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A key and diagnostic compendium to the species of the genus *Merlinius* Siddiqi, 1970 (Nematoda: Tylenchida) with description of *Merlinius khuzdarensis* n. sp. associated with date palm

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Summary – An identification key to 32 valid species of stunt nematodes (*Merlinius* spp.) is given. A compendium of the most important diagnostic characters for use in identification of species is included as a practical alternative and supplement to the key. The diagnosis of *Merlinius* is emended and a list of all valid species of the genus is given. The characters most useful for separating species include body and stylet lengths, shape of head, tail and tail terminus, number of head and tail annules, position of vulva (V), and c′ ratio in females. Also useful are length and shape of spicules and gubernacula in males. A new stunt nematode, *Merlinius khuzdarensis* n. sp., from the rhizosphere of date palm (*Phoenix dactylifera* L.) from Khuzdar, Balochistan Province, Pakistan, is described and illustrated. This new species resembles *M. bavaricus*, *M. communicus*, *M. bilqeesae* and *M. montanus*, but differs from these species by the following: body and stylet length, shape of head, tail and tail terminus, number of head and tail annules, and position of phasmids. Because this species is limited in distribution, its economic importance in date palm and other cultivated crops within the region is not known.

Keywords – Balochistan, identification, Khuzdar, morphology, morphometrics, stunt nematodes, taxonomy.

The genus *Merlinius* was established by Siddiqi (1970) to accommodate those forms previously in *Tylenchorhynchus* that have six incisures in the lateral field, a small trough-shaped nonprotrusible gubernaculum, and stout spicules with distal ends notched and without large ventral flanges. Tarjan (1973) gave a valuable synopsis, key and diagnostic data of the genera and species of Tylenchorhynchinae, and discussed some of Siddiqi's characters. Tarjan (1973) agreed with Siddiqi (1970) that the six-incisure character is consistent and easily recognisable and that establishment of *Merlinius* made the unwieldy genus *Tylenchorhynchus* less cumbersome, and *Merlinius*, therefore, justifiable. The present authors agree with both Siddiqi (1970) and Tarjan (1973) because their action makes it easier to handle this complex and large group of nematodes. At present *Merlinius* comprises 32 valid species of worldwide distribution that parasitise a wide variety of plants.

The history of *Merlinius* was discussed by Hooper (1978). Fortuner and Luc (1987) included *Merlinius* in the subfamily Telotylenchinae in the family Belonolaimidae. In a review of species of agriculturally important *Tylenchorhynchus*, *Merlinius* and *Amplimerlinius*, Anderson and Potter (1991) also presented a good historical background of stunt nematode taxonomy. Brzeski (1998) included all species of *Merlinius* in *Geocenamus* and gave a key to only 19 species and a compendium for 77 species. However, he concluded that the genus *Geocenamus* may be a collective group that could be split into separate genera, but additional investigations, including scanning electron microscope studies of cephalic structure, were needed for more of the species before any action could be taken.

A number of taxonomic changes to stunt nematodes were proposed by different workers (Siddiqi, 1979, 1986, 2000; Baldwin & Bell, 1981; Lewis & Golden, 1981; Sturhan, 1981; Anderson & Ebsary, 1982; Jairajpuri, 1982; Mulk & Siddiqi, 1982; Powers *et al*., 1983; Jairajpuri & Hunt, 1984; Skwiercz, 1984; Fortuner & Luc, 1987; Golden *et al*., 1987; Maqbool & Shahina, 1987;

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Mahajan, 1988; Rey & Mahajan, 1988; Esser, 1991; Brzeski & Dolinski, 1998; Handoo, 2000). As a result of these changes, compilation and development of a dichotomous key to species of *Merlinius* have become increasingly difficult. Many of the species included in *Merlinius* have been placed in new genera by different workers, and several species within other related genera have been either shifted or synonymised by several workers. The most important character used in distinguishing these genera is the number of lines, ranging from three to six, in the lateral field. In the present study *Merlinius* is defined as containing only those species with six lines in the lateral field.

The objectives of this study were: *i*) to describe a new species of *Merlinius* found in soil around roots of date palm from Balochistan, Pakistan; *ii*) to examine in detail representative specimens and publish data on *Merlinius* species; *iii*) to determine the interrelationships of the species and to define the valid and most significant differentiating characters; and *iv*) to prepare a new key and compendium containing morphometric and related details to facilitate easy identification of 32 valid *Merlinius* species.

