INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2002/04–3–350–354
http://www.ijab.org

Species Structure of Earthworms in Various Crop Fields of Gujranwala District

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ABSTRACT

In an attempt to have an exhaustive checklist of earthworm species in Pakistan, crop fields of Gujranwala were explored. A total of 15 species were found. Of these, six species, *viz.*, *Lampito trilobatus* (Steph), *L. templetonianus* (Rosa), *L. willeyi* (Mich), *Pheretima taprobanae* (Bedd), *P. lignicola* (Steph) and *P. birmanica* (Rosa) were the new addition in the fauna.

Key Words: Earthworms; Crop fields; Gujranwala

INTRODUCTION

Gujranwala is situated in north east of the Punjab. It is rich agricultural land. The pattern of the temperature and rainfall results into two periods of plant growth i.e., Rabi and Kharif. The main food crops are wheat and rice. The soil is mostly loamy clay and loamy. Texture of the soil plays a very important role in its water holding capacity of the soil. The same is true for various faunal species, which are important for adding the nutrients in the soil by the break down of organic matter and making it suitable for the agriculture. Earthworms are said to play the best in this functioning.

The number of earthworms is important in functioning of nutrient cycles in the crop fields; whereas, the species are also important with respect to the vegetation type as they have specific preferences for their dietary plant materials. Phillipson *et al.* (1978) showed a strong positive association between numbers of *Aporrectodea caliginosa* and eight species of ground flora in a beech wood in England. They suggested that the ground flora might have provided important food resources to the worms in form of dead roots and microorganisms associated with the decaying roots. In Faisalabad region, the soil is mostly sandy loam harbouring *Pheretima posthuma* and its congeners in mixed-crop cultivations and along water bodies amongst them (Qureshi *et al.*, 1999; Rana *et al*., 2000b). The wheat and rice being the major rotation crops present a relatively different agro environment to the earthworm number and species in Gujranwala. The present study is an attempt to determine earthworm species and their relative abundance in loamy clay soils of Gujranwala.

MATERIALS AND METHODS

For the collection of earthworms, various fields in the cropland of Gujranwala were sampled at regular intervals of time from May 2000 through October 2000. The samples were taken fortnightly. A tin quadrangle covering a space of 1 ft square up to the depth of 1.5 ft in the soil was used for each sample. In each field, four quadrangles were installed in a row with a distance of 2.0 ft. To exploit the maximum expulsion of worms, different solutions such as aqueous solution of potassium permanganate, formaline and simple water were sprayed on the soils of quadrangles. After an interval ranging from 60-90 min., soil dug by a hoe was sorted out for the worms.

After anesthetizing in 5% alcohol for 15-60 seconds, the specimens were washed with tap water and kept in 10% formaline for 24 h. Then, these specimens were permanently kept in 5% formaline solution.

RESULTS AND DISCUSSION

A total of 96 samples of earthworms were taken during the period extending from May 2000 through October 2000 with an interval of 14 days using different extraction techniques. As many as 686 specimens belonging to five genera and 15 species were collected. In an ecosystem of limited or homogenous physical environment, it is difficult to determine the specific life requirements of a species with respect to the tolerance ranges of various physical factors because of greater overlap for the species occurring in the same area. Nonetheless, Table I provides the habitat distribution alongwith some ranges of soil characteristics in which various species of earthworms have been observed to exist. Some ecological observations of some of the earthworm species with relatively better sample size are given as under:

1. *Pheretima posthuma* was the most abundant species (228) found in eight habitats *viz.*, wheat, green chili, bitter gourd, pumpkin, sorghum, jantar, rice and millet, having the range of organic matter as 0.88 to 2.08, pH 7.62-8.65, Calcium 0.35-1.20 meq/L and the moisture as 34-44%.

