |
| Nerve ring from ant. end | 74.4 | 71.7 ± 5.47 (61.6-80.8) | 83 | 80.2 ± 6.3 (72-92) | 80.5 ± 7.2 (60-90) |
| Tail length | 25.6 | 24.6 ± 6.0 (22.4-28) | 30 | 28.2 ± 2.1 (24-32) | 23.2 ± 6.39 (20-28) |
| Anal body width | 12 | 11.2 ± 1.22 (9.6-13.6) | 12.8 | 11.69 ± 0.96 (11-13) | 9.4 ± 13.6 (8-12.6) |
| Vulva-anus distance | 25 | 24.6 ± 2.23 (21.6-28) | – | – | 22.5 ± 2.0 (19-26) |
| Body width at vulva | 24 | 23.2 ± 2.47 (19-27.2) | – | – | 12.6 ± 1.53 (9-15) |
| Body width at stylet base | 11 | 10.35 ± 1.03 (9-14) | 9 | 8.65±0.67 (8-10) | 13.6 ± 0.78 (13-15) |
| Vulva to posterior end | 45 | 45±3.6 (41-53.6) | – | – | 45 ± 3.6 (41-53.6) |
| G%/T% | 71.6 | 71.7 ± 12.2 (52.1-92.9) | 45 | 53 ± 13.5 (32-73.8) | 41.1 ± 6.0 (34-53) |
| Spicules | – | – | 16 | 16.4 ± 0.84 (16-18) | – |
| Gubernaculum | – | – | 5.6 | 4.7 ± 0.66 (4.0-5.6) | – |

from anterior end and located anterior to nerve ring. Hemizonid 3 to 4 μm long, 16 to 22.2 μm posterior to excretory pore. Testis outstretched, reaching beyond posterior end of oesophageal gland. Spicules and gubernaculum typically tylenchoid. Bursa smooth, terminal, extending from approximately 20 to 22 μm anterior of spicules to the tail terminus.

*Infective female:* Body cylindrical 0.5 to 0.6 μm long, 15 to 21 μm wide, cuticle with transverse striae about 1.2-μm wide at midbody. Lateral field occupying 20% to 40% of body width, with six incisure. Lips appear fused; amphid pouch larger than those of mycetophygous female. Stylet 19 to 22 μm long, with large distinct basal knobs at base, 6 to 7 μm and 2 to 3 μm high, very different from that of mycetophagous female and male, dorsal gland orifice more posterior 10 to 12 μm from the base of stylet knobs. Excretory pore and hemizonid 16 to 24 μm apart. Corpus cylindrical. Isthmus short and broad, dorsal oesophageal gland finely granular, extending posteriorly to ovary, dorsal gland nucleus prominent. Nerve ring 60 to 90 μm from anterior end. Vulva a narrow transverse slit, lip barely protuberant, ovary prodelphic oviduct normally packed with small spermatozoa (0.8 to 1 μm) occupying about half of the body length. Tail conoid, rectum narrow and straight.

*Larvae:* Stylet (8.8 to 9.6 μm) similar with that of mycetophagous female and male; hemizonid and excretory pore well-separated.

*Differential diagnosis: Deladenus cocophilus* n. sp. is similar to those species in which the excretory pore is situated anterior to hemizonid viz., *D. apopkaetus* Chitambar, 1991; *D. leptosoma* Gagarin, 2001; *D. ipini* Massey, 1974; *D. laricis* (Blinova and Korentchenko, 1986) Ebsarry, 1991; *D.* (*siricidicola*) *canii* Bedding, 1974; *D.* (*s*) *imperialis* Bedding, 1974; *D. nevexii* Bedding, 1974; *D.* (*wilsoni*) *proximus* Bedding, 1974; *D.* (*s*) *rudyi* Bedding, 1974; *D.* (*s*) *siricidicola* Bedding, 1968; *D.* (*wilsoni*) *wilsoni* Bedding, 1968; and *D. minimus* Chizhov and Sturhan, 1998. It differs from *D. ipini* in the absence of post uterine sac vs. present; a = 17 to 30 μm vs. 35 to 40μm; stylet = 8 to 10 μm vs. 11 to 12 μm; and vulva-anus = 21 to 28 μm vs. 35 to 48 μm. From *D. apopkaetus* it differs in tail length in female 22.4 to 28 μm vs. 31 to 43 μm and in male it is 24 to 32 μm vs. 30 to 46 μm.

