

## Description of two new monhysterid species (Nematoda: Monhysterida) from sewage in India

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**Summary.**-Two monhysterid species, *Monhystera rolandi* sp. n. and *Geomonhystera glandulata* sp. n., obtained from drain (sewage water) in Aligarh, India are described and illustrated. *M. rolandi* sp. n. is characterised (L= 0.77-0.93; a= 28-35; b= 5.1-7.2; c= 4.5-6.1; c' = 7.5-10.3; V= 59-64) by having 3-5  $\mu$ m long, rod-shaped to rounded crystalloids; amphidial apertures occupying 25-28% of the corresponding body diameter; prominent glandular bodies associated with uterus and vagina; and relatively shorter tail of 7-10 anal body diameters. *G. glandulata* sp. n. (L= 0.63-0.93; a= 32-47; c= 6.9-8.1; c' = 5.1-6.4; V= 80-84) is diagnosed by faintly striated cuticle with few somatic setae; prominent hypodermal glands; well-developed, non articulate cephalic sensilla; amphidial aperture occupying 20-26% of the corresponding body diameter; considerably posterior vulva with strongly protruded lips; thick muscular rectum; and a long conoid tail.

**Key words:** Description, *Geomonhystera glandulata*, India, *Monhystera rolandi*, new species, taxonomy.

**Resumen.**- Se describen e ilustran dos nuevas especies de monistéridos, *Monhystera rolandi* sp. n. y *Geomonhystera glandulata* sp. n., recolectadas de drenaje (aguas residuales) en Aligarh, India. *M. rolandi* sp. n. se distingue (L= 0.77-0.93; a= 28-35; b= 5.1-7.2; c= 4.5-6.1; c' = 7.5-10.3; V= 59-64) por presentar cristaloides redondeados, con forma de bastoncillos y de 3-5  $\mu$ m de longitud; abertura anfídial que ocupa 25-28% de la anchura correspondiente del cuerpo; cuerpos glandulares prominentes asociados al útero y la vagina; y cola relativamente corta, de 7-10 veces la anchura anal de longitud. *G. glandulata* sp. n. (L= 0.63-0.93; a= 32-47; c= 6.9-8.1; c' = 5.1-6.4; V= 80-84) se caracteriza por tener un cutícula provista de tenue estriación y de pocas sedas somáticas; glándulas hipodérmicas prominentes; sensilas cefálicas bien desarrolladas pero inarticuladas; abertura del anfidio ocupando 20-26% de la anchura corporal correspondiente; vulva en posición bastante posterior y con sus labios francamente elevados; recto muscular grueso; y cola conoidea alargada.

**Palabras clave:** Descripción, *Geomonhystera glandulata*, India, *Monhystera rolandi*, nuevas especies, taxonomía.

### INTRODUCTION

The order Monhysterida De Coninck & Schuurmans Stekhoven, 1933 comprises of predominantly aquatic nematodes with fairly large number of fresh water species. Bastian (1865) proposed the genus *Monhystera* with type species *M. stagnalis* while de Man (1876) proposed the family Monhysteridae for the genus. Micoletzky (1922) classified the continental species of the family Monhysteridae and listed thirty-two non-marine

species and varieties of the genus *Monhystera*. New species were continuously added (Johnston, 1938; De Coninck, 1943; Goodey, 1963; Juget, 1969) to the genus when Andrassy (1984), after a thorough synonymisation, considered eight valid species under the genus. Later, Jacobs (1987), in his checklist for family Monhysteridae, increased the number of valid species to eighteen. New species were further added or known ones redescribed by Jacobs and Heyns (1992; 1994) and Eyuaelem and Coomans (1996).

Andrássy (1981) in his authoritative revision proposed the genus *Geomonhystera* for those species of *Monhystera* having well-developed cephalic setae; vulva near 80% of the body length; and a long, thick and muscular rectum. He transferred *Monhystera villosa* Bütschli, 1873 and made it the type species of the genus. Afterwards, a number of species were added to *Geomonhystera* by Brzeski (1993), Khan and Araki (2001), Gagarin (2002), Saha *et al.* (2002) and Siddiqi and Shahina (2004).

The present paper describes two monhysterid species from sewage waters, Aligarh, India.

## MATERIALS AND METHODS

Soil samples containing new species were processed by Cobb's (1918) sieving and decantation and modified Baerman's funnel techniques. Extracted nematodes were heat-killed and fixed in formaline-glycerol fixative, dehydrated by slow evaporation method (Seinhorst, 1959) and mounted in anhydrous glycerine. The mounted nematodes were later measured by ocular micrometer and drawn using drawing tube attached to Olympus BX-51 DIC Microscope. LM photographs were taken using Olympus digital camera C3030.

## DESCRIPTIONS

### *Monhystera rolandi* sp. n. (Figs 1&2)

*Measurements:* See Table I.