2. *Pheretima heterochaeta* (165) was found in seven habitats *viz.* green chili, bitter gourd, pumpkin, sorghum, jantar, rice and millet, having the same ranges as those for *P. posthuma* except moisture which was 34-46%.
3. *Lampito mauritii* was procured from seven habitats *viz.*, wheat, bitter gourd, pumpkin, sorghum, jantar, rice and millet, having the ranges of organic matter and calcium as those of *P. posthuma* except pH which was 7.70-8.60.
4. *Ramiella bishambari* was found in two habitats i.e., wheat and green chilli, having 1.3-1.56% organic matter, 0.48-0.50 meq/L calcium, 38-42% moisture and pH 7.6-8.23.
5. *Lampito templetonianus* was found in three habitats i.e., sorghum, rice and millet, having 0.83-1.29% organic matters, 8.0-8.4 pH, 0.5-1.0 meq/L calcium and 36% moisture.
6. *Pheretima hawayana* was found in six habitats *viz.*, wheat, green chili, bitter gourd, pumpkin, jantar, and rice, having the same organic matter, pH, moisture ranges as those for *P. heterochaeta* except calcium 0.35-0.8 meq/L.
7. *Pheretima suctoria* was found in four habitats *viz.*, green chili, bitter gourd, jantar, and millet, having 0.93-1.66% organic matter, 8.05-8.8 pH, 0.35-1.2 meq/L calcium and 38-44% moisture ranges.

The other species namely, *P. elongata, A. rosea, E. incommodus* were not frequently found in the samples taken from various habitats in this study. This might be either due to their restricted distribution to other areas unexplored in this study or their number was very low due to some other non-conducive conditions. To contribute to the checklist of earthworms of Punjab, nine species has already been described by various workers in central Punjab (Rana *et al*., 2000a,b; Jalal, 1998). Six species namely, *L. trilobatus, L. templetonianus, L. willeyi, P. taprobanae, P. lignicola* and *P. birmanica* were reported by Stephenson (1923) from Ceylon, Madagascar, Brazil, Bhamo, Burma, Bombay and Dibrugarh but not from Punjab (Pakistan). Therefore, the complete description (Figs. 1-6) of these species is given below:

1. ***Lampito trilobatus*** (Steph) (Fig. 1)

Characteristics

Color	Light brown with purple streak
Prostomium	Proepilobous
Segments	lst simple rest trianulate
No. of Segments	The No. of segments of mature specimens range from 135-148 and immatures 115-135
Length	9-10 mm of mature specimens and 5-7 mm of immature specimens
Breadth	1.9-3 mm of mature and 1.0-2.5 mm of immature
Clitellum	Extends over 4 segments (xiv-xvii). Colour of clitellum is similar to that of rest body color
Length of clitellum	2-3 mm
Breadth of clitellum	2-2.5 mm
Setae	Perichaetine, almost closed ring with ventral irregular breaks
Dorsal pore	Start from 11/12 segments
Male pore	On xviii segment with semicircular inner border forms three lobes
Female pore	Single on xiv segment
Genital papillae	Absent
Spermathecal pore	Three pairs (6/7, 7/8, 8/9)
Locality	Sialkot bypass (Gujranwala)
Habitats	Crop field (Rice)
Total No. of immature specimens	0
Total No. of mature specimens	10
Total No. of specimens	10
Distribution	Baroda

Table I. Habitat (crop field) preference and tolerance of various earthworm species toward soil characters