Materials and methods

Paratype specimens of seven species (*M. brevidens* (Allen, 1955) Siddiqi, 1970, *M. acuminatus* Minagwa, 1985, *M. adakensis* Bernard, 1984, *M. khuzdarensis* n. sp., *M. montanus* Maqbool & Shahina, 1987; *M. processus* Siddiqi, 1979) and non-type specimens of four other species were examined from the USDA Nematode Collection at Beltsville, MD, USA. These specimens were either mounted in glycerin or were preserved in 3% formaldehyde and 2% glycerin solution in vials, which ranged in number from one to 25, and were accompanied by pertinent records. Examinations were made with a compound light microscope usually at highest magnifications, and morphometric data were obtained with an eyepiece micrometer. In evaluation of the species, our own data and the original descriptions of most species, as well as any subsequent re-description or other related data, were utilised for the arrangement of the compendium included in Table 1.

Specimens of the new species of *Merlinius* were obtained from soil around roots of date palm from Khuzdar, Balochistan Province, Pakistan and were extracted from soil by sieving and Baermann funnel extraction, killed by gentle heat, fixed in TAF, then transferred to solution containing traces of picric acid and allowed to dehydrate before being mounted in glycerin on permanent slides for observation and measurements (Hooper, 1986). Line drawings were made with the help of a drawing tube attached to the microscope and photomicrographs of specimens were made with a 35 mm camera attached to a compound microscope where measurements were made with an ocular micrometer.

Genus *Merlinius* Siddiqi, 1970

EMENDED DIAGNOSIS (AFTER SIDDIQI, 2000)

Merliniinae. Usually under 1 mm long (except *M. adakensis* Bernard, 1984, *M. graminicola* (Kirjanova, 1951) Siddiqi, 1976 and *M. productus* (Thorne, 1949) Sher, 1974), straight to arcuate upon relaxation. Body cuticle lacking longitudinal striae or grooves; lateral field with six incisures, normally not areolated posterior to pharyngeal region. Deirids distinct, in four-incisure region of lateral field. Cephalic region continuous or slightly set off, not bulbous; annules broken by six radial grooves; perioral disc indistinct, hexagonal, not well demarcated from surrounding labial area; submedian sectors wider than lateral sectors bearing amphidial apertures located posterior to border of oral plate. Stylet usually under 20 μm long (except *M. adakensis* where it is 34 (32-36) μm long). Vulva closed, slit-like; epiptygma indistinct. Female tail conoid to subcylindrical, pointed or occasionally with a mucro. Spicules cylindroid, straight to slightly arcuate, tip blunt to notched. Gubernaculum crescent-shaped in lateral view.

TYPE SPECIES

Merlinius brevidens (Allen, 1955) Siddiqi, 1970
= *Tylenchorhynchus brevidens* Allen, 1955
= *Geocenamus brevidens* (Allen, 1955) Brzeski, 1991

OTHER VALID SPECIES*

M. acuminatus Minagawa, 1985
M. adakensis Bernard, 1984
M. alboranensis (Tobar Jiménez, 1970) Tarjan, 1973
M. bavaricus (Sturhan, 1966) Siddiqi, 1970
M. bijnorensis Khan, 1971
M. bilqeesae Khan & Khan, 1995
M. bogdanovikatjkovi (Kirjanova, 1941) Siddiqi, 1970
M. capitonis Ivanova, 1983

* Synonymy as in Siddiqi (2000).

Table 1. *Diagnostic data on species of* Merlinius.