*Female:* Body medium-sized, 0.77-0.93 mm long, slender, ventrally curved upon fixation, tapering at both extremities. Cuticle smooth without distinct striations under LM. Crystalloids densely distributed in the body; bigger in mid body region, mostly ellipsoidal to rod-shaped, 3-4  $\mu$ m long with few rounded ones in between. Submedian somatic setae 4-5  $\mu$ m long, 8-9 in cervical region. Lip region continuous with adjoining body contour. Lips amalgamated. Inner labial sensilla papilliform; outer labial sensilla small, setose; four cephalic sensilla

slightly longer than outer labials or about one-fourth of lip diameter. Amphidial apertures circular, 25-28% of the corresponding body diameter and located at about one lip width distance from anterior end. Stoma with parallel cheilostomal walls, posterior part funnel-shaped, entirely surrounded by pharyngeal tissue. Pharynx cylindroid anteriorly, basal part expanded, muscular, without valve plates or grinder. Nerve ring at 44-56% of pharyngeal length. Body at pharyngeal end 2.4-2.6 times wider than labial diameter. Excretory pore obscure. Cardia 9-16  $\mu$ m long with hanging lobes. Ventral gland 15-17  $\mu$ m long, located posterior to cardia. An ovoid pseudocoelomocyte often observed, closely posterior to ventral gland. Intestine transparent, thin-walled, granular with refractive lining of lumen. Rectum 17-20  $\mu$ m or about anal body diameter long, thin-walled with weak sphincter. Reproductive system monodelphic, prodelphic. Ovary outstretched, with distal end 40-50  $\mu$ m posterior to pharyngeal base. Oocytes arranged in several rows in germinal zone but in single row beyond that. Anterior uterine region marked with two to three smaller glandular cells with defined nuclei while posterior uterine region showed two large vacuolated glandular bodies close to vagina. Vagina cuticularized, anteriorly directed, about half of corresponding body diameter. An elongate post-vulval glandular body observed attached with dorsal vaginal wall while two small irregular bodies present close to ventral vaginal wall. Vulva post-equatorial, crescent-shaped slit. Post-uterine sac absent. Vulva-anus distance 156-186  $\mu$ m. Tail long, uniformly tapering, ventrally curved. Three caudal glands arranged in tandem, opening through common duct at the tail tip. Terminal spinneret small, 1-2  $\mu$ m long. Caudal setae 16-18 with 7-8 paired setae flanked by anterior and posterior mid dorsal setae. Dorsal seta 28-32  $\mu$ m anterior to tail tip.

*Male:* Not found.

*Diagnosis and relationships:* *Monhystera rolandi* sp. n. is characterised by medium-sized body having rod-shaped to rounded, densely packed crystalloids; smooth cuticle under LM; small-sized amphids occupying 25-28% of the corresponding body diameter; oblong pseudocoelomocyte closely posterior to ventral gland, prominent glandular bodies associated with uterus and vagina, and a tail of 7-10 anal body diameter long.

TABLE I. Morphometric data of *Monhyстера rolandi* sp. n. and *Geomonhyстера glandulata* sp. n. (measurements in  $\mu\text{m}$  and in the form: mean  $\pm$  standard deviation (range)).