	Habitats									O.M %	pH	Ca meq/L	Moisture %
Species	***Triticum aestivum* (Wheat)**	***Capsicum frutiscens* (Green Chili)**	***Mamodica charantia* (Bitter gourd)**	***Cucurbita pepo* (Pump-kin)**	***Sorghum bicolor* (Sorgh-um)**	***Sasbania sasban* (Jantar)**	***Oryza sativa* (Rice)**	***Pennisetum american* (Millet)**	**Total (Habitats)**	**O.R**	**O.R**	**O.R**	**O.R**
P. posthuma	24	60	25	45	23	28	1	22	228(8)	0.88-2.08	7.62-8.65	0.35-1.20	34-44
P. heterochaeta	-	21	42	52	12	27	1	10	165 (7)	0.88-2.08	7.62-8.65	0.35-1.20	34-46
L. mauritii	6	-	14	1	20	1	55	1	98 (7)	0.88-2.08	7.70-8.60	0.35-1.20	36-46
R. bishambari	1	74	-	-	-	-	-	-	75 (2)	1.30-1.56	7.6-8.23	0.48-0.50	38-42
L. templetonianus	-	-	-	-	18	-	6	2	26 (3)	0.83-1.29	8.0-8.4	0.50-1.0	36-36
P. hawayana	3	1	8	10	-	1	1	-	24 (6)	0.88-2.08	7.62-8.65	0.35-0.8	34-46
P. suctoria	-	7	10	-	-	5	-	2	24 (4)	0.93-1.66	8.05-8.8	0.35-1.20	38-44
P. elongata	-	-	-	-	9	1	-	1	11 (3)	1.0-1.66	7.62-8.8	0.46-0.80	38-44
P. taprobanae	-	-	4	-	6	-	-	-	10 (2)	0.88-1.40	8.0-8.6	0.5-0.58	36-38
L. trilobatus	-	-	-	-	-	-	6	4	10 (2)	1.4-1.66	7.52-7.72	0.48-0.49	42-42
A. rosea	-	6	-	-	-	-	-	-	6 (1)	1.0-1.56	7.62-8.60	0.48-1.2	36-42
P. lignicola	-	-	1	3	-	-	-	-	4 (2)	0.93-1.35	8.35-8.65	0.35-0.80	34-38
L. willeyi	-	-	-	3	-	-	-	-	3 (1)	1.2-2.08	7.7-8.34	0.70-0.74	34-46
P. birmanica	-	-	-	-	-	1	-	-	1 (1)	1.09-1.7	8.15-8.25	0.70-0.9	36-44
E. incommodus	-	1	-	-	-	-	-	-	1 (1)	1.4-1.66	7.52-7.7	0.48-0.49	34-42
Total (Species)	34 (4)	170 (7)	104 (7)	114 (6)	88 (6)	64 (7)	70 (6)	42 (7)	686				

Fig. 1. *Lampito trilobatus* (Steph)

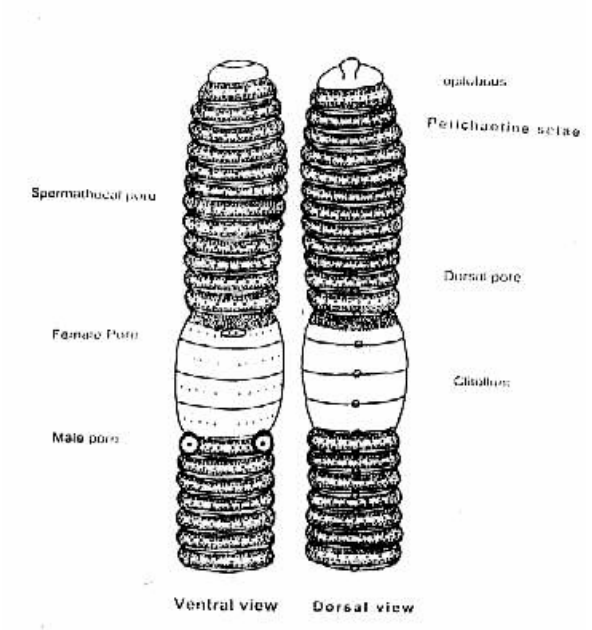
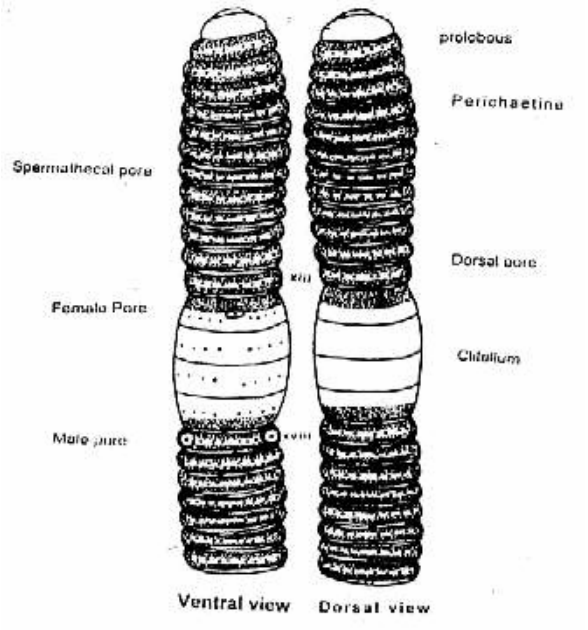