Species	L (mm)	a	b	c	V	Lip region[1]	Lip annules	Stylet (μm)	Tail annules	Tail shape[2]	Tail terminus[3]	Tail tip[4]	c′	Spicule (μm)	Gub (μm)
acuminatus	0.63 ± 0.39 (0.56-0.72)	26.7 ± 1.5 (23.7-29.5)	5.6 ± 0.3 (4.9-6.4)	12.4 ± 1.1 (10.1-14.4)	54.7 ± 1.1 (52.6-56.7)	OFF	5-8	13.2 ± 0.4 (12.7-14.0)	42-79	CON	FR, POINT	SMO	3.2 ± 0.5 (2.3-4.4)	22.8 ± 1.8 (20.0-26.7)	7.8 ± 0.7 (6.7-9.7)
adakensis	1.13 ± 0.94 (0.96-1.28)	32.8 ± 2.4 (27-37)	6.2 ± 0.4 (5.5-6.8)	12.5 ± 1.0 (10.6-14.2)	54 ± 1.5 (51-58)	OFF	6-8	34 ± 1.3 (32-36)	54 (49-68)	SCYL	BR	SMO	3.6 ± 0.3 (3.1-4.1)	33 (30-35)	8 (7-10)
alboranensis	0.45 ± 0.01 (0.43-0.47)	26.4 (24.6-29.6)	4.9 (4.5-5.3)	13.8 (12.4-15.1)	59.3 (57.7-60.5)	OFF	6	11	26-33	SCYL	SHEM	SMO	2.4-2.8	18.4 (16.9-20.4)	6.3 (5.4-7.3)
bavaricus	0.75	28	5.2	13	57	CNT	4	21	49-52	SCYL	SHEM	SMO	2.9	–	–
bijnorensis	0.63 (0.56-0.71)	29.5 (25-34)	4.4 (4.0-4.8)	13.2 (11.0-15.5)	55.7 (54.5-57.0)	CNT	5	20 (19-20)	32-37	SCYL	HEM	SMO	–	23 (21-25)	9 (8-10)
bilqeesae	0.57 ± 1.37 (0.5-0.6)	23 ± 0.26 (22-25)	5 ± 0.02 (4.9-5.1)	7.2 ± 0.13 (6.9-8.9)	55.9 ± 0.02 (55.9-56.0)	–	–	13.8 ± 0.34 (13.5-14.5)		SCYL	RND	SMO	3.5 ± 0.07 (3.2-4.4)	23.6 ± 0.22 (22.5-25.0)	
bogdanovikatjkovi	0.63 (0.58-0.70)	23-27	4-5	13-14	54-58	OFF	7-9	21-23	47	SCYL	HEM	ANN	2.8	–	–
brevidens	0.54-0.69	23-27	4.2-5.2	11-13	52-58	CON	5-7	14-16	42-66	SCYL, CON	HEM	SMO	2.8	15	10
capitonis	0.76 (0.68-0.81)	31.9 (29-36)	6.4 (5.6-7.5)	16.1 (14.3-18)	56.5 (52-59)	OFF	6-7	10.1 (9.6-12)	40-55	CON	BR	SMO	2.7 (2.5-3.3)	22	7.5
circellus	0.52-0.65	26-32	5.4-5.5	8-8.5	54	CON	3	9-10	72 (70-77)	CON	POINT	SMO	5.6-6.3	21	7
communicus	0.57-0.58	34-36	4.3-4.6	10-14.2	55-59	CON	5-6	15.6-17	25-30	CON	RND	SMO	3.1-3.8	18-20	10-12
gatevi	0.77-0.95	25-32	5-6.3	14.7-17.5	53.5-57.0	OFF	6	23-24	21-24	SCYL	RND	SMO	2.3-2.6	21.5-22.4	8.7-9.5
graminicola	1.02	40-42	6-7	15-18	51-52	CON	6	25-28	28-29	CON	BLP	SMO	3.1-3.7	22-24	7
indicus	0.55 ± 0.03 (0.51-0.58)	31.5 ± 3.2 (27.2-36.2)	5.3 ± 0.34 (4.8-5.7)	14.3 ± 1.21 (12.4-15.5)	56.6 ± 1.73 (54.7-59.3)	OFF	3-5	13.2 ± 0.69 (12.0-13.6)	40-50	SCYL	RND	ANN	3 ± 0.16 (2.8-3.4)	–	–
joctus	0.64 ± 0.03 (0.61-0.67)	29.7 ± 0.58 (29-30)	4.8 ± 0.10 (4.7-4.9)	10.3 ± 0.30 (10-10.6)	54.8 ± 0.21 (54.6-55)	OFF	7-9	16.3 ± 0.8 (15.5-17.0)	56-69	CON	BLP, IND	SMO, IND	4.2 ± 0.2 (4.0-4.4)	23 (22-25)	8 (7-9)
khuzdarensis n. sp.	0.79 ± 0.04 (0.73-0.87)	34.7 ± 1.6 (32-37)	5.9 ± 0.2 (5.6-6.2)	14.5 ± 0.7 (14-15)	56.4 ± 1.3 (53-59)	OFF	5	21 ± 0.62 (20-22)	26 (27-32)	SCYL	RND	SMO	3.1 ± 0.25 (2.8-3.6)	–	–
loofi	0.53 (0.51-0.55)	34 (32-38)	5.3 (5.1-5.6)	9 (8.4-9.7)	51.5 (49.6-52.7)	CON-OFF	6-7	9 (9-10)	50-60	CON	POINT	SMO	5.4 (5.2-5.7)	22	-