Species	<i>Monhyстера rolandi</i> sp. n.		<i>Geomonhyстера glandulata</i> sp. n.		
	n	Holotype ♀	Paratypes 13 ♀♀	Holotype ♀	Paratypes 13 ♀♀
<b>Characters</b>					
Body length		880	877 $\pm$ 43.3 (770-930)	742	774 $\pm$ 47.9 (630-938)
Body width		29	28.9 $\pm$ 2.1 (25-31)	23	20.4 $\pm$ 2.3 (15-23)
a		31	30.4 $\pm$ 1.8 (28.4-35.4)	31	38.2 $\pm$ 2.3 (31.8-46.6)
b		5.9	6.3 $\pm$ 0.3 (5.1-7.2)	5.6	5.6 $\pm$ 39.2 (5.1-6.4)
c		5.2	4.9 $\pm$ 0.4 (4.5-6.1)	7.1	7.7 $\pm$ 0.4 (6.9-8.1)
c'		9.6	9.0 $\pm$ 0.7 (7.5-10.3)	5.6	5.9 $\pm$ 0.5 (4.9-6.5)
V (%)		60	61.1 $\pm$ 1.2 (59-64)	80	82.2 $\pm$ 0.8 (80-84)
G <sub>1</sub>		37.3	36.6 $\pm$ 31.8 (32.8-41.4)	30.3	27.2 $\pm$ 7.1 (17.3-39.5)
Stoma length		7	5.8 $\pm$ 1.1 (4-7)	11	9.8 $\pm$ 2.0 (7-14)
Pharyngeal length		150	140.7 $\pm$ 8.3 (128-151)	131	135.8 $\pm$ 10.5 (124-160)
Nerve ring		74	69.4 $\pm$ 5.2 (60-80)	64	58.4 $\pm$ 10.1 (49-89)
ABD		19	19.6 $\pm$ 1.0 (18-22)	18	17.3 $\pm$ 2.8 (13-20)
Tail length		175	176.6 $\pm$ 12.8 (163-189)	104	104.5 $\pm$ 14.6 (88-134)
Vulva-anus distance: tail length		1.1	1.1 $\pm$ 0.1 (1.0-1.2)	0.3	0.3 $\pm$ 0.05 (0.2-0.4)
Labial diameter		12	12.0 $\pm$ 0.5 (12-13)	13	12.3 $\pm$ 1.4 (11-15)
Labial height		2	2.0 $\pm$ 0.5 (2-3)	2	2.1 $\pm$ 0.4 (2-3)
Cephalic setae length		3	3 $\pm$ 0.7 (3-4)	8	6.9 $\pm$ 1.6 (8-10)
Amphids from anterior end		9	9.5 $\pm$ 0.7 (8-11)	18	17.1 $\pm$ 1.6 (15-20)
Amphidial aperture diameter		3.5	3.6 $\pm$ 0.3 (2.9-3.8)	3	3.6 $\pm$ 0.4 (2-4)
Body diameter at amphidial level		14	13 $\pm$ 0.8 (11-14)	15	14.8 $\pm$ 0.3 (14-15)
Amphidial diameter to corresponding body diameter (%)		26	26.7 $\pm$ 0.8 (25-28)	25	14.3 $\pm$ 0.4 (20-26)

The new species most closely resembles *Monhyстера africana* Andr ssy, 1964, in most morphometric characteristics and in absence of ocellus but differs from it in having smaller  $L$  and  $c'$  values, smaller amphids in relation to the corresponding body diameter; presence of glandular bodies associated with uterus and outer vaginal wall and in the absence of males ( $vs L= 1.0-1.2$ ,  $c'= 10-14$ , amphids 35- 40% of corresponding body diameter, glandular bodies not reported and males found in *M. africana*).

The new species also comes closer to *M. wangi* Wu & Hoeppli, 1929 in most morphometrics but differs in having smaller body, absence of ocellus, presence of glandular bodies associated with uterus and vagina and absence of males ( $vs L= 0.9-1.5$ , ocellus present, glandular bodies not reported and males found in *M. wangi*).

It also resembles *M. lemani* Juget, 1969 in body size,  $a$  and  $b$  values, similar ratio of amphids to corresponding body diameter and in the absence of ocellus but differs in having relatively smaller  $c$  and

$V$  values, greater  $c'$  value, narrower lip region, relatively smaller labial sensilla, presence of glandular bodies associated with uterus and outer vaginal wall; and the absence of intra-uterine eggs and of males in population ( $vs c= 6.0-8.3$ ,  $V= 66-70\%$ ,  $c'= 5-7$ , lip region 20  $\mu\text{m}$  wide, labial sensilla 5-6  $\mu\text{m}$  long, glandular bodies associated with uterus and vaginal wall not reported, intra-uterine egg described and males found in *M. lemani*).

*M. rolandi* sp. n. also resembles *M. stagnalis* Bastian, 1865 in most morphometric values, and length of cephalic setae but differs in having greater 'a' value, smaller 'V' value, narrow lip region, smaller amphids, absences of ocellus, presence of glandular bodies associated with uterus and vagina and absence of males ( $vs a= 16-27$ ,  $V= 65-75\%$ , lip region 13-16  $\mu\text{m}$  wide, amphids one-half to one-third the corresponding body width, ocellus present, glandular bodies not reported and males found in *M. stagnalis*).

Further, the new species resembles *M. uncigubernaculum* Zeidan, Jacobs & Geraert, 1989 and

