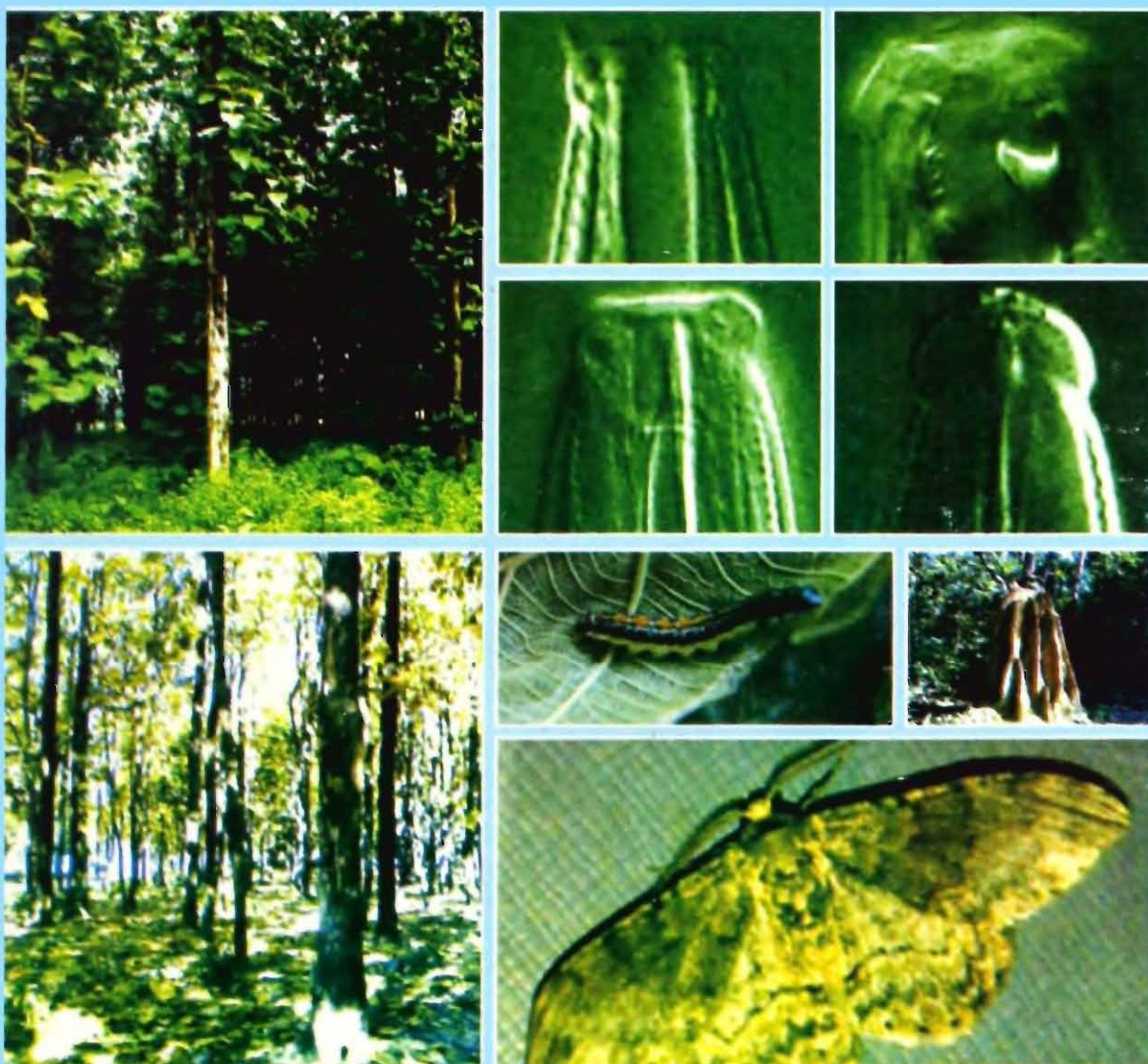


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# Nematodes Associated with Insect Pests and Soil of Teak and Sal Forests of Dehra Dun, Uttarakhand, India

**ANJUM NASREEN RIZVI**



ZOOLOGICAL SURVEY OF INDIA

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**RECORDS OF THE  
ZOOLOGICAL SURVEY OF INDIA**

**Nematodes associated with Insect Pests and  
Soil of Teak and Sal Forests of Dehradun  
(Uttarakhand), India**

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## **Chapter-1**

# **INTRODUCTION**

Nematodes are biologically diverse and versatile, occupying an enormous range of habitats with variable feeding habits. They belong to phylum Nematoda that includes plant, insect, animal and human parasites and predatory forms that consume microorganisms including bacteria fungi, algae and other nematodes (Platt, 1994). They constitute nearly 90% of all Metazoan in number and have 26646 recorded species with 8359 species parasitic in vertebrates, 10681 species free-living, 4105 species parasitic in plants and 3501 species parasitic in invertebrate hosts (Hugot *et al.*, 2001). Animal, plant and insect parasitic nematodes are of importance to agriculture, veterinary and human health. On the other hand, beneficial nematodes feed on other organisms and play important a role in recycling minerals and nutrients in the ecosystems (Wood, 1973). They are important components of food chains and possess several attributes that make them useful ecological indicators (Freckman, 1988; Bongers, 1990; Neher, 2001; Yeates 2003). Insect-parasitic nematodes play a very important role in regulating insect pest populations and in the biological control of many insect pests (Kaya & Gaugler, 1993; Grewal *et al.*, 2005). In the present study, nematodes including insect pest nematodes, insect associated nematodes and soil nematodes associated with the sal and teak forests of Dehradun were investigated.

The state of Uttarakhand, situated in the northern part of India shares an international boundary with China in the north and with Nepal in the east. The state has an area of 5.35 million ha and lies between lat 28° 43'N and 31° 28'N and long 77° 34'E and 81° 03'E.

Uttarakhand has a temperate climate except in the plains where the climate is tropical with temperature ranging from sub zero to 43°C. The average annual rainfall is 1.550mm. The recorded forest area is 34,662 km<sup>2</sup>, which constitutes 64.79% of its geographic area (FSI-State Forest Report-2005)

Dehradun or Doon valley is a distinct unique ecosystem in the foothills of Himalayas in Uttarakhand state. The valley is bound on the North-East by Lesser Himalayan belt, on the South-West by the Siwalik. Dehradun extends from the latitude 30° 19'N to longitude 78° 04'E. The mean average altitude is approximately 650 m. The Ganga and the Yamuna, demarcate South-Eastern and North-Eastern boundaries.

Dehradun has 51.59% of its geographic area under forest cover. Forest types are diverse ranging from temperate to tropical dry deciduous forest. Floristic composition of Doon valley determines it as a predominantly Sal forest region. Besides, having natural sal forests, Dehradun also has teak plantation forests along the sal forest in some areas like Timli forest range (Dharmawala, Sabbahwala), Thanu forest range, Kalsi forest and Lachchiwala forests. Plantation forests of both sal and teak are found in the New Forests of the Forest Research Institute.

## Chapter-2

# MATERIALS & METHODS

- Regular monthly surveys were done from April 2005 to December'2008 of the teak and sal forests of Dehradun.
- Insect pests belonging to orders Lepidoptera, Coleoptera, Isoptera and Orthoptera were regularly collected from Timli, Selaqui, Kalsi, Thano, Mohand, Langha Raipur, Lachchiwala, and Motichur Forest range and from New Forest, FRI, Dehradun.
- Shri R.S. Bhandari, Scientist-F, Forest Entomology Division, FRI, Dehradun, identified insect's adults and larvae.
- Some insect larvae were kept alive in jars for observation and emergence of parasites.
- Rests of the adults as well as larvae were dissected for the investigation of parasites.
- Dead larvae were also collected and examined for parasites.
- Nematode parasites collected were fixed in FA fixative (8ml Formalin, 2ml Acetic Acid, 90 ml Distilled water), dehydrated in desiccator containing anhydrous  $\text{CaCl}_2$  for 2-3 weeks.
- Permanent slides were prepared by mounting the dehydrated nematodes in anhydrous glycerine and wax-sealed.
- For soil nematodes, soil samples collected around the root zone of teak and sal were processed by sieving and decantation technique. Nematodes were fixed, dehydrated and mounted in anhydrous glycerine.
- Nematodes were studied under BX51 DIC Olympus microscope.
- Measurements were made with an ocular micrometer and photomicrographs taken with DP20 Olympus digital camera.

### ***Dimensions used:***

L	=	Body Length
W	=	Body width
T	=	Tail length
ES	=	Pharynx length
EP	=	Excretory pore
a	=	$L/W$
b	=	$L/ES$
c	=	$L/T$
c'	=	$T/ABD$
ABD	=	Anal Body Diameter
V	=	$Vulva /L \times 100$
H%	=	$Hyaline\ portion\ on\ tail/T \times 100$
D%	=	$EP/ES \times 100$
E%	=	$EP/T \times 100$

## Chapter-3

# INSECTS PESTS OF NATURAL SAL (*SHOREA ROBUSTA*) FORESTS & TEAK (*TECTONA GRANDIS*) PLANTATION FORESTS OCCURRING IN DEHRADUN

Forest insects, in terms of terrestrial synecology, represent an important component of forest biocoenosis, which includes all life communities occurring in the forest. Forest insects are associated with every stage of development and growth of forest trees, from the seed stage to the finished product, posing constant problems and constraints in the efficient management of forest resources.

### ***Insect pests of natural sal forests***

Floristic composition of Doon valley determines it as a predominantly sal forest region. The main forests areas occur in Timli forest range, Thano range, Langha range Lachhiwala, Raipur, Motichur range etc. Insect pests of sal are divided as defoliators, stem borers and sap suckers.

*Defoliators:* Defoliation is not a serious problem in sal nurseries, however, a large number of insect species cause defoliation in sal forests. Most important ones are lepidopterous defoliators, coleopteran beetles less so.

### ***Lepidopterous defoliators.***

- (i) *Ascotis selenaria imparata* Walker (Geometridae). It is a polyphagous insect feeding on many forest trees including sal. In Dehradun Forests Division, epidemic defoliation was recorded during 1964, 1967, 1971, 1974 and 1975 (Singh & Thapa, 1988).
- (ii) *Acrocercops chrysoplitis* Meyrick (Lithocolletidae). The larva of this moth is recorded as leaf minor pest of sal. The eggs are laid on leaves and the larvae burrows into the tissues forming a blotch mine.
- (iii) *Antheraea paphia* Linnaeus (Saturniidae). The larvae of this moth are polyphagous leaf feeders.
- (iv) *Cryptothelea crameri* Westw. (Psychidae). The larvae are polyphagous on the foliage and tender barks of broad leaved trees and conifers.
- (v) *Dasychira grotei* Moore (Lymantriidae). The larvae are polyphagous and feed on the foliage of several trees including sal. Trees of all age groups are infested and severe defoliation occurs from August to October.
- (vi) *Ectropis bhurmitra* Walker (Geometridae). The larvae are polyphagous and cause light to moderate defoliation in sal.
- (vii) *Euproctis scintillans* Walk. (Lymantriidae). It is also a polyphagous defoliating moth causing defoliation on many forest trees including sal.

- (viii) *Hyposidra successaria* Walker (Geometridae). The looper larvae are polyphagous on foliage of many trees including sal. Small population of this moth is always present in the sal forests.
- (ix) *Lymantria mathura* Moore (Lymantriidae). It is a polyphagous defoliator and recorded hosts include sal (Beeson, 1941; Mathur & Singh, 1960). Moth has two generations with larvae being active in April and during June to July. It is one of the principal defoliators of sal in northern India (Roonwal, Chatterjee & Thapa, 1962).
- (x) *L. ampla* Walker. It is also a polyphagous defoliator on several forests trees.
- (xi) *Ophiusa janata* Linnaeus (Noctuidae). It is polyphagous with sal as one of its host. The breeding of the insect continues round the year.
- (xii) *Orgyia postica* Walk. (Lymantriidae). It is also a polyphagous defoliator. It causes light to moderate defoliation in sal (Beeson, 1941).
- (xiii) *Selepa celtis* Moore (Noctuidae). It is polyphagous in nature, sometimes causing epidemic defoliation.
- (xiii) *Suana concolor* Walk. (Lasiocampidae). It is another polyphagous defoliator, causing defoliation in several forest trees including sal. It has two generations per year.
- (xiv) *Sylepta balteata* Fab. (Pyralidae). It is also a polyphagous defoliator feeding in a leaf roll.
- (xv) *Trabala vishnou* Lefebrae (Lasiocampidae). It is a polyphagous defoliator, feeding on young leaves mainly at night. This species has been reported to cause severe injury to sal.

**Borers of green standing trees:** A large number of insect borers cause extensive damage to green standing sal trees. Some of the common ones are:

- (i) *Aeolesthes holosericea* Fab. (Coleoptera: Cerambycidae). It is a longicorn beetle that breeds mainly in dead fallen trees of numerous species including sal.
- (ii) *Celosterna scabrator* Fab (Cerambycidae). It is a black-spotted beetle injurious to many forest trees including sal.
- (iii) *Diacavers furtivus* Sampson (Platygodidae). It exclusively attacks sal, the only known host of this beetle. It 's a secondary borer of weak and dying trees (Beeson, 1941).
- (iv) *Hoplocerambyx spinicornis* Newn.(Cerambycidae). It is a sal heartwood borer. It is the most serious pest of sal forests. The borer has a long recorded history of periodic epidemics from sal growing areas. Sal forest of Thanu Range suffered from the epidemic during 1916:1924 & 1965 and Timli forests during 1958-1960 (Beeson & Chatterjee, 1925; Chatterjee & Thapa, 1970).
- (v) *Sinoxylon crassum* Lesne (Bostrychidae). The beetle breeds in dead and dying sapwood branches and twigs and is injurious to the fuel wood lots. The adults tunnel in green shoots and young stems to feed (Beeson, 1941).

**Sap suckers:** Termites are the main sap suckers of sal forests.

- (i) *Coptotermes curvignathus* Holmgren (Isoptera: Rhinotermitidae). Attack of these termites on living trees takes place from the wounds or through the roots. The stem of the attacked tree is encased in a thick crust of earth, the bark is eaten away and the termites penetrate to the heartwood. The heartwood is hollowed and often filled with wood carton combs and infested trees are frequently wind thrown (Harris, 1961; Newsam & Rao, 1959).
- (ii) *Neotermes greeni* De Esneux (Kalotermitidae). It infests the heartwood of trees to which it usually gains entry through dead snags. It is a minor pest of sal (Mathur & Singh, 1960)
- (iii) *Odontotermes parvidens* Holmgren & Holmgren (Termitidae). It is subterranean termite, forages by runways to fallen timber and to the bark of living trees, on the stems of which it make mud plaster coverings. It is also injurious to roots.

### ***Insect pests of teak plantation forests***

Teak forests in Dehradun are mainly in the form of plantations, found in new forests of Forest Research Institute (FRI), Dharmawala, and Sabbahwala of Timli range, Langha Range, Thano Range and Lachchiwala.

Insect pests of teak can be divided as nursery pests and as pests of standing tree (Tiwari, 1992).

#### **Nursery pests comprise:**

- (i) White grubs (Coleoptera: Scarabaeidae): *Holotrichia serrata* Fabricius feed on the roots and rootlets of teak seedlings and *Clinteria klugi* feed on the rootlets.
- (ii) *Tarbinskiellus (Brachytrypes) portentosus* (Litch) (Orthoptera: Gryllidae): This cricket is injurious to the young seedlings in teak nurseries. Both nymphs and adults feed on the roots of the seedlings.
- (iii) *Aularches miliaris* Linnaeus (Orthoptera: Acrididae): The nymphs and adults of this grasshopper, commonly known as spotted locust, feed on the shoots and leaves.
- (iv) Termites: Termites cause serious damage to the seedlings e.g. *Coptotermes curvignathus*, *C. havilandi* and *Odontotermes parvidens*.

***Insect pests of standing trees comprise:*** Defoliators and stem borers.

***Defoliators:*** Defoliators are the main insect pests of teak. This includes lepidopterous, coleopterous, and orthopterous defoliators. Orthopterous defoliators are usually found in nurseries. The caterpillars of these lepidopteran insects cause severe defoliation in the teak plantations. Drastic reduction of mean annual increment due to defoliation has been reported every year.

**Lepidopterous defoliators:** The two most important defoliators of teak are:

- (i) *Eutechtona machaeralis* Walk. (Teak skeletonizer). All the larvae feed on the soft, green parenchymatous tissues between the network of veins, leaving the veins and vascular tissues intact. The leaves are skeletonized and gradually turn brown and fall. This defoliator is most abundant during October-November.
- (ii) *Hyblaea puera* Cramer (Hybaeidae). This is the most common teak defoliator. The larvae feed at night on leaves under the shelter of leaf fold. A series of 10 complete generations is possible at the average rate of development. The moth hibernates from December to February.

Other lepidopterous defoliators are not as injurious as the two above. Some of them are as given below:

- (iii) *Ascotis selenaria imparata* Walker is a casual feeder on new foliage of teak plants
- (iv) *Dasychira grotei* Moore (Lymantriidae) is also a casual feeder on teak foliage. The primary host being *Shorea robusta*
- (v) *Diacrisia obliqua* Butler (Arctidae) feeds on the leaves of teak along with other agricultural crops and plants.
- (vi) *Ectropis bhurmitra* Walker (Geometridae), the larvae are active on teak foliage during July to November.
- (vii) *Hyposidra successaria* Walker (Geometridae), it is polyphagous in habit and along with teak, feed on several forest trees. It is a minor pest of teak.
- (viii) *Prodenia litura* Fabricius (Noctuidae), it is also polyphagous and feeds on agricultural crops and forest trees including teak.

Coleopterous defoliators are minor pests. Most common is *Mylocercus discolor*.

**Stem borer:** Comprises mainly of coleopterous beetles. Some of the common borers of teak plantations are as given below:

### **Coleopterous borers:**

- (i) *Aristobia approximata*, it is reported to attack young trees. It feed on the bark of living shoots of several trees including teak.
- (ii) *Celosterna scabrator*, it lays its eggs on young living plants and the larvae bores on the stem.
- (iii) *Dihammus cervinus* Hope is known as canker grub of teak. It attacks living trees in plantations.
- (iv) *Zeuzera coffeae* Nietner. This is a serious pest of teak and coffee and is well known as coffee borer. It attacks woody stems of young living saplings.
- (v) *Xyleborus destruens* is a woody boring beetle of teak plantations

**Lepidopterous borer:** *Cossus cadambae* Moore is a borer of living, unhealthy and badly damaged trees.

**Table 1.** List of Insect pests occurring in Sal and Teak forests of Dehradun

S.N.	Insect Pest Lepidoptera	Sal		Teak
1	<i>Acrocercops chrysoplitis</i>	+		
2	<i>Antheraea paphia</i>	+		
3	<i>Archips micaceanus</i>			+
4	<i>Ascotis selenaria imparta</i>	+		+
5	<i>Blastobasis spermologa</i>	+		
6	<i>Cephonodes hylas</i>			+
7	<i>Cossus cadambae</i>			+
8	<i>Cryptothelea crameri</i>	+		
9	<i>Dasychira grotei</i>	+		+
10	<i>Dasychira mendosa</i>			+
11	<i>Diacrisia obliqua</i>			+
12	<i>Dichocrocis leptalis</i>	+		
13	<i>Dichocrocis punctiferalis</i>			+
14	<i>Ectropis bhurmitra</i>	+		+
15	<i>Euproctis scintillans</i>	+		
16	<i>Eupterote undata</i>			+
17	<i>Eurema hecabe</i>			+
18	<i>Eutectona machaeralis</i>			+
19	<i>Hyblaea puera</i>			+
20	<i>Hyposidra successaria</i>	+		+
21	<i>Hyposidra talaca</i>			+
22	<i>Hypsipyla robusta</i>			+
23	<i>Lymantria ampla</i>	+		+
24	<i>Lymantria mathura</i>	+		
25	<i>Ophiusa janata</i>	+		
26	<i>Orgyia basilis</i>			+
27	<i>Orgyia postica</i>	+		+
28	<i>Pagyda salvalis</i>			+
29	<i>Pammene thristis</i>	+		
30	<i>Prodenia litura</i>			+
31	<i>Selepa celtis</i>	+		
32	<i>Suana concolor</i>	+		+
33	<i>Sylepta balteata</i>	+		
34	<i>Trabala vishnou</i>	+		
35	<i>Zeuzera coffeae</i>			+
	<b>Coleoptera</b>			
36	<i>Aeolesthes holosericea</i>	+		
37	<i>Aristobia approximator</i>			+

Contd...

S.N.	Insect Pest Lepidoptera	Sal		Teak
3 8	<i>Batocera rufomaculata</i>	+		
3 9	<i>Celosterna scabrator</i>	+		+
4 0	<i>Clinteria klugi</i>			+
4 1	<i>Diacavas furtivus</i>	+		
4 2	<i>Dihammus cervinus</i>			+
4 3	<i>Dorysthes hugely</i>	+		
4 4	<i>Holotrichia problematica</i>	+		
4 5	<i>Holotrichia serrata</i>			+
4 6	<i>Hoplocerambyx spinicornis</i>	+		
4 7	<i>Mylocerus discolor</i>			+
4 8	<i>Plocaederus fastuosa</i>	+		
4 9	<i>Sinoxylon crassum</i>	+		
5 0	<i>Sitophilus rugicollis</i>	+		
5 1	<i>Sphaerotrypes siwalikensis</i>	+		
5 2	<i>Xyleborus destruens</i>			+
	<b>Isoptera</b>			
5 3	<i>Coptotermes curvignathus</i>	+		+
5 4	<i>Coptotermes havilandi</i>			+
5 5	<i>Neotermes greeni</i>	+		
5 6	<i>Odontotermes parvidens</i>	+		+
	<b>Orthoptera</b>			
5 7	<i>Auraches miliaris</i>			+
5 8	<i>Brachytrypes portentosus</i>			+

## **Chapter-4**

# **REVIEW OF WORK DONE ON INSECT NEMATODES**

Insect parasitism has arisen independently in four groups of nematodes. The first group is the Rhabditida, which gave rise to the gut-inhabiting Oxyurida and the bacteria carrying Steinernematidae and Heterorhabditidae. All these nematodes lack stylets like their ancestors and sometimes retain the dauer as an infective stage. Tylenchida and Aphelenchida characterized by the presence of stylet, form the second and third groups, which gave rise to insect parasitism. The Allantonematidae, Sphaerularidae and Entaphlenchida are descendents of these original plant-parasites. The fourth group from which insect parasitism evolved is the Dorylaimida, which gave rise to Mermithida. Mermithids have retained ancestral stylet, which is used to penetrate the body wall of their host.

Relationships between nematodes and insects vary from temporary to obligatory parasitism. According to Poinar (1975), insect nematode associations can be grouped into three basic types: phoretic relationship (insect associated), facultative parasitism and obligate parasitism.

### **Phoresis or insect associated relationship:**

This is a form of relationship in which one organism associates with another species in order to obtain transportation and is common between insects and nematodes. These occur in many rhabditids, which are carried from one habitat to another by insects frequenting decomposing matter. Many bark beetles serve as transport hosts for rhabditids, diplogasterids and aphelenchids, which feed on microorganisms found in the beetle galleries. These nematodes have little or no pathological effect on the host and benefit by being carried to a new environment.

### **Facultative parasitism:**

Some nematodes are able to infect healthy insects as well as have the ability to complete their life cycles as free-living organisms. These nematodes are regarded as facultative parasites of insects. Some rhabditids, diplogasterids and aphelenchids are facultative parasites.

### **Obligate parasitism:**

Obligate parasites cannot complete their life cycle in nature without a living insect. Most of the obligate nematode parasites, such as mermithids, tetradonematids, allantonematids, sphaerulariids and rhabditids occur in the hemocoel, exceptions being, oxyurids and a few other groups that are found in the insect's gut. Most of these nematodes castrate, debilitate, or kill their host and are potential candidates for biological control of insect pests.

## Research on insect nematodes in India

### *Mermithida*

The work on insect parasitic nematodes in India started as early as 1927. Iyengar (1927) reported Mermithids, an obligate parasite from *Anopheles* mosquitoes. Ayyar (1940) described a new species of mermithid, *Geomermis indica* from cotton stem weevil, *Pempheres affinis* Faust. New species of mermithid, *Romanomermis iyengari* from Tamil Nadu by Welch, 1964, led to the use of *Romanomermis* species for mosquito control at the Vector Control Research Centre, Pondicherry (Gajanana *et al.*, 1978; Bheema Rao *et al.* 1979; Paily *et al.* 1994). Besides, several mermithids species were reported as: *Hexamermis* sp. from potato tuber moth was recorded by Usman (1956). Khan *et al.* (1956) recorded mermithid sp. from rice stem borers. Srivastava (1964) collected *Hexamermis* sp. from sugarcane borers and it was also recorded from paddy field caterpillars, *Spodoptera mauritia* by Murad (1969). Mundiwale *et al.* (1978) recorded mermithids from sunflower pest *Heliothis*. Species of *Agamermis*, *Geomermis*, *Hexamermis*, *Limnomermis*, *Ramanomermis* have been reported to parasitize a wide range of insects of economic importance. *Hexamermis* sp. are frequent natural parasites of lepidopteran insects, with greater incidence of insects feeding on low growing crops such as groundnut, tomato and weeds (Bhatnagar *et al.* 1985). A high level of mermithids parasitism is generally reported from moist and moderate temperate conditions (Rahman *et al.* 2000).

### Rhabditida

#### *Steinernematidae* and *Heterorhabditidae*

Potential of *Steinernema carpocapsae* DD136 strain as the biocontrol agent of insect pest of rice, was first reported in India by Rao & Manjunath (1966). Several work on the effectiveness of DD136 strain of *Steinernema* were carried out against many insect pest by Mathur *et al.*, 1966; Singh & Bardhan, 1974; Singh, 1977 and Singh, 1993. Some species and strains of *Steinernema* were also isolated from soil by Vyas *et al.* (1999). Ganguly & Singh (2000) reported a new species of *Steinernema thermophilus* from soil. Two species, *S. mashoodi* and *S. seemai* were described by Ali *et al.* (2005). Several other known species of *Steinernema* have been recorded from soil from India. The research on Heterorhabditid group has not been carried out extensively in India. Sivakumar *et al.* (1989) recorded *Heterorhabditis* sp from Tamil Nadu and cultured these nematodes on larvae of wax moth, *Galleria melonella*, rice moth, *Corcyra cephalonica* and on dog biscuits. Few other studies include its occurrence in insect pests such as *Spodoptera*, *Helicoverpa*, *Amsacta* and *Holotricia*.

#### Other Rhabditids

*Panagrolaimus* sp. was recorded from alimentary canal from lepidopteran larval gallery by Mathur *et al.* (1966) and Muthukrishnan (1976). Besides, a new species, *Panagrolaimus migophilus* was described from *Musca domestica* by Poinar & Geethabhai (1976). Life cycle of *P. migophilus* was studied by Geethabhai & Shankaran

(1985), who reported that *M. domestica* is susceptible to *P. migophilus* nematodes. Another bacterivorous nematode, *Parasitorhabditis* sp. recovered from the larval stages of *Sesamia inferens* has been found to cause high mortality of rice pests when artificially inoculated (Nayak *et al.*, 1977, 1983).

## **Tylenchida**

The nematode allontonematids were reported to parasitize several orders of insects like Coleoptera, Thysanoptera, Lepidoptera and Hymenoptera (Devi *et al.* 1980; Reddy *et al.* 1982; Rukminidevi & Rao, 1982). An unidentified neotylenchid nematode was reported from *Scirophaga novella* by David (1962). Later, Muthukrishnan (1976) reported tylenchid association with important insect pests. Subsequently, life cycle and population dynamics of allontonematids, Heterotylenchid and *Howardula* were worked out by several workers (Devi *et al.*, 1980; Reddy & Rao, 1980; Yatham & Rao, 1980; Reddy *et al.*, 1982). *Howardula aptini* was recorded from thrips and was reported to occur throughout the year. Nymphs and females of thrips are susceptible to the nematode, and females have been reported to develop fewer eggs. The life cycle, nature of parasitism, occurrence and distribution of *H. aptini*, indicate it as a potential biocontrol agent under natural conditions (Rukminidevi & Rao, 1982). Further, *Howardula belgaumensis* was found to parasitize first and second stage of beetle grubs. The infected beetles have been reported to have a low reproductive potential (Raj & Reddy, 1989).

### ***Studies on nematodes from insect pests of Teak and Sal forests from Dehradun***

Very few reports are available from Dehradun on the insect pests of teak and sal forests. Mathur (1958) recorded mermithid nematode, *Mermis* sp. from several insect pests of forests trees including teak and sal. They recorded *Mermis* sp. from *Hyblaea puera* and *Eutechtone machaeralis* from teak plantations and from unidentified lepidopteran pest from sal forest of Dehradun. Similar work was done from several forest insect pests by Chatterjee & Singh (1965). They recorded *Hexamermis* sp. and *Mermis* sp. from *Hyblaea puera* from teak plantations and *Dichocrocis leptalis* from sal forests.

## Chapter-5

# INSECT PEST NEMATODES FROM SAL & TEAK FORESTS OF DEHRADUN

Insect pests belonging to four orders namely Lepidoptera, Coleoptera, Orthoptera and Isoptera were examined for insect nematodes. However, only two species of insect nematodes were recovered from these insects belonging to two different orders, Mermithida and Rhabditida.

Order MERMITHIDA

Family MERMITHIDAE

Genus *Hexamermis* Steiner, 1924

Members of the family Mermithidae are parasites of invertebrates. The larvae gain access to the body cavity of the host by means of piercing tooth. In the body cavity the mermithid absorbs food through its smooth skin and stores it as fat globules in the pseudo intestine (trophostome). Inside the host, mermithids can grow up to 50 cm in length. The pre-adult emerges from the host to mature in the soil to a free-living non-feeding adult. The adults have six cephalic papillae and two amphids. The reproductive tract is paired in both sexes. The vulva is equatorial in position. Spicules are paired or single, the caudal region bears numerous papillae arranged in 3 or more rows.

*Hexamermis truncata* (Rudolphi, 1809) Wouts, 1981

1809. *Mermis truncata* Rudolphi, *Hist Naturalis* Vol II, Amstelaedami.

1981. *Hexamermis truncata* Wouts, *Syst. Parasitology*, **3** : 127-132.

*Material examined*: 2 ♀♀, Timli sal forest, Dehradun, 4.v.06, Reg. No. IV/NRC/ZSI/385, coll. A. N. Rizvi & Party.

