



STUDIES ON THE GENUS *LAGENONEMA* ANDRÁSSY, 1987 (NEMATODA: THORNENEMATIDAE)

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INTRODUCTON

The genus *Lagenonema* was established by Andrassy (1987) belonging to the subfamily Thornenematinae Siddiqi, 1969, family Thornenematidae Siddiqi, 1969 under the order Dorylaimida. He erected the genus by differentiating it from *Thornenema* Andrassy, 1959 in having abruptly narrowed, bottle-shaped anterior region, well sclerotized spatulate cephalic framework, ventrally concave spear and smaller amphids. Jairajpuri and Ahmad (1992) did not agree with him and noted that *Lagenonema* was close to *Thornenema*. Gantait, Bhattacharya and Chatterjee (2010) however agreed with Andrassy's opinion that *Lagenonema* is a well defined, distinct genus.

Andrassy (1987) established the genus to accommodate four species viz. *Lagenonema caudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andrassy, 1987, *L. longicaudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andrassy, 1987, *L. loofi* (Jairajpuri, Ahmad and Dhanachand, 1980) Andrassy, 1987 and *L. wickeni* (Yeates, 1970) Andrassy, 1987. He shifted these species from the genus *Thornenema*. At the same time he described *L. tropicum* Andrassy, 1987 from New Guinea. He also provided a species key of the genus. Gantait, Bhattacharya and Chatterjee (2010) described *L. thornei* from west Bengal, India. We want to add *Thornenema spicatum* Shaheen and Ahmad, 2005 to this genus. Presently the genus possesses seven species globally. A compendium of these seven species and a revised species key of the genus are being provided hereunder.

SYSTEMATIC POSITION

- Class NEMATODA
- Subclass ADENOPHOREA (Von Linstow, 1905) Chitwood, 1958
- Order DORYLAIMIDA (De man, 1876) Pearse, 1942
- Suborder DORYLAIMINA (De man, 1876) Pearse, 1942
- Superfamily DORYLAIMOIDEA (De man, 1876) Thorne, 1934
- Family THORNENEMATIDAE Siddiqi, 1969
- Subfamily THORNENEMATINAE Siddiqi, 1969

Genus *Lagenonema* Andrassy, 1987

Diagnosis : *Lagenonema* comprises of small-sized nematodes, body 0.6-0.9 mm long. Cuticle smooth or very finely striated. Anterior end of body bottle-shaped, abruptly narrowing to a cylindroid truncate head. Lip region about half of adjacent body width; lips amalgamated. Labial framework well sclerotized, spatulate. Amphids small, $1/4^{\text{th}}$ - $1/3^{\text{rd}}$ of corresponding body width. Odontostylet straight, slightly concave distally on its ventral side; 9-15 μm long, about 1.5-2.0 times as long as cephalic diameter. Stylet aperture small, occupying about $1/5^{\text{th}}$ - $1/4^{\text{th}}$ of stylet length. Guiding ring thin. Oesophagus expands at 55-65% of its length. Female reproductive system mono-opisthodelphic. Vulva pre-equatorial or equatorial, at 33-52% of body.

Key words : Nematode, Dorylaimida, *Lagenonema*, compendium, species key.

Tail 3-15 anal diameters long; tapering gradually to the finely rounded tip, or first hemispheroid then digitate to filiform. Male unknown in all the species of the genus.

Relationship : The genus *Lagenonema* is related to the genus *Thornenema* Andr ssy, 1959. But it differs from that in the abruptly narrowed, bottle-shaped anterior region, the well sclerotized spatulate cephalic framework, ventrally concave spear and the smaller amphids. Besides, all the species of the genus *Lagenonema* are monosexual whilst the *Thornenema* species are bisexual.

Type species : *Lagenonema caudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andr ssy, 1987.

Synonym : *Thornenema caudatum* Jairajpuri, Ahmad and Dhanachand, 1979.

Other species : *L. longicaudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andr ssy, 1987, *Thornenema longicaudatum* Jairajpuri, Ahmad and Dhanachand, 1979

L. loofi (Jairajpuri, Ahmad and Dhanachand, 1980) Andr ssy, 1987 *Thornenema loofi* Jairajpuri, Ahmad and Dhanachand, 1980.