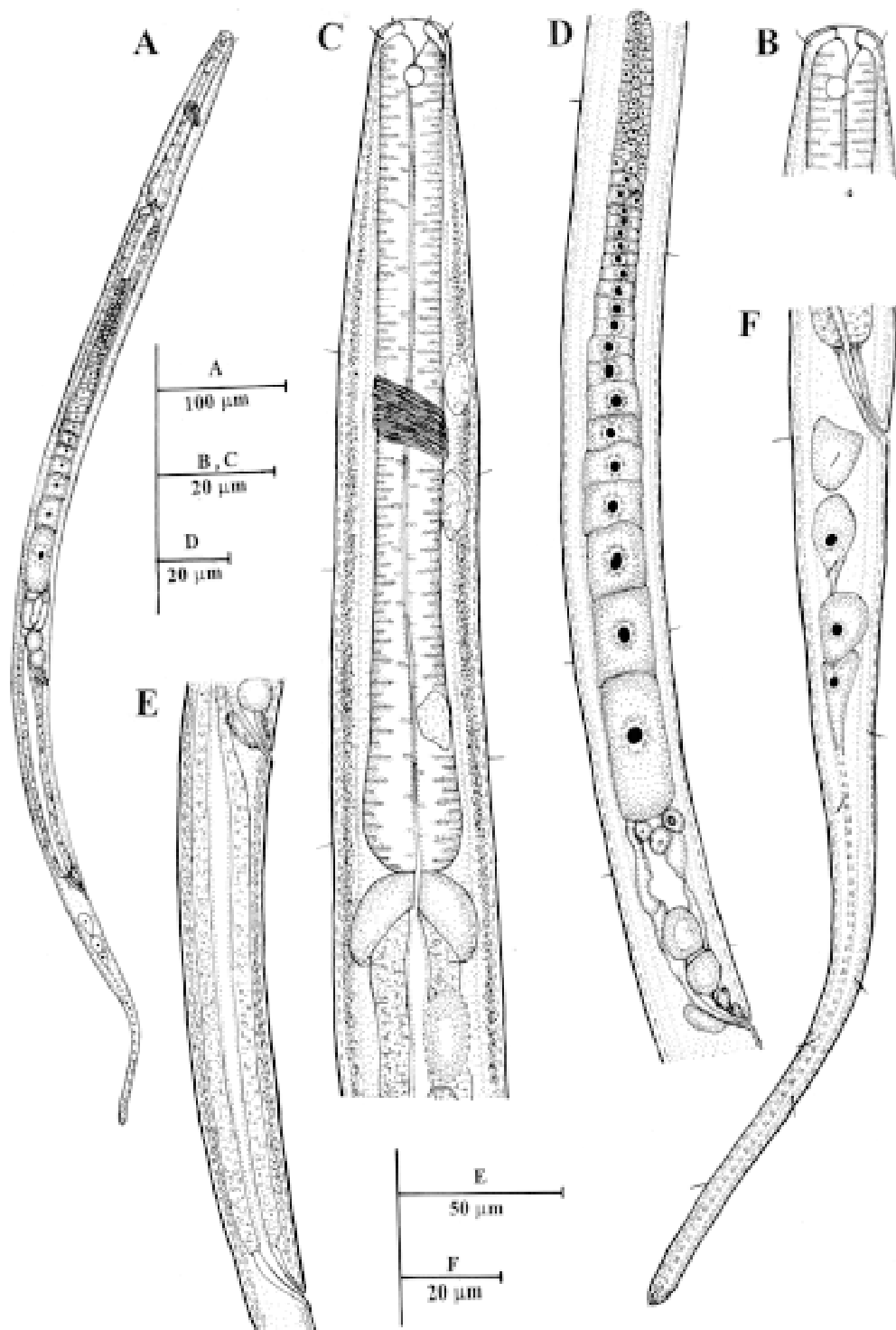


FIGURE 1. *Monhystera rolandi* sp. n. A: Entire female. B: Anterior end. C: Pharyngeal region. D: Female reproductive system. E: Vulva-anal region. F: Female tail.