The pre-adult nematodes collected from the larvae of *Eutectona machaeralis* were found to belong to the genus *Hexamermis* as per the diagnosis (Wouts, 1984): Post-parasitic larvae ranges in length from 10-30 cm, have a terminal mouth opening and a digitate appendage on the tip of the tail.

Species identification is based on the mature female, but these could not be collected from the soil of forest, despite regular soil sampling analysis for investigation of nematodes. Wouts (1984) listed numerous species of Lepidoptera as hosts of *Hexamermis* and speculated that in the majority of cases, the parasite involved was *Hexamermis truncata*; therefore, probably the present nematode also belongs to *Hexamermis truncata*.

Life cycle of *H. truncata* described by Rosenhauer (1847) and Von Siebold (1855) and modified by Couturier (1950) is as follows:

The infective larvae develop in the soil and can survive for several months. During rainy season, when the plants are covered with a layer of moisture, they move up the

plants in search of hosts feeding on foliage. Penetration of the nematode larva into host is achieved with the help of mouth stylet and the worms reside in the body cavity. The worms increase in length at the expense of host's body reserves. During the development of parasitic stage, the characteristic digitate tail appendage of the post-parasitic larva is formed.

The morphology and function of the pharynx of mermithids differ from other groups of nematodes. Mermithid pharynx lacks muscle attachments and has no connection with the intestine. Conspicuous unicellular structures occur in the pharyngeal region and are termed stichocytes. Each stichocyte is a pharyngeal gland and communicates with the lumen of the pharynx through a pore. Excretion of waste products occurs through excretory pore. It has been suggested that *H. truncata* leaves the host as the result of the depletion of essential substances and the accumulation of metabolic wastes in the host. Emergence from the host is usually completed within a few minutes. The host dies within hours from loss of body fluids and invading microorganisms. Parasitic larvae that emerge from a host, move into the soil to a depth of 10-30 cm, coil up and mature. Maturation takes place from three weeks to two months and may involve two molts. Males move about in search of the females. The copulating partners form a tight cluster. Egg laying starts 20-40 days after fertilization at the rate of 10-20 eggs per day, accumulating around 100-200 eggs in eight months. Unfertilized females do not lay eggs and can live up to four years. The eggs hatch after about three months at 16-18 °C. The newly hatched larvae are 2.8-3.5 mm long. They complete one molt in the egg and are infective.

Chatterjee and Singh (1965) demonstrated that the percentage of mermithid parasitism reduced with the distance of the host from the ground and is nil in insects feeding above 5 meters. Bhatnagar *et al.* (1985) reported greater incidence of mermithid infection in insects feeding on low-growing crops such as groundnut, tomato and weeds. These findings were confirmed during the present study as only one species of insect pest, *Eutectona machaeralis* was found to be parasitized by *Hexameris* when 58 species of insects were examined for parasitic infection. The insect pests were collected from Sabbahwala, Timli range.

#### *Potential of mermithids as biocontrol agent*

Mermithids have potential as biocontrol agent of insect pests, because the emergence of post parasitic larva from the body cavity of an insect host produces a large hole in the exoskeleton of the insect and death of insect results due to loss of body fluids and invading microorganisms. Besides, insects parasitized by mermithid show many morphological and biological changes such as swollen abdomen in ants, insects with intersexual characters such as females with male genitalia, intercastes in social insects, inability to pupate and many other deleterious changes.

However, though mermithids have been studied as potential control agents for insects, few have progressed to the stage of field trials and only mosquito mermithids have been used for serious attempts to control host population in nature. Only one species of mosquito mermithid, *Romanomermis culicivorax* can be produced in

sufficient quantities to be considered prospective for commercial production, but it is slow to develop due to environmental limitations, host specificity, and inherent problems associated with handling, storage, shipping and application procedures.

#### Order RHABDITIDA

#### Family STEINERNEMATIDAE

#### Genus *Steinernema* (Steiner, 1929) Travassos, 1927

Members of the Family Steinernematidae are parasites of invertebrates. The first stage larvae are parasites. The lip region is indistinct initially, but soon develops its distinct outline with six labial papillae. The second larval stage has a closed stoma and it develops into third stage free-living infective larval stage. Infective stage juveniles are characterized by closed stoma, a sharp tail and lateral fields marked by nine incisures. Stoma gradually opens in the parasitic larvae. The fourth larval stage resembles young females and males. Female cuticle is smooth, without lateral lines. The labial region has six lips. Four cephalic papillae are located near the base of the lips. Stoma is as wide as long and opens into a narrow pharynx, which is short and with a valved basal bulb. A distinct pharyngeal-intestinal valve is present. Ovaries are paired, opposite and reflexed. The rectum and the anus are distinct. The males are identical to females except for the size and the sexual characteristics. The testis is single and reflexed. Spicules are paired and gubernaculum is present. Caudal region has several pairs of genital papillae. Bursa is absent.

#### *Steinernema feltiae* Filipjev, 1934.

1934. *Steinernema feltiae* Filipjev, *Tr. Parazit. Lab. Zool. Inst. Akad. Nauk. SSSR.*, 4: 229-232.

Several juvenile nematodes were collected from dead larvae of *Ascotis selenaria* from Timli sal forest. The nematodes upon study were found to belong to *Steinernema feltiae*.

*Material examined*: 30 Juveniles, Timli sal forest, Dehradun, 21.vi.06, Reg.No.IV/NRC/ZSI/386, coll. A. N. Rizvi & Party.

*Dimensions*: Juveniles: L = 0.91-0.990 mm; a = 23-24; b = 6.8-7.2; c = 11.3-11.6; Excretory pore = 70-76, E % = 87-89; D% = 52-55; Pharynx = 145-152; Tail = 83-88 mm.

*Habitat & Locality*: The juvenile nematodes were collected from dead *Ascotis selenaria* larvae from Timli Sal forest of Dehradun.

*Remarks*: All the measurements are in conformity with the earlier descriptions.

This species is recorded for the first time from Uttarakhand and *Ascotis selenaria* is a new host record for the species.

### **Biology and Life cycle of the Genus *Steinernema***

The biology and life cycle of the genus *Steinernema* was studied by Bovien (1937) and re-examined by Wouts (1979). Life cycle comprises six distinct stages: eggs, four morphologically distinct larval stages and adults.

The free-living infective third stage larvae are resistant to desiccation and can survive in damp soil for several months. The larvae are attracted to chemo-stimulant on the external body of the host. They enter the host through the mouth or anus. After entering alimentary canal, they penetrate its wall and enter the body cavity. Nematodes take up host haemolymph and accumulate in the bacterial pouch in the anterior part of their intestine. The bacteria multiply and are released in to the lumen of the nematode intestine and later via the anus into the host body cavity. The bacteria multiply further and cause lethal septicemia and eventually death of the host. The nematode lives and develops on the bacteria and the decomposed tissue of the host. The third stage larva grows very little in length, but doubles in width, and develops into fourth stage larva, after 48-50 hours after penetrating the host. The latter doubles in width and increases in length. The genital primordial starts developing at this stage. Males and females develop and are present after 72 hours of penetrating the host.

Both sexes live for about only 4-5 days. Copulation takes place and females lay eggs. A first stage larva hatching from these eggs develops rapidly through one moult into fourth stage larvae and into adults that initially may lay eggs. Egg laying ceases as the condition of the host deteriorates. First stage larvae develop into second stage larvae that do not feed. Their stoma closes and their body grows thinner. At the same time, the pharynx reduces in width and the lumen of the intestine closes beginning at the anus and moving upwards with only a small pouch remaining immediately below the basal bulb. The bacteria in this pouch is retained to infect the next host. The cuticle of the third stage larva is formed and separates from the cuticle of second stage larva. The nematode then increase in length, old cuticle is ruptured and the free-living infective stage emerges. The third stage infective larva leaves the old host to infect a new one. Infective larvae are resistant to gradual desiccation and are able to survive dry summer conditions.

The life cycle is completed in about 10 days. If the nutrient supply is insufficient or if overcrowded, the infective juveniles develop to adult males and females of the first generation and eggs produced by the females develop directly to infective juveniles. This cycle takes six to seven days.

### **Potential of Steinernematids for biocontrol of insect pests**

The parasitic larvae of Steinernematids contain lethal bacteria, *Xenorhabdus* in their gut and because of these bacteria, they are extremely damaging to their hosts. The host normally dies within 48 hours after infection. The symbiotic bacteria in nematodes also produce antibiotics that prevents invasion of the host by other microorganisms and delay breakdown of host cuticle. *Steinernema feltiae* has the widest host range, but all species are suitable for biological control of insect pests because of the lethal effect they have on their hosts.

For biological control, the nematodes need to be cultured in large quantities and proper storage and transport are other crucial factors. Nematode cultures can be achieved by rearing in a natural host i.e. *in vivo*, as well as on artificial medium i.e. *in vitro*. *In vivo* culture is most appropriate for maintenance of colonies and production of infective juveniles for laboratories and small-scale production.

## ***In vivo* production of Steinernematids**

As Steinernematids infect and reproduce in a wide range of insects, they can be reared *in vivo* in the lab. Lepidoptera, *Galleria melonella* is most often used as a host because it is widely available, easily reared, very susceptible and an excellent host for nematode reproduction. Harvesting of up to 200,000 *S. feltiae* has been achieved by Dutky *et al.* (1964).

The basic *in-vivo* production method (Poinar, 1979) is as follows:

### **1. Infecting *Galleria*.**

Infective juveniles extracted from soil are used to infect *Galleria*. Approximately 200 nematodes per ml of sterile distilled water (sdw) suspension are made. 1 ml of the nematode suspension is evenly distributed on a 9 cm Whatman #1 filter paper in the lid of a 100x 14 mm plastic petri dish, 20 *Galleria* larvae are added to this petri dish and it is covered with inverted lid. Petri dish is labeled and stored in a plastic bag and kept at room temperature. Infected larvae are transferred to white traps after 5-7 days after infection. Infected larvae will be yellowish brown in colour.

### **2. Harvesting of Infective juveniles.**

White traps are prepared by placing 9 cm Whatman #1 filter paper in a concave side up watch glass in a large glass petri dish (150x20mm). It is autoclaved for 20 min. 70 ml sdw is poured into petri dish. Filter paper is draped over the watch glass, so that it is in contact with the liquid surface. Infected larvae are placed on to the filter paper over the edge of the watch glass. Infective juveniles start to exit 10-12 days after infection and migrate into the water. Nematodes are harvested daily.

### **3. Storage of Infective juveniles.**

Infective juveniles are rinsed in fresh water 4-5 times. Centrifugation at 300 rpm for 1 min is used to speed the settling process. Finally nematodes are transferred to a storage container. Nematodes may be stored in distilled water in tissue culture flasks. Steinernematids can be stored at 4-10 °C for 6-12 months without much loss of activity.

### **4. Transport of live nematodes.**

The live infective juveniles may be shipped as a semisolid paste on moist foam. The container should be kept cool (packed in ice and not dry ice) the use of overnight delivery systems is encouraged.

## ***In vitro* culture of Steinernematids.**

Steinernematids were cultured on a variety of substances in the past, however, a medium based on chicken offal is commonly used nowadays (Bedding, 1984) the method is outlined below.

### **1. Preparation of Rearing Flasks.**

The important factors seem to be monoxenicity (i.e. the only biotic agents are nematode and associated bacteria).

Small foam pieces are impregnated with chicken or duck offal homogenate (12.5 parts medium to 1 part foam by weight). Culture flasks are filled with foam homogenate mixture, plugged with cotton, wrapped in cheesecloth and autoclaved for 20 min at 121°C.

### **2. Inoculation with Bacteria.**

*Xenorhabdus* is cultured in Lab. Inoculation is done by pouring the contents of one tube of cultured bacteria into each autoclaved and cooled flask. Mixture is properly shaken and stored for 2-3 days at 25°C to allow *Xenorhabdus* population to build up.

### **3. Inoculation with Nematodes.**

Foam from monoxenic culture is used to inoculate the new flasks. Best results are obtained if the flask is not shaken after introduction of the nematodes. The flasks will be ready to be harvested in about two weeks.

### **4. Harvesting.**

The foam is piled up 5 cm deep on a 20-mesh sieve. Sieve is placed in a pan of tap water with water level adjusted so that the foam is just submerged. Within 2 hours, 95% of infective juveniles will migrate in to the water. The infective juveniles are sieved through a 500-mesh sieve. Nematodes are rinsed several times until the water appears clear.

### **5. Troubleshooting.**

Contamination will sometimes be visually evident in the form of fungal or bacterial colonies. Unusual odour is another indication of contamination. For *S. feltiae* 25 °C seems optimal, but optimum may be different for different species.

## Chapter-6

# INSECT ASSOCIATED NEMATODES

Insect associated nematodes or phoresis is a form of relationship in which one organism associates with another species in order to obtain transportation are common between insects and nematodes. These occur in many rhabditids, which are carried from one habitat to another by insect frequenting decomposing matter. Many bark beetles serve as transport hosts for rhabditids, diplogasterids and aphelenchids, which feed on microorganisms found in the beetle galleries. These nematodes have little or no pathological effect on the host and benefit by being carried to a new environment. Twelve species were found associated with termite, *Odontotermes parvidens* termite hill and beetles. Association of these nematodes with termites is a new finding. All these nematodes are recorded for the first time from India.

Order Rhabditida

Suborder Rhabditina

Superfamily Rhabditoidea

Family Rhabditidae

Subfamily Protorhabditinae

Genus *Protorhabditis* (Osche, 1952) Dougherty, 1953

### 1. *Protorhabditis elaphri* (Hirschmann, 1952) Dougherty, 1953.

1952. *Rhabditis elaphri* Hirschmann, *Zool. Jahrb. Syst.*, **56** : 173-179.

1953. *Protorhabditis elaphri* Dougherty, *Thapar Commemoration Volume 1* : 69-76.

*Material examined*: 4 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg.No.IV/NRC/ZSI/387, coll. A.N. Rizvi & Party.

*Dimensions*: Female: L = 0.52-0.58 mm; a = 20-23; b = 4.7-5.2; c = 5.8-6.2; Pharynx = 100-120 mm; V = 47- 48; Tail = 90-101 mm.

*Description*: Body cylindrical, tapering towards both ends. Cuticle distinctly annulated. Lip region with six small lips. Stoma rhabditoid, lacking glottoid apparatus. Cheilostome with weakly refractive walls. Buccal prism with straight walls, very long and narrow, Pharyngeal collar very short. Procorpus cylindrical, metacarpus slightly swollen. Isthmus long, basal bulb ovoid to pyriform. Reproductive system didelphic amphidelphic. Tail conical-elongate.

*Habitat & Locality*: Found associated with the soil of termite hill and termites, Timli sal forest, Dehradun.

*Remarks*: All the measurements are in conformity with the original description with slight variation observed in the length of pharynx (b = 4.7-5.2 against 5.7-7.1). This species is a new record from India and its association with termites is a new finding.

## 2. *Protorhabditis* sp.

**Material examined:** 4 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/388, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.45-0.46 mm; a = 17-18; b = 3.8-4.2; c = 9.1-9.8; Pharynx = 140-145 mm; Stoma = 28-30 mm.; Tail = 45-50 mm.

**Description:** Body cylindrical, tapering towards both ends. Cuticle distinctly annulated. Lip region with six small lips. Stoma rhabditoid, lacking glottoid apparatus. Pharyngeal collar very short. Procorpus cylindrical, metacarpus slightly swollen. Isthmus long, basal bulb ovoid to pyriform. Reproductive system not developed. Tail conical-elongate.

**Habitat & Locality:** Found attached to the head region of termite, Timli sal forests of Dehradun.

**Remarks:** The nematodes could not be assigned to species level, as the gonads were not developed; however, the body ratios are similar to *P. oxyuroides*. Association of *Protorhabditis* juveniles with termites is a new finding.

Family DIPLOSCAPERIDAE

Genus *Diploscapter* Cobb, 1913

## 3. *Diploscapter* sp.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/419, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.55-0.58 mm; a = 22-23; b = 5.0-5.9; c = 5.8-6.5; Pharynx = 105-111 mm; Stoma = 27-30 mm.; Tail = 85-100 mm.

**Description:** Body ventrally curved upon fixation. Cuticle annulated. Lip region with six lips, the subdorsal and subventral are very refractive and hook-like. The lateral lips are membranous (termed laciniae). Buccal cavity with straight walls, very long and narrow. Stegostom lacking glottoid apparatus. Pharyngeal corpus very slightly swollen, isthmus long and basal bulb spherical with well-developed valves. Reproductive system with only gonad primordial visible.

**Habitat & Locality:** Found attached to the head region of termites, Timli sal forests of Dehradun.

**Remarks:** The nematodes could not be assigned to species level, as the gonads were not developed. Association of *Diploscapter* juveniles with termites was reported for the first time by Rizvi (2009).

Suborder CEPHALOBINA

Family CEPHALOBIDAE

Subfamily CEPHALOBINAE

Genus *Macrolaimellus* Andrassy, 1966

**4. *Macrolaimellus longicauda*** (Rashid *et al.*, 1985) Rashid *et al.*, 1986.

1985. *Cephalonema longicauda* Rashid, Geraert and Sharma, *Nematologica*, **30** : 251.

1986. *Macrolaimellus longicauda* Rashid, Geraert and Sharma, *Nematologica*, **32** : 238.

*Material examined*: 5 ♀♀, Timli sal forest, Dehradun, 18.ix.05, Reg. No. IV/NRC/ZSI/420, coll. A. N. Rizvi & Party; 5 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/421, coll. A.N. Rizvi & Party.

*Dimensions*: Female: L = 0.43-0.45 mm; a = 23-29; b = 3.8-3.9; c = 4.3-4.9; c' = 9-10; Pharynx = 98-120  $\mu$ m; V = 51-58; Tail = 95-100 mm.

*Description*: Body cylindrical and ventrally curved upon fixation. Cuticle distinctly annulated. Lateral fields marked by protruding ridge with indistinct incisures. Head slightly set off from the body. Lips six, amalgated, each with a setiform papilla. Stoma sclerotized, 9-10 mm long, Cheilostom forming a wide cavity continuous with prostom and mesostom. The stoma wall anterior to constriction is more sclerotized than posterior to it. Pharynx cylindrical, with short isthmus and ovate basal bulb. Excretory pore at 60-66 mm from anterior end. Reproductive system monodelphic, prodelphic, ovary usually straight or with one flexure near the end. Postuterine sac variable in length, 10-18 mm long. Tail elongated, conical, ventrally curved with acute terminus.

*Habitat & Locality*: Always found associated with the soil of termite hill and one occasion attached to termite cuticle. This species was originally discovered from the soil around roots of *Theobroma cacao* L. from Brazil.

*Remarks*: All the measurements are in conformity with the original description with slight variation observed in the position of vulva (V = 51-58 as against 50-56 in original description).

This species is a new record from India. Association of *Macrolaimellus longicauda* with the termites and soil of termite hill is a new finding.

Genus ***Cephalobus*** Bastian, 1865

**5. *Cephalobus pseudoparvus*** Rashid, Geraert and Sharma, 1984.

1984. *Cephalobus pseudoparvus* Rashid, Geraert and Sharma, *Nematologica*, **30** : 260-265.

*Material examined*: 3 ♀♀, Timli sal forest, Dehradun, 18.ix.05, Reg. No. IV/NRC/ZSI/422, coll. A. N. Rizvi & Party.

*Dimensions*: Females: L = 0.40-0.56 mm; a = 22.7-24.3; b = 3.4-3.9; c = 11.6-14.7; c' = 2.1-3.1; V = 62-64; Pharynx = 117-143 mm; Tail = 35-38 mm.

*Description*: Body slightly curved ventrally upon fixation. Cuticle annulated. Lateral fields marked by three incisures, outer ones continuous beyond phasmid. Stoma 11-12 mm long. Lips three, low and rounded. Cheilorhabdions small, oval in shape, forming a

broad chamber. Metarhabdions with dorsal tooth. Pharynx cylindrical, isthmus short leading to ovate to spherical basal bulb. Nerve ring situated at the base of corpus. Excretory pore at 75-87 mm from anterior end. Reproductive system monodelphic, prodelphic. Post-vulval uterine sac very short, 15-20 mm. Tail sub-cylindrical to conoid without mucro.

**Habitat & Locality:** Found associated with the soil of termite hill, of Timli sal forest Dehradun.

**Remarks:** All the body measurements and descriptions are in conformity with the original description. *C. pseudoparvus* is a new record of cephalobid nematode from India.

Genus *Pseudacrobelus* Steiner, 1938.

**6. *Pseudacrobelus pauciannulatus*** (Marinari-Palmisano, 1967) De Ley, Siddiqi & Bostrom, 1993.

1967. *Heterocephalobus pauciannulatus* Marinari-Palmisano, *Redia*. **50** : 289.

1993. *Pseudacrobelus pauciannulatus* De Ley, Siddiqi & Bostrom, *Fund. Appl. Nematology*, **16** : 219.

**Material examined:** 8 ♀♀, Timli sal forest, Dehradun, 18.ix.05, Reg.No.IV/NRC/ZSI/423, coll. A. N. Rizvi & Party; 4 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg.No.IV/NRC/ZSI/424, coll. A. N. Rizvi & Party; 4 ♀♀, Timli sal forest, Dehradun, 4.v.06, Reg.No.IV/NRC/ZSI/425, coll. A. N. Rizvi & Party.

**Dimensions:** Females: L = 0.41-0.45 mm; a = 22.8-27.0; b = 3.4-3.9; c = 9.1-11.5; c' = 2.7-3.1; V = 62-66; Pharynx = 116-133  $\mu$ m; Tail = 36-50 mm.

**Description:** Body ventrally arcuate upon fixation. Body annulated. Head continuous with body. Lips three, low, rounded or conical. Stoma, 11-13 mm in length. Pharynx with slightly expanded corpus, short isthmus and ovate to spherical basal bulb. Nerve ring at 80-90 mm and excretory pore 75-100 mm from the anterior end.

Reproductive system monodelphic, prodelphic. Ovary straight or with double flexure beyond vulva. Posterior uterine sac 10- 20 mm long. Lateral fields marked with three incisures ending at phasmid. Tail, conical with finely pointed terminus.

**Habitat & Locality:** Found associated with the soil of termite hill, Timli sal forest, Dehradun.

**Remarks:** All the body measurements and descriptions are in conformity with the earlier descriptions with slight variation in the length of post-uterine sac (10-20 against 7-16 mm).

*Pseudacrobelus pauciannulatus* is a new record of cephalobid nematode from India.

**7. *Pseudacrobelus eurystoma*** (Andrassy, 1967) Abolafia *et al.*, 2002  
1967. *Heterocephalobus eurystoma* Andrassy, *Acta Zool. Acad. Scien. Hung.*, **13** : 32.  
2002. *Pseudacrobelus eurystoma*. Abolafia *et al.*, *J. Nem. Morph. Syst.*, **4**: 138.

*Material examined*: 7 ♀♀, Timli sal forest, Dehradun, 18.ix.05, Reg. No. IV/NRC/ZSI/426, coll. A.N. Rizvi & Party; 3 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/427, coll. A.N. Rizvi & Party; 2 ♀♀, 2 ♂♂, Timli sal forest, Dehradun, 4.v.06, Reg. No. IV/NRC/ZSI/428, coll. A. N. Rizvi & Party.

*Dimensions*: Females: L = 0.45-0.56 mm; a = 16-20; b = 3.8-5.1; c = 7.9-8.9; c' = 2.7-3.1; V = 73-75; Pharynx = 125-138 mm; Tail = 53-55 mm.

Males: L = 0.45-0.47 mm; a = 14-15; b = 3.5-3.8; c = 7.2-7.6; Pharynx = 89-100 mm; Tail = 45-50 mm; Spicule = 22-24 mm; Gubernaculum = 9-10 mm.

*Description*: Body cylindrical, tapering towards extremities, more pronounced posteriorly and slightly curved ventrally upon fixation. Lateral fields marked by three incisures, becoming inconspicuous near the phasmid. Cephalic probolae absent. Labial probolae high with low ridges connected to adjacent lips. Stoma cephaloboid, cheilorhabdions bar shaped. Pharyngeal corpus cylindrical 2.6-2.9 times as long as isthmus. Basal bulb ovoid. Cardia conoid. Excretory pore at 71-73% of neck length. Reproductive system monodelphic-prodelphic. Ovary without double flexure, with oocytes arranged in two rows anteriorly and then in a single row. Oviduct short. Spermatheca with spermatozoa. Uterus narrow tubular. Postvulval uterine sac with a proximal transverse septum. Vagina thick walled. Tail conical, ventrally curved with a short subventral mucro.

*Male*: Similar to females but more curved ventrally. Assumes 'J' shape upon fixation. Reproductive system monorchic. Testis reflexed anteriorly. Tail conical, ventrally curved bearing a small mucro. Spicules ventrally curved: manubrium rounded, calamus tapering, lamina ventrally curved and with dorsal hump. Gubernaculum with arched cuneus. Caudal papillae five pairs, two pairs anterior to phasmids and three near the tail tip.

*Habitat & locality*: Found associated with the soil of termite hill, of Timli sal forest, Dehradun.

*Remarks*: All the body measurements are in agreement with the earlier workers except for slightly longer tail mucro in females. Its occurrence with termite hill is a new finding.

#### Subfamily ACROBELINAE

Genus *Acrobelloides* (Cobb, 1924) Steiner & Buhrer, 1933.

**8. *Acrobelloides nanus*** (de Man, 1880) Anderson, 1968  
1880. *Acrobelloides nanus* de Man, *Tijds. Nederland. Dierk. Vereen.*, **5** : 1-10.  
1968. *Acrobelloides nanus* Anderson, *Can. J. Zool.*, **46** : 309-312.

**Material examined:** 5 ♀♀, Timli sal forest, Dehradun, 18.ix.05, Reg. No. IV/NRC/ZSI/429, coll. A.N. Rizvi & Party; 6 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/430, coll. A.N. Rizvi & Party; 4 ♀♀, Timli sal forest, Dehradun, 4.v.06, Reg. No. IV/NRC/ZSI/431, coll. A. N. Rizvi & Party; 4 ♀♀, Timli sal forest, Dehradun, 13.viii.05, Reg. No. IV/NRC/ZSI/432, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.31-0.41 mm, a = 16.7-19.1, b = 3.2-3.5, c = 14.3-21.3, V = 64-67; Stoma 10-12 mm; Pharynx = 100-120 mm; Tail = 16-21 mm.

**Description:** Body small, straight to slightly curve ventrally upon fixation. Cuticle transversely annulated. Lip region slightly expanded, with three rounded-conical labial probolae. Lateral fields marked by five incisures. Pharyngeal corpus forming an elongated spindle shaped swelling. Isthmus short, leading to a well-developed basal bulb. Nerve ring encircles isthmus near middle. Excretory pore opposite to nerve ring.

Reproductive system monodephic, prodelphic. Ovary straight or with double flexure beyond vulva. Tail variable in shape from conical to rounded terminus to bearing a minute spine.

**Habitat & locality:** Found associated with the soil of termite hill, of Timli sal forest Dehradun.

**Remarks:** All the measurements are in agreement with earlier workers. This species is being recorded for the first time from India.

#### Genus *Cervidellus* Thorne , 1937

#### 9. *Cervidellus neftasiensis* Bostrom, 1986.

1986. *Cervidellus neftasiensis* Bostrom, *Nematologica*, **31** : 365-370.

**Material examined:** 4 ♀♀, Timli sal forest, Dehradun, 13.viii.07, Reg. No. IV/NRC/ZSI/433, coll. A.N. Rizvi & Party.

**Dimensions:** Female: L = 0.26-0.3.1 mm; a = 19.5-20.2; b = 32.9-3.1; c = 14-17.5; Pharynx = 80-83 mm; V = 68-69; Tail 15-17 mm.

**Description:** Body dorsally curved upon fixation. Cuticle distinctly annulated. Lateral fields marked by three incisures, extending to phasmid level. Head offset from body. Six cephalic probolae symmetric, each consisting of five leaf-like tines, the largest one in the centre is slightly curved inwards and is flanked on both sides, first by a shorter tine, connected at the base with the central tine and then by a short guard process in each cephalic axil. Labial probolae three, slender, stout, slightly forked, not conspicuously curved, basally joined by tangential ridges, which form the anterior chamber of the buccal capsule. One circlet of six papillae, distinct on cephalic probolae, the circlet of four papillae and the two amphids are not distinct.

Stoma cephalopod 6-6.5 mm. Pharyngeal corpus cylindroid, isthmus slightly narrow, basal bulb ovate with crescentic valves. Nerve ring around corpus and at 38-42 m from anterior end. Excretory pore 36-38 mm from anterior end.

Gonad monodelphic, prodelphic. Ovary straight or with double flexure posterior to vulva. Vulva a transverse slit, vulval lips slightly protruded. Postvulval sac very small. Tail straight, conical, sharply pointed with smooth terminus.

*Habitat & locality:* Found associated with the soil of termite hill, Timli sal forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description with slight variation in the position of vulva ( $V = 68-69$  against  $61-68$ ).

*Cervidellus neftasiensis* is a new record from India.

Family TERATOCEPHALIDAE

Genus *Teratocephalus* De Man, 1876

**10. *Teratocephalus costatus* Andrassy, 1958.**

1958. *Teratocephalus costatus* Andrassy, *Acta zool. Acad. Sci. Hung.*, **4** : 1-8.

*Material examined:* 2 ♀♀, Timli sal forest, Dehradun, 4.v.06, Reg. No. IV/NRC/ZSI/434, coll. A.N. Rizvi & Party, 1 ♀, Timli sal forest, Dehradun, 13.viii.05, Reg. No. IV/NRC/ZSI/435, coll. A.N. Rizvi & Party.

*Dimensions:* Female: L = 0.36-0.37 mm; a = 21-26; b = 3.4-3.6; c = 4-6.5; c' = 8-11; Pharynx = 100-105 mm; V = 53-55; Tail = 70-90 mm.

*Description:* Body ventrally arcuate upon fixation. Cuticle thick, coarsely annulated, with eight longitudinal ridges throughout most of body length. Annules, 1.4 mm apart in the anterior region and 1 mm apart in the midbody and posterior region. Head 5-6 mm wide, cephalic plicae 3.5mm long, contour arcuate. Lips six, each with a perioral papilla. Stoma 4-5 mm long, metarhabdion elongated. Pharyngeal corpus cylindrical, basal bulb ovate. Nerve ring at 55-65 mm from anterior end. Gonad monodelphic, prodelphic, reflexed and with a short ovary, postuterine sac short. Tail long, attenuated and conoid.

*Habitat & Locality:* Found associated with the soil of termite hill and on one occasion attached to termite cuticle.