Fig. 2. *Lampito templetonianus* (Rosa)



2. ***Lampito templetonianus*** (Rosa) (Fig. 2)

Characteristics

Color	Yellowish to greenish grey
Prostomium	Proepilobous, protanylobous
Segments	i-iii simple, rest are trianulate
No of Segments	The No. of segments of mature specimens range from 150-160 and immatures 129-140
Length	55-70 mm of mature specimens and 40-45 mm of immature specimens
Breadth	2.5-5.0 mm of mature and 2.3-4.5 mm of immature
Clitellum	Extends over xiv-xvii segments
Length of clitellum	2-3 mm
Breadth of clitellum	2.9-5.0 mm
Shape of clitellum	Annular shape with dorsal pore
Setae	Perichaetine with dorsal and ventral breaks
Dorsal pore	Start from 12/13 segments
Male pore	Ventrally situated on small papillae in a rectangular depressed area, has swollen borders and extends over 1/3 xvii, xviii and xix
Female pore	Single on xiv segment
Genital papillae	Absent
Spermathecal pore	Two pairs (7/8, 8/9)
Locality	Peer Kot Road Sialkot bypass (Gujranwala)
Habitats	Crop fields (Rice, Millet, Jawar)
Total No. of immature specimens	9
Total No. of mature specimens	17
Total No. of specimens	26
Distribution	Colombo, Ceylon

3. ***Lampito willeyi*** (Mich) (Fig. 3)

Characteristics

Color	Live specimens dark grey. Preserved specimen-light grey
Prostomium	Proepilobous
Segments	i-v simple,vi-xiii bianulate and rest are trianulate
No of Segments	The No. of segments of mature specimens range from 135-155 and immatures 110-125
Length	55-70 mm of mature specimens and 40-45 mm of immature specimens
Breadth	2-3 mm of mature and 2-2.5 mm of immature
Clitellum	Extends over 4 segments (xiv-xvii)
Length of clitellum	4-4.5 mm
Breadth of clitellum	2.5-3.2 mm
Shape of clitellum	Ring shaped
Setae	Perichaetine
Dorsal pore	Start from 9/10 segments
Male pore	On xviii segment
Female pore	Single on xiv segment
Genital papillae	Absent
Spermathecal pore	Two pairs (7/8, 8/9)
Locality	Peer Kot Road (Ghakkhar) Gujranwala
Habitats	Crop field (Bitter gourd)
Total No. of immature specimens	1
Total No. of mature specimens	2
Total No. of specimens	3
Distribution	Labugana in Ratnapura Ceylon

