DESCRIPTION OF *PARAHADRONCHUS SHAKILI* (MONONCHIDA: NEMATODA) SHOWING SOME ABNORMALITIES IN THE BUCCAL CAVITY WITH AN UPDATED KEY TO SPECIES OF THE GENUS *PARAHADRONCHUS*

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Summary. *Parahadronchus shakili* (Jairajpuri, 1969) Mulvey, 1978 is widely distributed in India. The morphometrics of a population showing some abnormalities in the buccal cavity are reported. Both female and male specimens were collected from the district South 24-Parganas, West Bengal, India. Female body 2.74-2.85 mm long; a = 32.9-35.6; b = 4.2-4.5; c = 6.3-7.4; c´ = 7.7-12.8; V% = 65.1-72.8. Gonads double, ovary reflexed, length of ovary less than oviduct length, uterus longer than oviduct, sphincter distinct at oviduct-uterus junction. A few females gravid with 2-4 large intra-uterine eggs. Male body 2.90-3.55 mm long; a = 45.0-53.7; b = 4.8-5.1; c = 8.3-9.7; c´ = 4.7-6.4; PO = 11-15. Female and male specimens generally have four sub-ventral teeth on each of the two sub-ventral walls of the buccal cavity, but a few male specimens from South 24-Parganas showed some variability in their buccal cavity. Their two sub-ventral walls bear 0-5 sub-ventral teeth. Among the eleven described species of the genus *Parahadronchus* Mulvey, 1978, eight were reported from India. An updated list of species under the genus *Parahadronchus* and a key to their identification have been included.

Key words: Abnormal buccal cavity, list of species.

Parahadronchus shakili was first described by Jairajpuri in 1969 under the genus *Hadronchus.* Later, Mulvey (1978) transposed this species to the genus *Parahadronchus* Mulvey, 1978, which belongs to the subfamily Iotonchinae Jairajpuri, 1969, family Anatonchidae Jairajpuri, 1969, order Mononchida Jairajpuri, 1969.

Naseem and Jairajpuri (1981, 1982a and 1982b) analyzed the variability of *P. shakili* from Bareilly, Uttar Pradesh, India. Later, they observed the development of juveniles to adults through moulting (1982a) and showed some intra-specific variations within the same species (1982b). *Parahadronchus shakili* is widely distributed in Northern and North-Eastern India. Presently, eleven valid species are reported under the genus *Parahadronchus*, of which eight have been reported from India. Andrássy (1994) provided a key to six species of the genus *Parahadronchus*.

The present study was made on the morphometrics of females and males of *P. shakili* from the district South 24-Parganas, West Bengal, India. Reports on some abnormalities in the buccal cavity of males of *P. shakili* and an updated key to the species of the genus *Parahadronchus* have also been included.

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MATERIALS AND METHODS

The nematode specimens were extracted by a modified Baermann funnel technique (Christie and Perry, 1951), fixed in hot diluted 4% FA (formalin-acetic acid mixture) (Seinhorst, 1966), mounted on slides in anhydrous glycerin and sealed. Figures were drawn with the aid of a camera lucida attached to the microscope. Body dimensions were tabulated using de Man's formula (de Man, 1880).

DESCRIPTION

PARAHADRONCHUS SHAKILI
(Jairajpuri, 1969) Mulvey, 1978
(Figures 1, 2; Table I)

Female. Body long, habitus curved; cuticle moderately thick all over the body. Width of lips less than adjacent body width. Dorsal tooth basal, sub-ventral walls generally bear four teeth, geusids prominent. Excretory pore situated behind the nerve ring, oesophageal glands prominent, oesophagus cylindrical and muscular, length of cardia half its width. Gonads double (didelphic-amphidelphic), ovary reflexed, length of ovary less than oviduct length, uterus longer than oviduct, sphincter distinct at oviduct-uterus junction. A few females with 2-4 large intra-uterine eggs. Measurements of first intra-uterine eggs of anterior gonad 140.3 × 60.2 - 149.9 × 62.6 µm, second intra-uterine eggs of anterior gonad 140.6 × 60.0 - 142.6

× 62.0 µm, first intra-uterine eggs of posterior gonad 137.6 × 59.7 - 150.6 × 62.4 µm and second intra-uterine eggs of posterior gonad 139.5 × 59.5 - 142.2 × 62.4 µm. Vagina with three distinct parts, *pars proximalis vaginae, pars refringens vaginae* and *pars distalis vaginae*. Rectum length less than one anal diameter. Caudal pore absent. Tail elongate conoid, tip rounded, caudal glands three in number, spinneret opening terminal.