Table 1. *(Continued.)*

Species	L (mm)	a	b	c	V	Lip region[1]	Lip annules	Stylet (μm)	Tail annules	Tail shape[2]	Tail terminus[3]	Tail tip[4]	c′	Spicule (μm)	Gub (μm)
microdorus	0.58-0.70	24-28.5	4.8-5.9	10.8-13.3	54.5-58.5	OFF	4-6	12.5-14.5	53-54	SCYL	BLP	SMO	2.5-3.0	20-21.5	7-7.5
mollicephalus	0.43-0.53	18-27.3	4.7-7.4	8.6-10.1	-	-	6	21.0-23.1	64	CON	BLR	ANN	3.3-4.2	–	–
montanus	0.5 ± 0.03 (0.45-0.56)	22.3 ± 1.09 (21.2-24.4)	4.6 ± 0.35 (4.1-5.3)	11.3 ± 0.45 (10.7-12.1)	57 ± 1.77 (55-60)	CON	5-6	12 ± 1.25 (11-13)	44 (38-46)	CON	RND	SMO	2.8 ± 0.11 (2.7-3)	16 ± 1.37 (16-20)	8 ± 0.70 (6.5-8)
nanus	0.52-0.64	27-31	4.5-5.3	10-12	52-57	CON	7	11.2-12.0	55-60	CON	BLP	ANN	3.8	23	8
niazae	0.85 (0.75-0.92)	29.3 (27-33)	6.6 (6.1-7.1)	14.5 (12.2-17)	53 (51-56)	OFF	5-6	15 (14-16)	45-52	SCYL	TR	ANN	2.6-3	–	–
nothus	0.55-0.70	24-30	4-5.1	10-11	53-57	CON	6	16-18	55-60	CON	SHEM	ANN	3	–	–
pistaciei	0.66 ± 0.02 (0.63-0.68)	31.5 ± 1.1 (30-33.7)	5.3 ± 0.1 (5.3-5.4)	11.5	55.6 ± 1.07 (55-56.9)	CON	5	13.3 ± 0.24 (13.0-13.5)	90-95	SCYL	TR	SMO	3.6 ± 0.8 (3.6-3.8)	20.5	7.5
planitierus	0.80-0.94	25-35	4.6-6.0	15-21	55-59	CON-NAR	5-7	19-21	32	CYL-RND	-	ANN	1.9-2.2	–	–
plerorbus	0.58 (0.54-0.63)	26 (24-29)	4.4 (4-4.8)	12 (11-13)	55.5 (54-58)	–	–	16 (15.0-17.5)	38-40	CON	RND	SMO	3.3 (2.8-3.8)	20	7
processus	56 (0.50-0.63)	30 (27-35)	5 (4.6-5.5)	11.5 (10.2-13.0)	55.5 (54-58)	OFF	7-8	16 (15.0-17.5)	54 (46-58)	CON	SPOINT to	SMO FR, MUC	3.6 (3.2-4.1)	23.5 (22-25)	7.8 (7-9)
productus	1.2	25	7.1	17	53	CON	4-5	12	67	CON	POINT, AC	SMO	3.2	21	9
pseudobavaricus	0.68-0.71	26-30	5-5.4	14-16	54-56	CON-OFF	5-7	21-23	56-64	SCYL	SHEM	ANN	2.8-3.4	26-28	9-11
pyri	0.65-0.66	26.5-30	5.2-5.5	14.8-20.6	54-54.3	CON	5	14-15	70	SCYL	TR	SMO	2.3-2.7	20	6
tetylus	0.8	30	5.3	8.2	48	NAR	6-7	14	100	CON	FIL, POINT	SMO	4.9	24	6
tortilis	0.48-0.54	24.3-4.8	4.8-4.9	8.9-9.3	52-54	OFF	4-5	19.5	45	CON	BLP	SMO	4.2	–	–

Compendium based on female characters plus male spicule and gubernaculum length.

[1] CNT = continuous; CON = conoid; OFF = offset; NAR = narrow.

[2] CON = conoid; CYL = cylindrical; RND = rounded; SCYL = subcylindrical.

[3] AC = acute; BLP = bluntly pointed; BR = broadly rounded; FIL = filiform; FR = finely rounded; HEM = hemispherical; IND = indented; MUC = mucro; POINT = pointed; RND = round; SHEM = subhemispherical; SPOINT = sharply pointed; TR = truncate.