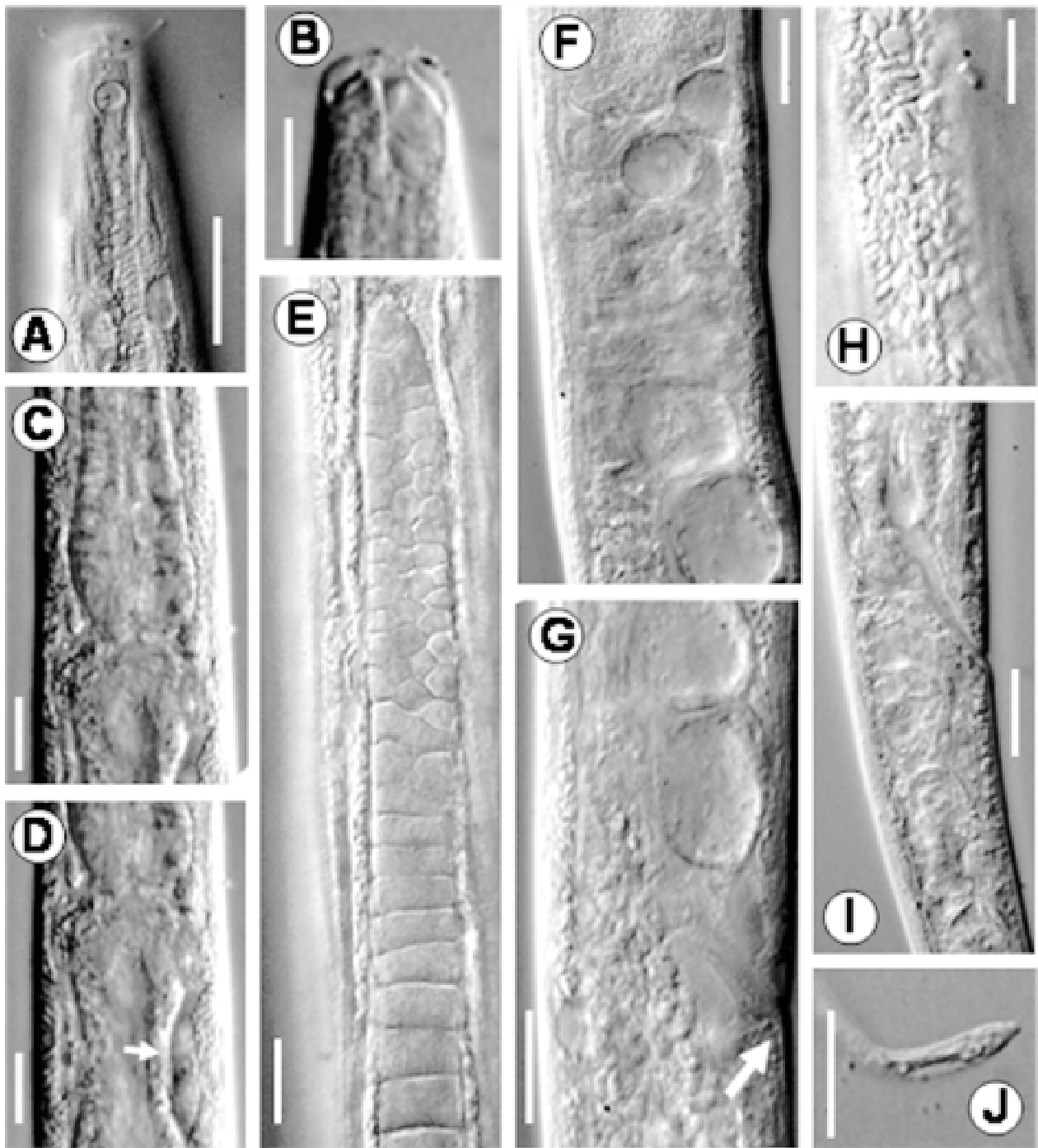


FIGURE 2. *Monhystera rolandi* sp. n. A, B: Anterior region. C: Posterior region of Pharynx. D: Pharyngo-intestinal region with ventral gland. E: Distal end of Ovary. F: Uterus with glandular bodies. G: Vulval region (arrow indicates vulva). H: Crystalloids. I: Anal region. J: Tail tip.

*M. magnacephala* Joubert & Heyns, 1980 in general body morphometrics and presence of uterine and postvulval gland cells. However, it can be differentiated from the former in having relatively posterior amphids and less cuticularized vagina while lacking perioral platelets around oral opening, ocellus, vaginal and rectal sphincters, and males in population (*vs* amphids 4-8  $\mu$ m from anterior body end, heavily cuticularized vagina, ring of perioral platelets and ocellus present, vaginal and rectal sphincters present and males reported in *M. uncigubernaculum*).

From *M. magnacephala* Joubert & Heyns, 1980, the new species can be differentiated in having greater *a* and *c'* values, smaller *V* value, greater number of distinct crystalloids, absence of ring of perioral platelets, sphincters associated with vagina and rectum and absences of males (*vs a*= 18-28, *c'*= 5-7, *V*= 64-69%, ring of perioral platelets around oral opening present, crystalloids few and small in size, vaginal and rectal sphincters present and males reported in *M. magnacephala*).

*Type habitat and locality:* Samples collected from drain (sewage water) at Jamalpur, Aligarh.

*Type material:* Holotype female with eleven paratype females on slide *Monhystera rolandi* sp. n. No. A/1-7 deposited in 'Nematode Collection' of the Department of Zoology, Aligarh Muslim University, Aligarh. Two paratype females on slide *Monhystera rolandi* sp. n. No. A/8 deposited at the Laboratory of Nematology, Wageningen University and Research Center (WUR), 6700 ES Wageningen, The Netherlands.

*Etymology:* The species is named after the Nematologist Prof. Roland N. Perry, Rothamsted Research, England.

*Remarks:* The new species shows marked differences from the Indian monhysterid species *M. pseudomacrura* Khera's (1971), a junior synonym of *M. africana* Andr ssy, 1964 as considered by Andr ssy (1981) and of *M. stagnalis* Bastian, 1865 revised by Jacobs (1987). The present specimens differ from the population described by Khera in having smaller, presumably amictic females with post-vulval glands, lacking intra-uterine eggs and vaginal sphincter in contrast to those reported by Khera (1971). The other character which differs, is the slit-like vulva in *M.*

*rolandi* sp. n. which has been unusual to be pore-like in Khera's description.