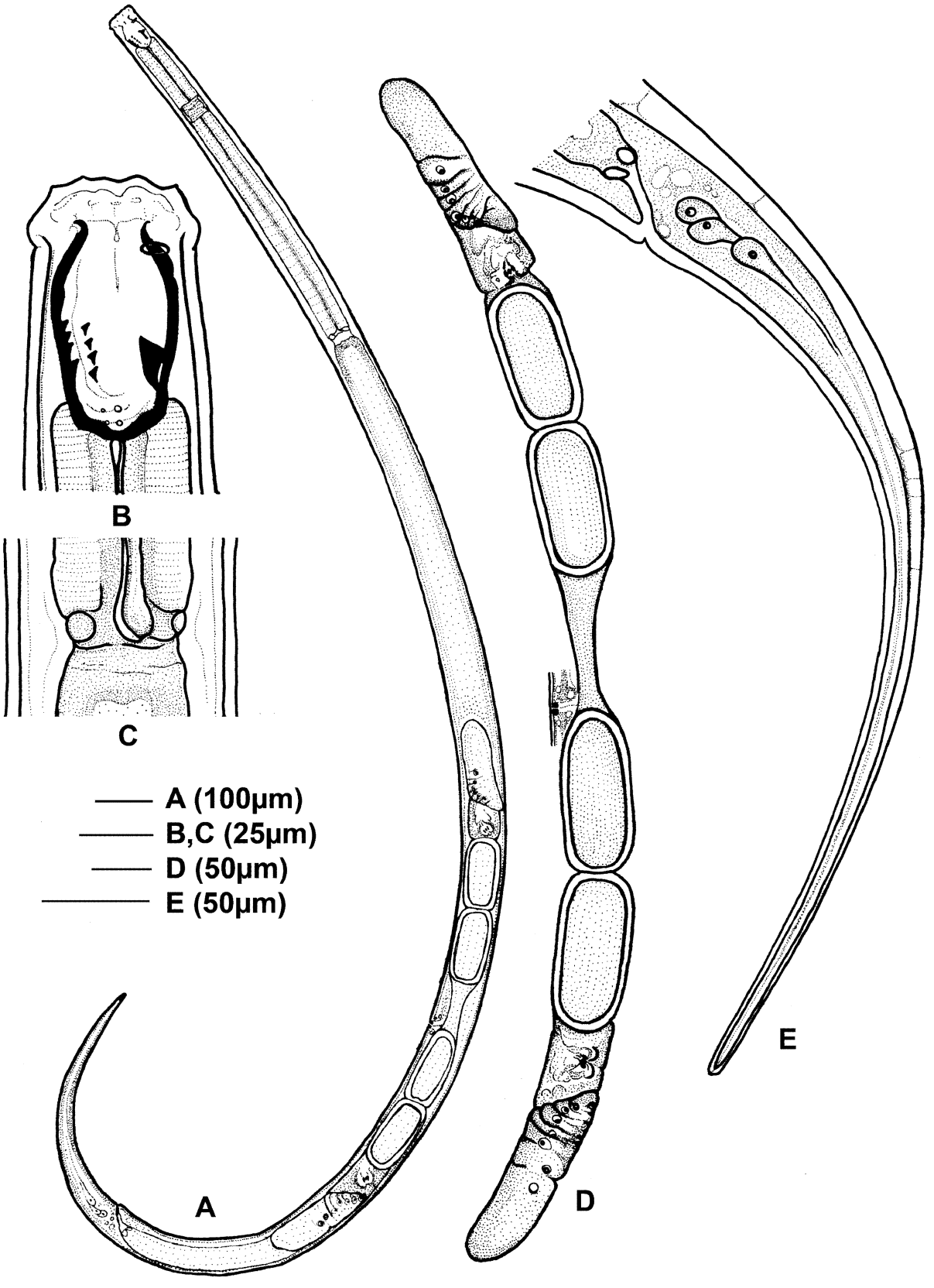

Fig. 1. Camera lucida drawings of female *Parahadronchus shakili.* Whole body; B. Head; C. Oesophago-intestinal junction; D. Gonad; E. Tail.