*Remarks:* All the measurements are in conformity with the original description with slight variation observed in the position of vulva and the values of 'a' ( $V = 51-55$  as against  $52-58$ ; 'a' = 21-26 as against 22-25 in original description).

This species is a new record from India. Association of *Teratocephalus costatus* with the soil of termite hill and with termites is a new finding.

Order ARAEOLAIMIDA

Family PLECTIDAE

Genus *Wilsonema* Cobb, 1913

**11. *Wilsonema auriculatum* (Butschli, 1873) Cobb, 1913.**

1873. *Plectus auriculatum* Butschli, *Nova Acta. Leop. Carol.*, **36** : 1-4.

1913. *Wilsonema auriculatum* Cobb, *J. Wash. Acad. Sci.*, **3** : 432-436.

**Material examined:** 1 ♀, Timli sal forest, Dehradun, 13.viii.07, Reg. No. IV/NRC/ZSI/436, coll. A. N. Rizvi & Party; 3 ♀♀, Timli sal forest, Dehradun, 4.v.06, Reg. No. IV/NRC/ZSI/437, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.3-0.35 mm; a = 15-16; b = 3.8-4.2; c = 10.1-10.7; Pharynx = 70-92 mm; V = 52-53.5; Tail = 28-35 mm.

**Description:** Body short and plump bearing scattered somatic setae. Head provided with dorsal and ventral lamellae, which join the dorsal and ventral lips respectively. Each lamellae ends in forwardly projecting, incurved cirrus flanked on either side by similar cirrus with a slight swollen base and below each a projection on either side of the lamella. Amphids spiral and prominent. Pharyngeal corpus almost cylindrical, isthmus short expanding to form a large terminal basal bulb with prominent valves. Gonads paired, opposed and flexed. Vulva equatorial. Tail arcuate ventrally and contains- caudal glands.

**Habitat & Locality:** Found associated with the soil of termite hill and attached to termite cuticle, Timli sal forest, Dehradun.

**Remarks:** All the measurements are in conformity with earlier description with slight variation observed in the body length, values of c and position of vulva (body length = 0.3-0.35 mm against 0.45-0.57 mm; c = 10-10.7 against 12-14; V = 52-53.5 as against 50-52 in earlier descriptions).

This species is a new record from India. Association of *Wilsonema auriculatum* with the soil of termite hill and with termites is a new finding.

Order DIPLOGASTERIDA

Family DIPLGASTERIDAE

Genus *Rhabditolaimus* Fuchs, 1915

## 12. *Rhabditolaimus* sp.

**Material examined:** 3 ♀♀, Thanu forest, Dehradun, 20.ii.06, Reg. No. IV/NRC/ZSI/438, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.54-0.56 mm; a = 28-30; b = 3.8-3.9; c = 12.4-12.9; Pharynx = 135-137 mm; Tail = 42-44 mm.

**Description:** Body slightly arcuate upon fixation. Cheilostom separated from the Prostom. Metarhabdions twice as long as prorhabdions. Anterior part of pharynx shorter than posterior. Procorpus relatively wide and very slightly swollen to form the valvated corpus. Tail narrow.

**Habitat & Locality:** Found attached to dead beetle, *Celosterna scrabrator* Fab. (Cerambycidae), Thanu forest, Dehradun.

**Remarks:** All the three female specimens were not mature enough to assign it to species level and hence it is regarded as *Rhabditolaimus* sp. Association of *Rhabditolaimus* with beetles forms the first report from India.

## Chapter-7

# SOIL NEMATODES ASSOCIATED WITH THE TEAK & SAL FORESTS OF DEHRADUN

Soil nematode communities have the potential to provide insights into many soil processes and function, as most nematodes are active in soil throughout the year (Ritz & Trudgill, 1999). Nematodes can be used as bioindicators of soil health because they are ubiquitous and have diverse feeding behaviors and life strategies (Bongers & Bongers, 1998; Neher, 2001). They can serve as a model subsystem and provides a holistic measure of the biotic and functional status of soils (Bongers & Ferris, 1999). Nematodes occupy a central position in the soil food web and play significant role in biological processes such as nitrogen cycling and plant growth patterns (Neher, 2001). Nematode community of soil nematodes from Timli sal forest of Dehradun has been studied by Rizvi (2008). Besides, 196 species of soil nematodes have been compiled from Uttarakhand by Rizvi (2010).

A thorough knowledge of nematode population structure in different habitats is a prerequisite to assess the importance of soil nematodes in the ecosystem. The present chapter presents a taxonomic account of soil nematodes occurring in sal and teak forests, as very few species are reported from forests. The soils around the sal and teak have been found to be new host and habitat records for most of the species described herein.

Order RHABDITIDA

Suborder RHABDITINA

Superfamily RHABDITOIDEA

Family RHABDITIDAE

Subfamily MESORHABDITINAE

Genus *Mesorhabditis* (Osche, 1952) Dougherty, 1953

### 1. *Mesorhabditis spiculigera* (Steiner, 1936) Dougherty, 1953

1936. *Rhabditis spiculigera* Steiner, *Proc. Helminth. Soc. Wash.*, 3 : 74.

1953. *Mesorhabditis spiculigera* Dougherty, *Thapar Comm.*, Vol. 1 : 69.

*Material examined*: 10 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/439, coll. A. N. Rizvi & Party, 5 ♀♀, Timli sal forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/440, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.43-0.47 mm; a = 22-24; b = 3.6-4.2; c = 8.5-9.4; c' = 4.3-4.5; V = 75-76; Stoma = 16-19 mm; Tail = 50-52 mm.

*Description*: Body almost straight upon fixation, tapering at both ends. Cuticle transversely striated. Lateral fields with four ridges. Lip region distinctly set-off by a

constriction. Lips large, prominent, each with a setose papilla. Amphids minute, indistinct. Stoma tubular, Cheilostom simple, not cuticularized. Gymnostom with parallel walls. Stegostom isoglottoid, each with two prominent denticles. Pharyngeal collar absent. Metacarpus slightly swollen. Excretory pore 70-88 mm from anterior end. Reproductive system mono-prodelphic. Vulva a small transverse slit, slightly depressed, without prominent lips. Tail conical with pointed tip. Vulva-anus distance 1.0-1.2 times longer than tail.

*Habitat & Locality:* Soil around roots of sal, Timli sal forest, Kalsi forest, Dehradun.

*Remarks:* Though the specimens of *Mesorhabditis spiculigera* studied conform well to the measurements and original description, however, slight variation has been observed in the position of vulva (V= 75-76 against 78-84).

This species is a new record of mesorhabditid nematode from India.

#### Subfamily PELODERINAE

Genus *Caenorhabditis* (Osche, 1952) Dougherty, 1953

#### 2. *Caenorhabditis elegans* (Maupas, 1899) Dougherty, 1953

1899. *Rhabditis elegans* Maupas, *Arch.zool.expt.*, **8** :480

1953. *Caenorhabditis elegans* Dougherty, *Thapar Comm.*, Vol. **1** : 70

*Material Examined:* 3 ♀♀, 2 ♂♂, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/441, coll. A.N. Rizvi & Party.

*Dimensions:* Female: L = 0.70-1.1mm; a = 19-21; b = 6-8; c = 8-10; V = 52-55; Stoma = 14-15 mm; Tail = 88-110 µm.

Male: L = 0.53-0.65 mm; a = 16-18; b = 4.2-4.8; c = 22-25.

*Description:* Body tapering slightly at extremities. Lips with the usual circlets of six labial papillae and four cephalic papillae. Stoma 14- 15 mm long, 4 mm wide; denticles on metarhabdions not clearly visible. Pharyngeal collar with prominent basal swelling surrounds about half the stoma and is without a median bulb. Basal bulb with valve plate. Lateral fields marked by four incisures. Nerve ring located at the middle of isthmus. Excretory pore opposite to anterior end of bulb. Vulva median, ovaries paired, opposed, reflexed. Female tail conical and long. Phasmids located at one-fourth–one-third of the tail.

Male tail peloderan with 9 pairs of bursal papillae. Spicules straight to slightly curved, 40-48 µm long. Gubernaculum straight to slightly curved, 28-30 µm long. Tail conical with a pointed tip.

*Habitat & Locality:* Soil around roots of sal, Timli sal forest, Dehradun.

*Remarks:* All the measurements are in agreement with the measurements given by earlier workers. This species is recorded around the root zone of sal for the first time.

## Subfamily PROTORHABDITINAE

Genus *Protorhabditis* (Osche, 1952) Dougherty, 1953**3. *Protorhabditis oxyuroides* Sudhaus, 1974.**1974. *Protorhabditis oxyuroides* Sudhaus, *Teil. Zool. Jb. Syst.*, **101** : 173.

**Material Examined:** 3 ♀♀, 2 ♂♂, Langha forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/442, coll.A.N. Rizvi & Party.

**Dimensions:** Female: L = 0.84-0.91mm; a = 23-24; b = 4.8-5.0; c = 7.8-8.1; c' = 5.2-6.1; V = 49.7-51.2; Stoma = 18-22 mm; Tail = 105-115 µm.

Male: L = 0.67-0.71 mm; a = 25-26; b = 4.1-4.2; c = 18-19; c' = 1.6-1.7; Tail = 35-38 µm Spicules = 34-35 µm.

**Description:** Body cylindrical, tapering towards both ends. Cuticle with distinct annulations. Lip region with six small papillae. Stoma rhabditoid, lacking glottoid apparatus. Procorpus cylindrical, metacarpus swollen. Isthmus as long as procorpus, basal bulb, ovoid or pyriform. Reproductive system didelphic amphidelphic. Rectum long. Tail conical-elongate.

Male: Similar to female in general morphology. Habitus ventrad curved upon fixation. Reproductive system monorchic. Testis reflexed ventrally anteriorly. Tail conical. Bursa peloderan, closed anteriorly with eight papillae (2+1+3+2). Spicules long and free. Gubernaculum sigmoid.

**Habitat & Locality:** Soil around roots of sal, Langha range, Dehradun.

**Remarks:** All the measurements are in agreement with the measurements given by earlier workers. This species is being recorded for the first time from India.

Suborder CEPHALOBINA

Family CEPHALOBIDAE

Subfamily CEPHALOBINAE

Genus *Pseudacrobelus* Steiner, 1938.**4. *Pseudacrobelus tabacum* (Rashid, Geraert and Sharma, 1984) De Ley, Siddiqi & Bostrom, 1993.**1984. *Heterocephalobuss tabacum* Rashid, Geraert and Sharma, *Nematologica*, **30** : 251.1993. *Pseudacrobelus tabacum* De Ley, Siddiqi & Bostrom, *Fund. Appl. Nematology*, **16** : 219.

**Material examined:** 4 ♀♀, Selaqui sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/443, coll. A.N. Rizvi & Party; 4 ♀♀, Kalsi forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/444, coll. A.N. Rizvi & Party; 4 ♀♀, Selaqui sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/445, coll. A.N. Rizvi & Party.

**Dimensions:** Female: L = 0.54-0.56 mm; a = 23.7-23.9; b = 3.2-3.4; c = 8.2-9.0; V = 62-63; Pharynx = 170-184 mm; Tail = 67-70 mm.

**Description:** Body ventrally arcuate after fixation. Cuticle annulated. Head continuous with body. Lips three, low, rounded or conical. Stoma, 9-10 mm in length. Pharynx with slightly expanded corpus, short isthmus and ovate to spherical basal bulb. Nerve ring at base of corpus. Excretory pore 110-120 mm from the anterior end. Reproductive system monodephic, prodelphic. Ovary straight or with double flexure beyond vulva. Posterior uterine sac 25-27 mm long. Lateral fields marked with three incisures ending at phasmid. Tail, elongated, conical with sharply pointed terminus.

**Habitat & locality:** Soil around roots of sal, Selaqui sal forests, Kalsi forest, Dehradun.

**Remarks:** All the body measurements are in agreement with the original description except for longer pharynx (170-184 against 121-148). This species is recorded for the first time from India.

### 5. *Pseudacrobelus multinctus* (Cobb, 1893) Andrassy, 1967

1893. *Cephalobus multinctus* Cobb, *MacLeay Mem. Vol. Linn. Soc. N.S.W.*, 1 : 252.

1967. *Pseudacrobelus multinctus* Andrassy, *Acta zool. Acad. Scient. Hung.*, 11 : 30.

**Material examined:** 2 ♀♀, Thanu forest range, Dehradun, 13.viii.07, Reg. No. IV/NRC/ZSI/446, coll. A. N. Rizvi & Party; 1 ♀, Kunjagrang forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/447, coll. A.N. Rizvi & Party; 1 ♀, Kunjagrang forest, Dehradun, 29.v.08, Reg. No. IV/NRC/ZSI/448, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.41-0.43 mm; a = 0.23-0.26; b = 3.4-3.8; c = 10.5-11.5; Pharynx = 120-130 mm; V = 63-65; Tail = 36-40 mm.

**Description:** Body ventrally arcuate upon fixation. Cuticle annulated. Lateral fields marked with three incisures. Lip region variable, low, with three rounded to conical pointed lips. Labial papillae variously developed, ranging from protruding to low. Cheilorhabdions small, oval to elongate. Stoma 10-11 mm, prostom usually open. Pharynx cylindrical with short isthmus and ovate basal bulb. Reproductive system monodephic, prodelphic. Postuterine sac, small. Tail conical with pointed tip and a small mucro.

**Habitat & locality:** Soil around roots of sal, Thanu range, Kunjagrang forest, Dehradun.

**Remarks:** All the body measurements are in agreement with the original description with slight variation in the tail length (40-48 against 48-79). This species is recorded for the first time from India.

Genus *Eucephalobus* Steiner, 1936**6. *Eucephalobus oxyuroides* (de Man, 1876) Steiner, 1936**

1876. *Cephalobus oxyuroides* de Man, *Tijds. Nederland. Dierk. Vereen*, **2** : 80

1936. *Eucephalobus oxyuroides* Steiner, *Proc. Helminth. Soc. Wash.*, **3** : 76

*Material examined*: 10 ♀♀, Selaqui forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/449, coll. A. N. Rizvi & Party; 5 ♀♀, Timli sal forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/450, coll. A. N. Rizvi & Party; 5 ♀♀, Dharmawala forest, Dehradun, 30.i.05, Reg. No. IV/NRC/ZSI/451, coll. A.N. Rizvi & Party; 5 ♀♀, Sabbahwala sal forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/452, coll. A. N. Rizvi & Party; 5 ♀♀, Thanu forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/453, coll. A. N. Rizvi & Party; 5 ♀♀, Kalsi sal forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/454, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.47-0.56 mm, a = 23-26, b = 3.2-4.1, c = 4.9-8.3, V = 55-56; Pharynx = 121-130 mm; Tail = 80-98 mm.

*Description*: Body straight to slightly curve upon fixation. Cuticle finely striated, lateral field marked by three incisures. Lips conoid, pointed with papillae well down on their outer contour. Amphid apertures slightly dorsal to median line. Stoma 9-10 mm deep. Corpus slender, cylindrical with nerve ring surrounding its base. Basal bulb with strongly sclerotized valve. Cardia conoid. Gonads with spermatheca at first flexure and double flexure in distal portion. Vulva post equatorial. Ovary mono-prodelphic, reflexed. Tail uniformly conoid to acute terminus, usually ventrally bent in posterior third.

*Habitat & locality*: Soil around roots of sal, Selaqui sal forests, Timli sal forest, teak, Dharmawala, sal, Sabbahwala, Timli forest range, sal, Thanu forest range, Kalsi forest, Dehradun.

*Remarks*: All the measurements are in agreement with earlier workers.

## Subfamily ACROBELINAE

Genus *Acrobeloides* (Cobb, 1924) Steiner & Buhner, 1933**7. *Acrobeloides buetschlii* (de Man, 1884) Steiner & Buhner, 1933**

1884. *Cephalous buetschlii*, de Man, *der niederlandischen Fauna*, 92.

1933. *Acrobeloides buetschlii* Steiner & Buhner, *Plant Dis. Repr.*, **17** : 172-173.

*Material examined*: 6 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/455, coll. A. N. Rizvi & Party; 4 ♀♀, Dharmawala forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/456, coll. A. N. Rizvi & Party; 5 ♀♀, Sabbahwala forest, Dehradun, 30.i.05, Reg. No. IV/NRC/ZSI/457, coll. A. N. Rizvi & Party; 8 ♀♀, FRI, Dehradun, 5.ix.05, Reg. No. IV/NRC/ZSI/458, coll. A. N. Rizvi & Party; 2 ♀♀, Kalsi forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/459, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.30-0.62 mm; a = 12-19; b = 3.2-5.2; c = 14-16; V = 61-65.

*Description:* Female: Body small, straight, tapering at extremities. Cuticle transversely annulated. Lip region slightly expanded, with three rounded-conical labial probolae. Stoma about a head-width long. Lateral field with three incisures. Labial papillae conoid. Basal half of corpus forming an elongated spindle shaped swelling. Isthmus about as long as neck width. Nerve ring encircles isthmus near middle. Excretory pore opposite to nerve ring. Basal bulb well developed, with valvular apparatus. Cardia conoid. Vulva post equatorial. Ovary mono-prodelphic, reflexed, flexure extends beyond vulva. Tail sub cylindrical, tapering to a bluntly rounded terminus.

*Habitat & locality:* Soil around roots of sal, Timli Sal forest, teak, Dharmawala, sal, Sabbahwala, Timli forest range, teak, FRI, Kalsi forest, Dehradun.

*Remarks:* All the measurements are in agreement with earlier descriptions.

Genus *Acrobeles* von Linstow, 1877

### 8. *Acrobeles timmi* Chaturvedi & Khera, 1979

1979. *Acrobeles timmi* Chaturvedi & Khera, *Zool. Surv. India. Tech. Monogr.*, 2 : 95.

**Material examined:** 3 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/460, coll. A. N. Rizvi & Party; 2 ♀♀, Dharmawala forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/461, coll. A. N. Rizvi & Party; 3 ♀♀, Motichur sal forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/462, coll. A. N. Rizvi & Party; 2 ♀♀, FRI, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/463, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.4-0.52 mm, a = 16.8-18.7; b = 3.5-3.7; c = 10.2-11.7; V = 61-68; Stoma = 10-12 mm; Tail = 44-46 mm.

*Description:* Female: Body robust, tapering towards both ends. Cuticle thick and coarsely striated. Lateral fields marked with four incisures. Labial probolae deeply furcated, 10-12 mm long, furcating at about half of length. Cephalic probolae reaching half way to labials, acute, forwardly pointing, lightly fringed. Head offset, 13-14 mm wide deep. Pharynx with sub cylindrical corpus, short isthmus and valvated terminal bulb. Vulva post equatorial. Ovary single, anterior and reflexed. Post-vulval sac very small. Tail conoid.

*Habitat & locality:* Soil around roots of sal, Timli sal forest, teak, Dharmawala, Timli forest range, sal, Motichur, sal, FRI forests, Dehradun.

*Remarks:* All the measurements are in conformity with the original description except for slight variation in the position of vulva (V = 61-68 as against V= 60-62).

**9. *Acrobelus ciliatus* Linstow, 1877.**

**1877.** *Acrobelus ciliatus* Linstow, *Arch. Naturgesch.*, **43** : 1-18.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/464, coll. A.N. Rizvi & Party; 2 ♀♀, Timli sal forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/465, coll. A.N. Rizvi & Party; 2 ♀♀, FRI forest, Dehradun, 5.ix.05, Reg. No. IV/NRC/ZSI/466, coll. A.N. Rizvi & Party; 2 ♀♀, Thanu forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/467, coll. A.N. Rizvi & Party.

**Dimensions:** Female: L = 0.38-0.42 mm, a = 15-16; b = 3.5-3.7; c = 8.4-8.7; Pharynx = 108-110; V = 59-60; Tail = 45-48 mm.

**Description:** Female: Body stout, tapering towards both ends. Cuticle thick and coarsely striated. Lateral fields consisting of two pairs of longitudinal striae forming two bright lines which are separated by a minutely spotted area. Labial probolae deeply furcated. Each labial probola fringed with acutely pointed membranous tines, usually five on inner, opposing sides and eight on outer sides. Cephalic probolae surrounds the labials, each with a fringe of membranous tines. Pharynx with sub cylindrical corpus, short isthmus and valvated terminal bulb. Vulva post equatorial. Ovary single, anterior and reflexed. Post-vulval sac very small. Tail conoid.

**Habitat & locality:** Soil around roots of sal, Timli sal forest, teak, FRI forests, sal, Thanu range, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

This species is being recorded for the first time from Uttarakhand.

Genus ***Zeldia*** Thorne, 1937

**10. *Zeldia punctata* (Thorne, 1925) Thorne, 1937**

**1925.** *Acrobeles punctata* Thorne, *Trans. Amer. Micr. Soc.*, **44** : 171.

**1935.** *Acrobeles glaphyrus* Steiner, *Proc. Helm. Soc. Wash.*, **2** : 41.

**1937.** *Zeldia punctata* Thorne, *Proc. Helm. Soc. Wash.*, **4** : 1.

**1972.** *Zeldia minor* Allen & Noffsinger, *Proc. Helm. Soc. Wash.*, **39** : 206.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/468, coll. A. N. Rizvi & Party; 1 ♀♀, Timli sal forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/469, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.70- 0.82 mm; a = 18.5-29-0.5; b = 3.6-4.0; c = 11.0-12.5; V = 58-60; Stoma = 15-16; Pharynx = 210-235; Tail = 65-68 mm.

**Description:** Body straight or slightly curved ventrally upon fixation. Cuticle without punctuation. Cuticle annulated, annules 1.8-1.9 mm at midbody and 2.6 mm on tail. Lateral fields marked by five incisures. Outer incisures widely spaced, three inner incisures very closely placed and not visible clearly. Lip region 10-12 mm wide, 2.5

mm high. Labial probolae with rounded margins and shallow grooves. Cephalic probolae six, flap-like, edges crenate anteriorly projecting margins at the primary cephalic axils. Amphidial apertures elongate oval. Cheilostome wall prominent. Gymnostom smaller than stegostom. Excretory pore opposite nerve ring. Cardia conoid, 3.0-3.5 mm long. Gonad single, prodelphic. Ovary reflexed, with additional flexures near the tip. Post-uterine sac 15-20 mm long. Vulval lips depressed, radially ridged. Rectum, 24-26 mm long. Tail long, conoid, with pointed terminus. Phasmids anterior to middle of tail.

*Habitat & locality:* Soil around roots of sal, Timli sal forest, Kalsi forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description. Soil around sal is a new habitat record for the species.

### Genus *Chiloplacus* Thorne, 1937

#### 11. *Chiloplacus magnus* Rashid & Heyns, 1990.

1990. *Chiloplacus magnus* Rashid & Heyns, *Phytophylactica*, **22** : 189-199.

*Material examined:* 2 ♀♀, 1 ♂, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/470, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.80-0.99 mm; a = 25.5-30.2; b = 3.8-4.1; c = 20.4-30.5; V = 65-70; Stoma = 10-12; Pharynx = 210-241; Tail = 32-39 mm.

Male: L = 0.77 mm; a = 25.7; b = 3.9; c = 15.4; Stoma = 10-12 mm.; Pharynx = 198; Tail = 50 mm.

*Description:* Female: Body sigmoid upon fixation. Cuticle annulated. Lateral fields marked by five incisures. Lip region with six lips amalgamated in pairs. Primary axils deep, secondary axils shallow. Labial probolae bifurcate with prongs. Pharyngeal corpus cylindrical, isthmus short and basal bulb ovoid bearing valves. Gonad single, prodelphic. Ovary without flexures. Postuterine sac well developed. Tail subcylindrical with rounded terminus.

Male: General morphology similar to female. Genital system monorchic with testis reflexed ventrally. Tail conical, ventrally curved anteriorly. Genital papillae comprising five pairs: one pair lateral and one pair subventral anterior to phasmid, one pair lateral near tail terminus and two terminal pairs. Spicules ventrally curved, 36 mm long. Gubernaculum well developed, 20 mm long.

*Habitat & locality:* Soil around roots of sal, Timli sal forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description with slight variation in body lengths of both male and female (female body length = 0.80-0.99 mm against 0.88-1.52 mm, male body length = 0.77 mm against 0.80-1.23 mm).

*Chiloplacus magnus* is a new record from India.

## Order CHROMADORIDA

## Family CYTHOLAIMIDAE

Genus *Achromadora* Cobb, 1913**12. *Achromadora ruricola* (de Man, 1880) Micoletzky, 1925.**

1880. *Cytholiamus ruricola* de Man, *Tijdschr. ned. dierk.Vereen*, **5** : 18.

1913. *Achromadora minima* Cobb, *J. Wash. Acad. Sci.*, **3** : 432.

1925. *Achromadora ruricola* Micoletzky, *K. danske.Vidensk. Selsk. Skr. Natur. Og. Math. Afd.*, ser8, **10** : 133.

*Material examined*: 4 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/471, coll. A.N. Rizvi & Party.

*Dimensions*: Female: L = 0.41-0.45 mm; a = 19-21; b = 5.1- 5.5; c = 6.8-6.9; Pharynx = 80-85µm; V = 43-46; Tail = 60-65µm.

*Description*: Female: Body stout, cylindrical, curved ventrally, narrowing posteriorly. Cuticle transversely striated, striae ornamented with rows of punctuations. Head truncated lips with small apical papillae. Amphid spiral, 10 µm from anterior end. Stoma funnel shaped, 12 µm long, dorsal tooth situated near the base of stoma. Pharynx cylindrical; with a terminal bulb. Rectum less than one anal body diameter. Vulva equatorial, flush with body surface. Ovary two, opposed, reflexed. Tail long, conoid, curved ventrally with a terminal peg. Caudal glands present.

*Habitat & Locality*: Soil around roots of sal Timli sal forest, Dehradun.

*Remarks*: All the measurements are in conformity with the original description. Soil around sal is a new habitat record for the species.

## Order ARAEOLAIMIDA

## Superfamily PLECTOIDEA

## Family PLECTIDAE

## Subfamily PLECTINAE

Genus *Plectus* Bastian, 1865**13. *Plectus cirratus* Bastian, 1865.**

1865. *Plectus cirratus* Bastian, *Linn. Soc. Lond. Trans.*, **25** : 73.

*Material examined*: 1 ♀, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/472, coll. A. N. Rizvi & Party; 2 ♀♀, Dharmawala, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/473, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.90-0.93 mm, a = 21-22; b = 4.1-4.3; c = 7.9-8.1; V = 47-49

**Description:** Female: Body arcuate ventrally upon fixation. Cuticle thick finely striated. Head slightly set off, 9-10  $\mu\text{m}$  wide. Setae behind the head region. Amphid open circle. Stoma 21-30  $\mu\text{m}$  long, 4-5  $\mu\text{m}$  wide. Pharynx cylindrical with a valvular terminal bulb. Cardia long, surrounded by intestine. Vulva median. Ovaries two, opposed reflexed. Tail long tapering, terminus with spinneret.

**Habitat and Locality:** Soil around roots of sal, Timli sal forest, teak, Dharmawala, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal and teak are new host records for the species.

#### 14. *Plectus thornei* Ruhm, 1956.

1956. *Plectus thornei* Ruhm, *Parasit. Schr. Reihe.*, **6** : 412.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/474, coll. A. N. Rizvi & Party; 2 ♀♀, FRI, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/475, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.44-0.49 mm, a = 24-25; b = 2.9-3.5; c = 9.4-9.7; V = 50-52.

**Description:** Body arcuate, cuticle transversely striated, lateral field marked with four incisures, inner pair feeble and with wider gap. Many glands open in the lateral field. Pharynx cylindrical with a valvular terminal bulb, anterior to the terminal bulb, a swollen structure present.

**Habitat and Locality:** Soil around roots of sal, Thanu range, teak, FRI forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal and teak are new habitat records for the species.

#### Genus *Chiloplectus* Andrassy, 1984

#### 15. *Chiloplectus indicus* Tahseen et al, 2004.

2004. *Chiloplectus indicus* Tahseen et al, *Nematology*, **6** : 760.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/476, coll. A.N. Rizvi & Party; 1 ♀, Dharmawala forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/477, coll. A. N. Rizvi & Party; 2 ♀♀, Sabbahwala forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/478, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.49-0.58 mm, a = 17-20; b = 3.5-3.7; c = 11-12; V = 53.2-54; Tail = 70-78  $\mu\text{m}$ .

**Description:** Female: Body arcuate towards posterior extremity. Cuticle thick, strongly annulated. Lateral fields with three incisures. Lip region strongly set off, with conical lips, separated from each other by a distinct gap, with inner setose projections

pointing towards oral aperture. Cephalic setae 2-3  $\mu\text{m}$  long, originating from second to third annule. Cervical setae 7-9 in number. Stoma with cuticularized cheilostome. Amphidial apertures plectoid, located anterior to middle of stoma, at 5-6 annules from base of lips. Pharynx with corpus, slightly narrower isthmus and a basal bulb with post-bulbar extension leading to a small cardia. Basal pharyngeal bulb with a six pairs of denticulate ridges in grinder. Reproductive system didelphic, amphidelphic, genital tract weakly developed. Ovaries small, reflexed. Vagina straight with weak sphincter muscles. Vulval lips protruding. Tail, ventrally curved, gradually narrowing towards tip with a subterminal mid dorsal spur and three pairs of caudal setae.

*Habitat and Locality:* Soil around roots of sal, Timli sal forest, teak, Dharmawala, sal, Sabbahwala, Dehradun.

*Remarks:* All the measurements are in conformity with the original description except for smaller body length ( $L = 0.695\text{-}1.041\text{mm}$ ). Soil around sal and teak are new habitat records for the species.

Order MONHYSTERIDA

Family MONHYSTERIDAE

Subfamily MONHYSTERINAE

Genus *Prismatolaimus* de Man, 1880

**16. *Prismatolaimus andrassyi* Khera and Chaturvedi, 1977.**

1977. *Prismatolaimus andrassyi* Khera & Chaturvedi, *Rec. Zool. Surv. India*, **72** : 137.

*Material examined:* 2 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/479, coll. A. N. Rizvi & Party; 2 ♀♀, Dharmawala forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/480, coll. A. N. Rizvi & Party; 2 ♀♀, Sabbahwala forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/481, coll. A. N. Rizvi & Party.

*Dimensions:* Female:  $L = 0.66\text{-}0.80\text{ mm}$ ,  $a = 36\text{-}38$ ;  $b = 4.3\text{-}4.5$ ;  $c = 3.2\text{-}3.5$ ;  $V = 53\text{-}54$ .