L. spicatum (Shaheen and Ahmad, 2005) comb. n. *Thornenema spicatum* Shaheen and Ahmad, 2005.

L. thornei Gantait, Bhattacharya and Chatterjee, 2010.

L. tropicum Andr ssy, 1987.

L. wickeni (Yeates, 1970) Andr ssy, 1987 *Thornenema wickeni* Yeates, 1970.

DISCUSSION

At the time of establishment of the genus *Lagenonema*, Andr ssy (1987) shifted four species viz. *Thornenema caudatum*, *T. longicaudatum*, *T. loofi* and *T. wickeni* to this genus. *T. wickeni* was described by Yeates (1970) from Wicken, Fen, Cambridgeshire, England. He collected the holotype female from 'mixed fen' and paratypes (46 female and 38 juveniles) from sites in sedge (*Cladium mariscus* Pohl.) bed, alder buckthorn (*Frangula alnus* Mill.) carr and buckthorn (*Rhamnus catbarticus* L.) carr. The species is characterized in having almost straight, cylindrical body, tapering over about three body widths anteriorly and from beginning of prerectum posteriorly. Cuticle smooth, thick

opposite to spear base. Lip region rounded, amalgamated and distinctly narrower than adjacent body, about one-fifth as wide as body at base of oesophagus. Odontostyle basically cylindroid, its aperture about one-third of its length. Odontophore as long as odontostyle. Guiding ring appeared fine and simple. Slender part of oesophagus slightly constricted posterior to spear extensions and at nerve ring. Basal expanded part of oesophagus occupied 37- 44% of total oesophageal length. Oesophago-intestinal vulve globular. Vulval opening transverse, vaginal opening cross-like; no sclerotization in vulval region. Gonad opisthodelphic. Prerectum about two and a half anal body widths long. Rectum about one anal body width long. Tail elongate-conoid with a rounded lip in most specimens. Carbonell and Coomans (1986) redescribed the species from Maraou , Ivory Coast from grass savanna. Despite some differences in measurements their specimens are considered conspecific with the type populations of Yeates (1970).

T. caudatum and *T. longicaudatum* were described by Jairajpuri *et al.* (1979) from Imphal of Manipur state, India. The specimens were collected from soil around roots of unidentified wild flowering plants. *T. caudatum* has almost straight body, tapering towards both the extremities. Cuticle finely striated. At base of lip region the cuticle suddenly thickens and then becomes thinner at level of base of odontophore. A little above the anus it again gradually starts to become thicker and remains so in the anterior one-third of tail length. Lip region amalgamated, strongly sclerotized, very narrow, about one-fourth of body width as base of oesophagus. Odontostyle cylindroid, about two head-widths long; its aperture about one-fourth of its length. Odontophore equal to spear length. Guiding ring appeared fine and simple. Basal expanded part of oesophagus occupied 35-38% of total oesophageal length. Vulva a transverse slit. Vagina thick walled, about one-half of body-width long. Gonad opisthodelphic, reflexed. Pre-vulval uterine sac almost absent. Prerectum 1.5-2.3 anal body widths long. Rectum about one anal body width long. Tail long, two parts; the first part hemispheroid and covered with very thick cuticle, the second part elongate filiform with a rounded terminus. Sauer

(1981) redescribed the species from Gemas, Malaysia, collected from paddy soil. Carbonell and Coomans (1986) also redescribed the species based on two paratypes, deposited in the nematode collection of the Instituut voor Dierkunde, Gent, Belgium, by Jairajpuri *et al.* (1979). Carbonell and Coomans (1986) found two principal differences with respect to the original description (Jairajpuri *et al.*, 1979): (a) smaller amphidial aperture, about two thirds of the fovea width, already noted by Sauer (1981); (b) different position of the pharyngeal gland nuclei and outlets.

T. longicaudatum has ventrally curved body, tapering towards both the extremities. Cuticle finely striated. At base of lip region the cuticle suddenly expands and then becomes thinner at level of base of odontophore. Lip region amalgamated, strongly sclerotized, very narrow, about $1/6^{\text{th}}$ - $1/5^{\text{th}}$ of body-width as base of oesophagus. Odontostyle cylindroid, about two head-widths long; its aperture about one-fifth of its length. Odontophore nearly equal to spear length. Basal expanded part of oesophagus occupied 40-45% of total oesophageal length. Vulva a transverse slit. Vagina thick walled, about one-half of body-width long. Gonad opisthodelphic, reflexed. Preuvulval uterine sac almost absent. Prerectum 1.5-2.5 anal body widths long. Rectum 1.2-1.6 anal body widths long. Tail long filiform with rounded terminus. Sauer (1981) redescribed the species from Bachok, Malaysia, collected from tobacco field. Carbonell and Coomans (1986) also redescribed the species based on one paratype, deposited in the nematode collection of the Instituut voor Dierkunde, Gent, Belgium, by Jairajpuri *et al.* (1979). Carbonell and Coomans (1986) observed the specimen differs from the original description (Jairajpuri *et al.*, 1979) in amphidial shape, position of pharyngeal gland nuclei and a distinct sphincter between uterus and oviduct.