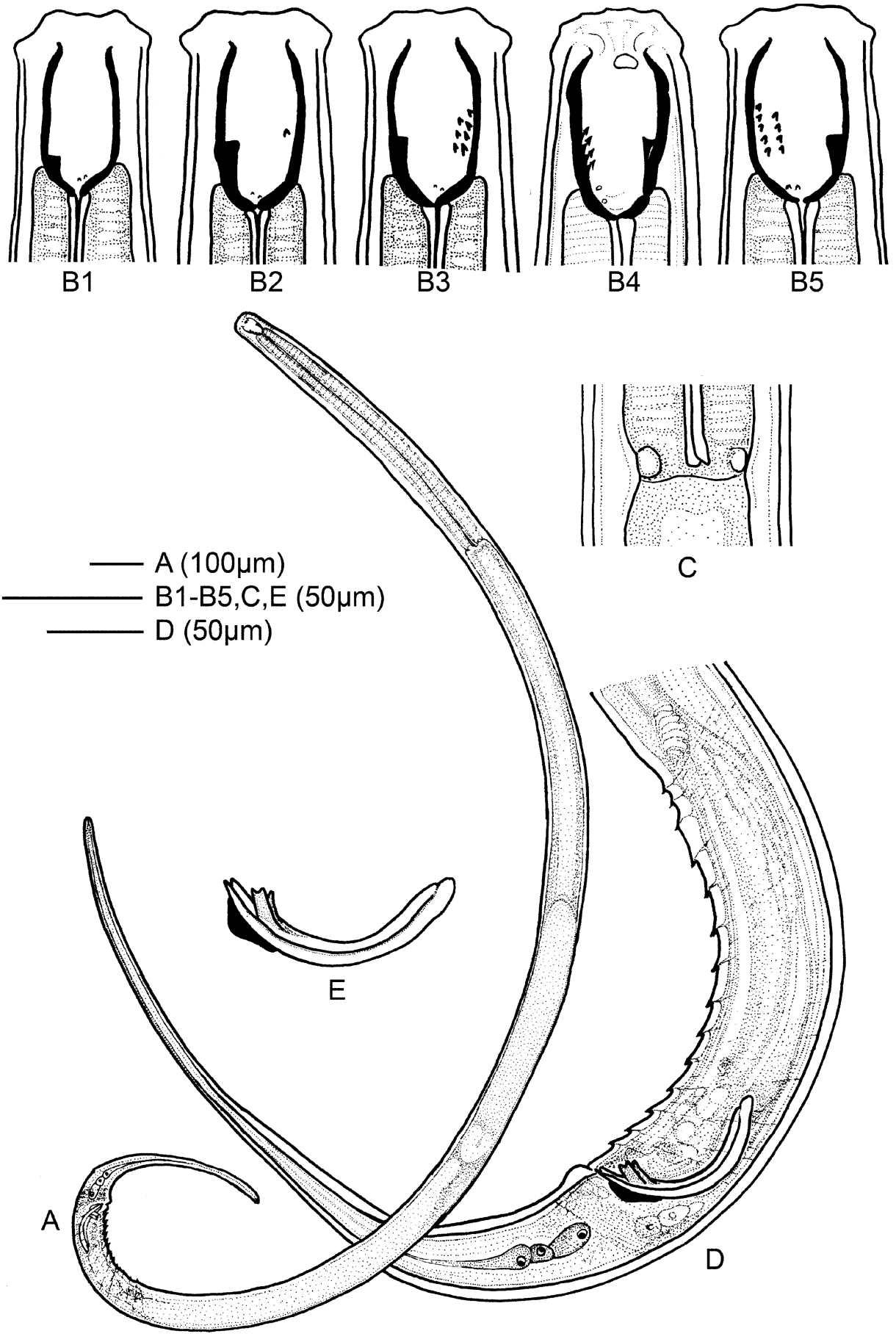

Fig. 2. Camera lucida drawings of male *Parahadronchus shakili.* A. Whole body; B1-B5. Variations of number of sub-ventral teeth in buccal cavity; C. Oesophago-intestinal junction; D. Caudal region; E. Spicules.

Table I. Morphometric data of *Parahadronchus shakili* (all measurements are in µm, except L in mm).