[4] ANN = annulated; IND = indented; SMO = smooth.

M. circellus Anderson & Ebsary, 1982
M. communicus Sultan, Singh & Sakhuja, 1989
M. gatevi Budurova, 1988
M. graminicola (Kirjanova, 1951) Siddiqi, 1976
M. indicus Zarina & Maqbool, 1995
M. joctus (Thorne, 1949) Sher, 1974
M. khuzdarensis n. sp.
M. loofi Siddiqi, 1979
M. microdorus (Geraert, 1966) Siddiqi, 1970
M. mollicephalus Eroshenko & Volkova, 1988
M. montanus Maqbool & Shahina, 1987
M. nanus (Allen, 1955) Siddiqi, 1970
M. niazae Maqbool, Fatima & Hashmi, 1983
M. nothus (Allen, 1955) Siddiqi, 1970
M. pistaciei Fatema & Farooq, 1992
M. planitierus Eroshenko, 1984
M. plerorbus Anderson & Ebsary, 1982
M. processus Siddiqi, 1979
M. productus (Thorne, 1949) Sher, 1974
M. pseudobavaricus Saltukoglu, Geraert & Coomans, 1976
M. pyri Fatema & Farooq, 1992
M. tetylus Anderson & Ebsary, 1982
M. tortilis Kazachenko, 1980

Identification of *Merlinius* species

The key is based on the overall morphology of females, and males. In the present paper, 32 species (including one new species) are included in *Merlinius* on the basis of commonly shared characters. The measurements of most of the examined specimens closely fit the original description and any subsequent re-descriptions of species. Some of the variations noted in certain populations of species were incorporated into the morphometric compendium (Table 1). This key is significant because it provides an all-inclusive guide to identifications and it works well with all the valid 32 *Merlinius* spp., including the specimens of this genus deposited in the USDA Nematode Collection (Handoo *et al*., 1998).

In many *Merlinius* species the known range of variation is limited to observation of specimens in single populations from the type locality. Further morphological studies, including SEM, of specimens from a broader spectrum of habitats is needed to clarify further the relationships and identities of many species.

Key to species

1 – Stylet < 18 μm 2
– Stylet > 19 μm 22
2 – Tail terminus smooth 3
– Tail terminus annulated 19
3 – Tail conoid with rounded to bluntly rounded, acute, filiform or pointed to bluntly pointed terminus . . . 4
– Tail subcylindrical with rounded to hemispherical, subhemispherical, truncate or bluntly pointed terminus 14
4 – Stylet < 13.5 μm 5
Stylet > 14 μm 10
5 – Lip region with 3 annules; tail > 70 annules with a pointed terminus . . . . . *M. circellus*
– Lip region with > 4 annules; tail < 70 annules with rounded, acute or pointed terminus 6
6 – L > 1 mm . . . . . *M. productus*
– L < 1 mm 7
7 – Lip region continuous; vulva at 50-60% 8
– Lip region set off; vulva at 52-59% 9
8 – Stylet 9-10 μm; tail > 50 annules with a pointed terminus; c′ mean $= 5.4$; spicule > 20 μm . . . . . *M. loofi*
– Stylet 11-13 μm; tail < 46 annules with a rounded terminus; c′ mean $= 2.8$; spicule < 20 μm . . . . . *M. montanus*
9 – Tail terminus broadly rounded, c′ mean $= 2.7$ . . . . . *M. capitonis*
– Tail terminus finely rounded to pointed; c′ mean $=$ 3.2 . . . . . *M. acuminatus*
10 – Tail terminus rounded, with 25-40 annules 11
– Tail terminus filiform, pointed to sharply pointed, indented or mucronate with 46-100 annules 12
11 – Stylet 15.6-17 μm; tail with 25-30 annules . . . . . *M. communicus*
– Stylet 15-17.5 μm; tail with 38-40 annules . . . . . *M. plerorbus*
12 – Lip region narrow, continuous with 6-7 annules; stylet 14 μm; tail with 100 annules and a filiform to pointed terminus . . . . . *M. tetylus*
– Lip region set off with 7-9 annules; stylet 15-17 μm; tail with 46-69 annules 13
13 – Lip region with 7-8 annules; tail terminus sharply pointed to mucronate with 46-58 annules; c′ $= 3.2$-4.1 . . . . . *M. processus*
– Lip region with 7-9 annules; tail terminus bluntly pointed, indented with 56-69 annules; c′ $= 4.0$-4.4 . . . . . *M. joctus*