*Description:* Female: Body slender, curved ventrally upon fixation. Cuticle with fine transverse striations. Head low and rounded anteriorly. Cephalic setae in two circlets of six and four. Stoma 8  $\mu\text{m}$  long, walls cuticularized, posterior part narrow, provided with denticulate basal part and dorsal tooth. Pharynx cylindrical with slight expansion towards the posterior end. Esophago-intestinal valve oval with 2 rows of 4 cells. Gonad mono-prodelphic and reflexed. Tail long, narrow and filiform with a spinneret.

*Habitat and Locality:* Soil around roots of sal, Timli sal forest, teak, Dharmawala, sal, Sabbahwala, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

## Order ENOPLIDA

## Family IRONIDAE

## Subfamily IRONINAE

Genus *Ironus* Bastian, 1865**17. *Ironus longicaudatus* de Man, 1884.**

1884. *Ironus longicaudatus* de Man, *der niederlandischen Fauna*, 102.

*Material examined*: 6 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/482, coll. A. N. Rizvi & Party; 2 ♀♀, Lachchiwala, Dehradun, 26.iv.05, Reg. No. IV/NRC/ZSI/483, coll. A. N. Rizvi & Party; 2 ♀♀, Dharmawala forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/484, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 1.4-1.6 mm; a = 50-55; b = 5.3-6.1; c = 4.1-4.9; V = 42-44.

*Description*: Body slender, tapering towards extremities, ventrally curved in position upon fixation. Cuticle smooth. Head set off, 12-13 µm wide, 5-7 µm high. Lips round, each with an apical papilla and four submedian setae. Amphid cup-shaped. Pharynx composed of sclerotized shields with three teeth at its base, one dorsal and two subventral. Stoma tubular, 3-4 µm wide, 82-84 µm long. Pharynx almost cylindrical. Cardia long and conical. Vulva pre-equatorial. Ovary paired, opposed and reflexed. Tail very long and filiform.

*Habitat and Locality*: Soil around roots of sal, Timli sal forest, sal, Lachchiwala, teak Dharmawala, Dehradun.

*Remarks*: All the measurements are in conformity with the original description.

## Order TYLENCHIDA

## Suborder TYLENCHINA

## Superfamily TYLENCHOIDEA

## Family TYLENCHIDAE

## Subfamily TYLENCHINA

Genus *Tylenchus* Bastian, 1865**18. *Tylenchus filiformis* Butschli, 1873.**

1873. *Tylenchus filiformis* Butschli, *Nova Acta Acad. Caesor. Leop. Carol.*, **36** : 37.

*Material examined*: 3 ♀♀, Timli sal forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/485, coll. A. N. Rizvi & Party; 2 ♀♀, Dharmawala forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/486, coll. A. N. Rizvi & Party; 2 ♀♀, Sabbahwala forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/487, coll. A.N. Rizvi & Party.

*Dimensions*: Females: L = 0.41-0.52 mm; a = 26-35; b = 4.1-5.0; c = 3.2-4.5; V = 60-65; stylet = 10- 11 µm.

**Description:** Body cylindrical from medium body to vulva, tapering uniformly to the acute terminus. Tail twice as long as vulva-anus distance. Striae course, 1.5  $\mu\text{m}$  at midbody. Lateral field marked with four incisures, crenate along its borders. Stylet with small rounded knobs. Median Pharyngeal bulb ovate. Nerve ring near middle of slender isthmus. Basal Pharyngeal bulb elongate-pyriform. Cardia discoid.

**Habitat and Locality:** Soil around roots of sal, Timli sal forest, teak, Dharmawala, sal, Sabbahwala, Dehradun.

**Remarks:** All the measurements are in conformity with the original description with slight variation observed in the length of pharynx and position of vulva (b = 4.1-5.0 against 5.2-5.5 and V = 60-65 against 58-59). Soil around sal and teak are new host records for the species.

#### Subfamily ATYLENCHINAE

#### Genus *Aglenchus* Andrassy, 1954

#### 19. *Aglenchus lycopersicus* Husain & Khan, 1975.

1975. *Aglenchus lycopersicus* Husain & Khan, *Indian J. Nematol.*, **5** : 49.

**Material examined:** 10 ♀♀, Selaqui forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/488, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.45-0.47 mm; a = 27-32; b = 4.9-5.2; c = 5.0-5.6; V = 64-66; spear = 11-12  $\mu\text{m}$ .

**Description:** Body cylindrical, tapering towards both extremities, ventrally arcuate upon fixation. Cuticle with striations, 2  $\mu\text{m}$  apart at midbody; longitudinal lines ten. Lip region set-off from the body. Spear with strong basal knobs. Orifice of the dorsal Pharyngeal gland at about 1.5  $\mu\text{m}$  from spear base. Pharynx typical for the genus, isthmus crossed by nerve ring at about 55  $\mu\text{m}$  from the anterior end. Excretory pore at level of beginning of basal bulb and situated 6  $\mu\text{m}$  apart from anterior end. Basal Pharyngeal bulb pyriform. Cardia rounded. Distinct vulval flap present, ovary single, prodelphic, outstretched. Post-uterine sac short and rudimentary, less than half body width at vulval region. Vulva-anus distance less than tail length, about 73  $\mu\text{m}$  long. Tail measures 87  $\mu\text{m}$ , long and filiform, gradually tapering to acute terminus, about 8-9 times the anal-body width.

**Habitat and Locality:** Soil around roots of sal, Selaqui sal forests, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal is a new host record for the species.

#### Subfamily BOLEODORINAE

#### Genus *Boleodorus* Thorne, 1941

#### 20. *Boleodorus typicus* Husain & Khan, 1967.

1967. *Boleodorus typicus* Husain & Khan, *Nematologica*, **13** : 497.

*Material examined:* 5 ♀♀, 2 ♂♂, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/489, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.44-0.58 mm; a = 23-27; b = 3.9-5.3; c = 6-9; V = 62-68  
spear = 12-14 µm.

Male: L = 0.52-0.56 mm; a = 33-47; b = 4.5-5.3; c = 7; spear = 13-14 µm; spicules = 18-20 µm; gubernaculum = 3-5 µm.

*Description:* Females: Body assumes open 'C'-shape upon fixation, tapering at both extremities. Cuticle distinctly annulated. Lateral fields marked by six incisures, outer ones crenate and more distinct. Phasmids behind middle of tail. Head continuous with body contour truncated and copulate. Spear 12-14 µm long with broad basal flanges. Basal Pharyngeal bulb pyriform with three gland nuclei. Excretory duct prominent, opening through a cuticularized pore at 90-100 µm from anterior end of body. Ovary single, prodelphic, outstretched with oocytes arranged in multiple rows. Spermatheca present. Post-uterine sac about half vulval body-width long. Vulva-anus distance about twice tail length. Tail elongate-conoid with rounded terminus, ventrally curved, 5-6 times anal body-width long.

Males: Similar to females in general shape and appearance. Testis single and outstretched. Spicules paired, cephalated, 18-20 µm long. Gubernaculum short, simple and rudimentary, measuring 3-5 µm in length. Bursa adanal, nearly twice cloacal body-width.

*Habitat and Locality:* Soil around roots of sal, Timli sal forests; sal, Selaqui sal forests, Dehradun.

*Remarks:* All the measurements are in conformity with the original description. Soil around sal is a new host record for the species.

### Genus *Psilenchus* de Man, 1921

#### 21. *Psilenchus minor* Siddiqi, 1963.

1963. *Psilenchus minor* Siddiqi, *Z. Parasitenk.*, **23** : 397-402.

*Material examined:* 2 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/490, coll. A. N. Rizvi & Party; 2 ♀♀, 1 ♂, Dharmawala forest, Dehradun, 12.viii.07, Reg. No. IV/NRC/ZSI/491, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.75-0.85 mm; a = 43-45; b = 5.2-5.6; c = 5.7-5.9; c' = 11-12; V = 47-48; stylet = 11-13 µm.

Males: L = 0.89 mm; a = 49; b = 6.4; c = 6.3; spicules = 28 µm; gubernaculum = 6 µm.

*Description:* Lip region rounded, smooth, and continuous with body contour. Lateral fields marked by four incisures. Orifice of dorsal Pharyngeal gland 7 µm behind stylet base. Tail elongate-filiform, regularly tapering to a bluntly rounded tip. Phasmids two anal body-widths behind anus. Bursa adanal, crenate arising near head of spicules and extending up to phasmid.

**Habitat and Locality:** Soil around roots of, Sal, Timli Sal forests; sal, teak Dharmawala, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal and teak are new host records for the species.

Family BELONOLAIMIDAE

Subfamily TELOTYLENCHINAE

Genus *Tylenchorhynchus* Cobb, 1913

**22. *Tylenchorhynchus annulatus* (Cassidy, 1930) Golden, 1971.**

1930. *Tylopharynx annulatus* Cassidy, *Hawaii Plant Rec.*, **34** : 381.

1971. *Tylenchorhynchus annulatus* Golden, In: *Plant Parasitic Nematodes, Vol. I.* eds: Zuckerman, Mai. & Rohde. Academic press : 198.

**Material examined:** 6 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/492, coll. A. N. Rizvi & Party; 2 ♀♀, FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/493, coll. A. N. Rizvi & Party; 2 ♀♀, Mohand, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/494, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.57-0.61 mm; a = 26-31; b = 5.0-5.2; c = 14-16; c' = 2.8-3; V = 53-56; stylet = 16-18 µm.

**Description:** Female: Body slightly curved on ventral side upon fixation, cuticle transversely striated. Lateral fields with four incisures. Stylet basal knobs rounded with slight convex anterior surface. Reproductive system amphidelphic with non-functional spermatheca. Tail cylindrical slightly curved ventrally.

**Habitat and Locality:** Soil around roots of sal, Timli sal forests; teak, FRI forest and Mohand, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

**23. *Tylenchorhynchus mashoodi* Siddiqi & Basir, 1959.**

1959. *Tylenchorhynchus mashoodi* Siddiqi & Basir, Proc. 46<sup>th</sup> Indian Science Congr. 35; Siddiqi, 1961 *Z. Parasitenk.*, **21** : 48.

**Material examined:** 4 ♀♀, 2 ♂♂, Timli sal forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/495, coll. A. N. Rizvi & Party; 5 ♀♀, Selaqui forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/496, coll. A. N. Rizvi & Party; 2 ♀♀, Sabbahwala forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/497, coll. A. N. Rizvi & Party; 2 ♀♀, Thanu forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/498, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.54-0.72 mm; a = 28-37; b = 4.4-5.8; c = 13-18; c' = 2.5-4.0; V = 52-58; stylet = 16-19 µm.

Male: L = 0.57-0.66 mm; a = 27-35; b = 4.5-5.6; c = 14-17; T = 36-50; Spicule = 23-25  $\mu\text{m}$ ; Gubernaculum = 10-15  $\mu\text{m}$ .

*Description:* Lip region continuous with body contour, with 3-4 annules. Cuticle marked with distinct transverse striae, 1- 2 $\mu\text{m}$  apart. Cephalic framework lightly sclerotized. Stylet with rounded basal knobs which may be anteriorly slightly flattened. Excretory pore posterior to level of nerve ring. Hemizonid just anterior to excretory pore. Spermatheca rounded. Tail cylindrical to subcylindrical in shape, narrowing slightly behind anus, ending in a rounded to bluntly rounded, unstriated terminus, with 14-29 striae. Phasmids in anterior half of tail. Male tail elongate-conoid with acute or subacute terminus.

*Habitat and Locality:* Soil around roots of sal, Timli sal forests, Selaqui, Sabbahwala; teak, Thanu range, Dehradun.

*Remarks:* All the measurements are in conformity with the original description with slight variation in the length of spicules (spicule length= 23-25  $\mu\text{m}$  as against 18-22  $\mu\text{m}$ ). Soil around sal and teak are new host records for the species.

Family HOPLOLAIMIDAE

Subfamily HOPLOLAIMINAE

Genus *Hoplolaimus* Daday, 1905

**24. *Hoplolaimus indicus* Sher, 1963.**

1963. *Hoplolaimus indicus* Sher, *Nematologica*, **9** : 280.

*Material examined:* 4 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/499, coll. A. N. Rizvi & Party; 6 ♀♀, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/500, coll. A. N. Rizvi & Party; 4 ♀♀, Raipur forest, Dehradun, 4.vii.07, Reg. No. IV/NRC/ZSI/501, coll. A. N. Rizvi & Party; 6 ♀♀, Lachchiwala, Dehradun, 26.iv.05, Reg. No. IV/NRC/ZSI/502, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 1.02-1.40 mm; a = 22-36; b = 8.4-9.1; b' = 7.0-8.1; c = 45-74; c' = 0.66-0.68; V = 50-59; Stylet = 30-34  $\mu\text{m}$ .

Males: L = 0.94-1.30 mm; a = 26-36; b = 8.9-12.0; b' = 6.2-9.0; c = 31-38; Spicules = 37-48  $\mu\text{m}$ ; Gubernaculum = 12-20  $\mu\text{m}$ .

*Descriptions:* Cuticle coarsely annulated. Lateral fields marked by single incisures or 2-3 incomplete broken incisures. Anterior phasmid about 24-44 % from anterior end, posterior phasmid at 76-86 % from anterior end. Lip region hemispherical, marked by 3-4 annules, basal annule with 6-12 longitudinal striations. Cephalic framework strongly sclerotized. Stylet robust; basal knobs tulip shaped. Pharyngeal gland with six nuclei. Excretory pore anterior to esophago-intestinal junction. Spermatheca filled with sperms. Intestine overlapping rectum. Tail rounded with 8-13 annules. Spicules arcuate and cephalated. Bursa terminal.

**Habitat and Locality:** Soil around roots of sal, Motichur, sal, Timli sal forests, Raipur, teak Lachchiwala, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal and teak are new host records for the species.

Genus *Helicotylenchus* Steiner, 1945

**25. *Helicotylenchus dihystrera* (Cobb, 1893) Sher, 1961.**

1893. *Tylenchus dihystrera* Cobb, *Dept.Agr.N.S.Wales.Misc.Publ.*, 13.

1961. *Helicotylenchus dihystrera* Sher, *Nematologica*, **6** : 157.

1968. *H. punicae* Swarup & Sethi, *Bull.Ent.Loyala.Coll.*, **9** : 78.

1972. *H. dihysteroides* Siddiqi, *Nematologica*, **18** : 76.

1980. *H. crenatus* Das, *Z. Parasitenk.*, **19** : 560.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/503, coll. A. N. Rizvi & Party; 2 ♀♀, Kunjagrant forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/504, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.50-0.57 mm; a = 21-28; b = 4.3-6.6; b<sub>2</sub> = 3.7-5.2; c = 32-65; c<sub>2</sub> = 1.1-1.3; V = 61-66.

**Description:** Female: Body spiral, cuticle with distinct transverse striae. Lip region continuous with body, hemispherical. Cephalic framework conspicuous. Pharynx with overlapping glands. Both genital branches equally developed. Spermatheca rounded, offset, without sperm. Tail dorsally convex-conoid, usually with slight ventral projection.

**Habitat and Locality:** Soil around roots of sal, Timli sal forests, Kunjagrant forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal is a new host record for the species.

**26. *Helicotylenchus indicus* Siddiqi, 1963.**

1963. *Helicotylenchus indicus* Siddiqi, *Z.Parasitenk.*, **23** : 399.

**Material examined:** 5 ♀♀, Thanu forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/505, coll. A. N. Rizvi & Party; 5 ♀♀, Selaqui forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/506, coll. A. N. Rizvi & Party; 5 ♀♀, Dharmawala forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/507, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.45-0.541 mm; a = 23-25; b = 4.5-5.8; b' = 3.5-5.1; c = 24-39; c' = 1.1-1.5; V = 59-65; Stylet = 24-26 µm.

**Description:** Female: Body spirally curved. Lip region conoid-rounded with 4-5 indistinct annules. Lateral field  $1/7^{\text{th}}$  of body width, marked with four incisures, continuous till the tip of the tail. Tail hemispherical.

**Habitat and Locality:** Soil around roots of sal, Thanu forest, Dehradun, Selaqui forests, teak, Dharmawala, Dehradun.

**Remarks:** All the measurements are in conformity with the original description with slight variation in the length of stylet (Stylet = 24-26  $\mu\text{m}$ . as against 22-24  $\mu\text{m}$ ).

**27. *Helicotylenchus multicinctus* (Cobb, 1893) Golden, 1956.**

1893. *Tylenchus multicinctus* Cobb, *Mem. Vol. Linn. Soc. N.S.W.*, **1** : 260.

1956. *Helicotylenchus multicinctus* Golden, *Maryland Agric. Exp. Stn. Bull.*, **A-85** : 18.

**Material examined:** 2 ♀♀, Selaqui forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/508, coll. A. N. Rizvi & Party; 2 ♀♀, Kunjagrang forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/509, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.40-0.67 mm; a = 26; b = 5.3; b' = 4.4; c = 31-66; c' = 1.02; V = 61-76; stylet = 20-28  $\mu\text{m}$ .

**Description:** Lip region hemispherical, continuous with the body contour, with 4-5 annules. Stylet knobs indented anteriorly. Excretory pore posterior to esophago-intestinal junction. Tail dorsally curved, with hemispherical terminus marked with 10-14 annules.

**Habitat and Locality:** Soil around roots of sal, Selaqui sal forest, Kunjagrang forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal is a new host record for the species.

Family PRATYLENCHIDAE

Subfamily PRATYLENCHINAE

Genus *Pratylenchus* Filipjev, 1936

**28. *Pratylenchus penetrans* (Cobb, 1917) Filipjev & Stekhoven, 1941.**

1917. *Tylenchus penetrans* Cobb, *J. agr. Res.*, **11** : 32.

1927. *Tylenchus pratensis* Stienen, *J. agric. Res.*, **35** : 961.

1941. *Pratylenchus penetrans* Filipjev & Stekhoven, *E.J.Brill. Leiden*, 712.

**Material examined:** 2 ♀♀, 2 ♂♂, Timli forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/510, coll. A. N. Rizvi & Party; 4 ♀♀, Selaqui forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/511, coll. A. N. Rizvi & Party; 2 ♀♀, FRI forest, Dehradun, 29.ix.05, Reg. No. IV/NRC/ZSI/512, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.43-0.65 mm; a = 17-30; b = 5.7 -6.5; c =15-21; V = 78-83; Stylet =13-18  $\mu$ m.

Male: L = 0.44-0.56 mm; a = 23-30; b = 5.2-6.0; c =15-20; T = 43-52; Stylet =13-14  $\mu$ m; Spicules =13-14  $\mu$ m; Gubernaculum = 4-6  $\mu$ m.

**Description:** Lip region bearing three annules. Spear 16 to 18  $\mu$ m long, with broadly rounded knobs. Spermatheca present usually filled with spermatozoa. Posterior uterine branch about as long as vulva body width. Tail dorsally convex-conoid, the posterior portion being somewhat subcylindroid and ending in a broadly rounded terminus.

**Habitat and Locality:** Soil around roots of sal, Timli and Selaqui sal forest, teak, FRI forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

### **29. *Pratylenchus kumaonensis* Lal & Khan 1989.**

1989. *Pratylenchus kumaonensis* Lal & Khan, *Ind. J. Nematol.*, **19** : 44.

**Material examined:** 2 ♀♀, Timli forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/513, coll. A. N. Rizvi & Party; 2 ♀♀, Selaqui forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/514, coll. A. N. Rizvi & Party; 2 ♀♀, Sabbahwala forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/515, coll. A. N. Rizvi & Party; 2 ♀♀, Kunjagrang forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/516, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.39-0.48 mm; a = 25.0-29.0; b = 5.8-6.8; b' = 3.9-4.8; c = 20.0-24.0; c' = 2.0-2.5; V = 81.0-82.5; Spear = 14.0-15.0  $\mu$ m.

**Description:** Female: Body straight or slightly arcuate upon fixation, head almost continuous with body contour with 3 annules, heavily sclerotized skeleton extending to two annules, Lateral fields with four incisures at the level of metacarpus and continuous up to the posterior third of tail. Stylet 14-15  $\mu$ m long with rounded basal knobs. Opening of dorsal Pharyngeal gland 2.8-3.5  $\mu$ m posterior to spear knobs.

**Habitat and Locality:** Soil around roots of sal, Timli and Selaqui forest, teak, Sabbahwala forest, Kunjagrang forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

### **30. *Pratylenchus neglectus* (Rensch, 1924) Filipjev & Schur. Steck., 1941.**

1924. *Tylenchus neglectus* Rensch, *Mitt. Deut.Landwirts.Ges.*, **38** : 412.

1941. *Pratylenchus neglectus* Filipjev & Schur. Stekhoven, *E.J.Brill, Leiden*, 714.

**Material examined:** 4 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/517, coll. A. N. Rizvi & Party; 6 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No.

IV/NRC/ZSI/518, coll. A. N. Rizvi & Party; 5 ♀♀; Selaqui forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/519, coll. A. N. Rizvi & Party; 5 ♀♀, Thano forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/520, coll. A. N. Rizvi & Party.

*Dimensions:* Females: L = 0.32-0.58 mm; a = 16.5-32.2; b = 4.9-7.8; c = 13.8-26.8; V = 75.5-86.5; Stylet = 15-19 µm.

*Description:* Females obtained from roots are more robust than females obtained from the rhizophere, which become more linear when relaxed. Head with 2 annules of about equal size, the apical one comprising the lips. Spear knobs 4-6 µm across, typically indented on anterior surfaces. Excretory pore 75-87 µm from anterior end. Hemizonid immediately anterior to excretory pore, extending over 2-3 body annules. Lateral field with 4 incisures, but median zone is often marked by 1 or 2 longitudinal or several oblique striae. Female monodelphic, prodelphic, ovary outstretched with oocytes in tandem. Intra-uterine eggs in older adults may be segmented or contain early first stage larva. Post-uterine branch less than or equal to body width, 12-18 µm long and is undifferentiated. Tail variable in shape usually conoid with little curvature of ventral surface with 15-20 annules. Phasmids in posterior half of tail.

*Habitat and Locality:* Soil around roots of sal, Motichur forests, sal, Timli and Selaqui forest, teak, Thanu range, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

### 31. *Pratylenchus pratensis* (de Man, 1880) Filipjev, 1936.

1880. *Tylenchus pratensis* de Man, *Tijds. Nederland. Dierk.Vereen*, 5 : 10.

1936. *Pratylenchus pratensis* Filipjev, *Proc. Helminth. Soc. Wash.*, 3 : 80.

*Material examined:* 2 ♀♀, 2 ♂♂, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/521, coll. A. N. Rizvi & Party, 2 ♀♀, Selaqui forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/522, coll. A. N. Rizvi & Party; , 2 ♀♀, Mohand forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/523, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.37-0.70 mm; a = 22-32; b = 4-6; c = 19-24; V = 80-84; Stylet = 17-19 µm.

Males: L = 0.32-0.54 mm; a = 22-31; b = 6; c = 16-20; T = 45-67; Stylet = 17-19 µm.

*Descriptions:* Lip region with annules. Stylet with slightly cupped knobs. Vulvanus distance three times tail length. Spermatheca filled with sperms. Tail, cylindrical in posterior half, posteriorly ending in a blunt, rounded terminus with thick annules.

*Habitat and Locality:* Soil around roots of sal, Timli and Selaqui sal forest, teak, Mohand forest range, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

## Superfamily CRICONEMATOIDEA

## Family CRICONEMTIDAE

## Subfamily CRICONEMATINAE

Genus *Hemicriconemoides* Chitwood & Birchfield, 1957**32. *Hemicriconemoides mangifera* Siddiqi, 1961.**1961. *Hemicriconemoides mangifera* Siddiqi, *Proc. Helm. Soc. Wash.*, **28** : 28.

*Material examined*: 4 ♀♀, Timli forest, Dehradun, 29.ix.05, Reg. No. IV/NRC/ZSI/524, coll. A. N. Rizvi & Party; 4 ♀♀, Selaqui forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/525, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.48-0.51 mm; a = 13-14; b = 4.2-4.7; c = 13-15; V = 90-92; VL/VB = 1.2-1.5; R = 136-145; Rv = 14-16; Ran = 8-14; Rvan = 3-5; Rst = 23-25; Roes = 28-38; Rex = 31-46; Stylet = 70-86 µm.

*Description*: Female: Cuticular sheath attached to body at anterior end. Lip region slightly offset with 2 annules, angular, directed outward. Labial disc slightly elevated, cephalic framework strongly sclerotized, hexaradiate with lateral sectors larger than submedians. Stylet knobs strong, 5-7 µm across, anterior margins directed forward. Excretory pore 3-4 annules posterior to pharyngeal base. Vulva transverse, vulval sheath absent. Spermatheca rounded. Tail convex-conoid or rounded.

*Habitat and Locality*: Soil around roots of sal, Timli and Selaqui sal forest, Dehradun.

*Remarks*: All the measurements are in conformity with the original description.

Soil around sal is a new host record for the species.

**33. *Hemicriconemoides doonensis* Srivastava et al., 2000.**2000. *Hemicriconemoides doonensis* Srivastava et al., *Indian J. Nematol.*, **30** : 97.

*Material examined*: 2 ♀♀, Selaqui forest, Dehradun, 29.ix.05, Reg. No. IV/NRC/ZSI/526, coll. A. N. Rizvi & Party; 2 ♀♀, Kunjagrang forest, Dehradun, 13.viii.07, Reg. No. IV/NRC/ZSI/527, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.62-0.71 mm; a = 14-17; b = 3.9-4.7; c = 8.0-9.6; c' = 1.7-2.4; V = 89-94; R = 140-145; Rv = 120-128; Ran = 10-12; Rvan = 4-6; Rst = 18-21; Roes = 34-36; Rex = 36-39; Stylet = 80-88 µm; Pharynx = 150-163 µm; Tail = 38-43 µm.

*Description*: Female: Body curved ventrally upon fixation, tapering towards both extremities, posteriorly terminating as elongate conoid tail. Annules 3-4 µm apart at midbody. Lip region slightly offset with one annule. Lip width 10 µm and lip height 3 µm. Lip annule ovoid depressed laterally. Amphidial aperture slit-like, located behind oral disc. Cephalic framework moderately sclerotized. Stylet well developed; metenchium slender, 62-63 % of total stylet length; telenchium 28-30 % long, basal knobs anchor-shaped, 5 µm long and 9 µm wide. Dorsal Pharyngeal gland opening 18

$\mu\text{m}$  from stylet base. Prometacarpus muscular 15  $\mu\text{m}$  wide, 9-10  $\mu\text{m}$  long with valve plates. Isthmus 4-6  $\mu\text{m}$  long. Basal bulb saccate, rounded, 24-25  $\mu\text{m}$  long. Nerve ring 130-132  $\mu\text{m}$  from anterior end. Hemizonid one annule wide, located anterior to excretory pore. Vulva transverse slit-like, vagina, 10-11  $\mu\text{m}$  long. Spermatheca spherical, 12-13  $\mu\text{m}$ , filled with sperms. Tail elongate-conoid slightly swelling near the tip, finely rounded.

*Habitat and Locality:* Soil around roots of sal, Selaqui sal forest, Kunjagrang forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal is a new host record for the species.

### 34. *Criconema rishikensis* (Singh & Khan, 1999) Rizvi, 2010.

1999. *Lobocriconema rishikensis* Singh & Khan, *Indian J. Nematol.*, **29** : 48.

2010. *Criconema rishikensis* Rizvi, *State Fauna Series, Zool. Surv. India*, **18** : 107

*Material examined:* 4 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/528, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.32-0.47 mm; a = 7.5-9.1; b = 3.3-5.11; V = 91.2-92.8; Spear = 62-74  $\mu\text{m}$ ; R = 39-45; Rst = 8-10; Roes = 11-15; Rv = 3-4.

*Description:* Female: Body assumes almost straight posture upon fixation, plump, cylindrical, tapering at either end. Body annules with thick cuticle. Head separate from body and comprises of two annules. The first annule is distinctly set off with inwardly directed margins measures 22-24 x 5-6  $\mu\text{m}$  in dimensions. Second head annule with almost rounded margin and measuring 18-20  $\mu\text{m}$ . Lateral breaking of annules starts from fifth annule, thereafter the margins of annules become distinctly serrated. Lateral mounts, a distinct groove is clearly visible below the neck region, which continues throughout the body till the vulva. Fourth and fifth annule from tail do not break on the pattern of body annule but forms a depression in lateral area. The last two annules have the serrated margins taking the form of spines. Labial framework strongly developed, hexaradiate with I- shaped lateral sectors slightly larger than the others. Amphid aperture slit-like located at the base of lateral lips. Spear extending over 8-10 annules, 62-74  $\mu\text{m}$  long, and shaft 7-8  $\mu\text{m}$  in length, spear knobs anteriorly cupped and 9  $\mu\text{m}$  across.

Pharynx typically criconematoid, extending over 11-15 long annules. Metacarpus measuring 37 x 25  $\mu\text{m}$  in dimensions, enclosing a 9  $\mu\text{m}$  valve. Dorsal pharyngeal gland opening located at 7-9  $\mu\text{m}$  behind the spear knobs. Vulva located 3-4 annules from tail tip, a transverse slit. Tail terminus spinate.

*Habitat and Locality:* Soil around roots of sal, Motichur sal forests, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal is a new host record for the species.

## Family TYLENCHULIDAE

## Subfamily PARATYLENCHINAE

Genus *Paratylenchus* Micoletzky, 1922**35. *Paratylenchus nainianus* Edward & Misra, 1963.**

1963. *Paratylenchus nainianus* Edward & Misra, *Nematologica*, **9** : 215.

*Material examined*: 2 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/529, coll. A. N. Rizvi & Party; 2 ♀♀, Thanu forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/530, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.25-0.29 mm; a = 21.2-25.5; b = 4.0-5.5; c = 19.4-20.4; V = 80-84; Spear = 22-27 µm.

*Description*: Female: Body tapering at both ends, in the normal relaxed position ventrally curved, cuticle fairly well- marked by transverse striae about 0.7 microns wide. The lip region somewhat conoid-truncate, striated, not sclerotized, continuous with the body contour and bearing six lips. Mid-labial extension not prominent. Lateral field marked by four incisures, occupying 1/3 of the body width. Amphids not observed phasmids clear, situated 10 µm from tail end. Excretory pore distinct, located 52µm behind the anterior end at the junction between isthmus and basal bulb. Hemizonid present just above the excretory pore. The distance between the base of the basal knobs and the base of the median valve is 14 µm. Stomatostylet slender, 22 µm long bearing heavy, laterally conoid and somewhat pointed basal knobs. Median bulb criconemoid with a prominent valvular apparatus, leading into appear shaped basal bulb through an isthmus. Intestine with a rectum and fairly distinct anus.

Ovary monodelphic, out-stretched, occupying half of the intestinal length with oocytes arranged in two rows except at the region of multiplication. Vulva a prominent slit, with a vulval sheath, leading into a broad uterus. Spermatheca located close to the uterus, measuring 10 x 8 µm. Post-uterine sac lacking.