Jairajpuri *et al.* (1980) opined that the description of *T. thienemanni* by Jairajpuri (1966) is no longer conspecific with *Dorylaimus* (= *Thornenema* now *Dorylaimoides*) *thienemanni* Schneider, 1937. Accordingly, a new name has to be proposed by them for *T. thienemanni* apud Jairajpuri, 1966. Jairajpuri *et al.* (1980) designated it as *T. loofi* and described as new species. The species is characterized in having ventrally curved body,

tapering towards both the extremities. Cuticle finely striated. Lip region amalgamated, strongly sclerotized, very narrow, about $1/5^{\text{th}}$ of body-width as base of oesophagus. Odontostyle cylindroid, about two head-widths long; its aperture about one-fourth of its length. Odontophore about 1.5 times the odontostyle length. Basal expanded part of oesophagus occupied 45% of total oesophageal length. Cardia tongue shaped. Vulva a transverse slit. Vagina thick walled, about one-half of body-width long. Gonad opisthodelphic. Prerectum 1.5-2.0 anal body widths long. Rectum 1.2-1.5 anal body widths long. Tail long, gradually tapering with rounded terminus. Carbonell and Coomans (1986) also redescribed the species based on a population, collected from Maraoué, Ivory Coast from grass savanna. They observed that the specimens differed in body length and vulval position from the type population described by Jairajpuri (1966). Since then they also studied three females, collected from soil, near the bank of the Mayel Sao river, Ouro Haousas, Cameroon and found that the measurements of the specimens are closer to those of the type population (Jairajpuri, 1966). Both Ivory Coast and Cameroon populations studied, differ in amphid shape from that description by Jairajpuri (1966).

Andrásy (1987) described *L. tropicum* (holotype female; two female and a juvenile paratypes) from Gogol River, Papua New Guinea, humus from a primary rain forest. The species is characterized in having ventrally curved body, tapering towards both the extremities. Cuticle smooth. Head very narrow, 4.5-5.0 μm , about half as wide as adjacent body. Lips amalgamated. Labial frame work and collare sclerotized. Spear almost twice the head diameters; its aperture about one-fourth of its length. Guiding ring very thin. Basal expanded part of oesophagus occupied 64-65% of total oesophageal length. Cardia short, tongue shaped. Vulva a transverse slit, not sclerotized. Vagina piriform, slightly directed backward. Gonad monopisthodelphic. Anterior uterine sac practically absent. Rectum as long as prerectum, 1.0-1.6 times longer than anal body diameter. Tail 4 anal body diameters long, first rounded then elongate-digitiform with finely rounded terminus. Andrásy (1987) opined that the species of Coomans and Carbonell (1981) described as *Thornenema loofi* from the Ivory Coast agrees very well with *L. tropicum*.

Table 1. Measurements and diagnostic features of *Lagenonema* species (all measurements in μm ; except L in mm)

Morphometric chracters	<i>L. caudatum</i> n = 17 ♀♀	<i>L. longicaudatum</i> n = 12 ♀♀	<i>L. loofi</i> n = 11 ♀♀	<i>L. thornei</i> n = 11 ♀♀
L	0.60-0.89	0.67-0.75	0.60-0.70	1.48-1.55
a	22-31	26-31	20-26	39.5-39.8
b	3.5-4.5	4.3-4.7	4.0-4.6	5.0-5.2
c	8-10	3-4	6-8	7.7-7.9
c'	3-4	13-15	5-6	9.1-9.2
V	44-52	33-41	32-38	33.1-34.4
G2	12-18	11-15	14-15	10.8-12.0
Odontostyle length	13-15	10-11	9	16.9-17.9
Odontophore length	13-17	12-13	11-13	23.4-24.4
Guiding ring from ant. end	7	6-7		9.1-9.6
Nerve ring from ant. end		60-65		119.7-121.4
Basal expanded part of oesophagus	70-75	75-80	46-50	137.1-142.1
Vulva from ant. end	385-395	275-285	215-235	491.3-520.7
Prerectum	30-35	22-40	27-32	44.7-47.7
Rectum	20-28	18-22	19-20	20.8-21.4
Tail length	78-94	175-225	72-86	191.7-196.4