14 – Tail terminus rounded, hemispherical to subhemispherical, with 42-66 annules 15
– Tail terminus truncate or bluntly pointed with 53-95 annules 17
15 – Stylet 11 μm; tail with 26-33 annules with a subhemispherical terminus . . . . . *M. alboranensis*
– Stylet 13.5-16 μm; tail rounded to hemispherical 16
16 – Tail terminus hemispherical; c′ mean = 2.8; spicule short 15 μm . . . . . *M. brevidens*
– Tail terminus rounded; c′ mean = 3.5; spicule long 22.5-25 μm . . . . . *M. bilqeesae*
17 – Stylet 13-15 μm; tail > 70 annules with truncate terminus 18
– Stylet 12.5-14.5 μm; tail < 54 annules with a bluntly pointed terminus . . . . . *M. microdorus*
18 – Stylet 13-13.5 μm; tail truncate with 90-95 annules; c′ = 3.6-3.8 . . . . . *M. pistaciei*
– Stylet 14-15 μm; tail truncate with 70 annules; c′ = 2.3-2.7 . . . . . *M. pyri*
19 – Lip region continuous with 5-7 annules; stylet 11-18 μm 20
– Lip region set off with 3-6 annules; stylet 12-16 μm 21
20 – Lip region with 7 annules; stylet 11-12 μm; tail with 55-60 annules with a bluntly pointed terminus; males present . . . . . *M. nanus*
– Lip region with 6 annules; stylet 16-18 μm; tail with 55-60 annules with a subhemispherical terminus; males absent . . . . . *M. nothus*
21 – Lip region with 3-5 annules; stylet 12-13.6 μm; tail terminus rounded . . . . . *M. indicus*
– Lip region with 5-6 annules; stylet 14-16 μm; tail terminus truncate . . . . . *M. niazae*
22 – Tail terminus smooth 23
– Tail terminus annulated 29
23 – Stylet 19-22 μm 24
– Stylet 23-36 μm 27
24 – Tail terminus bluntly pointed; c′ > 4 . . . . *M. tortilis*
– Tail terminus rounded, hemispherical to subhemispherical; c′ < 3.6 25
25 – Lip region continuous with 4-5 annules; stylet 19-21 μm 26
Lip region set off with 5 annules; stylet 20-22 μm; tail terminus rounded, with 26-32 annules . . . . . *M. khuzdarensis* n. sp.
26 – Stylet 21 μm; tail terminus subhemispherical with 49-52 annules; males absent . . . . . *M. bavaricus*
– Stylet 19-20 μm; tail terminus hemispherical, with 32-37 annules; males present . . . . . *M. bijnorensis*
27 – L > 1 mm; stylet 25-36 μm 28
– L < 1 mm; stylet 23-24 μm . . . . . *M. gatevi*
28 – Stylet 32-36 μm; tail with 49-68 annules with a broadly rounded terminus; spicule and gubernaculum long 30-35 μm and 7-10 μm, respectively . . . . . *M. adakensis*
– Stylet 25-28 μm; tail with 28-29 annules with a bluntly pointed terminus; spicule and gubernaculum short 22-24 μm and 7 μm, respectively . . . . . *M. graminicola*
29 – Lip region with 5-7 annules; stylet 19-21 μm; tail with 32 annules; c′ = 1.9-2.2 . . . . . *M. planitierus*
– Lip region with 5-9 annules, stylet 21-23 μm; tail with 47-64 annules; c′ = 2.8-4.2 30
30 – Lip region with 7-9 annules; tail terminus hemispherical with 47 annules . . . *M. bogdanovikatjkovi*
– Lip region with 5-7 annules; tail terminus subhemispherical to bluntly rounded with 56-64 annules . 31
31 – L = 0.68-0.71 mm; tail subcylindrical with subhemispherical terminus; males present . . . . . *M. pseudobavaricus*
– L = 0.43-0.53 mm; tail conoid with bluntly rounded terminus; males absent . . . . . *M. mollicephalus*

Merlinius khuzdarensis* **n. sp.**
(Fig. 1)

Measurements

See Table 2.