*Habitat and Locality*: Soil around roots of sal, Motichur sal forests, teak Thanu range, Dehradun.

*Remarks*: All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

Genus *Tylenchulus* Cobb, 1913**36. *Tylenchulus semipenetrans* Cobb, 1913.**

1913. *Tylenchulus semipenetrans* Cobb, *J. Wash. Acad. Sci.*, **3** : 288.

*Material examined*: 2 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/531, coll. A. N. Rizvi & Party; 2 ♀♀, Kunjagrang forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/532, coll. A.N. Rizvi & Party; 2 ♀♀, Sabbahwala forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/533, coll. A.N. Rizvi & Party.

**Dimensions:** Female: L = 0.31-0.46 mm; a = 3.5-6.4; b = 2.4-4.3; V = 88-93; Stylet = 11-12  $\mu\text{m}$ ; body width at vulva = 21-31  $\mu\text{m}$ ; Dorsal pharyngeal gland nuclei = 4-6  $\mu\text{m}$ ; Pharyngeal length = 104-159  $\mu\text{m}$ .

**Description:** Body translucent white, 60-70% of body variably saccate, widest at excretory pore, narrowing at vulva and ending in a digitate terminus. Lip region hemispherical, smooth; labial sclerotization weak. Stylet knobs rounded. Procorpus cylindrical, metacarpus oval. Basal bulb, elongate-saccate. Gonad convoluted extending anteriorly to basal bulb. Tail slightly tapering to a broadly rounded terminus.

**Habitat and Locality:** Soil around roots of sal, Motichur sal forests, teak Kunjagrang forest, sal Sabbahwala forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

Order APHELENCHIDA SIDDIQI

Suborder APHELENCHINA HOOPER

Family APHELENCHIDAE

Genus *Aphelenchus* Bastian 1865

**37. *Aphelenchus avenae* Bastian 1865.**

1865. *Aphelenchus avenae* Bastian, Linn. Soc. Lond. Trans., 25 : 122.

**Material examined:** 2 ♀♀, 2 ♂♂, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/534, coll. A. N. Rizvi & Party; 2 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/535, coll. A. N. Rizvi & Party, 4 ♀, Raipur forest, Dehradun, 4.vii.07, Reg. No. IV/NRC/ZSI/536, coll. A. N. Rizvi & Party; 2 ♀♀, Selaqui forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/537, coll. A. N. Rizvi & Party, 3 ♀♀, FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/538, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.56-0.68 mm; a = 27-34; b = 7-8; c = 30-38; V = 73-77; Stylet = 12-16  $\mu\text{m}$ .

Male: L = 0.58-0.71 mm; a = 30-35; b = 6-8; c = 26-30; Stylet = 12-17  $\mu\text{m}$ .

**Description:** Female: Body cylindrical and tapers towards extremities. Cuticle finely striated. Lip region hemispherical. Stylet knobs absent. Pharynx aphelenchoid type. Nerve ring just behind median bulb. Vulva posterior with slightly protruding vulval lips. Ovary monoprodelphic. Post-vulval sac empty. Tail cylindroid with round terminus.

Male with bursa supported by one preanal, 3 postanal, sub terminal ribs. Spicules 25-27  $\mu\text{m}$  long, paired, slender, ventrally arcuate, slightly cephalated at proximal end. Gubernaculum simple, 15-18  $\mu\text{m}$  long.

**Habitat and Locality:** Soil around roots of sal, Motichur sal forests, sal Timli Raipur, Selaqui sal forests, teak FRI forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.  
Soil around sal and teak are new host records for the species.

Order DORYLAIMIDA

Suborder DORYLAIMINA

Superfamily DORYLAIMOIDEA

Family DORYLAIMIDAE

Subfamily LAIMYDORINAE

Genus *Amphidorylaimus* Andrassy, 1960

**38. *Amphidorylaimus infecundus* (Cobb, 1936) Andrassy, 1960.**

1936. *Dorylaimus infecundus* Cobb in Thorne & Swanger, *Capita. zool.* , **6** : 31.

1960. *Amphidorylaimus infecundus* (Cobb, 1936) Andrassy, *Acta Zool. Hung.* , **6** : 12.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/539, coll. A. N. Rizvi & Party; 2 ♀♀, Thanu forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/540, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.90-0.95 mm; a = 45 b = 4.3; c = 3.5-3.7; V = 36-37; Stylet = 10-11 µm.

**Description:** Small nematodes, characterized by the well set-off, well developed head. Lips angular and set off by a deep constriction. Pharynx gradually expanding near its middle. Tail tapering evenly beyond anus, about 10 anal-body widths long. Rectum 2 anal-widths long, pre-rectum twice as long.

**Habitat and Locality:** Soil around roots of sal, Timli sal forest, teak, FRI forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

Genus *Prodorylaimium* Andrassy, 1969

**39. *Prodorylaimium brigdammense* (de Man, 1876) Andrassy, 1969.**

1876. *Dorylaimus brigdammense* de Man, *Tijdschr.ned.dierk.Vereen* , **2** : 85.

1969. *Prodorylaimium brigdammense* Andrassy, *Opuscula Zoologica, Bpst.*, **9** : 230.

**Material examined:** 2 ♀♀, FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/541, coll. A. N. Rizvi & Party; 1 ♀, Kunjagrang forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/542, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 1.49-1.74 mm; a = 41-45; b = 5.4-5.7; c = 5-6; c' = 13-15; V = 46-49; G<sub>1</sub> = 12-16; G<sub>2</sub> = 12-14; Odontostyle = 13-14; Odontophore = 17-18; Pharynx

= 276-312  $\mu\text{m}$ ; Pre-rectum = 60-62  $\mu\text{m}$ ; Rectum = 27-31  $\mu\text{m}$ ; Tail = 259-344  $\mu\text{m}$ ; ABD = 20-23  $\mu\text{m}$ .

*Habitat & Locality:* Soil around roots of sal, FRI forest, Kunjagrang forest, Dehradun.

*Remarks:* All the body measurements are in agreement with the measurement and description of earlier workers. Soil around sal is a new host records for the species.

Genus *Mesodorylaimus* Andrassy, 1959

**40. *Mesodorylaimus chamolienses* Ahmad, 1995.**

1995. *Mesodorylaimus chamolienses* Ahmad, *Afro Asian J. Nematol.*, 5 : 210.

*Material examined:* 2 ♀♀, Timli sal forest, Dehradun, 30.xi.05, Reg. No. IV/NRC/ZSI/543, coll. A. N. Rizvi & Party; 2 ♀♀, Thanu forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/544, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.86-0.92 mm; a = 32-36; b = 3.9-4.2; c = 4.2-4.8; c' = 10-12; V = 46-47; G<sub>1</sub> = 9-12; G<sub>2</sub> = 10-13; Odontostyle = 11-12; Odontophore = 14-15; Tail = 185-270  $\mu\text{m}$ .

*Description:* Body slightly curved ventrally upon fixation and tapering posteriorly into a whip-like, filiform tail. Cuticle finely striated 2-3  $\mu\text{m}$  thick at midbody and 3-4  $\mu\text{m}$  on tail. Lateral, dorsal and ventral pores indistinct. Lateral hypodermal chords about 1/3<sup>rd</sup> of body width near midbody. Lip region continuous, 8-9  $\mu\text{m}$  wide or about 1/3<sup>rd</sup> of body width at base of pharynx and 3-4  $\mu\text{m}$  high. Amphid stirrup-shaped, apertures 5  $\mu\text{m}$  wide or about slightly more than half of corresponding body width. Odontostyle 1.3-1.4 lip widths long, its aperture about 33 % of its length. Guiding ring single, at 7  $\mu\text{m}$  or 0.8-0.9 lip width from anterior end. Odontophore simple, rod-like. Pharyngeal length, 210-217  $\mu\text{m}$ . Expanded part of pharynx 38-40 % of pharyngeal length. Cardia small, hemispheroid, 10-13  $\mu\text{m}$  long. Pharyngeal gland nuclei located as follows: DO = 63-65; DN = 69-79; DO-DN = 3-4; S<sub>1</sub>N<sub>1</sub> = 79-80; S<sub>1</sub>N<sub>2</sub> = 84-85; S<sub>2</sub>N = 91-92; S<sub>2</sub>O = 92-93. Reproductive system amphidelphic. Vulva transverse; vagina 9-10  $\mu\text{m}$  or about one-third of corresponding body width. Pre-rectum 27-30  $\mu\text{m}$  or 1.9-1.0 anal body widths long. Rectum 15-20  $\mu\text{m}$  long or 1.1-1.3 anal body widths long. Tail 185-270  $\mu\text{m}$  10-12 anal body widths long with a pair of caudal pores on each side.

*Habitat & Locality:* Soil around roots of sal, Timli sal forest, teak, Thanu range, Dehradun.

*Remarks:* All the body measurements are in agreement with the measurement and description of earlier workers. This species is recorded for the first time from Teak and Sal forests.

## Subfamily THORNENEMATINAE

Genus *Thornenema* Andrassy, 1959**41. *Thornenema cavalcantii* (Lordello, 1955) Andrassy, 1959.**

1955. *Dorylaimus cavalcantii*. Lordello. *Revta. bras. Biol.*, 5 : 216.

1959. *Thornenema cavalcantii* Andrassy, *Acta Zool. Hung.*, 5 : 196.

**Material examined:** 3 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/545, coll. A. N. Rizvi & Party; 2 ♀♀, Selaqui forest, Dehradun, 29.vi.06, Reg. No. IV/NRC/ZSI/546, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.97-1.05 mm; a = 32-33; b = 3.8-4.1; c = 9.5-10.2; c' = 4-5; V = 43-45; Odontostyle = 11-12; Odontophore = 16-17; Pharynx = 245-248 µm; Pre-rectum = 50-55 µm; Rectum = 26-27 µm; Tail = 93-101 µm; ABD = 20-21 µm.

**Description:** Female: Body slightly ventrally arcuate upon fixation, tapering towards both extremities. Cuticle with fine transverse striae thickest at tail. Lateral hypodermal chords about 1/8th of body width near midbody. Lip region smoothly rounded, continuous with body contour, 10-11 or about 1/3<sup>rd</sup> of body width at base of pharynx. Cephalic framework weakly sclerotized. Amphid stirrup-shaped, apertures 5-6 µm wide or about half of lip-width. Odontostyle slightly longer than lip width, its aperture about two-fifths of its length. Guiding ring single. Odontophore rod-like, 1.2-1.4 times the odontostyle length. Nerve ring encircling anterior slender part of pharynx at 93-100 µm from anterior end. Expanded part of pharynx 46-51 % of pharyngeal length. Pharyngeal gland nuclei located as follows: DO = 55-58; DN = 58-61; DO-DN = 2.5-3.4; S<sub>1</sub>N<sub>1</sub> = 69-72; S<sub>1</sub>N<sub>2</sub> = 74-76; S<sub>2</sub>N = 81-83; S<sub>2</sub>O = 82-84.

Reproductive system amphidelphic. Vulva transverse; vagina 24-26 µm or about half of corresponding body width. Gonads equally well developed, sphincter present at oviduct-uterus junction. Pre-rectum 1.6-1.22 anal body widths long. Rectum 1.2-1.6 anal body widths long. Tail short, conoid with a pair of caudal pores on each side.

**Habitat and Locality:** Soil around roots of sal, Timli sal forest, Selaqui forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal and teak are new host records for the species.

Genus *Opisthodorylaimus* Ahmad & Jairajpuri, 1982**42. *Opisthodorylaimus caudatus* Ahmad & Jairajpuri, 1982.**

1982. *Opisthodorylaimus caudatus* Ahmad & Jairajpuri, *Revue Nematol.*, 5 : 267.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/547, coll. A. N. Rizvi & Party; 2 ♀♀, Lachchiwala, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/548, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 1.35-1.37 mm; a = 31-34; b = 4.0-4.5; c = 12-15; c' = 4-5; V = 47-48; G<sub>2</sub> = 13; Odontostyle = 18-19 µm; Odontophore = 21-23 µm; Pharynx = 326-345 µm; Pre-rectum = 39-48 µm; Rectum = 39-44 µm; Tail = 90-115 µm; ABD = 27-30 µm.

**Description:** Female: Body slightly curved ventrally upon fixation and tapering towards both extremities. Cuticle with fine transverse striae, 2 µm thick at midbody and 4-5 µm on tail. Lateral chords about one-fourth of body-width at midbody. Lateral, ventral and dorsal body pores indistinct. Lip region truncated, continuous with body contour, 12-13 µm or about 1/3<sup>rd</sup> of body width at base of pharynx. Amphid stirrup-shaped, apertures 5-6 µm or about half of corresponding body width. Odontostyle, 1.4-1.6 lip widths long, its aperture about 1/3<sup>rd</sup> of its length. Guiding ring single, at 10-11 µm or 0.7-0.8 lip width from anterior end. Odontophore simple rod-like, 1.1-1.3 times the odontostyle length. Nerve ring 120-130 µm from anterior end. Expanded part of Pharynx occupying 42-46 % of Pharyngeal length. Cardia elongate conoid, 19-23 µm long. Pharyngeal gland nuclei located as follows: DO = 54-58; DN = 57-60; DO-DN = 2.4-3.2; S<sub>1</sub>N<sub>1</sub> = 70-73; S<sub>1</sub>N<sub>2</sub> = 75-79; S<sub>2</sub>N = 83-85; S<sub>2</sub>O = 84-87.

Reproductive system opisthomonodelphic. Vulva longitudinal with heavily muscular lips. Vagina 19-20 µm or about half of corresponding body width. Anterior uterine sac absent. Sphincter present at oviduct-uterus junction of the posterior branch. Pre-rectum, 1.5-1.6 anal body widths long. Rectum, 1.4-1.6 anal body widths long. Tail elongate-conoid dorsally curved with two caudal pores on each side.

**Habitat & Locality:** Soil around roots of sal, Timli Sal forest, teak, Lachchiwala, Dehradun.

**Remarks:** All the body measurements are in agreement with the measurement and description of earlier workers. This species is recorded for the first time from Teak and Sal forests.

### Family QUDSIANEMATIDAE

#### Subfamily QUDSIANEMATINAE

#### Genus *Labronema* Thorne, 1974

#### 43. *Labronema pararapax* Ahmad & Jairajpuri, 1982.

1982. *Labronema pararapax* Ahmad & Jairajpuri, *Nematologica*, **28** : 42.

**Material examined:** 2 ♀♀, Timli sal forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/549, coll. A. N. Rizvi & Party, 2 ♀♀, 2 ♂♂, Kalsi forest, Dehradun, 5.i.06, Reg. No. IV/NRC/ZSI/550, coll. A. N. Rizvi & Party; 2 ♀♀, Raipur forest, Dehradun, 4.vii.07, Reg. No. IV/NRC/ZSI/551, coll. A.N. Rizvi & Party.

**Dimensions:** Female: L = 1.5-1.6 mm; a = 28-29; b = 4.2-4.5; c = 43-45; V = 56-58; G<sub>1</sub> = 17-21; G<sub>2</sub> = 16-22; Odontostyle = 37-38; Odontophore = 26-27; Pharynx = 379-381µm; Pre-rectum = 75-95 µm; Rectum = 45-46 µm; Tail = 36-38 µm; ABD = 33-37µm.

**Male:** L = 1.81-1.83 mm; a = 26-32; b = 4.4-4.8; c = 50-51; T = 60-61; Odontostyle = 26-27; Odontophore = 38; Pharynx = 380-393  $\mu\text{m}$ ; Spicules = 60-65  $\mu\text{m}$ ; Lateral guiding pieces = 18  $\mu\text{m}$ , Ventromedian supplements = 19-20; Pre-rectum = 150-159  $\mu\text{m}$ ; Tail = 33-36  $\mu\text{m}$ ; ABD = 36-40  $\mu\text{m}$ .

**Description:** Body slightly curved ventrally upon fixation and tapering towards both extremities. Cuticle with fine transverse striae, 3-4  $\mu\text{m}$  thick at midbody and 9-10  $\mu\text{m}$  on tail. Lateral chords narrow,  $1/7^{\text{th}}$ - $1/8^{\text{th}}$  of body width at midbody width. Lips well developed, angular. Amphid stirrup -shaped, apertures 10-11  $\mu\text{m}$  wide or about half of corresponding body width. Odontostyle 1.3-1.4 lip widths long, its aperture about  $1/3^{\text{rd}}$  of its length. Guiding ring 'double', 14-15  $\mu\text{m}$  or 0.7-0.8-lip width from anterior end. Odontophore simple rod-like, 1.3-1.4 times the odontostyle length. Nerve ring 138-166  $\mu\text{m}$  from anterior end. Expanded part of pharynx 42-48% of pharyngeal length. Cardia a narrow disc with a conoid portion extending into the intestine. Pharyngeal gland nuclei located is follows: DO = 55-57; DN = 58-61; DO-DN = 3.5-4.2;  $S_1N_1$  = 70-73;  $S_1N_2$  = 76-78;  $S_2N$  = 83-85;  $S_2O$  = 84-87.

Reproductive system amphidelphic. Vulva transverse, vagina sclerotized distally, occupying about one-third of corresponding body width. Gonads equally well developed, sphincter present at oviduct-uterus junction. Uterus filled with one or two eggs measuring 72-73 x 34-36  $\mu\text{m}$ . Pre-rectum 2-3 anal body widths long. Rectum about one anal body widths long. Tail short, digitate about one anal body widths long with a pair of caudal pores on each side.

**Male:** Supplements and adanal pair and 15-20 regularly spaced ventromedians. Spicules 1.5-1.8 anal body-widths long; lateral guiding pieces simple rod-like. Pre-rectum 3-4 anal body widths long. Tail digitate, about one anal body widths long with a pair of caudal pores on each side.

**Habitat and Locality:** Soil around roots of sal, Timli sal forest, teak, Kalsi forest, sal, Raipur, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal and teak are new host records for the species.

#### Genus *Eudorylaimus* Andrassy, 1959

#### 44. *Eudorylaimus Himalus* Jairajpuri & Ahmad, 1982.

1982. *Eudorylaimus himalus* Jairajpuri & Ahmad, *Nematologica*, **28** : 432.

**Material examined:** 5 ♀♀, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/552, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 1.22-1.28 mm; a = 28-31; b = 3.3-3.8; c = 54-57; c' = 0.9-1.0; V = 50-55; G<sub>1</sub> = 13-14; G<sub>2</sub> = 10-12; Odontostyle = 21-24; Odontophore = 34-38; Pharynx = 308-363  $\mu\text{m}$ ; Prerectum = 55-65  $\mu\text{m}$ ; Rectum = 23-25  $\mu\text{m}$ ; Tail = 22-24  $\mu\text{m}$ ; ABD = 24-26  $\mu\text{m}$ .

**Description:** Body curved, more strongly in posterior half upon fixation and tapering only slightly towards extremity. Cuticle 2-3  $\mu\text{m}$  thick at midbody and 5-6  $\mu\text{m}$  on tail finely striated. Lateral hypodermal chords about one-third of body width at midbody width. Body pores indistinct. Lip region offset from body, 18-19  $\mu\text{m}$  wide, and 6-7  $\mu\text{m}$  high. Lips conoid, anterior sensilla protruding slightly above lip contour. Amphid aperture 11-13  $\mu\text{m}$  wide, situated at 6-8  $\mu\text{m}$  from anterior end of body, fuses 24-26  $\mu\text{m}$  aperture. Odontostyle attenuated 1.2-1.3 lip widths long, its aperture about 1/3rd of its length. Guiding ring single, 9-10  $\mu\text{m}$  from anterior end. Odontophore simple rod-like, 1.4-1.6 times the odontostyle length. Nerve ring 114-134  $\mu\text{m}$  from anterior end. Expanded part of Pharynx 42-49% of pharyngeal length. Cardia short and rounded, 10-13  $\mu\text{m}$  long. A thin cardiac disc present. Pharyngeal gland nuclei located as follows: DO = 64; DN = 68-70; DO-DN = 4-6; S<sub>1</sub>O<sub>1</sub> = 77-79; S<sub>1</sub>N<sub>1</sub> = 78-80; S<sub>1</sub>O<sub>2</sub> = 80-81; S<sub>1</sub>N<sub>2</sub> = 81-82; S<sub>2</sub>N = 89-90; S<sub>2</sub>O = 91-93.

Reproductive system amphidelphic. Vulva transverse. Unicellular glands and cuticularized pieces present at vulva-vagina junction. Vagina small, reaching nearly about one-third of corresponding body width. Oviduct and uterus not clearly demarcated from one another, sphincter obscure. Ovary with several oocytes arranged in two to three rows. Pre-rectum 2-3 anal body widths long. Tail short, conoid, provided with 'saccate bodies' on the ventral side and a pair of caudal pores on each side.

**Habitat and Locality:** Soil around roots of sal, Timli sal forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal is a new host records for the species.

#### Subfamily DISCOLAIMINAE

#### Genus *Discolaimus* Cobb, 1913

#### 45. *Discolaimus tenax* Siddiqi, 1964.

1964. *Discolaimus tenax* Siddiqi, *Labdev J. Sci. Tech.*, 2: 37.

**Material examined:** 3 ♀♀, Timli sal forest, Dehradun, 13.viii.07, Reg. No. IV/NRC/ZSI/553, coll. A. N. Rizvi & Party.

**Dimensions:** Female: 1.1- 1.2 mm; a = 35-37; b = 3.8-4.1; c = 43-46; V = 50-52; G<sub>1</sub> = 16-17; G<sub>2</sub> = 16-18; Odontostyle = 14-15  $\mu\text{m}$ ; Odontophore = 24-25  $\mu\text{m}$ ; Pharynx = 296-315  $\mu\text{m}$ ; Pre-rectum = 15-16  $\mu\text{m}$ ; Rectum = 15-16  $\mu\text{m}$ ; Tail = 26-28  $\mu\text{m}$ ; ABD = 17-19  $\mu\text{m}$ .

**Description:** Female: Body slightly curved ventrally upon fixation. Cuticle finely striated. Lateral chords about 1/3<sup>rd</sup> of body width near mid body. Body pores, leading to glandular bodies in hypodermis. Lip region discoidal, offset by a deep constriction, 16-17  $\mu\text{m}$  wide. Lips with distinct papillae, liplets six, surround stoma. Amphids stirrup-shaped foveae, their apertures, 6-7  $\mu\text{m}$  wide. Odontostyle slightly smaller than the lip-width, its aperture about one-third of its length. Guiding ring single. Odontophore rod-like, 1.5-1.7 of odontostyle length. Nerve ring at 96-98  $\mu\text{m}$  from anterior end of body. Expanded portion of pharynx 52-54% of pharyngeal length. Cardia conoid. Gonads

amphidelphic Vulva a transverse slit, vagina thick-walled, extending to about 2/3rds of corresponding body width. Tail elongate conoid, dorsally bent.

*Habitat and Locality:* Soil around roots of sal, Timli sal forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description. Soil around sal forms new host record for the species. This species is being recorded for the first time from Uttarakhand.

Family NORDIIDAE

Subfamily PUNGENTINAE

Genus *Enchodelus* Thorne, 1939

**46. *Enchodelus (Paraenchodelus) constrictus* Jairajpuri & Loof, 1968.**

1968. *Enchodelus (Paraenchodelus) constrictus* Jairajpuri & Loof, *Nematologica*, **13** : 505.

*Material examined:* 3 ♀♀, Dharmawala forest, Dehradun, 13.viii.07, Reg. No. IV/NRC/ZSI/554, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 1.40- 1.45 mm; a = 24-25; b = 5.2 -5.4; c = 36-38; c' = 1.5-1.6 V = 51-53; G1 = 26- 27; G2 = 30-31.

*Description:* Body ventrally curved upon fixation, more strongly in posterior half. Cuticle finely striated its thickness 3µm on body and 4 µm on tail tip. Dorsal, ventral and lateral pore indistinct. Lip region slightly set off from body, somewhat angular in contour, about 1/6<sup>th</sup> of body-widths at base of Pharynx. Amphids stirrup-shaped, more than half as wide as lip-width. Odontostyle 26-27 µm or 2.7 head-widths long. Guiding ring 1.5 head-widths from anterior end, wall of stoma anterior to guiding ring thickened. Odontophore linear, not flanged, 29µm or 3.2 head-widths long. Basal expanded part of pharynx occupies 41% of neck length. Nerve ring surrounding slender part of pharynx at 50% of neck length from anterior end of body. Cardia round, surrounded by intestinal tissues. Pre-rectum 2.7 and rectum about one anal body-width long.

Vulva a transverse slit. Vagina extending inwards less than 1/2 of corresponding body-width and distinctly sclerotized. Gonads amphidelphic. A well developed sphincter present between uterus and oviduct. Ovaries reflexed, oocytes arranged in a single row. Tail 1.5 anal body-width long, conoid, ventrally curved with two caudal pores on each side.

*Habitat and Locality:* Soil around roots of teak, Dharmawala, Dehradun.

*Remarks:* All the measurements are in conformity with the original description. Soil around and teak is a new host record for the species.

## Subfamily ACTINOLAIMOIDINAE

Genus *Oriverutus* Siddiqi, 1971**47. *Oriverutus labiatus* Ahmad & Jairajpuri, 1987.**

1987. *Oriverutus labiatus* Ahmad & Jairajpuri, *Nematologica*, **33** : 15.

*Material examined*: 3 ♀♀, Timli sal forest, Dehradun, 10.iv.08, Reg. No. IV/NRC/ZSI/555, coll. A. N. Rizvi & Party; 2 ♀♀, Thanu forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/556, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.85-0.95 mm; a = 32-36; b = 3.4-3.5; c = 22-24; c' = 2.3-2.5; V = 52-56; G2 = 13-16; Odontostyle = 15-16 µm; Odontophore = 19-20 µm; Pharynx = 253-269 µm; Pre-rectum = 39-44 µm; Rectum = 24-27 µm; Tail = 41-45 µm; ABD = 17 µm.

*Description*: Body slightly curved ventrally upon fixation, tapering towards both extremities. Cuticle finely striated, about 1 µm thick at mid body and 3 µm on tail. Lateral chords about 1/3<sup>rd</sup> of body width near mid body. Body pores indistinct. Lip region offset, 11-13 µm wide, lips lobe-like with distinct labial papillae. Amphids stirrup-shaped foveae, their apertures, 7-8 µm wide. Odontostyle attenuated 1.2-1.4 lip region widths long, its aperture 2-3 µm or about 1/5-1/6<sup>th</sup> of its length. Guiding ring 6-8 µm long or about 0.6-0.7 lip region widths from anterior end, 1.2-1.3 of odontostyle length. Nerve ring at 94-109 µm from anterior end of body. Expanded portion of pharynx 45-46% of pharyngeal length. Cardia conoid, glandular organ present at esophago-intestinal junction. Gonads amphidelphic. Vulva a transverse slit, vagina thick-walled, extending to about 2/3<sup>rd</sup>s of corresponding body width. Sclerotized pieces present at vulva-vagina junction. Pre-rectum, 2-3 anal body widths long. Rectum 1.2-1.3 anal body widths long. Tail elongate conoid, dorsally bent, 2.3-2.6 anal body-width long with two caudal pores on each side.

*Habitat and Locality*: Soil around roots of sal, Timli sal forest, teak, Thanu range, Dehradun.

*Remarks*: All the measurements are in conformity with the original description. Soil around sal and teak are new host records for the species.

## Family APORCELAIMIDAE

## Subfamily APORCELAIMINAE

Genus *Aporcelainimus* Thorne & Swanger, 1936**48. *Aporcelainimus litchi* Srivastava et al., 2000.**

2000. *Aporcelainimus litchi* Srivastava et al., *Indian J. Nematol.*, **30** : 50.

*Material examined*: 3 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/557, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 4.9-5.0 mm; a = 49-50; b = 5.3-5.6; c = 80-86; c' = 1-2; V = 46-50; Odontostyle = 46-50  $\mu\text{m}$ ; Odontophore = 37-40  $\mu\text{m}$ ; Pharynx = 885-937  $\mu\text{m}$ ; Pre-rectum = 69-97  $\mu\text{m}$ ; Rectum = 34.0-35.5  $\mu\text{m}$ ; Tail = 58-64  $\mu\text{m}$ .

**Description:** Body curved upon fixation, more towards posterior region. Cuticle marked by criss-cross fibers and 5-7  $\mu\text{m}$  thick at midbody. Lip region sclerotized, set off by deep depression. Odontostyle wide, long and aperture occupying three-fourth of the odontostyle length. Odontophore long slender and rod-like. Guiding ring located at 6-8  $\mu\text{m}$  from anterior region. Amphid cup-shaped, occupying three-fourth labial width. Cardia conoid. Nerve ring at 240  $\mu\text{m}$  from anterior end. Pharynx narrows, with expanded basal region. Pharyngeal gland nuclei and their orifice are as follows: DO = 41; DN = 44; S<sub>1</sub>N<sub>1</sub> = 66; S<sub>1</sub>N<sub>2</sub> = 69.6; S<sub>2</sub>O = 88; S<sub>2</sub>N = 90; S<sub>2</sub>N<sub>2</sub> = 96.

Female reproductive system amphidelphic. Vulva transverse. Vagina extending over 50 % of vulval body diameter. Sclerotization well developed, rounded trapezoid to triangular trapezoid. Sphincter present between uterus and oviduct. Pre-rectum about one anal-body diameter and rectum half of it. Tail convex-conoid with two caudal pores on each side.

**Habitat and Locality:** Soil around roots of sal, Timli sal forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description. Soil around sal is a new host records for the species.

Superfamily LONGIDOROIDEA

Family LONGIDORIDAE

Subfamily LONGIDORINAE

Genus *Longidorus* Micoletzky, 1922

**49. *Longidorus doonensis* (Singh & Khan, 1996) n. comb.**

1996. *Neolongidorus doonensis* Singh & Khan, *Indian J. Nematol.*, **26** : 168.

**Material examined:** 2 ♀♀, Timli sal forest Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/558, coll. A. N. Rizvi & Party; 2 ♀♀, Kunjagrang forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/559, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 4.0-4.3mm, a = 85-90; b = 17.1-17.7; c = 160-177; V = 42-46; Spear = 123-127  $\mu\text{m}$ ; Odontophore = 60-70  $\mu\text{m}$ ; Guiding ring = 62-76  $\mu\text{m}$ .