It differs from *D. leptosoma* in c ratio in female, c = 21 to 37 vs. 16 to 22; in the presence of 6 lines in lateral field vs. 10 lines; and in slightly longer spicules 16 to 18 vs. 15 to 16 μm. It differs from *D. laricis* in shorter stylet length, 8 to 10 vs. 11 to 12 μm; in male c ratio 16 to 22 vs. 22 to 35; and in hemizonid from anterior end 76 to 90 μm vs. 90 to 119 μm. It also differs from the following species, namely, *D.*(*siricidicola*) *canii*; *D.*(*s*) *imperialis*; *D. nevexii; D.*(*wilsoni*) *proximus*; *D.*(*s*) *rudyi*; *D.*(*s*) *siricidicola*; *D.*(*wilsoni*) *wilsoni* and *D. minimus* in having shorter tail length, lower values of a,b,c ratios, and slightly anteriorly located vulva in females (Table 2).

*Type host and locality:* Specimens of all stages of both the life cycles (mycetophagous or free-living cycle and parasitic cycle) were recovered from infected coconut (*Cocos nucifera* L.) fruits from Winder, Balochistan, Pakistan.

*Type specimens:* Holotype (female) slide no. NNRC 120/1 and paratype slide no. NNRC 120/2-25 (50 females, 40 males, 17 juveniles, and 16 infective females) are deposited in the National Nematode Collection of NNRC, University of Karachi, Karachi-75270, Pakistan. Three

TABLE 2. Comparative data of morphometrics of *Deladenus* Thorne, 1941 species having excretory pore anterior to hemizonid.

| Measurements | Mycetophagous females | | | | | | | Mycetophagous male | | Infective female |
|---|---|---|---|---|---|---|---|---|---|---|
| | L | a | b | c | V% | Stylet | TL | L | Spicules | L |
| *D. apophkaetus* Chitambar, 1991 | 0.61-0.84 | 21-24 | 6.4-10 | 16.5-24.8 | 90-93 | 8.7-13.5 | 31-43 | 0.50-0.76 | 14-22 | – |
| *D. leptosoma* Gagarin, 2001 | 0.60-0.94 | 23-43 | 8.4-10.8 | 16.6-22.5 | 90.7-92.6 | 8-9 | – | 0.61-0.87 | 15-16 | – |
| *D. ipini* Massey, 1974 | 0.89-1.08 | 35-40 | 10.4-15.2 | 29.6-38.8 | 92-93 | 11.6-12 | 24-32 | 0.63 | 14 | – |
| *D. laricis* (Blinova and Korentchenko, 1986) Ebsarry, 1991 | 0.50-1.03 | 17-37 | – | 20-41 | 90-94 | 8-12 | – | 0.57-0.93 | 14-18 | – |
| *D.* (*siricidicola*) *canii* Bedding, 1974 | 1.61-2.39 | 47.9-62 | 14.8-22.5 | 41.7-54.4 | 94.5-95.8 | 8.5-10 | 33-64 | 1.30-1.64 | 16-19 | 0.91-1.37 |
| *D.* (*s*) *imperialis* Bedding, 1974 | 1.18-2.13 | 40.4-62.5 | 12.5-23.2 | 31.1-66.5 | 93.5-95 | 8-10 | 32-51 | 1.11-1.75 | 13-19 | 1.01-1.39 |
| *D. newexi* Bedding, 1974 | 1.42-1.98 | 31.5-47.3 | 14.2-17.5 | 38-45 | 93.7-95.2 | 9-10 | 36-47 | 1.03-1.83 | 16-22 | 0.89-1.22 |
| *D.* (*wilsoni*) *proximus* Bedding, 1974 | 1.75-2.2 | 40-53.7 | 16.3-21.3 | 44-60 | 95.1-95.9 | 11-12 | 31-47 | 1.34-1.59 | 24-38 | 1.17-1.37 |
| *D.* (*s*) *rudyi* Bedding, 1974 | 1.46-1.98 | 43.6-56.7 | 15.5-21.1 | 41.1-60.0 | 94.6-96.1 | 8-9 | 27-36 | 1.25-1.72 | 15-19 | 0.88-1.25 |
| *D.* (*s*) *siricidicola* Bedding, 1968 | 1.50-2.71 | 33-69.1 | 15.2-26.6 | 32.6-58.9 | 93.2-96.2 | 10-11 | 45.4 | 1.15-1.92 | – | 0.80-1.60 |
| *D.* (*wilsoni*) *wilsoni* Bedding, 1968 | 1.49-2.7 | 34.6-62.6 | 15.5-26.5 | 46.6-66.9 | 94.6-96.2 | 10-11 | 39.7 | 1.29-2.02 | 19-23 | 0.88-1.74 |
| *D. minimus* Chizhov and Sturhan, 1998 | – | – | – | – | – | – | – | 0.34-0.48 | 10-14 | 0.33-0.51 |
| *D. cocophilus* n. sp. | 0.5-0.9 | 16.6-30 | 4-11 | 21-32 | 90-94 | 8-10 | 22-28 | 0.5-0.68 | 14-18 | 0.55-0.61 |