***Geomonhystera glandulata* sp. n.**  
(Figs 3& 4)

*Measurements:* See Table I.

*Female:* Body medium-sized, 0.63-0.93 mm long, tapering at both extremities, strongly ventrally curved after fixation. Cuticle with faint striations, visible in midbody region. Somatic setae anterior to tail 10-14, scattered without definite arrangement. Hypodermis with round to ovoid glands, 4-8  $\mu$ m across. Lip region continuous with adjoining body. Lips amalgamated; inner labial sensilla papilliform, outer labial sensilla small, setose. Cephalic sensilla well developed, elongate, more than half lip diameter long, non-articulate. Amphidial apertures circular, nearly one-fourth to one-fifth of the corresponding body diameter, about 1.5 labial width from anterior end. Stoma thin-walled, differentiated into anterior funnel-shaped part and a posterior narrow part entirely surrounded by pharyngeal tissue. Pharynx cylindroid with slightly expanded posterior end. Pharyngeal lumen thin, with refractive walls. Nerve ring encircling pharynx at 36-55% of its length. Body at pharyngeal end 1.5-1.7 times wider than lip diameter. Cardia 4-8  $\mu$ m long, with compactly arranged central part having six cells in two columns, hanging in intestinal lumen flanked by two small pericardial cells. Intestine with equal-sized, granulated and, elongate polygonal cells; intestinal lumen narrow. Rectum thick, muscular, about 1.3-2.0 times anal body diameter. Anus a crescentic slit with protruded lips. Reproductive system monodelphic, prodelphic. Ovary out-stretched. Oocytes arranged in single row in germinal zone. Mature oocytes 60-100 x 20-22  $\mu$ m in dimension; uterus long. Vagina anteriorly directed, L-shaped, equal to the corresponding body diameter. Vagina vera about half of the vagina uterina in length. Vulva post-equatorial, a transverse slit close to anal opening; vulval lips strongly protruded. Post-uterine sac absent. Vulva-anus distance 29-39  $\mu$ m. Tail elongate conoid, uniformly narrowing, ventrally arcuate. Three caudal glands, arranged linearly with ducts leading to a chamber (5-6  $\mu$ m), opening terminally into 2-3  $\mu$ m long spinneret. Caudal setae 5-6 with terminal dorsal seta 10-12  $\mu$ m anterior from the tail tip.