**Description:** Female: Body assumes close c-shape when killed by gentle heat. Body robust, cuticle thick in the anterior and posterior regions of body and measures 3 and 4  $\mu\text{m}$  respectively. Body tapering gradually from neck base to a conoid rounded head with a slight depression at the base, whereas the body width gradually narrows down in the posterior two-third region of the body terminating into a dorsally convex rounded tail. First lateral body pores located at about one lip width from the anterior region, thereafter followed at equidistance by the rest arranged serially throughout the neck. Posterior to neck their arrangement becomes irregular in the rest of the body. Single

ventral and dorsal body pore located at 24  $\mu\text{m}$  from anterior and opposite each other. Lip region elevated, continuous with the body, rounded with a slight depression at the base and measures 12.5 x 4  $\mu\text{m}$  in dimension. Guiding ring single located at more than 5 lip width from anterior end of body, lateral hypodermal chords arise as thin band at level with the middle of the spear. Lateral hypodermal glands not distinctly demarcated throughout the body, maximum width of lateral hypodermal chords one-sixth of body width at mid- body. Pharynx with anterior convoluted part expanding basally to basal bulb measuring 72-90  $\mu\text{m}$  in length and 21- 22  $\mu\text{m}$  in width.

Dorsal pharyngeal gland and its orifice located at 14 and 17  $\mu\text{m}$ ; right first subventral gland and its orifice are at 34 and 36  $\mu\text{m}$ , left first subventral glands and its orifice are at 36 and 40  $\mu\text{m}$  while the opening of second pair of subventral glands are at 56 and 59  $\mu\text{m}$  respectively from anterior end of bulb. Pharyngo-intestinal valve conoid, rounded, small. Pre-rectum about 8-9 anal body width in length. Rectum more than half of anal body width in length. Female gonads didelphic, amphidelphic, equally developed, ovary reflexed at the oviduct, uteri thick, muscular at the distal end. Vulva a transverse slit. Tail dorsally convex, conoid, rounded, less than one anal body width in length. Subcuticle with fine transverse striations. Two pairs of caudal pores present.

*Habitat and Locality:* Soil around roots of sal, Timli sal forest, Kunjagrunt forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description with slight variation in the position of vulva and size of spear ( $V = 42-46$  against 45-50 and spear = 123-127  $\mu\text{m}$  against 100-121  $\mu\text{m}$ ). Soil around sal is a new host record for the species.

Family XIPHINEMATIDAE  
Subfamily XIPHINEMATINAE  
Genus *Xiphinema* Cobb, 1913

**50. *Xiphinema inaequale*, Khan & Ahmad, 1975.**

1975. *Xiphinema inaequale*, Khan & Ahmad, *Nematol. medit.*, **3** : 24.

*Material examined:* 5 ♀♀, Kunjagrunt forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/560, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 1.7-2.0 mm, a = 35-39; b = 5.6-5.9; c = 61-64; c' = 1.1-1.4; V = 50-53; G<sub>1</sub> = 10-15; G<sub>2</sub> = 10-15; Odontostyle = 92-101  $\mu\text{m}$ ; Odontophore = 53-55  $\mu\text{m}$ ; Guiding ring = 70-81  $\mu\text{m}$ ; DO = 9-12; DN = 10-15; RS<sub>1</sub>N = 48-51; LS<sub>1</sub>N = 48-53; S<sub>2</sub>O = 71-80.

*Description:* Female: Body 'C' shaped upon fixation, long and attenuated with tapering extremities. Body cuticle in two layers, thickest in the region of vulva and on tail. Lateral chords about 1/4<sup>th</sup> of the midbody-width. Lip region rounded, almost continuous with the rest of body. Amphid stirrup shape with slit-like aperture nearly 3/5<sup>th</sup> of the labial-width. Odontostyle 8.0-9.5 labial-widths long, odontophore nearly 1/1.8<sup>th</sup> of the odontostyle length. The fixed guiding ring is at 6.5-8.0 labial-widths from

the oral aperture. Basal bulb of the pharynx 2.0- 2.5 times of the corresponding body-width and about 20 % of neck length long. Nerve ring surrounding the anterior slender part of the pharynx at about one labial-width from the base of odontophore. Pre-rectum 4-5 times of anal body-width long. Rectum about one half anal-width long. Gonads amphidelphic, each branch consisting of reflexed ovary, distal narrow and proximal expanded part of oviducts and a short uterus. Vulva at 48-53 % of total length from the anterior extremity. Vagina about  $1/3^{\text{rd}}$  of the corresponding body-width long. Tail short and conoid, 1.1-1.5 the anal body-width long and provided with 2 papillae on each side.

*Habitat and Locality:* Soil around roots of sal, Kunjagrunt forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description. Soil around sal is a new host record for the species.

Suborder NYGOLAIMINA

Superfamily NYGOLAIMINA

Family NYGOLAIMIDAE

Subfamily NYGOLAIMINAE

Genus *Clavicaudoides* Heyns, 1968

**51. *Clavicaudoides clavicaudatus*** (Altherr, 1953) Ahmad & Jairajpuri, 1982.

1953. *Nygolaimus clavicaudatus* Altherr, *Bull. Soc. Vaud. Sci. nat.*, **66** : 450.

1982. *Clavicaudoides clavicaudatus* Ahmad & Jairajpuri, *Rec. zool. Surv. India. Misc. Publ. Occ. Paper*, **34** : 55.

*Material examined:* 3 ♀♀, Timli forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/561, coll. A. N. Rizvi & Party.

*Dimensions:* Female L = 0.8-0.9mm; a = 34-36; b = 3.5-3.7; c = 45-49; V = 42-45; Tooth = 8-10µm.

*Description:* Female: Body curved ventrally upon fixation. Cuticle thin at midbody and marked with fine transverse striae. Lip region continuous with body contour. Amphidial apertures slit-like. Tooth deltoid, almost equal to lip-width. Expanded part of pharynx occupying about 50 % of pharyngeal length, enclosed in an inconspicuous sheath of muscles. Cardiac glands well developed elongate-ovoid. Nerve ring surrounding anterior slender part of pharynx at 85-100 µm from anterior end. Location of pharyngeal gland nuclei and their orifices as follows: DO = 57-59; DN = 63-65; DO-DN = 4.0-5.5; S<sub>1</sub>N = 75-78; S<sub>1</sub>O = 74-78; S<sub>2</sub>N = 84-87; S<sub>2</sub>O = 83-85.

Vulva a transverse slit. Reproductive system amphidelphic. Ovaries short and reflexed. A distinct sphincter present at oviduct- uterus junction. Tail hemispherical, clavate. Two caudal pores

*Habitat and Locality:* Soil around roots of sal, Timli sal forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description. Soil around sal forms new host record for the species.

Order ALAIMIDA

Family ALAIMIDAE

Genus *Alaimus* de Man, 1880

**52. *Alaimus jaulasali* Siddiqi & Husain, 1967.**

1967. *Alaimus jaulasali* Siddiqi & Husain, *Proc. Helm. Soc. Wash.*, **34** : 159.

*Material examined:* 3 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/562, coll. A. N. Rizvi & Party; 3 ♀♀, Timli sal forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/563, coll. A. N. Rizvi & Party; 3 ♀♀, Raipur forest, Dehradun, 4.vii.07, Reg. No. IV/NRC/ZSI/564, coll. A. N. Rizvi & Party; 3 ♀♀, Selaqui forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/565, coll. A. N. Rizvi & Party; 3 ♂♂, FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/566, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 1.1-1.2 mm; a = 60-62; b = 4.1-4.3; c = 7.9-8.3; V = 41-42.

Male: L = 1.15-1.17 mm; a = 6-75; b = 4.3-4.8; c = 11.1-11.6; Spicule = 10-12 µm.

*Description:* Female: Body tapering at both ends, assumes 'C' form after fixation. Cuticle with fine transverse striations. Head rounded, not off set. Lip region continuous with body contour. Stoma reduced. Pharynx narrow, tubular and posterior expended in to a small bulb. Vulva a transverse slit. Ovary single, posteriorly reflexed. Tail elongate, tapering to a pointed terminus.

Male: Testis single. Spicules short, 10-12 µm. Six ventromedian supplementary papillae present. Tail curved ventrally in a semicircle.

*Habitat and Locality:* Soil around roots of sal, Motichur sal forests, sal Timli, Raipur, Selaqui sal forests, teak, FRI forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

**53. *Alaimus primitivus* de Man, 1880.**

1880. *Alaimus jaulasali* de Man, *Tijds. Nederland Dierk.Vereen*, **5** : 10.

*Material examined:* 1 ♀ FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/567, coll. A. N. Rizvi & Party; 1 ♀♀, Motichur sal forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/568, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.8-1.2 mm; a = 42-58; b = 3.7-4.3; c = 7.1-8.4; V = 39-55.

*Description:* Female: Body, tapering uniformly at both extremities. Cuticle smooth. Lip region rounded. Pharynx in two parts, anterior narrow tubular and posterior slowly expanding to form an elongated basal swelling. Vulva a transverse slit. Ovary reflexed about half way to vulva. Gonad mono-opisthodelphic. Tail long and narrow.

**Habitat and Locality:** Soil around roots of teak FRI forest, sal, Motichur forests, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal and teak are new host records for the species.

Order MONONCHIDA

Superfamily MONONCHOIDEA

Family MONONCHIDAE

Family MONONCHIDAE

Subfamily PRIONCHULINAE

Genus *Clarkus* Jairajpuri, 1970

**54. *Clarkus papillatus* (Bastian, 1865) Jairajpuri, 1970.**

1865. *Mononchus papillatus* Bastian, *Linn. Soc. Lond. Trans.*, **25** : 78.

1970. *Clarkus papillatus* Jairajpuri, *Nematologica*, **16** : 215.

**Material examined:** 2 ♀♀, Raipur forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/569, coll. A. N. Rizvi & Party; 1♀, Timli sal forest, Dehradun, 30.xi.05, Reg. No. IV/NRC/ZSI/570, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.9-1.7 mm; a = 16-24; b = 3.1-3.3; c = 15-19; V = 61-66.

**Description:** Female: Body slightly curved upon fixation. Lip region angular, 23-29 µm wide, 7-11 µm high. Amphidial aperture 3-5 µm wide, located at 10-13 from anterior end of body and 22-27 µm from base of buccal cavity. Buccal cavity straight 24-32 µm long, 11-15 µm wide. Dorsal tooth of medium size, situated in anterior half of buccal cavity, its apex 19-26 µm or 82-87 % of the length of buccal cavity from base. Sub ventral walls with non- denticulate ridge. Nerve ring at 115-154 µm from anterior end of body. Reproductive system amphidelphic. Sphincter at oviduct-uterus absent. Tail conoid, ventrally curved. Caudal gland and terminal opening absent.

**Habitat and Locality:** Soil around roots of sal, Raipur, Timli, sal forests, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

**55. *Clarkus elongatus* Jairajpuri & Khan, 1977.**

1977. *Clarkus elongatus* Jairajpuri & Khan, *Nematologica*, **23** : 92.

**Material examined:** 5 ♀♀, Raipur forest, Dehradun, 4.vii.07, Reg. No. IV/NRC/ZSI/571, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 1.9-2.2 mm; a = 24-30; b = 3.3-4.6; c = 16-18; V = 60-61.

**Description:** Female: Body slightly curved upon fixation. Lip region 36-42 µm wide, 10-12 µm high. Amphidial apertures 3-4 µm wide, located at 15-17 µm from anterior

end of body and 38-48  $\mu\text{m}$  from base of buccal cavity. Buccal cavity 45-46  $\mu\text{m}$  long and 20-23  $\mu\text{m}$  wide. Dorsal tooth of medium size situated in anterior half of buccal cavity, its apex 33-36  $\mu\text{m}$ . Subventral walls with non-denticulate ridge. Reproductive system amphidelphic. Sphincter not present at oviduct- uterus junction. Tail elongate- conoid, 140-160  $\mu\text{m}$  or 3-4 anal body-widths long, ventrally curved. Caudal glands absent.

*Habitat and Locality:* Soil around roots of sal, Timli sal forests, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal is a new habitat record for the species.

Genus *Prionchulus* (Cobb, 1916) Wu & Hoeppli, 1929

**56. *Prionchulus muscorum* (Dujardin, 1845) Wu & Hoeppli, 1929.**

1845. *Oncholaimus muscorum* Dujardin, *Histoire naturelle des helm. vers. intestinaux Paris*, 515.

1929. *Prionchulus muscorum* Wu & Hoeppli, *Arch. Schiffs- u Tropenhyg*, **33** : 38.

*Material examined:* 3 ♀♀, 1 ♂, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/572, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 1.45-3.00 mm; a = 21-33; b = 3.0-5.0; c = 11-28; V = 66-68.

Male: L = 2.81 mm; a = 32; b = 4.1; c = 29; T = 45.

*Description:* Female: Lip region 32-56  $\mu\text{m}$  wide, 10-22  $\mu\text{m}$  high. Amphidial aperture 3-7  $\mu\text{m}$  wide, located at 8-29 from anterior end of body and 31-53  $\mu\text{m}$  from base of buccal cavity. Buccal cavity 39-64  $\mu\text{m}$  long, 18-35  $\mu\text{m}$  wide. Dorsal tooth of medium size, situated in anterior half of buccal cavity, its apex 28-48  $\mu\text{m}$  or 68-83% of the length of buccal cavity from base. Subventral walls with two longitudinal denticulate ridges. Nerve ring at 116-224  $\mu\text{m}$  from anterior end of body. Excretory system well developed, comprising an excretory pore, ampulla, excretory duct and the renettes. Reproductive system amphidelphic. Sphincter at oviduct-uterus junction weakly developed or absent. Uterine eggs measuring 77-101x 60-80  $\mu\text{m}$ , with smooth shell. Tail conoid, arcuate ventrally, 96-185  $\mu\text{m}$  or 2.0-3.5 anal body-widths long. Caudal glands and terminal opening absent.

Male: Spicules 107  $\mu\text{m}$  long medially. Gubernaculum 30  $\mu\text{m}$  long, accessory pieces poorly developed. Supplement 20. Tail conoid, 96  $\mu\text{m}$  or two anal body-widths long.

*Habitat and Locality:* Soil around roots of sal Timli sal forest and teak FRI forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal and teak are new habitat records for the species.

Family MYLONCHULIDAE

Subfamily MYLONCHULINAE

Genus *Mylonchulus* (Cobb, 1916) Altherr, 1953

**57. *Mylonchulus brachyuris* (Butschli, 1873) Altherr, 1954.**

1873. *Mononchus brachyuris* Butschli, *Nova.Acta.Acad.Nat.Curios*, **36** : 82.

1954. *Mylonchulus brachyuris* Altherr, *Bull. Soc. vaud.Sci.nat.*, **66** : 52.

*Material examined:* 2 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/573, coll. A. N. Rizvi & Party; 2 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/574, coll. A. N. Rizvi & Party; 2 ♀♀, Raipur forest, Dehradun, 4.vii.07, Reg. No. IV/NRC/ZSI/575, coll. A. N. Rizvi & Party; 2 ♀♀, Selaqui forest, Dehradun, 13.viii.07, Reg. No. IV/NRC/ZSI/576, coll. A.N. Rizvi & Party; 2 ♀♀, Mohand forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/577, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.8-1.1 mm; a = 27-30; b = 3.1-3.5; c = 30-34; V = 63-64.

*Description:* Female: Body ventrally arcuate upon fixation, tapering slightly towards extremities. Cuticle smooth. Lip region 20-24 µm wide and 7-8 µm high. Buccal cavity 21-26 µm long and 12-24 µm wide. Dorsal tooth massive, its apex at 16-20µm from base of buccal cavity. Subventral walls bearing six transverse rows of denticles. Submedian teeth present. Reproductive system amphidelphic. Sphincter not present at oviduct-uterus junction. Tail conoid with blunt terminus. Caudal glands grouped. Spinneret subterminal.

*Habitat and Locality:* Soil around roots of sal, Motichur sal forests, Timli, Raipur, Selaqui forests, teak Mohand range, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

**58. *Mylonchulus minor* (Cobb, 1893) Andrassy, 1958.**

1893. *Mononchus minor* Cobb, *Dept. Agr. N.S. Wales Misc. Publ.*, **13**.

1958. *Mylonchulus minor* Andrassy, *Annl. hist. nat. mus. Hung.*, **50** : 151.

*Material examined:* 3 ♀♀, Timli sal forest, Dehradun, 27. iv. 05, Reg. No. IV/NRC/ZSI/578, coll. A. N. Rizvi & Party; 3 ♀♀, Lachchiwala forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/579, coll. A. N. Rizvi & Party; 2 ♀♀, Selaqui forest, Dehradun, 30.xi.05, Reg. No. IV/NRC/ZSI/580, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.82-1.40 mm; a = 18-32; b = 3.0-3.8; c = 32-47; V = 54-67.

*Description:* Female: Body slightly to strongly ventrally arcuate upon fixation, tapering gradually to base of Pharynx but sharply behind vulva. Cuticle smooth, 2-3 µm thick. Lateral chords about 1/3<sup>rd</sup> body-width wide near middle. Lip region 20-25 µm wide, 7-10 µm high. Buccal cavity 21-26 µm long, 12-15 µm wide. Dorsal tooth massive, its apex at 15-19 µm from base of buccal cavity. Subventral walls bearing five or six transverse rows of denticles. Submedian teeth present. Reproductive system amphidelphic. Sphincter not present at oviduct-uterus junction. Tail arcuate conoid with blunt terminus. Caudal glands tandem. Spinneret terminal.

*Habitat and Locality:* Soil around roots of sal, Timli, teak Lachchiwala, sal, Selaqui forests Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal and teak are new habitat records for the species.

**59. *Mylonchulus hawaiiensis*** (Cassidy, 1931) Andrassy, 1958.

1931. *Mononchus hawaiiensis* Cassidy, *Hawaii Plrs .Rec.*, **34** : 381.

1958. *Mylonchulus hawaiiensis* Andrassy, *Annl. hist. nat. mus. Hung.*, **50** : 155.

*Material examined:* 2 ♀♀, Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/581, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.87-0.98 mm; a = 22-26; b = 3.2-3.6; c = 27-31; V = 58-60.

*Description:* Female: Body ventrally arcuate upon fixation, tapering towards extremities. Cuticle smooth, 2-3 µm thick. Lateral chords about 1/3<sup>rd</sup> body-width wide near middle. Lip region 20-25 µm wide, 7-10 µm high. Buccal cavity 22-25 µm long, 14-17 µm wide. Dorsal tooth massive, its apex at 14-18 µm from base of buccal cavity. Subventral walls bearing six transverse rows of denticles. Submedian teeth present. Nerve ring 85-98 µm from anterior end body. Reproductive system amphidelphic. Sphincter not present at oviduct-uterus junction. Tail 30-40 µm long, elongate with slightly clavate terminus. Caudal glands tandem. Spinneret terminal.

*Habitat and Locality:* Soil around roots of sal, Motichur sal forests, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal and teak are new habitat records for the species.

**60. *Mylonchulus lacustris*** (N.A. Cobb In M.V Cobb, 1915) Andrassy, 1958.

1931. *Mononchus lacustris* Cobb, *Trans. Amer. Micr. Soc.*, **34** : 25.

1958. *Mylonchulus lacustris* Andrassy, *Annl. hist. nat. mus. Hung.*, **50** : 156.

*Material examined:* 2 ♀♀, FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/582, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 1.06-1.67 mm; a = 25-40; b = 3.8-4.1; c = 24-31; V = 60-66.

*Description:* Female: Body slightly to strongly ventrally arcuate upon fixation, tapering gradually towards base of Pharynx but sharply behind vulva. Cuticle smooth, 2-4 µm thick. Lateral chords about 1/3<sup>rd</sup> body-width wide near middle. Lip region 24-29 µm wide, 10-13 µm high. Buccal cavity 25-32 µm long, 15-20 µm wide. Apex of dorsal tooth 16-21 µm from base of stoma. Subventral walls bearing seven transverse rows of denticles; submedian teeth present. Nerve ring at 110-125 µm from anterior end of body. Reproductive system amphidelphic. Rectum 24-30 µm, less than one anal body diameter. Tail 42-59 µm arcuate and conoid. Caudal glands in tandem. Spinneret terminal.

**Habitat and Locality:** Soil around roots of sal, FRI forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal is a new habitat record for the species.

### 61. *Mylonchulus amurus* Khan & Jairajpuri, 1979.

1979. *Mylonchulus amurus* Khan & Jairajpuri, *Nematologica*, **25** : 406.

**Material examined:** 5 ♀♀, Timli sal forest, Dehradun, 27.iv.05, Reg. No. IV/NRC/ZSI/583, coll. A. N. Rizvi & Party; 2 ♀♀, 1 ♂ Motichur forest, Dehradun, 21.x.08, Reg. No. IV/NRC/ZSI/584, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.81-1.15 mm; a = 17-34; b = 2.8-3.3; c = 28-42; V = 58-66.

Male: L = 0.85 mm; a = 25; b = 3.0; c = 42; T = 47.

**Description:** Female: Body ventrally arcuate upon fixation, tapering towards extremities. Lip

region 21-36 µm wide, 8-10 µm high. Amphidial apertures 3-4 µm wide, located at 9-12 µm from anterior end of body and 16-19 µm from base of buccal cavity. Buccal cavity 22-25 µm long, 11-15 µm wide. Dorsal tooth of medium size, its apex at 17-19 µm or 70-80% from base of buccal cavity. Subventral walls bearing five transverse rows of denticles. Submedian teeth present. Nerve ring 88-120 µm from anterior end body. Reproductive system amphidelphic. Sphincter not present at oviduct-uterus junction. Tail 30-44 µm long, conoid with clavate terminus. Caudal glands well developed and grouped. Spinneret terminal.

Male: Spicules 25 µm long medially. Gubernaculum 8 µm long, accessory pieces 5 µm long. Supplements 13. Rectal glands three. Tail 35 µm or about one anal body-width long.

**Habitat and Locality:** Soil around roots of sal, Timli and Motichur sal forests, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around sal and teak are new habitat records for the species.

### Genus *Paramylonchulus* Jairajpuri & Khan 1981

#### 62. *Paramylonchulus mulveyi* (Jairajpuri, 1970) Jairajpuri & Khan 1981.

1970. *Mylonchulus mulveyi* Jairajpuri, *Nematologica*, **16** : 444.

1981. *Paramylonchulus mulveyi* Jairajpuri & Khan, *Assoc. Publ. Co. N. Delhi, India*, 118.

**Material examined:** 4 ♀♀, Timli sal forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/585, coll. A. N. Rizvi & Party; 4 ♀, Raipur forest, Dehradun, 4.vii.07, Reg. No. IV/NRC/ZSI/586, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.83-1.12; a = 21-40; b = 2.8-3.4; c = 20-28; V = 76-83.

*Description:* Female: Body slightly to strongly arcuate upon fixation, tapering towards extremities. Cuticle smooth, 2-3  $\mu\text{m}$  thick. Lateral chords about  $1/3^{\text{rd}}$  body-width wide near middle. Lip region 16-20  $\mu\text{m}$  wide, 7-9  $\mu\text{m}$  high. Amphids 2-3  $\mu\text{m}$  wide, apertures situated at 9-11  $\mu\text{m}$  from anterior end. Buccal cavity 15-19  $\mu\text{m}$  long, 10-13  $\mu\text{m}$  wide. Apex of dorsal tooth 12-15  $\mu\text{m}$  from base of stoma. Subventral walls bearing four transverse rows of denticles; submedian teeth absent. Nerve ring at 87-102  $\mu\text{m}$  from anterior end of body. Reproductive system mono prodelphic, posterior uterine sac absent. Ovary reflexed with 6-10 oocytes. Proximal part of oviduct with large glandular cells. Small cuticularized pieces present at vagina-vulva junction. Rectum 15-21  $\mu\text{m}$ , less than one anal body diameter. Tail 39-48  $\mu\text{m}$  about two anal widths long. Caudal glands large and grouped. Spinneret terminal.

*Habitat and Locality:* Soil around roots of sal, Timli, Raipur forests, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal and teak are new habitat records for the species.

### **63. *Paramylonchulus index* (Cobb, 1906) Jairajpuri & Khan, 1981.**

1906. *Mononchus index* Cobb, *Exptl. Sta. Div. Pathol. Physiol Bull.*, **5** : 105.

1958. *Mylonchulus index* Andrassy, *Ann. Hist. Nat. Mus. Hung.*, **50** : 151.

1981. *Paramylonchulus index* Jairajpuri & Khan, *Assoc. Publ. Co. N. Delhi, India*, 122.

*Material examined:* 2♀♀, Timli sal forest, Dehradun, 6.ix.05, Reg. No. IV/NRC/ZSI/587, coll. A. N. Rizvi & Party.

*Dimensions:* Female: L = 0.63-0.80 mm; a = 23-28; b = 2.9-3.4; c = 12-23; V = 70-73.

*Description:* Female: Body ventrally arcuate upon fixation, tapering towards base of Pharynx and the tail end. Cuticle smooth, 2-4  $\mu\text{m}$  thick. Lateral chords about  $1/3^{\text{rd}}$  body-width wide near middle. Lip region 15-18  $\mu\text{m}$  wide, 6-7  $\mu\text{m}$  high. Buccal cavity 17-20  $\mu\text{m}$  long, 10-12  $\mu\text{m}$  wide. Apex of dorsal tooth 12-15  $\mu\text{m}$  from base of stoma. Subventral walls bearing five transverse rows of denticles submedian teeth absent. Nerve ring 65-80  $\mu\text{m}$  from anterior end of body. Reproductive system mono-prodelphic, posterior uterine sac absent, anterior uterus with sperms. Tail 26-32  $\mu\text{m}$  long, hemispheroid with a ventral finger like projection. Caudal glands large, grouped. Spinneret terminal.

*Habitat and Locality:* Soil around roots of sal, Timli forest, Dehradun.

*Remarks:* All the measurements are in conformity with the original description.

Soil around sal is a new habitat record for the species.

Family IOTONCHIDAE  
Subfamily IOTONCHINA

Genus *Iotonchus* (Cobb, 1916) Altherr, 1950

**64. *Iotonchus trichurus*** (Cobb, 1917) Altherr, 1958.

1917. *Mononchus trichurus* Cobb, *Soil Sci.*, **3** : 435.

1958. *Iotonchus trichurus* Altherr, *Mem. Soc. Vaudoise Sci. Nat.*, **12** : 47.

*Material examined*: 4 ♀♀, Selaqui forest, Dehradun, 23.iii.06, Reg. No. IV/NRC/ZSI/588, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 1.4-1.8; a = 30-45; b = 3.5-4.7; c = 3-5; V = 54-65.

*Description*: Female: Lip region 24-30 µm wide, 7-12 µm high. Amphids 4-6 µm wide, apertures situated at 11-15 µm from anterior end and 24-30 µm from base of buccal cavity. Buccal cavity 26-33 µm long, 16-19 µm wide. Dorsal tooth small and basal, its apex 5-8 µm from base of buccal cavity. Nerve ring at 88-110 µm from anterior end of body. Excretory system present. Reproductive system mono prodelphic. Sphincter not present at oviduct-uterus junction. Tail long, whip-like, 370-430 µm or 14-18 anal widths long. Caudal glands present; terminal opening present.

*Habitat and Locality*: Soil around roots of sal, Selaqui forests, Dehradun.

*Remarks*: All the measurements are in conformity with the original description.

Soil around sal is a new habitat record for the species.

**65. *Iotonchus parabasidontus*** Mulvey & Jensen, 1967.

1967. *Iotonchus parabasidontus* Mulvey & Jensen, *Can. J. Zool.*, **45** : 680.

*Material examined*: 3 ♀♀, Timli sal forest, Dehradun, 30.xi.05, Reg. No. IV/NRC/ZSI/589, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 2.04-2.73; a = 27-35; b = 4.0-4.5; c = 5-9; V = 57-90.

*Description*: Female: Lip region 40-50 µm wide, 18-20 µm high. Amphidial apertures 5-6 µm wide, located at 16-19 µm from anterior end. Buccal cavity, 44-54 µm long, 30-36 µm wide. Dorsal tooth minute and basal, its apex 10-16 µm from base of buccal cavity. Nerve ring at 156-160 µm from anterior end of body. Excretory system not observed. Reproductive system amphidelphic. Sphincter present at oviduct-uterus junction. Vulval papillae present, two pre- and one post-vulval. Tail conoid then cylindroid, 330-420 µm or 8-9 anal widths long. Caudal glands present; opening terminal.

*Habitat and Locality*: Soil around roots of sal, Timli sal forest, Dehradun.

*Remarks*: All the measurements are in conformity with the original description.

Soil around sal and teak are new habitat records for the species.

## Order TRIPLONCHIDA

## Superfamily TRICHODOROIDEA

## Family TRICHODORIDAE

Genus *Trichodorus* Cobb, 1913**66. *Trichodorus pakistanensis* Siddiqi, 1962.**

1962. *Trichodorus pakistanensis* Siddiqi, *Nematologica*, **8** : 193.

*Material examined*: 4 ♀♀, 4 ♂♂, FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/590, coll. A. N. Rizvi & Party.

*Dimensions*: Female: L = 0.72-0.91 mm; a = 21-25; b = 5.6-6.2; V = 52-53; Spear length = 40-45 µm.

Male: L = 0.7-0.9 mm; a = 24-26; b = 5.6-6.2; T = 46-65; Spear length = 40-57 µm.

*Description*: Female: Body straight to slightly curve ventrally upon fixation. Body cuticle thick, apparently double layered, marked by fine uninterrupted transverse striae, slightly separated from the body except at the head and cloacal region. Lip region slightly sclerotized, bluntly rounded anteriorly, distinctly set off from the body. Stoma, tubular with distinct sclerotization at front end, ending posteriorly to form a spear guiding ring. Onchiostyle slender. Pharynx cylindrical tube. Pharyngeal bulb set off from the intestine. Female reproductive system didelphic- amphidelphic with an oval shaped spermatheca. Vulva a transverse slit.

Males: Similar to females in general characters. Three ventro-median cervical papillae, two anterior and one posterior. Testis single, outstretched, lying on the right side of the intestine. Spicules paired, similar with a rounded cephalated proximal and appointed distal end. They are cylindrical with irregular thickenings giving a striated appearance to the surface. Gubernaculum linear with thickened distal portion. With the three ventromedian precloacal supplements, only the posterior supplement clearly within the region of the retracted spicules. Tail obtusely rounded, terminal cuticle not thickened.

*Habitat and Locality*: Soil around roots of teak, FRI forest, Dehradun.

*Remarks*: All the measurements are in conformity with the original description.

Soil around teak is a new host record for the species.

Genus: *Paratrichodorus* Siddiqi, 1974

**67. *Paratrichodorus porosus* (Allen, 1957) Siddiqi, 1974.**

1957. *Trichodorus porosus* Allen, *Nematologica*, **2** : 32.

1974. *Paratrichodorus porosus* (Allen, 1957) Siddiqi, *Nematologica*, **19** : 270.