Description

Female

Body slightly arcuate when killed by gentle heat. Lip region set off with five annules measuring 8 × 5 μm in diam.; labial framework weakly sclerotised. Stylet slender, with posteriorly sloping knobs; stylet knobs 5 μm wide. Median bulb 18 × 10 μm with prominent valve. Isthmus slender, encircled with nerve ring at about its midpoint. Cuticle finely annulated, each annule measuring *ca* 2.4 μm at mid-body. Maximum body diam. at level of vulva 21-25 μm. Lateral field with six incisures (occasionally seen with subcuticular punctations between lines). Basal bulb short, oval shaped to pyriform. Cardia

* The species name refers to the type locality of Khuzdar.

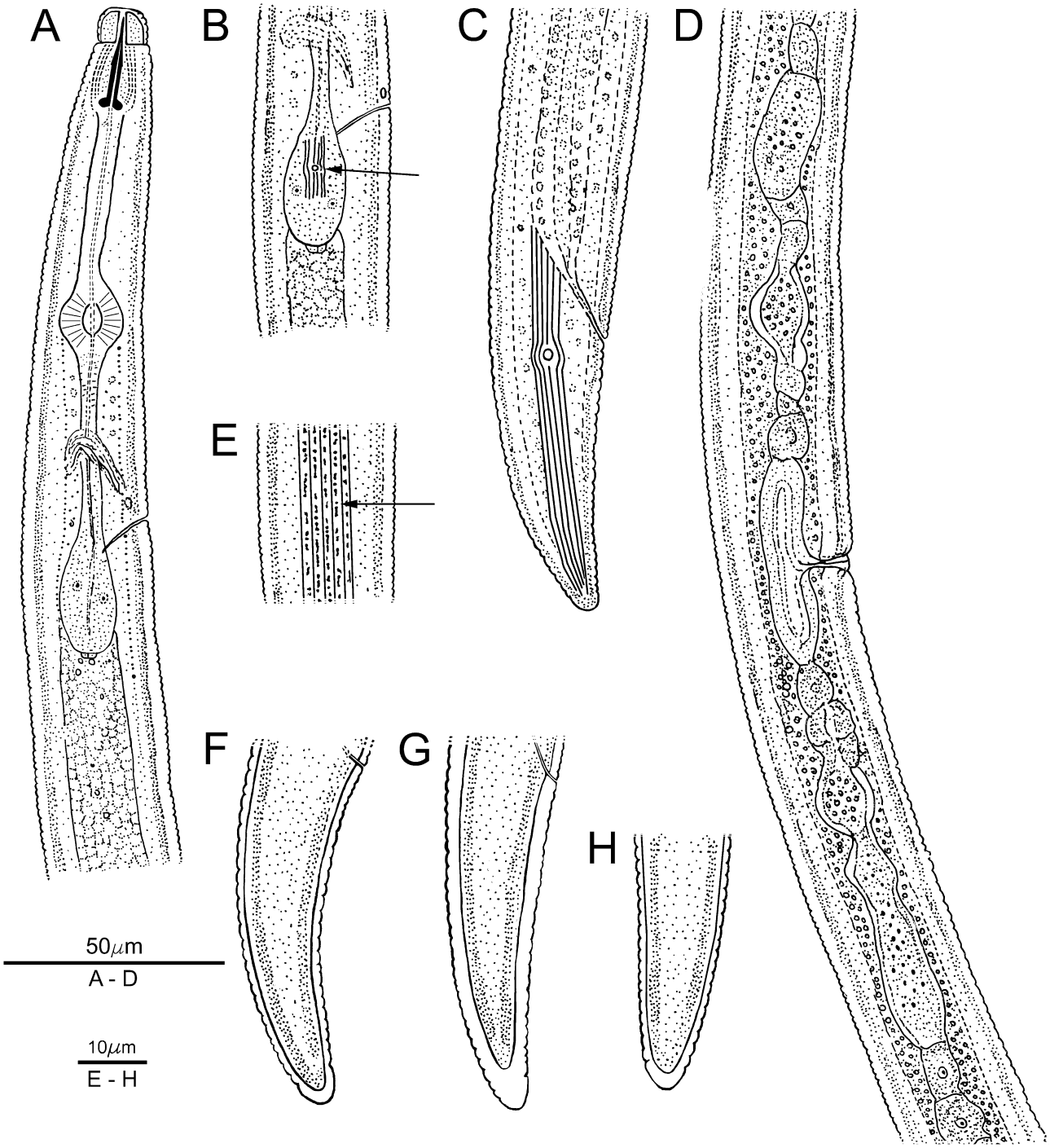

Fig. 1. Merlinius khuzdarensis *n. sp. female. A: Anterior region; B: Lateral field showing six incisures near basal pharyngeal bulb (arrow); C: Tail region; D: Vulva and reproductive structures; E: Lateral field near mid-body showing subcuticular punctations (arrow); F-H: Tail region showing variation in tail shape.*