Measurements	Females (n = 16)	Males (n = 13)
	Mean ± SD (Min.-Max.)	Mean ± SD (Min.-Max.)
L	2.80±0.06 (2.74-2.85)	3.18±0.21 (2.90-3.55)
a	34.3±1.4 (32.9-35.6)	49.3±4.5 (45.0-53.7)
b	4.34±0.12 (4.2-4.5)	4.94±0.15 (4.8-5.1)
c	6.84±0.58 (6.3-7.4)	9.0±0.7 (8.3-9.7)
c'	10.27±2.66 (7.7-12.8)	5.57±0.9 (4.7-6.4)
V/T	68.9±4.0 (65.1-72.8)	19.5±11.2 (8.7-30.2)
G1	22.07±4.78 (16.66-27.37)	-
G2	21.24±3.21 (18.15-24.33)	-
Cuticle thickness at head region	4.18±0.04 (4.14-4.22)	4.18±0.04 (4.14-4.22)
Cuticle thickness at mid-body	8.89±0.01 (8.88-8.90)	8.89±0.01 (8.88-8.90)
Cuticle thickness at tail region	5.42±0.08 (5.34-5.50)	5.42±0.08 (5.34-5.50)
Lip height	5.45±0.05 (5.40-5.50)	6.27±0.41 (5.88-6.66)
Lip diameter	53.3±3.4 (50.0-56.6)	51.6±1.7 (49.9-53.3)
Mid-body diameter	81.6±1.7 (80.0-83.3)	71.6±5.2 (66.6-76.6)
Anal body diameter	51.1±5.7 (45.7-56.6)	63.3±3.5 (59.9-66.6)
Length of buccal cavity	63.3±3.4 (60.0-66.6)	63.3±3.5 (59.9-66.6)
Diameter of buccal cavity	37.5±2.6 (35.0-40.0)	43.3±7.0 (36.6-50.0)
Position of dorsal tooth from the base of buccal cavity	25.9±2.4 (23.5-28.2)	24.7±1.2 (23.5-25.9)
% of dorsal tooth of total buccal cavity length	40.6±1.5 (39.2-42.0)	39.2±4.1 (35.3-43.1)
Position of amphid from the anterior end	6.42±0.12 (6.30-6.54)	7.85±0.37 (7.50-8.20)
Diameter of amphidial aperture	5.90±0 (5.90-5.90)	7.85±0.37 (7.50-8.20)
Position of excretory pore from anterior end	181.6±4.1 (177.7-185.5)	178.9±1.5 (177.5-180.3)
Length of oesophagus	644.7±4.9 (640.0-649.4)	628.9±4.0 (625.0-632.7)
Length of cardia	15.8±0.2 (15.6-16.0)	16.8±1.2 (15.7-18.0)
Diameter of cardia	37.2±0.6 (36.6-37.8)	36.2±0.4 (35.8-36.5)
Position of nerve ring from anterior end	171.0±9.1 (162.2-179.8)	164.5±0 (164.5-164.5)
D	26.00±0.37 (25.65-26.36)	27.21±0.24 (26.98-27.44)
AS1	26.76±0.11 (26.66-26.87)	27.93±0.41 (27.54-28.33)
AS2	28.16±0.50 (27.68-28.64)	28.88±0.24 (28.65-29.10)
PS1	45.7±5.9 (40.0-51.3)	46.8±1.2 (45.7-47.9)
PS2	53.6±2.1 (51.5-55.6)	50.0±0.5 (49.6-50.5)
Glandularium	477.5±21.9 (456.4-498.7)	464.5±9.9 (455.0-474.0)
Anterior gonad	635.8±118.6 (521.6-750.1)	-
Uterus	267.8±111.3 (160.6-375.0)	-
Oviduct	207.0±1.4 (205.7-208.4)	-
Ovary	161.0±5.9 (155.4-166.7)	-
Posterior gonad	592.1±77.4 (517.6-666.7)	-
Uterus	225.0±60.6 (166.7-283.4)	-
Oviduct	204.4±4.2 (200.4-208.4)	-
Ovary	162.6±12.9 (150.2-175.0)	-
Vulval length	1924.8±72.5 (1855.0-1994.7)	-
Total length of vagina	19.02±0.07 (18.95-19.09)	-
Pars proximalis vagina	12.85±0.32 (12.55-13.16)	-
Pars refringes vagina	4.51±0.11 (4.40-4.61)	-
Pars distalis vagina	1.66±0.35 (1.32-2.00)	-
cw	14.01±0.49 (13.54-14.48)	-
Spicules	-	128.2±12.2 (116.6-139.9)
Gubernaculum	-	38.29±5.22 (33.30-43.29)
Ventro-median supplements	-	13.00±2.09 (11.00-15.00)
Accessory pieces	-	15.86±0.83 (15.07-16.65)
Pre- rectum	-	247.5±2.7 (244.9-250.1)
Rectum length	42.35±0.21 (42.15-42.55)	47.67±1.18 (46.55-48.80)
Tail length	410.6±26.6 (385.0-436.2)	348.0±40.0 (309.7-386.3)
Tail length as % of total body length	14.71±1.26 (13.50-15.92)	11.15±0.87 (10.32-11.99)