*Material examined*: 2 ♀♀, FRI forest, Dehradun, 28.iv.05, Reg. No. IV/NRC/ZSI/591, coll. A. N. Rizvi & Party.

**Dimensions:** Female: L = 0.42-0.57 mm; a = 13.6-16.6; b = 4.5; V = 54-58; Spear length = 39-47  $\mu$ m.

**Description:** Cuticle finely striated. Lip region slightly offset from body. Stoma, 18-20  $\mu$ m. Pharyngeal bulb large with a distinct dorsal and two large sub-ventral Pharyngeal gland nuclei. A small rounded valve present at esophago-intestinal junction. Vagina trapezoid in lateral view. Two pairs of ventral body pores near vulva; the anterior one always close to vulva. Lateral hypodermal body pores absent. Tail hemispherical with two terminal caudal pores.

**Habitat and Locality:** Soil around roots of teak, FRI forest, Dehradun.

**Remarks:** All the measurements are in conformity with the original description.

Soil around teak is a new host record for the species.

### SUMMARY

A total 81 species are recorded from the teak and sal forest of Dehradun. 13 species forms new records from India and three species are new records from Uttarakhand. The soil around teak and sal form new host /habitat records for 57 species of nematodes and 14 species are found associated with insect pests. Out of these 81 species, two species were recovered from insect pests belonging to two different orders. Potential of these insect nematodes for the biological control of insect pests is being discussed. Twelve species were found to be associated with termites, termite hills and beetles and found to belong to 3 orders, 6 families and 10 genera. Association of these nematodes with termites is a new finding. Rest, 67 species were found to be associated with the teak and sal trees. They were found to occur in 11 orders, 26 families and 49 genera of which 57 species are recorded for the first time from teak and sal forests of Dehradun.

**Table 2:** List of nematodes described in the present study

S.No	Nematode species
	<b>Insect Nematode</b>
1	<i>Hexameris truncata</i> (Rudolphi, 1809) Wouts, 1981
2	<i>Steinernema feltiae</i> Filipjev, 1934
	<b>Insect Associated Nematodes</b>
3	<i>Protorhabditis elaphri</i> (Hirschmann, 1952) Dougherty, 1953
4	<i>Protorhabditis</i> sp.
5	<i>Diploscapter</i> sp.
6	<i>Macrolaimellus longicauda</i> (Rashid et al., 1985) Rashid et al., 1986
7	<i>Cephalobus pseudoparvus</i> Rashid et al., 1984
8	<i>Pseudacrobelus pauciannulatus</i> (Marinari-Palmisano, 1967) Ley et al., 1993
9	<i>Pseudacrobelus eurystoma</i> (Andrassy, 1967) Abolafia et al., 2002

Contd...

S.No	Nematode species
10.	<i>Acrobeloides nanus</i> (de Man, 1880) Anderson, 1968
11	<i>Cervidellus neftasiensis</i> Bostrom, 1968
12	<i>Teratocephalus costatus</i> Andrassy, 1958
13	<i>Wilsonema auriculatum</i> (Butschli, 1873) Cobb, 1913
14	<i>Rhabditolaimus</i> sp.
	<b>Soil nematodes</b>
15	<i>Mesorhabditis spiculigera</i> (Steiner, 1936) Dougherty, 1953
16	<i>Caenorhabditis elegans</i> (Maupas, 1899) Dougherty, 1953
17	<i>Protorhabditis oxyuroides</i> Sudhaus, 1974
18	<i>Pseudacrobelus tabacum</i> (Rashid <i>et al.</i> , 1984) Ley <i>et al.</i> , 1993
19	<i>Pseudacrobelus multicinctus</i> (Cobb, 1893) Andrassy, 1967
20	<i>Eucephalobus oxyuroides</i> (de Man, 1876) Steiner, 1936
21	<i>Acrobeloides buetschlii</i> (de Man, 1884) Steiner & Buhner, 1933
22	<i>Acrobeles timmi</i> Chaturvedi & Khera, 1979
23	<i>Acrobelus ciliatus</i> Linstow, 1877
24.	<i>Zeldia punctata</i> (Thorne) Thorne, 1937
25	<i>Chiloplacus magnus</i> Rashid & Heyns, 1990
26	<i>Achromadora ruricola</i> (de Man, 1880) Micoletzky, 1925
27	<i>Plectus cirratus</i> Bastian, 1865
28	<i>Plectus thornei</i> Ruhm, 1956
29	<i>Chiloplectus indicus</i> Tahseen <i>et al.</i>
30	<i>Prismatolaimus andrassyi</i> Khera and Chaturvedi, 1977
31	<i>Ironus longicaudatus</i> de Man, 1884
32	<i>Tylenchus filiformis</i> Butschli, 1873
33	<i>Aglenchus lycopersicus</i> Husain & Khan, 1975
34.	<i>Boleodorus typicus</i> Husain & Khan, 1967
35	<i>Psilenchus minor</i> Siddiqi, 1963
36	<i>Tylenchorhynchus annulatus</i> (Cassidy, 1930) Golden, 1971
37	<i>Tylenchorhynchus mashoodi</i> Siddiqi & Basir, 1959
38	<i>Hoplolaimus indicus</i> Sher, 1963
39	<i>Helicotylenchus dihystra</i> (Cobb, 1893) Sher, 1961
40.	<i>Helicotylenchus indicus</i> Siddiqi, 1963
41	<i>Helicotylenchus multicinctus</i> (Cobb, 1893) Golden, 1956
42	<i>Pratylenchus penetrans</i> (Cobb, 1917) Filipjev & Stekhoven, 1941
43	<i>Pratylenchus kumaonensis</i> Lal & Khan, 1989
44	<i>Pratylenchus neglectus</i> (Rensch, 1924) Filipjev & Stekhoven, 1941

S.No	Nematode species
45	<i>Pratylenchus pratensis</i> (de Man, 1880) Filipjev, 1936
46.	<i>Hemicriconemoides mangifera</i> Siddiqi, 1961
47	<i>Hemicriconemoides doonensis</i> Srivastava <i>et al.</i> , 2000
48.	<i>Criconema rishikensis</i> (Singh & Khan, 1999) Rizvi, 2010
49	<i>Paratylenchus nainianus</i> Edward & Misra, 1963
50	<i>Tylenchulus semipenetrans</i> Cobb, 1913
51	<i>Aphelenchus avenae</i> Bastian, 1865
52	<i>Amphidorylaimus infecundus</i> (Cobb, 1936) Andrassy, 1960
53	<i>Prodorylaimium brigdammense</i> (de Man, 1876) Andrassy, 1969
54	<i>Mesodorylaimus chamolienses</i> Ahmad, 1995
55	<i>Thornenema cavalcantii</i> (Lordello, 1955) Andrassy, 1959
56	<i>Opisthodorylaimus caudatus</i> Ahmad & Jairajpuri, 1982
57	<i>Labronema pararapax</i> Ahmad & Jairajpuri, 1982
58.	<i>Eudorylaimus himalus</i> Jairajpuri & Ahmad, 1982
59	<i>Discolaimus tenax</i> Siddiqi, 1964
60.	<i>Enchodelus constrictus</i> Jairajpuri & Loof, 1968
61	<i>Oriverutus labiatus</i> Ahmad & Jairajpuri, 1987
62	<i>Aporcelaimus litchi</i> Srivastava <i>et al.</i> , 2000
63	<i>Longidorus doonensis</i> (Singh & Khan, 1996) n. comb.
64	<i>Xiphinema inaequale</i> Khan & Ahmad, 1975
65	<i>Clavicaudoides clavicaudatus</i> (Altherr, 1953) Ahmad & Jairajpuri, 1982
66.	<i>Alaimus jaulasali</i> Siddiqi & Husain, 1967
67	<i>Alaimus primitivus</i> de Man, 1880
68.	<i>Clarkus papillatus</i> (Bastian, 1865) Jairajpuri, 1970
69.	<i>Clarkus elongatus</i> Jairajpuri & Khan, 1977
70	<i>Prionchulus muscorum</i> (Dujardin, 1845) Wu Hoeppli, 1929
71	<i>Mylonchulus brachyuris</i> (Butschli, 1873) Altherr, 1954
72	<i>Mylonchulus minor</i> (Cobb, 1893) Andrassy, 1958
73	<i>Mylonchulus hawaiiensis</i> (Cassidy, 1931) Andrassy, 1958
74	<i>Mylonchulus lacustris</i> (Cobb, 1915) Andrassy, 1958
75	<i>Mylonchulus amurus</i> Khan & Jairajpuri, 1979
76	<i>Paramylonchulus mulveyi</i> (Jairajpuri, 1970) Jairajpuri & Khan, 1981
77	<i>Paramylonchulus index</i> (Cobb, 1906) Jairajpuri & Khan, 1981
78	<i>Iotonchus trichurus</i> (Cobb, 1917) Altherr, 1958
79	<i>Iotonchus parabasidontus</i> Mulvey & Jensen, 1967
80.	<i>Trichodorus pakistanensis</i> Siddiqi, 1962
81	<i>Paratrichodorus porosus</i> (Allen, 1975) Siddiqi, 1974

**Table 3.** List of new records of nematodes.

S.No.	New records from India
1	<i>Protorhabditis elaphri</i> (Hirschmann, 1952) Dougherty, 1953
2	<i>Protorhabditis oxyuroides</i> Sudhaus, 1974
3	<i>Macrolaimellus longicauda</i> (Rashid <i>et al.</i> , 1985) Rashid <i>et al.</i> , 1986
4	<i>Cephalobus pseudoparvus</i> Rashid <i>et al.</i> , 1984
5	<i>Pseudacrobelus pauciannulatus</i> (Marinari-Palmisano, 1967) Ley <i>et al.</i> , 1993
6	<i>Pseudacrobelus tabacum</i> (Rashid <i>et al.</i> , 1984) Ley <i>et al.</i> , 1993
7	<i>Pseudacrobelus multicinctus</i> (Cobb, 1893) Andrassy, 1967
8	<i>Acrobeloides nanus</i> (de Man, 1880) Anderson, 1968
9	<i>Cervidellus neftasiensis</i> Bostrom, 1968
10	<i>Teratocephalus costatus</i> Andrassy, 1958
11	<i>Wilsonema auriculatum</i> (Butschli, 1873) Cobb, 1913
12	<i>Mesorhabditis spiculigera</i> (Steiner, 1936) Dougherty, 1953
13	<i>Chiloplacus magnus</i> Rashid & Heyns, 1990
	<b>New records from State Uttarakhand</b>
1	<i>Steinernema feltiae</i> Filipjev, 1934
2	<i>Acrobelus ciliatus</i> Linstow, 1877
3	<i>Discolaimus tenax</i> Siddiqi, 1964

### ACKNOWLEDGEMENTS

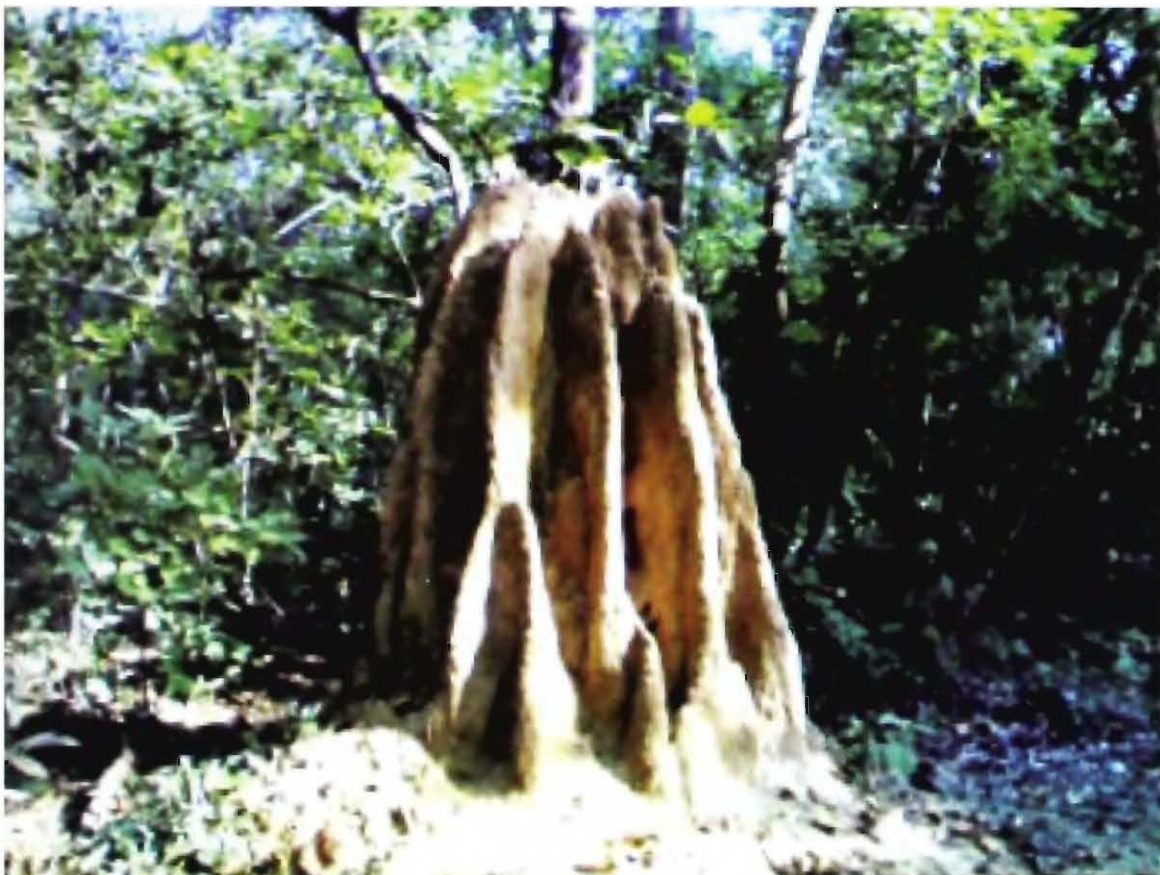
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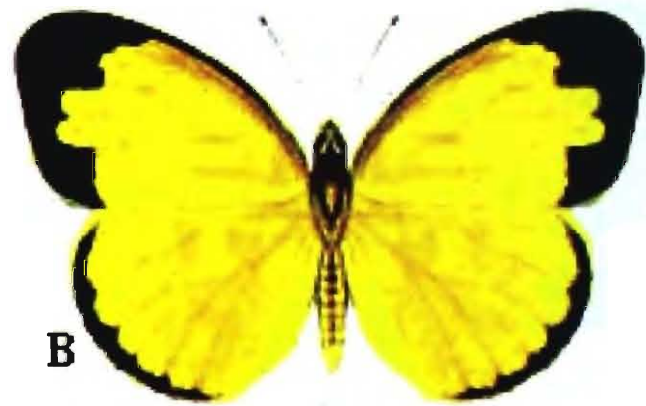
**Fig. 1.** Sal Forests at Sabbahwala and Thano Range



**Fig. 2.** Teak Plantation Forests in Dehradun **A.** Dharmawala Timli Range **B.** Thano Range **C.** Sabbahwala Timli Range

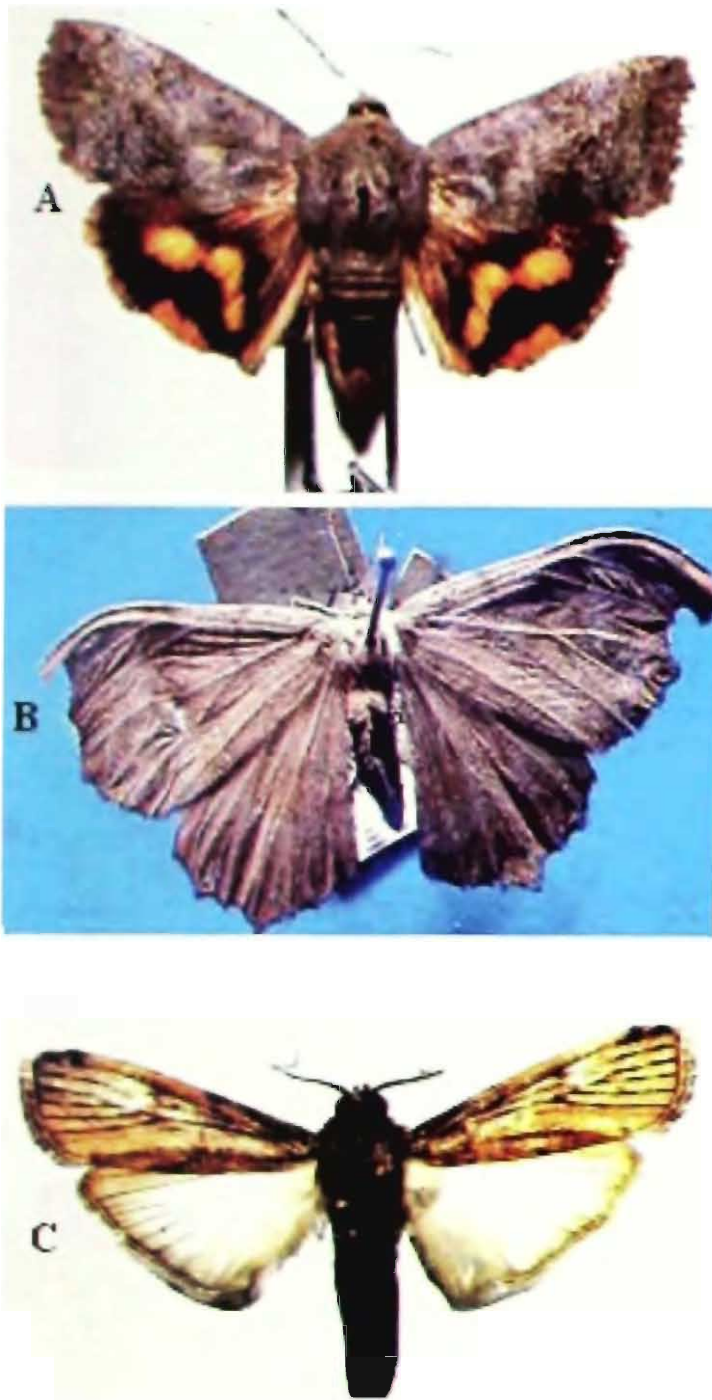


**Fig. 3.** Termite Hills at Timli Sal Forests of Dehradun

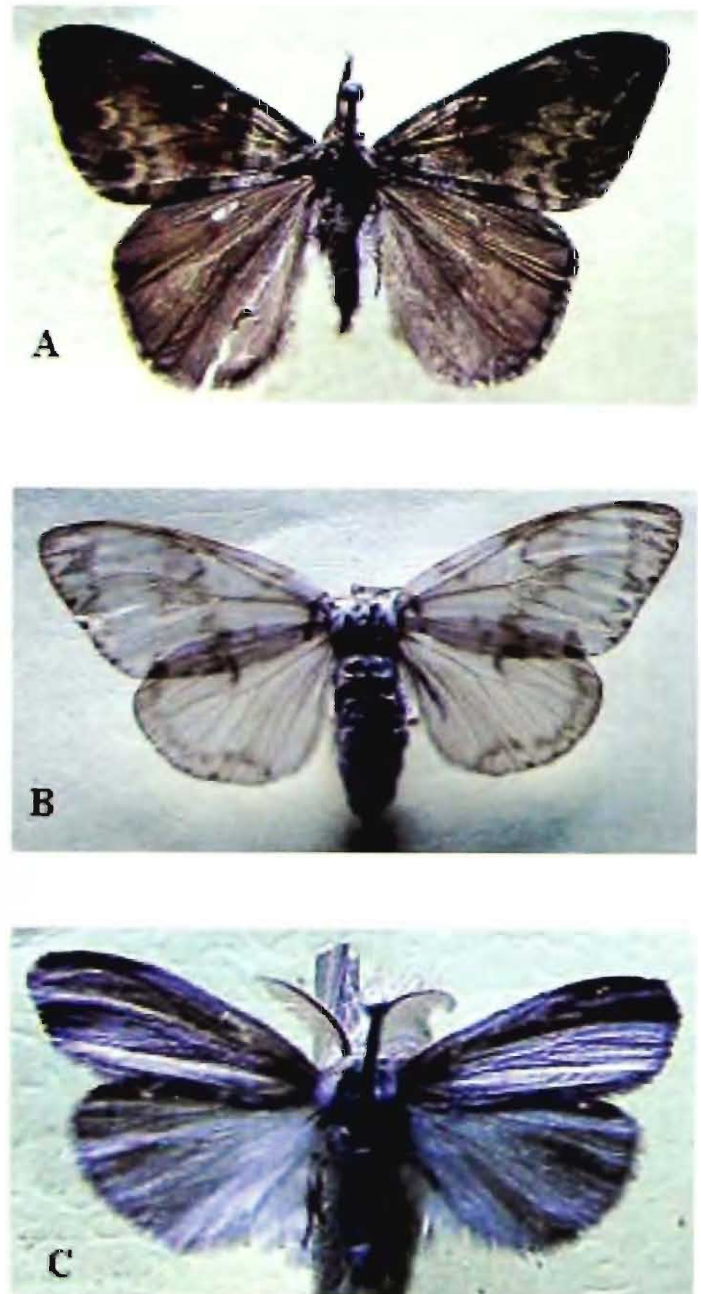


**Fig. 4.** Lepidopteran Pests of Sal and Teak Forests A. *Antheraea paphia* B. *Ascotis selenaria* C. *Dasychira grotei*

**Fig. 5.** Lepidopteran Pests of Sal and Teak Forests A. *Diacrisia Obligua* B. *Eurema hecabe* C. *Dasychira mendosa*



**Fig. 6.** Lepidopteran Pests of Sal and Teak Forests **A.** *Hyblaea puera* **B.** *Hyposidra successaria* **C.** *Hypsipyla robusta*

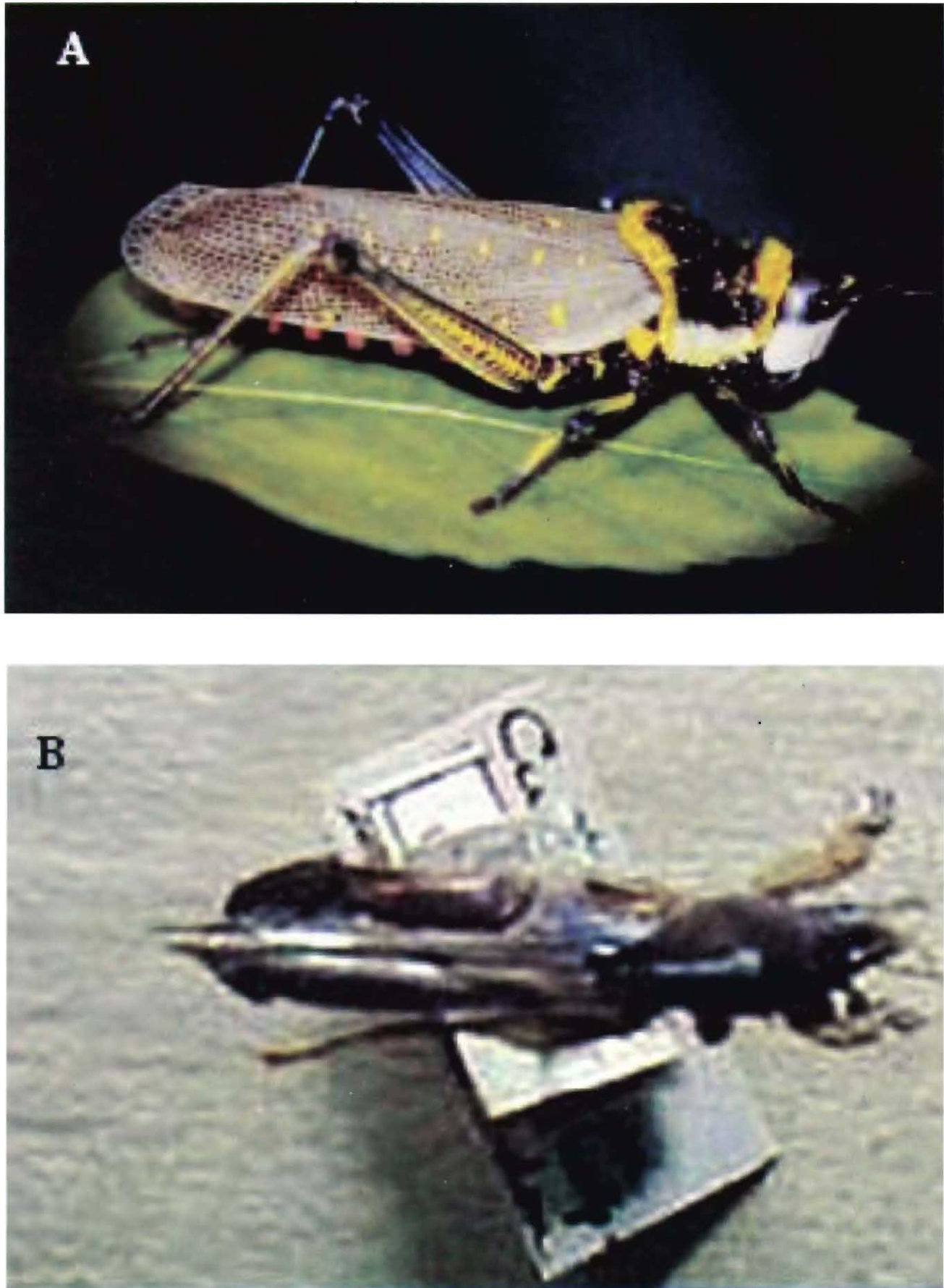


**Fig. 7.** Lepidopteran Pests of Sal and Teak Forests **A.** *Lymantria ampla* **B.** *Lymantria mathura* **C.** *Orgyra postica*



**Fig. 8.** Lepidopteran larvae of Teak Plantation Forests **A.** *Eutechtoma machaeralis* **B.** *Hyblaea puera*

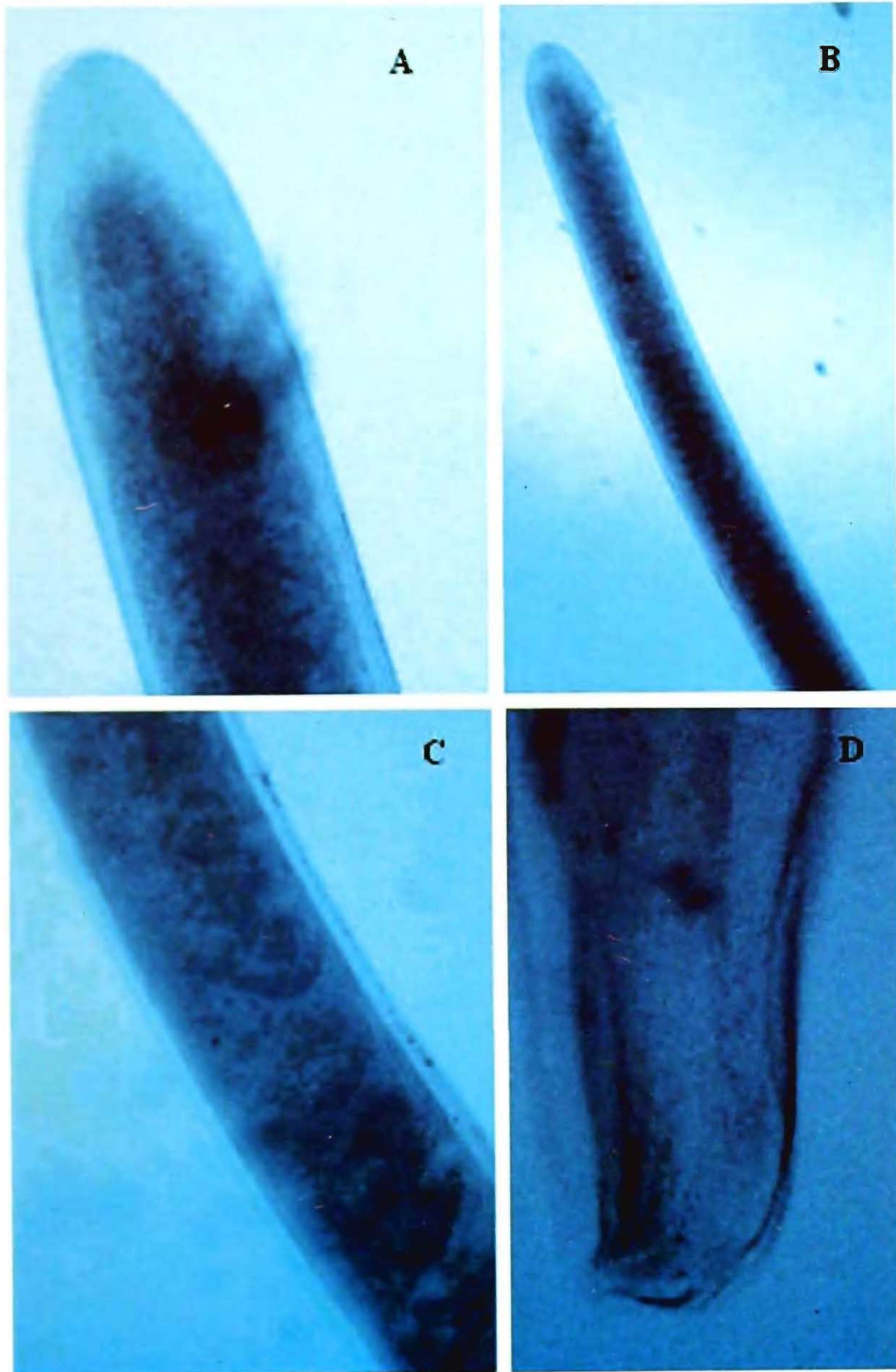
**Fig. 9.** Coleopteran Pests of Teak and Sal Forests **A.** *Aristobia approximator* **B.** *Celosterna scabrator* **C.** *Batocera rufomaculata*