Continued to Table 1

Morphometric chracters	<i>L. spicatum</i> n = 3 ♀♀	<i>L. tropicum</i> n = 3 ♀♀	<i>L. wickeni</i> n = 36 ♀♀
L	0.61-0.68	0.57-0.59	0.78-0.96
a	24-32	21-23	25-36
b	3.9-4.2	4.0-4.1	4.1-4.7
c	15-18	7.6-8.3	4.8-7.8
c'	1.92-1.95	4	6.3-8.9
V	43-45	40-41	39-44
G2	10.5-11.5	11-12	19-40
Odontostyle length	8.0-8.5	8	9-12
Odontophore length	10.5-11.0	10-11	9.5-13.0
Guiding ring from ant. end	5.8	6	8
Nerve ring from ant. end	72-73	68-70	85-90
Basal expanded part of oesophagus	60-68	62-64	70-73
Vulva from ant. end	276-296	271-284	298-311
Prerectum	48-52	22-32	52-56
Rectum	24-25	19-26	29-32
Tail length	34-43	70-77	121-143

Shaheen and Ahmad (2005) described *Thornenema spicatum* from soil around roots of forest trees from Haflong, North Cachar Hill, Assam State, India. The species is characterized by having small sized body (L=0.6 mm); abruptly narrowed, bottle-shaped anterior region; amalgamated lips; genital system mono-opisthodelphic with anterior uterine sac less than one anal body width long and spicate tail. In the characteristic shape of lip region the species closely resembles to the species of the genus *Lagenonema*. Thus we shifted the species from the genus *Thornenema* to *Lagenonema*, and described as *L. spicatum*. Besides the above characteristics, the other important characters of the species are slightly curved ventrad body upon fixation; cuticle with fine transverse striations; amphids with cup-shaped fovea and slit-like aperture; spear 1.8-2.0 times the lip region width long with its aperture about one-third of its length; guiding ring single; odontophore 1.2-1.5 times the spear length; cardia dome-shaped; vulva a transverse slit, not sclerotized; prerectum and rectum 2.4-2.9 and 1.2 anal body widths long respectively; tail hemispheroid then spicate, terminus rounded.

L. thornei was described by Gantait *et al.* (2010) from Paschim Medinipur district of West Bengal, India, collected from rhizospheric soil of banana cv. Kanthali. The species is characterized in having ventrally curved body mainly at posterior region, tapering towards both the extremities. Cuticle with fine transverse striations. Lip region amalgamated, narrow and cylindroids-truncated in shape. Labial 1 framework strongly sclerotized. Odontostyle 2.5-2.7 times the lip region width long, its aperture about 1/4th-1/3th of its length. Guiding ring single. Basal expanded part of oesophagus occupied 46-48% of total oesophageal length. Cardia tongue-shaped. Vulva a transverse slit. Vagina thick-walled. Gonad mono-opisthodelphic. Preovulval uterine sac short (3.5 μ m). Prerectum 2.0-2.5 times anal body width long. Rectum as long as anal body diameter. Tail long, filiform with subacute terminus, about 9 times anal body width long.

We can conclude that the genus *Lagenonema* Andrassy, 1987 is a well defined and distinct genus. It possesses seven species globally viz. *L. caudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andrassy, 1987, *L. longicaudatum* (Jairajpuri, Ahmad

and Dhanachand, 1979) Andrassy, 1987, *L. loofi* (Jairajpuri, Ahmad and Dhanachand, 1980) Andrassy, 1987, *L. spicatum* Shaheen and Ahmad, 2005, *L. thornei* Gantait, Bhattacharya and Chatterjee, 2010, *L. tropicum* Andrassy, 1987 and *L. wickeni* (Yeates, 1970) Andrassy, 1987.

Key to species of *Lagenonema*

(Based on female; male unknown in all the species)