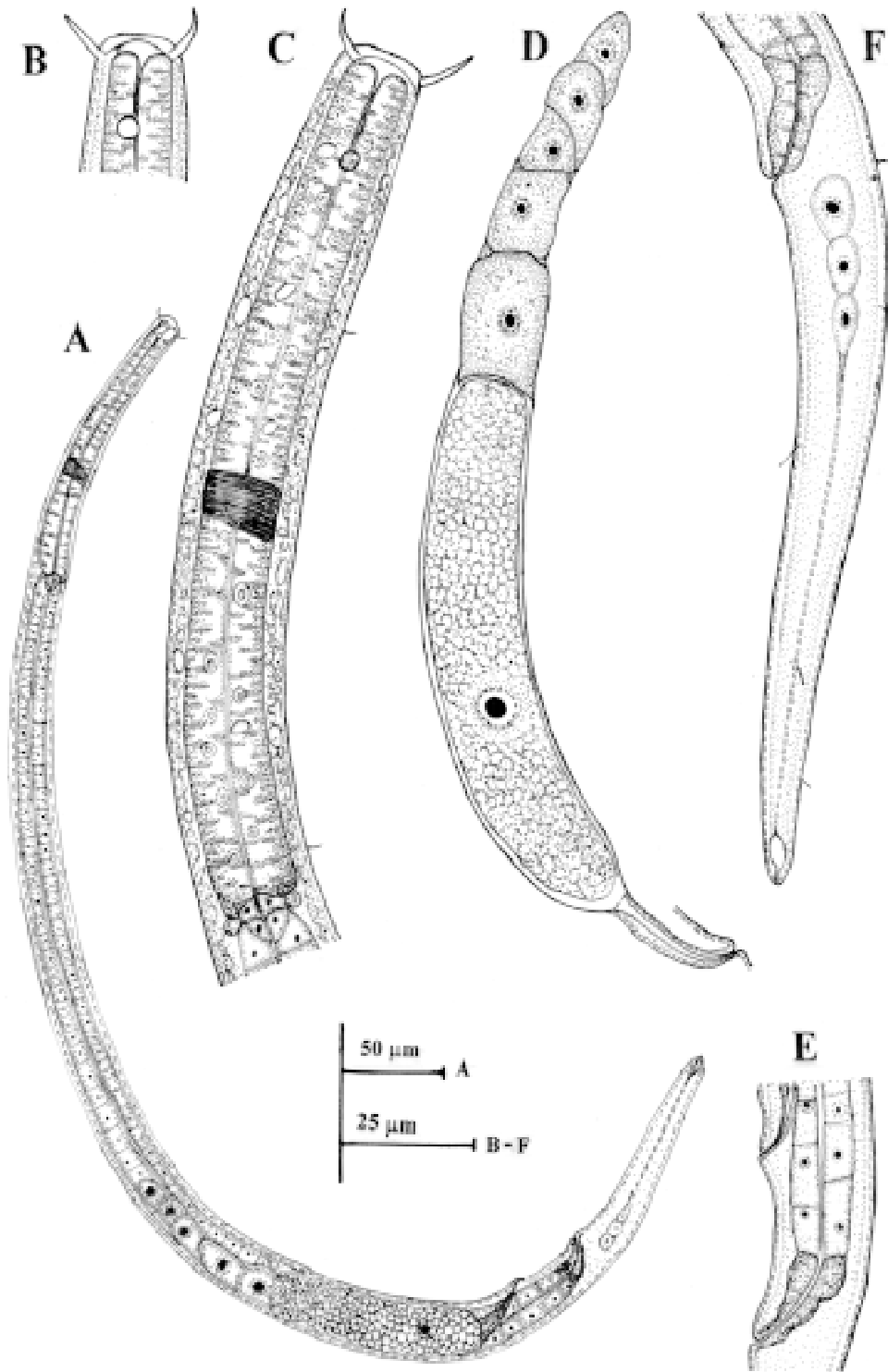


FIGURE 3. *Geomonhystera glandulata* sp. n. A: Entire female. B: Anterior end. C: Pharyngeal region. D: Female reproductive system. E: Vulva-anal region. F: Female tail.