Male. General characters similar to females. Each sub-ventral wall of the buccal cavity generally bears four teeth but marked variations were observed: the two sub-ventral walls may contain 0-5 teeth. All the adult males bear double testes, spicules, gubernaculum and accessory pieces. Rectal glands and ejaculatory glands markedly developed.

Locality and associated plants. During a survey in the district South 24-Parganas in the years 2004 and 2005, a few specimens of *Parahadronchus shakili* were collected from the rhizospheric soil of paddy (*Oryza sativa* L.), guava (*Psidium guajava* L.), litchi (*Litchi chinensis* Sonn.), mango (*Mangifera indica* L.), and jack fruit (*Artocarpus heterophyllus* L.). All specimens were deposited at the National type collection of the Zoological Survey of India, Kolkata, India.

Remarks. The specimens fit with the description given by Jairajpuri and Khan (1982) and Andrassy (1994), though in the present observations male specimens were found larger than the previously described specimens. Dorsal tooth apex at 39.2-42.0% of total buccal cavity length in females and 35.3-43.1% in males is a lower value than in the previous descriptions of Jairajpuri and Khan (1982) and Andrássy (1994) (40-45% and 50-60%, respectively). Females collected from South 24-Parganas generally bear four sub-ventral teeth in each of the sub-ventral walls, in front of a medium-sized dorsal tooth; the variations were mainly found in male specimens. They bear 0-5 sub-ventral teeth in front of the dorsal tooth (Figure 2, B1-B5), possibly as a consequence of intra-specific variation within this species. The variations in numbers of sub-ventral teeth in the two sub-ventral walls are as follows: 0-0, 0-1, 3-4, 4-4 and 4-5. However, other taxonomic characters, viz. the shape of the whole body, shape of the buccal cavity, lip region, oesophagus, oesophago-intestinal junction, didelphic-amphidelphic gonad, the shape of tail caudal glands and spinneret opening, coincide with the previous descriptions of the species. This species has only been reported from India, namely from Kathgodam, Nainital (Uttar Pradesh), Lakhimpur (Kheri), Bareilley, Haridwar (Saharanpur) (Jairajpuri and Khan, 1982) and Cooch Behar (West Bengal) (Baqri and Khera, 1977). The present report of *P. shakili* is for the first time from the district South 24-Parganas, West Bengal, India.

List of the eleven species under the genus *Parahadronchus*

P. andamanicus (Jairajpuri, 1969) Mulvey, 1978
  Hadronchus andamanicus Jairajpuri, 1969
P. diphuensis Phukan *et* Sanwal, 1981
  Hadronchus diphuensis Phukan *et* Sanwal, 1981
P. egregius Andrassy, 1994
P. magnus Dhanam *et* Jairajpuri, 1998
P. mangiferi Saha, Lal *et* Singh, 2006
P. marami Renubala *et* Dhanachand, 1992
P. selangorensis Loof, 2006
P. shakili (Jairajpuri, 1969) Mulvey, 1978
  Hadronchus karangensis Phukan *et* Sanwal, 1981
  Hadronchus shakili Jairajpuri, 1969
P. siroii Renubala & Dhanachand, 1992
P. subhonicus Dhanachand, Renubala *et* Mohilal, 1991
P. yuenae (Thong, 1971) Mulvey, 1978