1. Tail long, filiform, 13-15 times as long as anal body width.....2
 - Tail shorter, 3-9 times as long as anal body width 3
2. Body 0.67-0.75 mm long; a= 26 -31; b= 4.3-4.7; c= 3- 4; c'= 13-15; odontostyle = 10-11 μ m; odontophore=12-13 μ m
 -*longicaudatum* (Jairajpuri, Ahmad & Dhanachand, 1979) Andrassy, 1987
 - Body 1.48-1.55 mm long; a = 39.52-39.86; b = 5.07-5.27; c = 7.72-7.93; c' = 9.20-9.23; odontostyle= 16.92-17.96; odontophore= 23.46-24.44*thornei* Gantait *et al.*, 2010
3. Tail in two parts: anterior portion hemispheroid and posterior portion digitate or spicate, suddenly narrowing about one anal body width behind anus4
 - Tail not so abruptly tapering between its anterior and posterior part5
4. Body 0.60-0.89 mm long; c= 8-10; c'= 3-4; V= 44-52; odontostyle= 13-15 μ m; Odontophore =13-17 μ m; tail= 78-94 μ m.....
 - *caudatum* (Jairajpuri, Ahmad & Dhanachand, 1979) Andrassy, 1987
 - Body 0.61- 0.68 mm long; c = 15-18; c' = 1.92-1.95; V = 43-45; odontostyle = 8.0-8.5 μ m; odontophore= 10.5-11.0 μ m; tail= 34-43 μ m.....*spicatum* Shaheen & Ahmad, 2005
5. Body 0.8-0.9 mm long; tail 6-9 times anal body width long; c'= 6.5-9
 - *wickeni* (Yeates, 1970) Andrassy, 1987
 - Body 0.6-0.7 mm long; tail 4-6 times anal body width long; c'= 4-6 6
6. Cuticle conspicuously thickened behind spear; oesophagus gradually enlarged; L= 0.6-0.7

- mm; a = 24-26; b = 4.1-4.3; V = 32-38; c' = 5-6
 *loofi* (Jairajpuri,
 Ahmad & Dhanachand, 1980) Andrassy, 1987
- Cuticle not thickened behind spear; oesophagus
 abruptly enlarged; L= 0.57-0.59; a= 21-23; b=
 4.0-4.1; V= 40-41; c'= 4
*tropicum* Andrassy, 1987

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REFERENCES

- Andrassy, I. 1959. Taxonomische Übersicht der Dorylaimen (Nematoda). I. *Acta Zoologica Academia Scientiarum Hungarica*, **5**: 191-240.
- Andrassy, I. 1987. The superfamily Dorylaimoidea (Nematoda) – a review. Families Thorniidae and Thornenematidae. *Acta Zoologica Hungarica*, **33** (3- 4): 277-315.
- Carbonell, E. and Coomans, A. 1986. The genus *Thornenema* Andrassy, 1959 (Nematoda: Thornenematidae). *Nematologica*, **32**: 125-179.
- Coomans, A. and Carbonell, E. 1981. Observations on the genus *Thornenema* Andrassy, 1959, with description of two new species from Ivory Coast. *Nematologica*, **27**: 292-305.
- Gantait, V.V., Bhattacharya, T. and Chatterjee, A. 2010. A new species of the genus *Lagenonema* Andrassy, 1987 (Nematoda: Dorylaimidae) from West Bengal, India. *Opuscula Zoologica Budapest*, **41** (1): 77-81.
- Jairajpuri, M.S. 1966. On *Basirotyleptus caudatus* n. sp. and a redescription of *Thornenema thienemanni* (Schneider, 1937) Andrassy, 1959. *Proceedings of the helminthological Society of Washington*, **33**: 30-33.
- Jairajpuri, M.S. and Ahmad, W. 1992. Dorylaimida: free-living, predaceous and plant parasitic nematodes. Oxford and IBH Publishing Company Private Limited, New Delhi. 458 pp.
- Jairajpuri, M.S., Ahmad, M. and Dhanachand, C.H. 1979. Two new species of *Thornenema* Andrassy, 1959 from Manipur, India. *Nematologica*, **25**: 136 -141.
- Jairajpuri, M.S., Ahmad, M. and Dhanachand, C.H. 1980. Nomenclatorial notes on *Thornenema thienemanni* with a key to species of *Thornenema* (Nematoda: Dorylaimida). *Nematologica*, **26**: 182-186.
- Sauer, M.R. 1981. Comparative morphology of six *Thornenema* species. *Nematologica*, **27**: 72-81.
- Shaheen, A. and Ahmad, W., 2005. Descriptions of four new species of Dorylaimida (Nematoda). *Journal of Nematode Morphology and Systematics*, **8** (1): 19-29.
- Schneider, W. 1937. Freilebende Nematoden der Deutschen Limnologischen Sundaexpedition nach Sumatra, Java und Bali. *Arch. Hydrobiol. Suppl.*, **15**: 30-108.
- Yeates, G.W. 1970. Four Dorylaimina (Nematoda) from Wicken Fen, Cambridgeshire. *Nematologica*, **16**: 273-283.