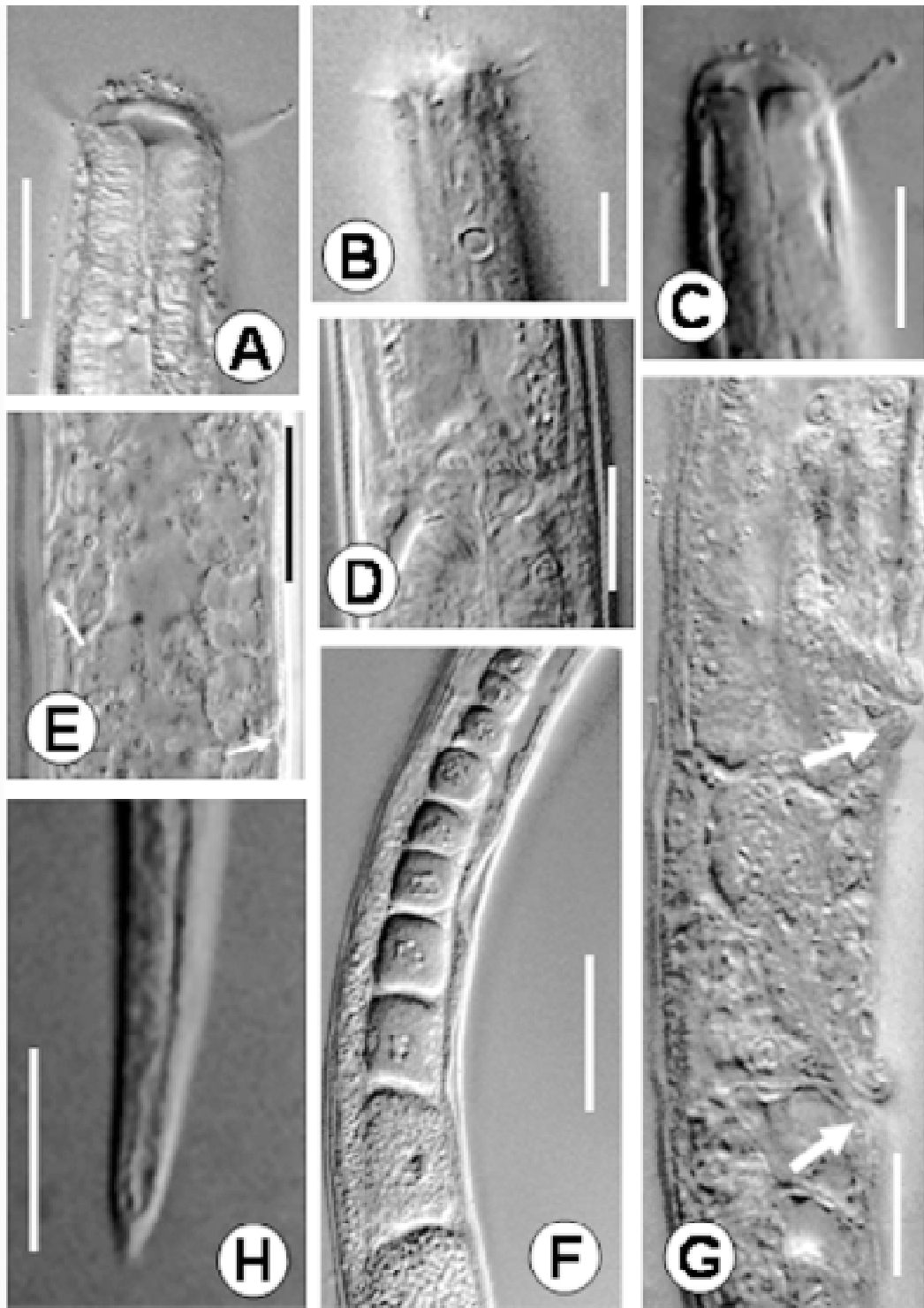


FIGURE 4. *Geomonhystera glandulata* sp. n. A-C: Anterior end. D: Pharyngo-intestinal region. E: Hypodermal glands (arrows indicate openings). F: Ovary. G: Vulva-anal region (Arrows indicate vulval and anal openings). H: Tail end.



Male: Not found.

*Diagnosis and relationships:* *Geomonhystera glandulata* sp. n. is characterised by faintly striated cuticle with sparse somatic setae; prominent hypodermal glands; well developed, non articulate cephalic sensilla; amphidial apertures one-fourth to one-fifth of the corresponding body diameter; considerably posterior vulva (80-84%); strongly protruded vulval and anal lips; thick muscular rectum and a long conoid tail of 4-6 anal body diameters.

The new species most closely resembles *G. pervaga* (Argo & Heyns, 1973) Andrásy, 1981 in most morphometric characteristics but differs in having relatively greater *b* value; smaller *c'* value; prominent hypodermal glands; smaller, posteriorly located amphids; relatively longer, non cuticularised stoma; strongly protruded vulval lips and body slightly narrowing posterior to vulva (*vs b* = 4.5-5.5; *c'* = 7-8; hypodermal glands absent; amphids 3.6-4.8  $\mu$ m across and one labial diameter from anterior end, stoma shallow and cuticularised; vulval lips slightly protruded and body posterior to vulva markedly narrow in *G. pervaga*).

It also comes closer to *G. karuni* Siddiqi & Shahina, 2004 in most morphometric characteristics but differs in having relatively smaller *c'* value, prominent hypodermal glands, striated outer cuticle, prominently protruded vulval and anal lips and absence of rectal glands (*vs c'* = 6-9, outer cuticle smooth, hypodermal glands absent, vulval and anal lips not protruded and three large rectal glands with nuclei found in *G. karuni*).

*Geomonhystera glandulata* sp. n. further resembles *G. australis* (Cobb, 1893) Andrásy, 1981 in the size and location of amphids and in some morphometric values but differs from it in having greater *b* value, smaller *c'* value, striated outer cuticle, prominent hypodermal glands and absence of males (*vs b* = 4.3-5.4, *c'* = 7-8, only inner cuticle striated, hypodermal glands absent and males reported in *G. australis*).

It also differs from *G. auvillis* Saha, Lal & Singh, 2002 in having relatively greater *a* and smaller *c* values, striated cuticle, prominent hypodermal glands, unsegmented cephalic setae, longer pharynx without terminal swelling and oocytes arranged in single row in germinal zone (*vs a* = 27- 34, *c* = 8.1-8.8, cuticle smooth, hypodermal glands absent, pharynx with bulb like terminal swelling and oocytes arranged in multiple rows in germinal zone in *G. auvillis*).

From *G. villosa* (Bütschli, 1873) Andrásy, 1981 the new species differs in having greater *b* value; smaller *c'* value, unsegmented cephalic setae, prominent hypodermal glands, shorter rectum in relation to anal body diameter and in the absence of post-uterine sac and males (*vs b* = 4.6-5.6, *c'* = 6-9, cephalic setae segmented, hypodermal glands absent; rectum 2.5-2.8 times anal body diameter, post-uterine sac present and males reported in *G. villosa*).

*Type habitat and locality:* Samples collected from ditch at railway road (Katpulla) Aligarh, India.

*Type material:* Holotype female and eleven paratype females on slide *Geomonhystera glandulata* sp. n. No. NON/10-1 deposited in 'Nematode Collection' of the Department of Zoology, Aligarh Muslim University, Aligarh. Two paratype females on slide *Geomonhystera glandulata* sp. n. No. A/8 deposited at the Laboratory of Nematology, Wageningen University and Research Center (WUR), 6700 ES Wageningen, The Netherlands.

*Etymology:* The name of the species is derived from the prominently glandular hypodermis.

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