Key to the species of the genus *Parahadronchus*

1.	Female prodelphic ……..……..…….	2
	Female amphidelphic ……..……..…….	4
2.	Post-uterine sac absent; tail 590-660 µm long. ♀: L = 2.3-2.9 mm; a = 35-41; b = 4.2-4.7; c = 3.9-4.7; V = 56-62%; c' = 12-13. ♂: unknown. (Singapore) ……..……..	*yuenae*
	Post-uterine sac 2-3 times the body width; tail 410-500 µm long ……..……..	3
3.	Buccal cavity 60-80 µm long, 35-45 µm wide; caudal spinneret terminal. ♀: L = 2.2-3.2 mm; a = 30-41; b = 3.7-4.4; c = 5-13; V = 64-75%; c'= 8-10. ♂: L = 2.2-2.8 mm; a = 32-42; b = 4.0-4.4; c = 6-8; PO = 12-13. (India) ……..	*andamanicus*
	Buccal cavity 50 µm long, not so wide; caudal spinneret subdorsal. ♀: L = 2.8 mm; a = 38; b = 4.7; c = 5.7; V = 67%; c' = 8-9. ♂: L = 2.2-2.5 mm; a = 36-39; b = 4.2-4.9; c = 6.6-7.1; PO = 12-13. (India) ..... ……	*subhonicus*
4.	Body longer than 3.6 mm. ♀: L = 3.6-4.7 mm; a = 48-51; b = 4.4-4.9; c = 8-9; V = 58-60%; c' = 7.9-9.9. ♂: L = 4.0-4.1 mm; a = 50-57; b = 4.1-4.4; c = 10-11; PO = 15-16. (India) ……..……..……..……..……..……	*magnus*
	Body about 3 mm long or shorter ……..……	5
5.	Tail about 400 µm long or shorter ……..……..……	6
	Tail longer than 500 µm ……..……..…….	7

6.	Sub-ventral denticles arranged along four ridges; caudal spinneret lacking. ♀: L = 2.5mm; a = 42; b = 4.5; c = 4.2; V = 54%; c' = 18. ♂: unknown. (Vietnam)	*egregius*
	Sub-ventral denticles arranged along two ridges; caudal spinneret present	8
7.	Tail with terminal spinneret opening and without any caudal pores. ♀: L = 2.34-3.11 mm; a = 40.6-60.8; b = 5.0-6.3; c = 4.1-5.2; V = 52.2-59.3%; c' = 15.2-18.6. ♂: L = 2.18 mm; a = 42.5; b = 4.99; c = 4.52; PO = 11. (India)	*siroii*
	Tail with sub-ventral spinneret opening and with 3 pairs of caudal pores. ♀: L = 3.05-3.21 mm; a = 44-50; b = 3.9-4.9; c = 4.9-5.3; V = 58-60%; c' = 13-16. ♂: L = 2.18 mm; a = 42.5; b = 4.99; c = 4.52; PO = 11. (Western Malaysia)	*selangorensis*
8.	Apex of dorsal tooth at less than 30% of buccal length. ♀: L = 2.47-2.58 mm; a = 24-28; b = 4.2-4.3; c = 6.9-7.3; V = 60-62%; c' = 6.8-7.4. ♂: L = 2.48 mm; a = 33; b = 4.7; c = 11; PO = 12. (India)	*mangiferi*
	Apex of dorsal tooth at more than 30% of buccal length	9
9.	Spinneret opening subterminal. ♀: L = 2.38 mm; a = 46.6; b = 4.37; c = 6.3; V = 57.7%; c'= 10.6. ♂: L = 1.66-2.16 mm; a = 31.5-45.1; b = 3.7-4.6; c = 5.9-6.7; PO = 8-9. (India)	*marami*
	Spinneret opening terminal	10
10.	Apex of dorsal tooth at 60-70% of buccal length; sub-ventral ridges with 2-3 denticles each; spicula 65-70 µm long. ♀: L = 1.9-2.2 mm; a = 34-38; b = 4.2-4.7; c = 4.9-5.3; V = 56-59%; c' = 10-12. ♂: L = 1.9-2.2 mm; a = 36-40; b = 4.4-4.8; c = 5-6; PO = 10-11. (India)	*diphuensis*
	Apex of dorsal tooth at 40-60% of buccal length; sub-ventral ridges with 3-6 denticles each; spicula 80-95 µm long. ♀: L = 2.3-3.3 mm; a = 32-47; b = 4.2-4.9; c = 5.5-11.0; V = 56-73%; c' = 6-13. ♂: L = 2.0-3.55 mm; a = 28-54; b = 3.4-5.1; c = 6-10; PO = 11-15. (India)	*shakili*

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