females, three males, and three infected females on slide no. 120/26-28 deposited in the USDA Nematode Collection (USDANC) at Beltsville, MD. Two females, two males, and two infected females deposited in the Zoology Museum, Ghent University, Ghent, Belgium (slide no.120/29-31).

## LITERATURE CITED


Andrassy, I. 2007. Free-living nematodes of the Hungary (Nematoda errentia), vol. 2. Budapest: Hungarian Natural History Museum and Systematic Zoology Research Group of the Hungarian Academy of Science.

Bedding, R. A. 1967. Parasitic and free-living cycles in entomogenous nematodes of genus *Deladenus*. Nature 214:174–175.

Bedding, R. A. 1968. *Deladenus wilsoni* n. sp. and *D. siricidicola* n. sp. (Neotylenchidae), entomophagous-mycetophagous nematodes parasitic in siricid woodwasps. Nematologica 14:515–525.

Bedding, R. A. 1974. Five new species of *Deladenus* (Neotylenchidae), entomophagous-mycetophagous nematodes parasitic in siricid woodwasps. Nematologica 20:204–225.

Blinova, S. L., and Korentchenko, E. A. 1986. [*Phaenopsitylenchus laricis* n.g., n. sp. (Nematoda: Phaenopsitylenchidae n. fam.)—parasite of *Phaenops guttulata* and notes on the taxonomy of nematodes of the superfamily Sphaerularioidea.]. Trudy Gel'mintologicheskoi Laboratorii (Voprosy biotsenologii gel'mintov) 34:4–23.

Chitambar, J. J. 1991. On the genus *Deladenus* Thorne, 1941 (Nemata: Allantonematidae). Review of the mycetophagous stage. Revue de Nematologie 14:427–444.

Chizhov, V. N., and Sturhan, D. 1998. Description of *Deladenus minimus* sp. n. (Tylenchida: Phaenopsitylenchidae) an entomogenous nematode from Germany. Russian Journal of Nematology 6:1–4.

Ebsary, B. A. 1991. Catalog of the Order Tylenchida (Nematoda). Agriculture Canada, Research Branch, Publication 1869/B. Ottawa, Canada: Agriculture Canada.

Fortuner, R., and Raski, D. J. 1987. A review of Neotylenchoidea Thorne, 1941 (Nemata: Tylenchida). Revue de Nematologie 10:257–267.

Gagarin, V. G. 2001. [*Neoditylenchus vipriensis* sp. n. and *Deladenus leptosoma* sp. n. (Nematoda: Tylenchida) from goat manure in Borok of Yaroslavi oblast (Central Russia). Zoologicheskii Zhurnal 80:1268–1272.

Massey, C. L. 1974. Biology and taxonomy of nematode parasites and associates of bark beetles in the United States. Agriculture Handbook Forest Service, USDA No. 446.

Seinhorst, J. W. 1959. A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. Nematologica 4:67–69.

Shahina, F., and Maqbool, M. A. 1992. Description of *Deladenus pakistanensis* n. sp., (Nematoda: Tylenchida) from Pakistan. Pakistan Journal of Nematology 10:1–6.

Siddiqi, M. R. 2000. Tylenchida: Parasites of Plants and Insects. 2nd ed. Wallingford, UK: CAB International.

Southey, J. F. 1986. Laboratory methods for work with plant and soil nematodes. Technical Bulletin No. 2. Ministry of Agriculture, Fish & Food. London: HMSO.

Thorne, G. 1941. Some nematodes of family Tylenchidae that do not possess a valvular median oesophageal bulb. Great Basin Naturalist 2:37–85.