Fig. 3. ***Lampito willeyi*** **(Mich)**

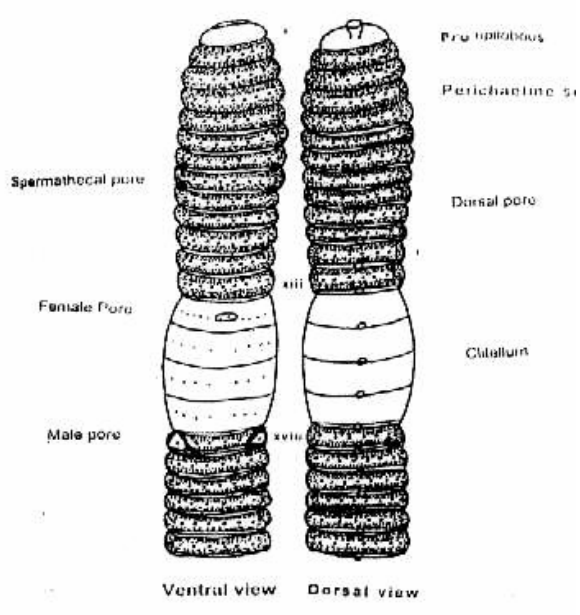
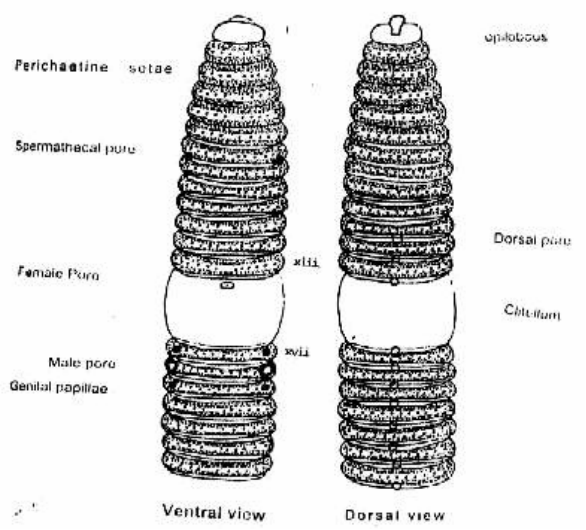


Fig. 4. ***Pheretima taprobanae*** **(Bedd)**



4. ***Pheretima taprobanae*** (Bedd) (Fig. 4)

Characteristics

Color	Preserved specimens yellowish grey
Prostomium	Protanylobous, Proepilobous
Segments	i-iii simple, iv-vi biannulate and rest are trianulate
No of Segments	The No. of segments of mature specimens range from 90-140 and immatures 85-125
Length	55-90 mm of mature specimens and 35-60 mm of immature specimens
Breadth	4-4.5 mm of mature and 3-4.2 mm of immature
Clitellum	Extends over 3 segments (xiv-xvi)
Length of clitellum	3-4 mm
Breadth of clitellum	3.5-4.12 mm
Shape of clitellum	Annular shaped
Setae	Perichaetine, Setal rings indistinctly broken dorsally, closed ventrally
Dorsal pore	Start from 11/12 or 12/13 segments
Male pore	On xviii segment
Female pore	On xiv segment
Genital papillae	Four pairs on 17, 19, 20, 21 segments
Spermathecal pore	On 7/8 segment
Locality	Peer Kot Road (Ghakkhar) Gujranwala
Habitats	Crop fields (Bitter gourd, Jawar)
Total No. of immature specimens	3
Total No. of mature specimens	7
Total No. of specimens	10
Distribution	Ceylon, India, Madagasar and Brazil

5. ***Pheretima lignicola*** (Steph) (Fig. 5)

Characteristics

Color	Olive green
Prostomium	Proepilobous
Segments	i-v simple, vi-vii bianulate and rest are trianulate
No of Segments	The No. of segments of mature specimens range from 110-120
Length	50-70 mm of mature specimens
Breadth	3.7-5.0 mm of mature
Clitellum	Extends over 3 segments (xiv-xvi)
Length of clitellum	4-5 mm
Breadth of clitellum	2.5-3.4 mm
Shape of clitellum	Saddle shaped
Setae	Perichaetine, circular ridges, the rings unbroken ventrally, a very slight gap dorsally
Dorsal pore	Start from 12/13 segments
Male pore	On xviii segment
Female pore	Single on xiv segment
Genital papillae	Two pairs on 17 and 19 segments
Locality	Peer Kot Road (Gujranwala)
Habitats	Crop fields (Pumpkin, Bitter gourd)
Total No. of immature specimens	0
Total No. of mature specimens	4
Total No. of specimens	4
Distribution	Dibrugarh, Assam, Lower Burma, Bombay