Table 2. *Morphometrics of female* Merlinius khuzdarensis *n. sp. Measurements (except where indicated) are in* μm *and in the form: mean* ± *standard deviation (range).*

Character	Holotype	Paratypes
n	–	17
L (mm)	0.81	0.79 ± 0.04 (0.73-0.87)
a	34.0	34.7 ± 1.6 (32.0-37.0)
b	6.0	5.9 ± 0.2 (5.6-6.2)
c	14.0	14.5 ± 0.7 (14.0-15.0)
c′	3.6	3.1 ± 0.25 (2.8-3.6)
V	54.5	56.4 ± 1.3 (53.0-59.0)
Lip annules	5	5
Body diam. at midbody	25.6	24.2 ± 1.85 (21.0-27.0)
Body diam. at anus	16.0	16.6 ± 1.14 (14.5-18.0)
Lip region diam.	8.5	7.9 ± 0.28 (7.5-8.5)
Lip region height	4.5	4.3 ± 0.35 (3.5-5.0)
Pharynx length	140	133.5 ± 11.7 (98.0-145.0)
Stylet length	21.5	21 ± 0.6 (20.0-22.0)
Tail length	57.5	52.6 ± 3.44 (48.0-57.5)
Tail annules	32	26 ± 1.45 (27-32)

small. Excretory pore and canal located within an area slightly anterior or posterior to pharyngo-intestinal junction. Hemizonid prominent, located 2-3 annules anterior to excretory pore. Vulval slit transverse; vulval lips not elevated; reproductive tracts didelphic; oocytes arranged in a single row; spermatheca round, filled with sperm. Phasmids prominent, located in anterior half of tail. Tail 48-57.5 μm long, subcylindrical with 27-32 annules, tail terminus smooth, slightly set off, bluntly rounded to sometimes acute to bulb-like.

Male

Not found.

TYPE HOST AND LOCALITY

Soil around roots of date palm (*Phoenix dactylifera* L.) from Khuzdar, Balochistan Province, Pakistan. The global positioning coordinates for Khuzdar district are 25E 43 and 28E 52 north and 65E 42 and 67E 29 east.

TYPE MATERIAL

Holotype (female): Slide T-579t, deposited in the US Department of Agriculture Nematode Collection, Beltsville, MD, USA. Paratypes (16 females): Same data and repository as holotype. Slides T-5208p-T5210p, T-5382p-T-5384p: Additional females on slide numbers CDNRI N 143-147, deposited in Nematode Collection, Crops Disease Research Institute, University of Karachi, Karachi, Pakistan.

DIAGNOSIS AND RELATIONSHIPS

Merlinius khuzdarensis n. sp. is characterised by having females with a body length of 0.73-0.87 mm; lip region set off with five annules; stylet 20-22 μm long with prominent, posteriorly sloping knobs; V = 53-59; phasmids distinct, located in the anterior half of tail; tail, 48-57.5 μm long, subcylindrical with 27-32 annules; tail terminus smooth, slightly set off, bluntly rounded to sometimes acute to bulb-like.

*Merlinius khuzdarensi*s n. sp. comes close to *M. bavaricus* (Sturhan, 1966) Siddiqi, 1970, *M. communicus* Sultan, Singh & Sakhuja, 1988, *M. bilqeesae* Khan & Khan, 1995 and *M. montanus* Maqbool & Shahina, 1987. It differs: from *M. bavaricus* in having females with a set off lip region with five annules *vs* continuous with four annules, fewer tail annules (27-32 *vs* 49-52) and in the shape of the tail terminus which is acute to bluntly rounded *vs* subhemispherical; from *M. communicus* in having females with a longer body length (0.73-0.87 *vs* 0.56-0.58 mm), set off lip region *vs* continuous, and by the longer stylet (20-22 *vs* 15.6-17.0 μm); from *M. bilqeesae* by a longer body (0.73-0.87 *vs* 0.50-0.68 mm) and longer stylet (20-22 *vs* 13.5-14.5 μm); and from *M. montanus* in having females with a longer stylet (20-22 *vs* 11-13 μm) and in the tail being subcylindrical with 27-32 annules, terminus smooth, bluntly rounded to sometimes acute *vs* tail conoid bearing 38-46 annules, tapering to a minutely rounded tip.

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