Fig. 5. *Pheretima lignicola* (Steph)

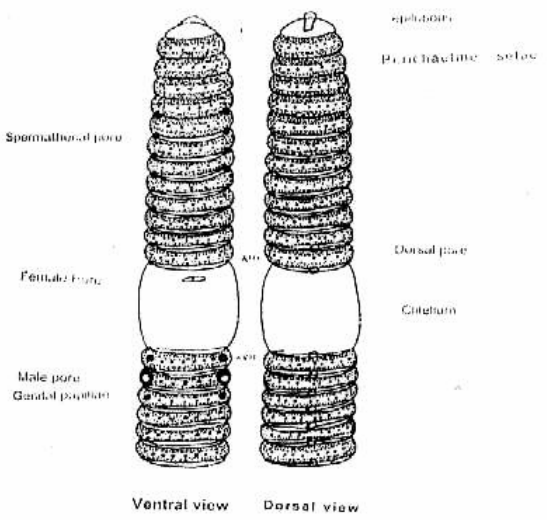
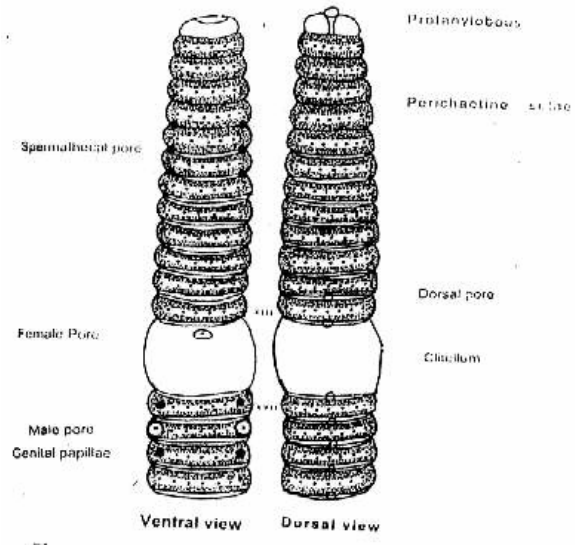


Fig. 6. *Pheretima birmanica* (Rosa)



6. ***Pheretima birmanica*** (Rosa) (Fig. 6)

Characteristics

Color	Reddish brown
Prostomium	Protanylobous
Segments	i-v simple, vi-vii bianulate and rest are trianulate
No of Segments	The No. of segments of mature specimens range from 104-115
Length	70-90 mm of mature specimens
Breadth	4.5 mm of mature specimens
Clitellum	Extends over 3 segments (xiv-xvi)
Length of clitellum	5 mm
Breadth of clitellum	4.5-5.0 mm
Shape of clitellum	Ring shaped
Setae	Perichaetine, setae in continue ring
Dorsal pore	Start from 11/12 segments
Male pore	On xviii segment
Female pore	Single on xiv segment
Genital papillae	One pair on xix segment
Spermathecal pore	Three pairs (6/7, 7/8, 8/9)
Locality	Rahwali (Gujranwala)
Habitats	Crop field (Jantar)
Total No. of immature specimens	0
Total No. of mature specimens	1
Total No. of specimens	1
Distribution	Metelio, Cheba or Biapo Dist. Burmas

CONCLUSION

Six species namely, *Lampito trilobatus* (Steph), *Lampito templetonianus* (Rosa), *Lampito willeyi* (Mich), *Pheretima taprobanae* (Bedd), *Pheretima lignicola* (Steph) and *Pheretima birmanica* (Rosa) are new additon to the checklist of earthworms of Punjab.There is no record of these species from Punjab, Pakistan. Yet, these have been reported from Ceylon, Madagascar, Brazil, Bhamo, Burma, Bombay and Dibrugarh in India.

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(Received 01 March 2002; Accepted 20 April 2002)