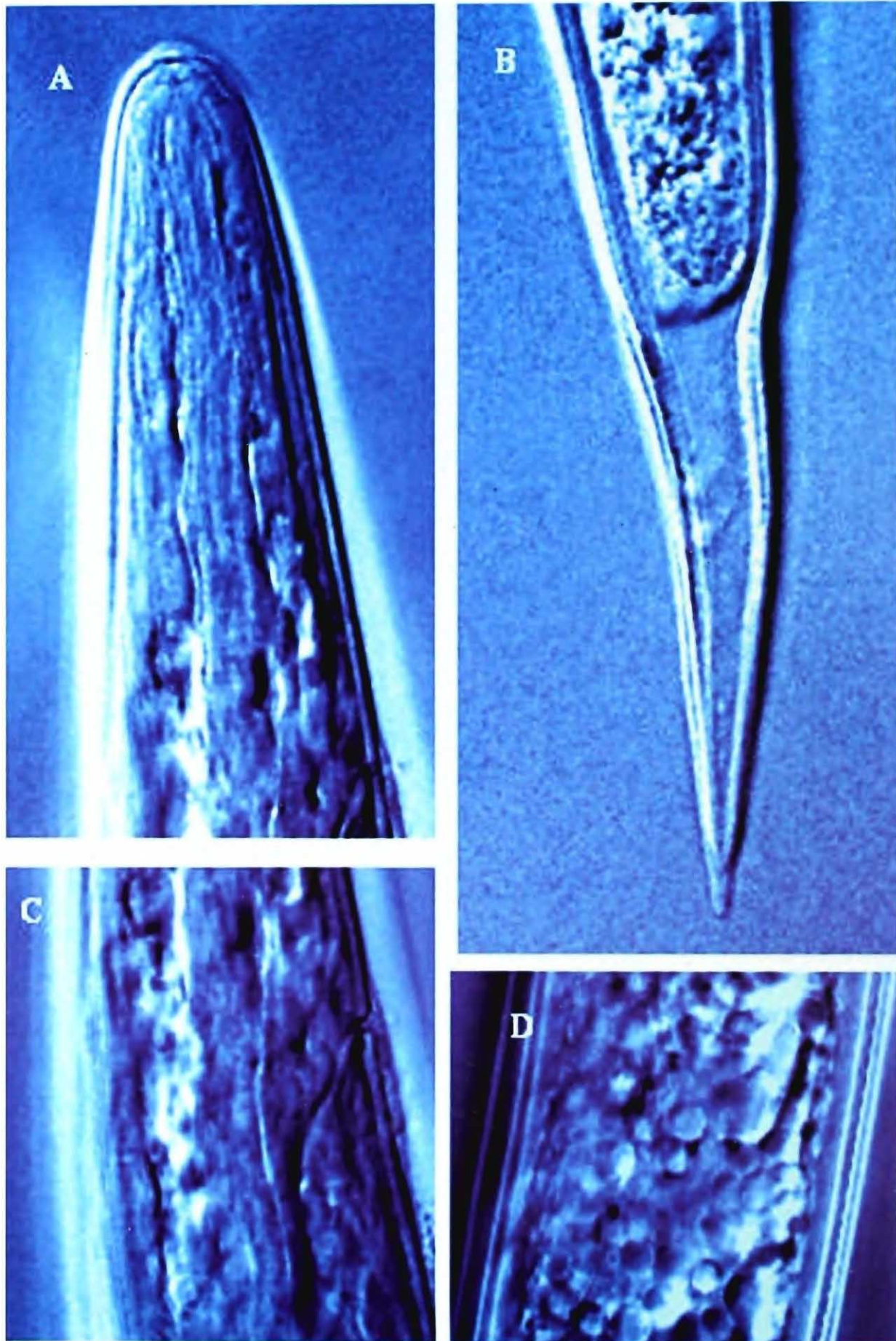
**Fig. 10.** Orthopteran Pests of Teak Plantation Forests **A.** *Auraches miliaris* **B.** *Brachytrypes portentosus*



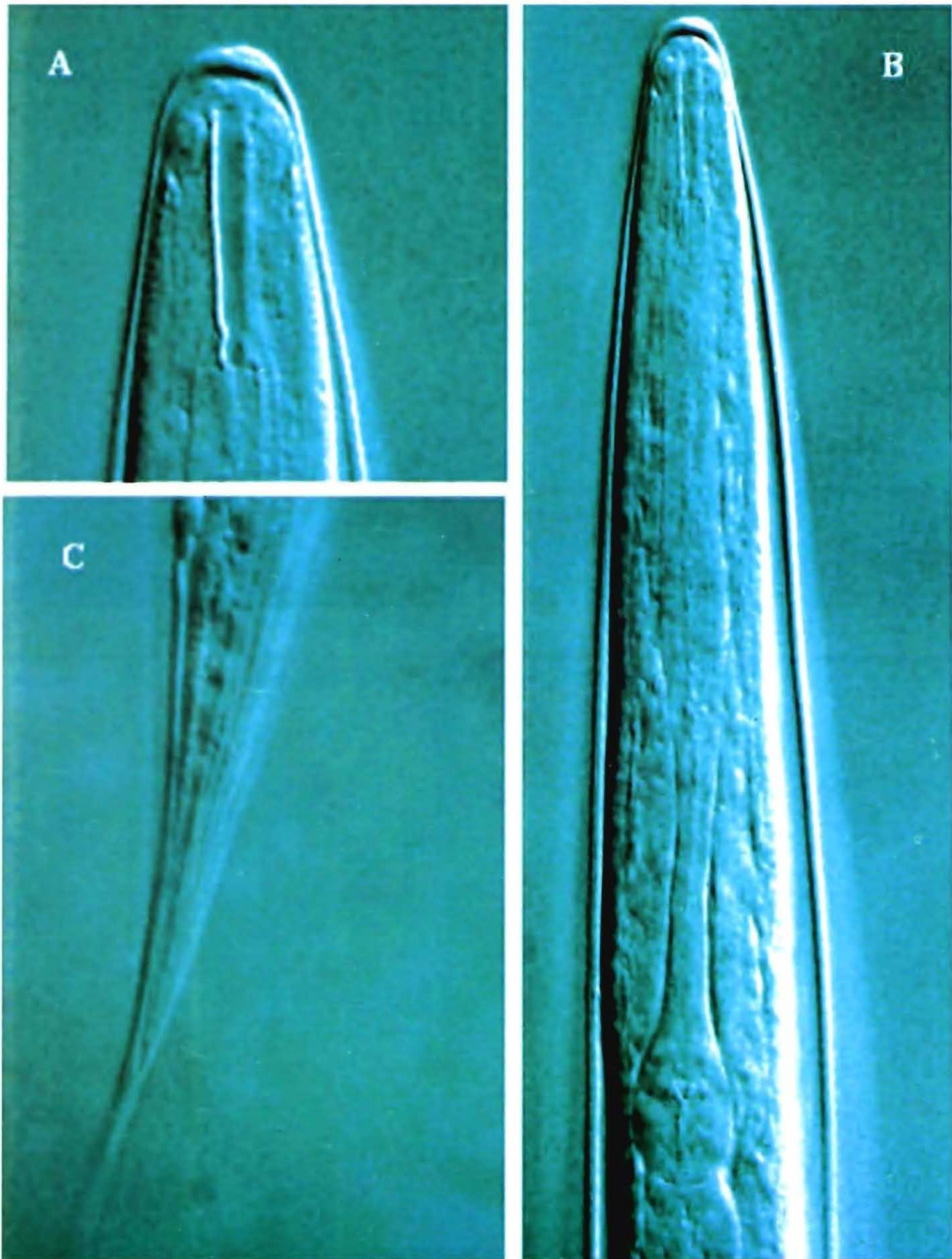
**Fig. 11.** Isopteran Pests from Sal Forests **A.** *Coptotermes curvignathus* **B.** *Neotermes greeni*



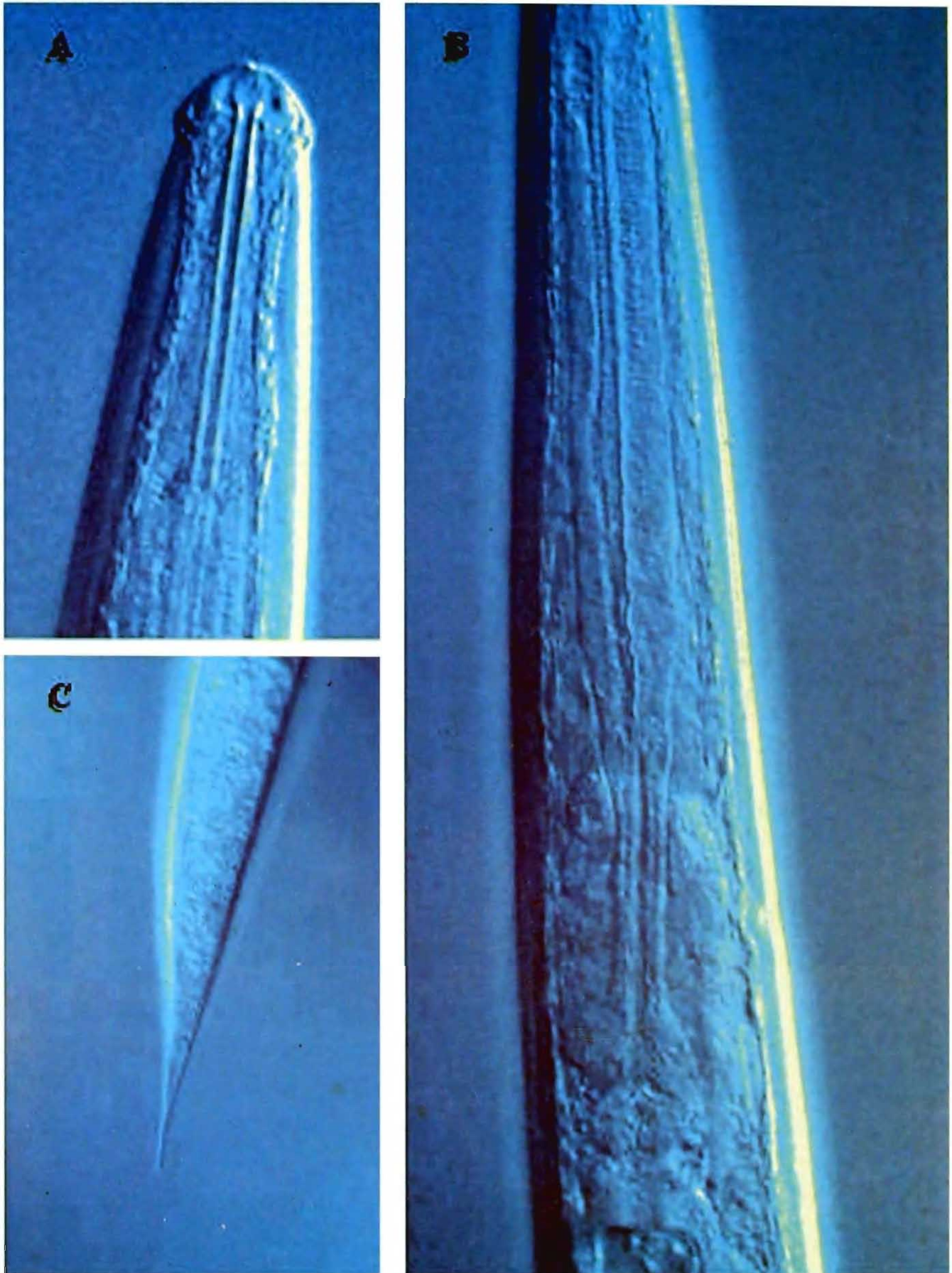
**Plate 1.** *Hexameris truncata* Juvenile **A & B.** Anterior end **C.** Intestinal region **D.** Tail



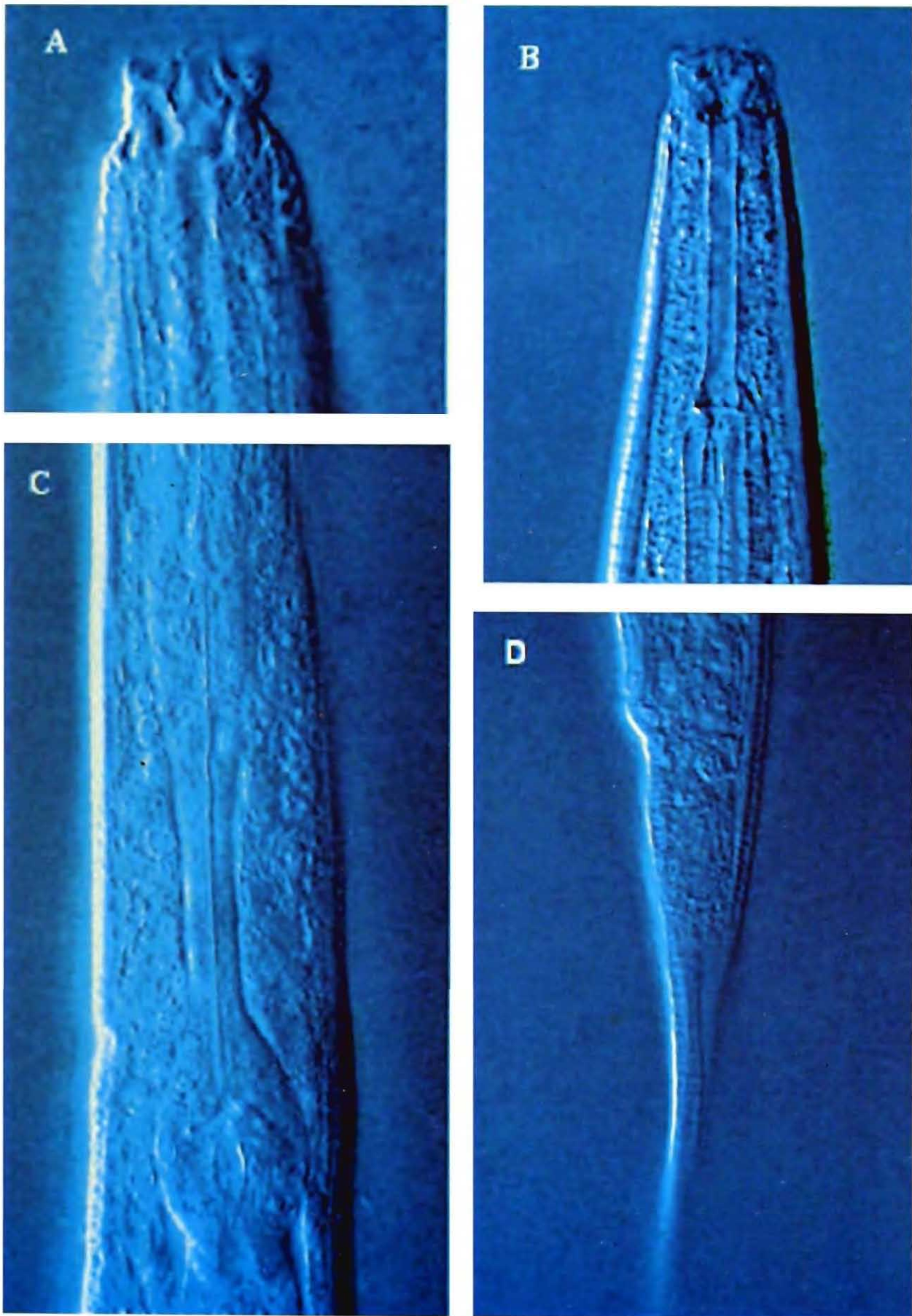
**Plate 2.** *Steinernema feltiae* Juvenile **A.** Anterior end **B.** Tail **C.** Excretory pore **D.** Cuticle



**Plate 3.** *Protorhabdits elaphiri* (Female) A. Buccal cavity B. Pharynx C. Tail region



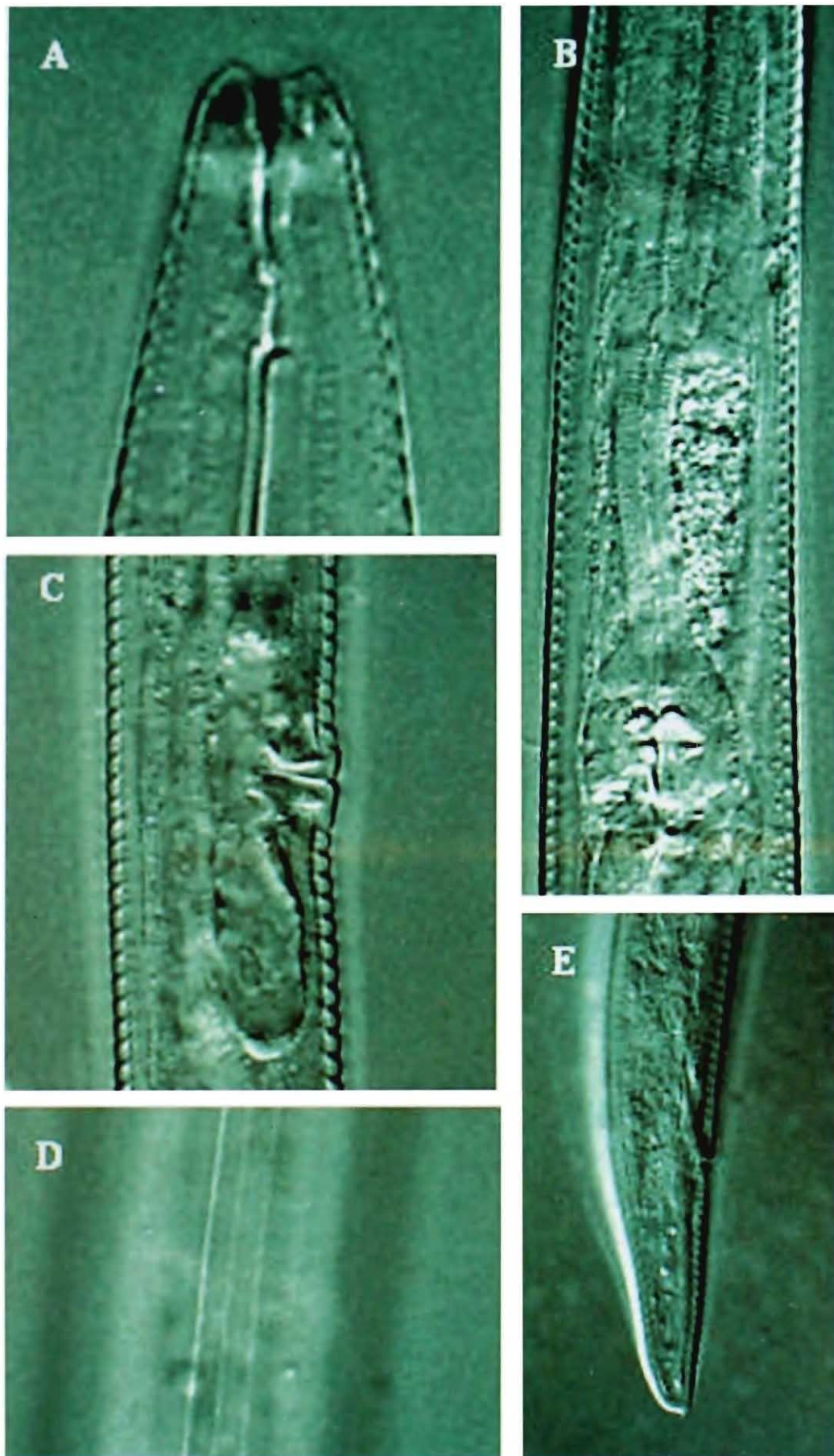
**Plate 4.** *Protorhabditis* sp. Juvenile **A.** Anterior end **B.** Pharyngeal region **C.** Tail



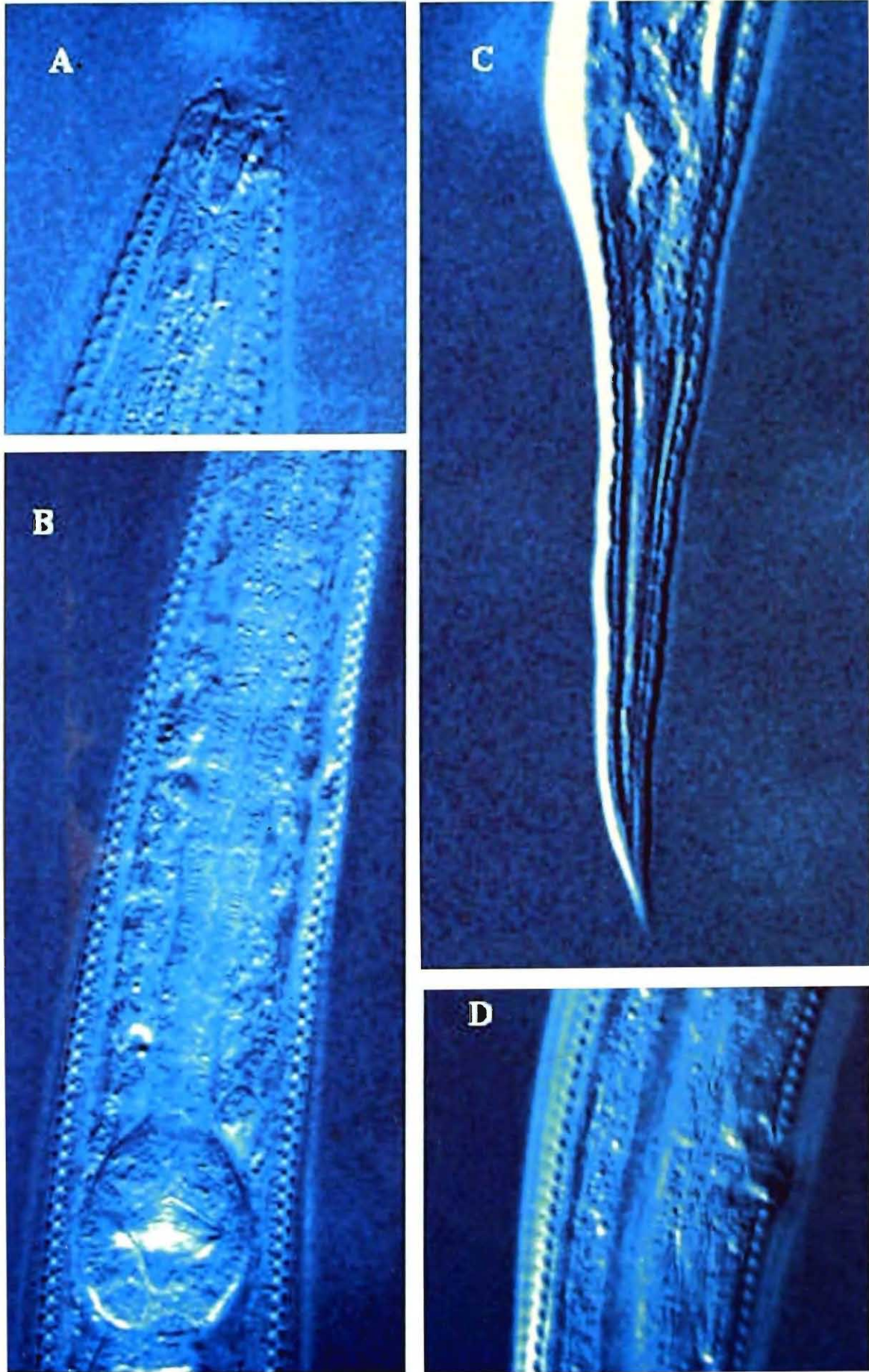
**Plate 5.** *Diploscapter* sp. **A.** Head region **B.** Buccal cavity **C.** Pharynx **D.** Tail region



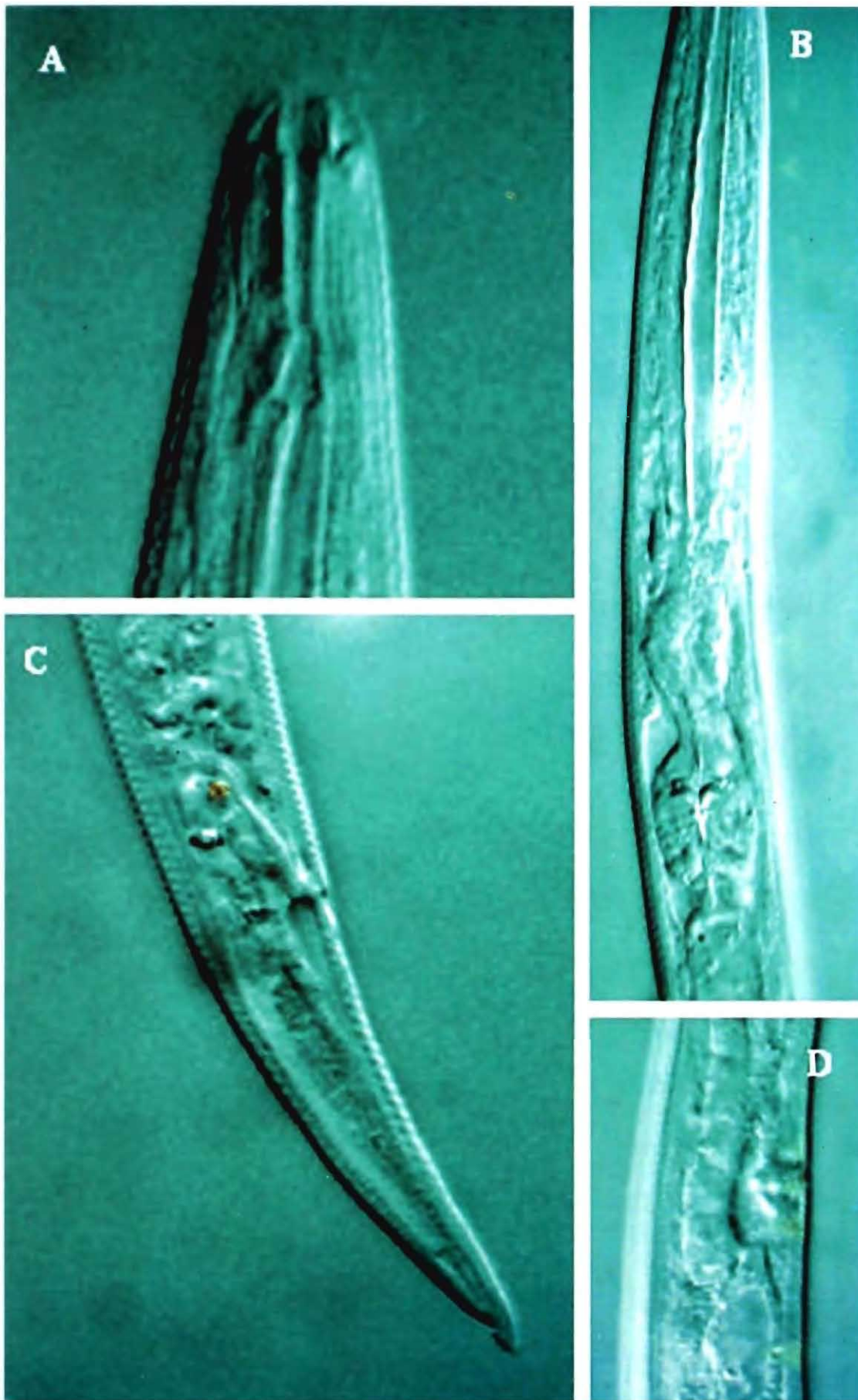
**Plate 6.** *Macrolaimellus longicauda* (Female) A. Head region B. Pharynx C. Tail D. Vulva



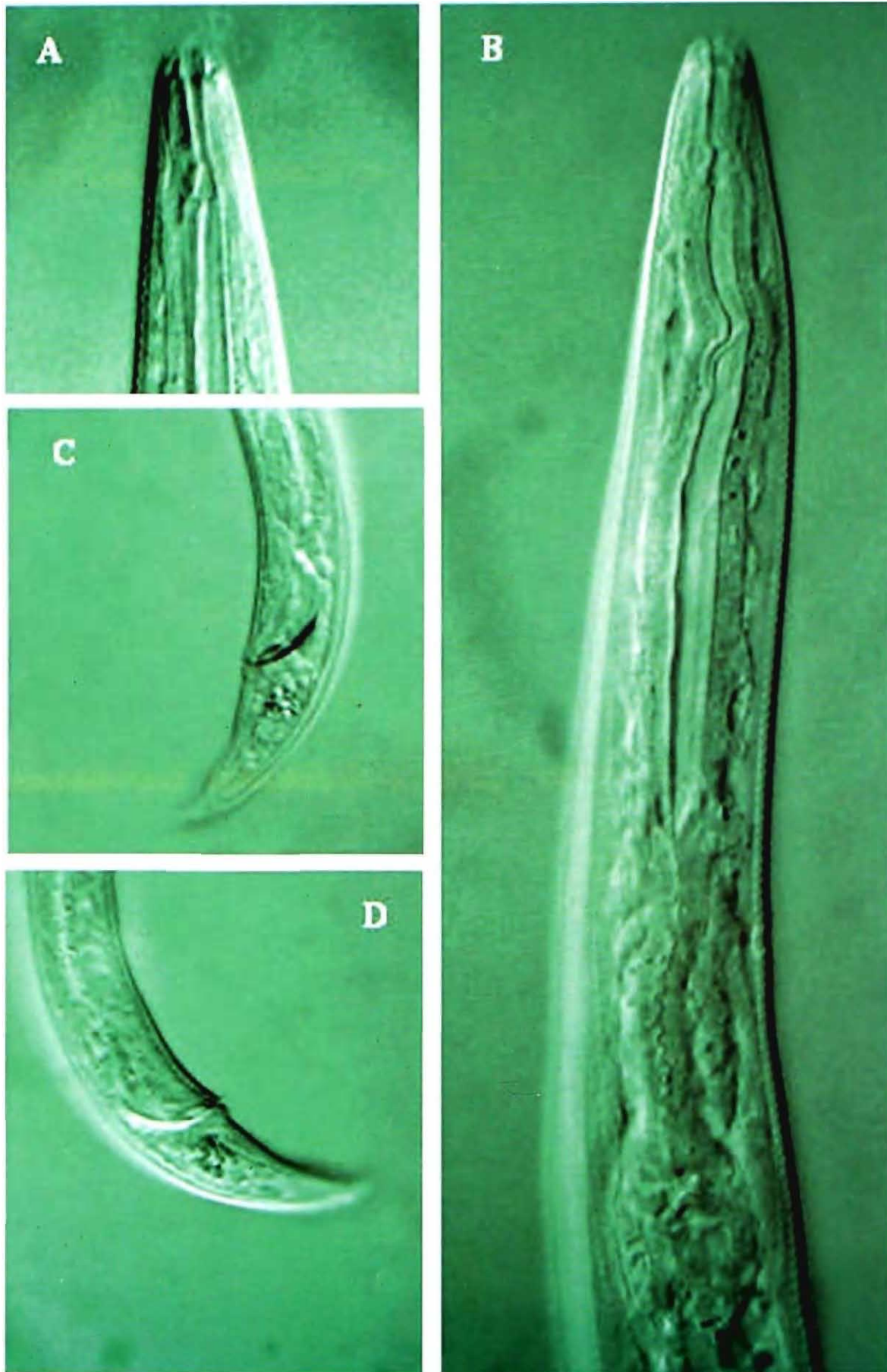
**Plate 7.** *Cephalobus pseudoparvus* (Female) **A.** Buccal Cavity **B.** Pharynx **C.** Vulva **D.** Lateral lines **E.** Tail



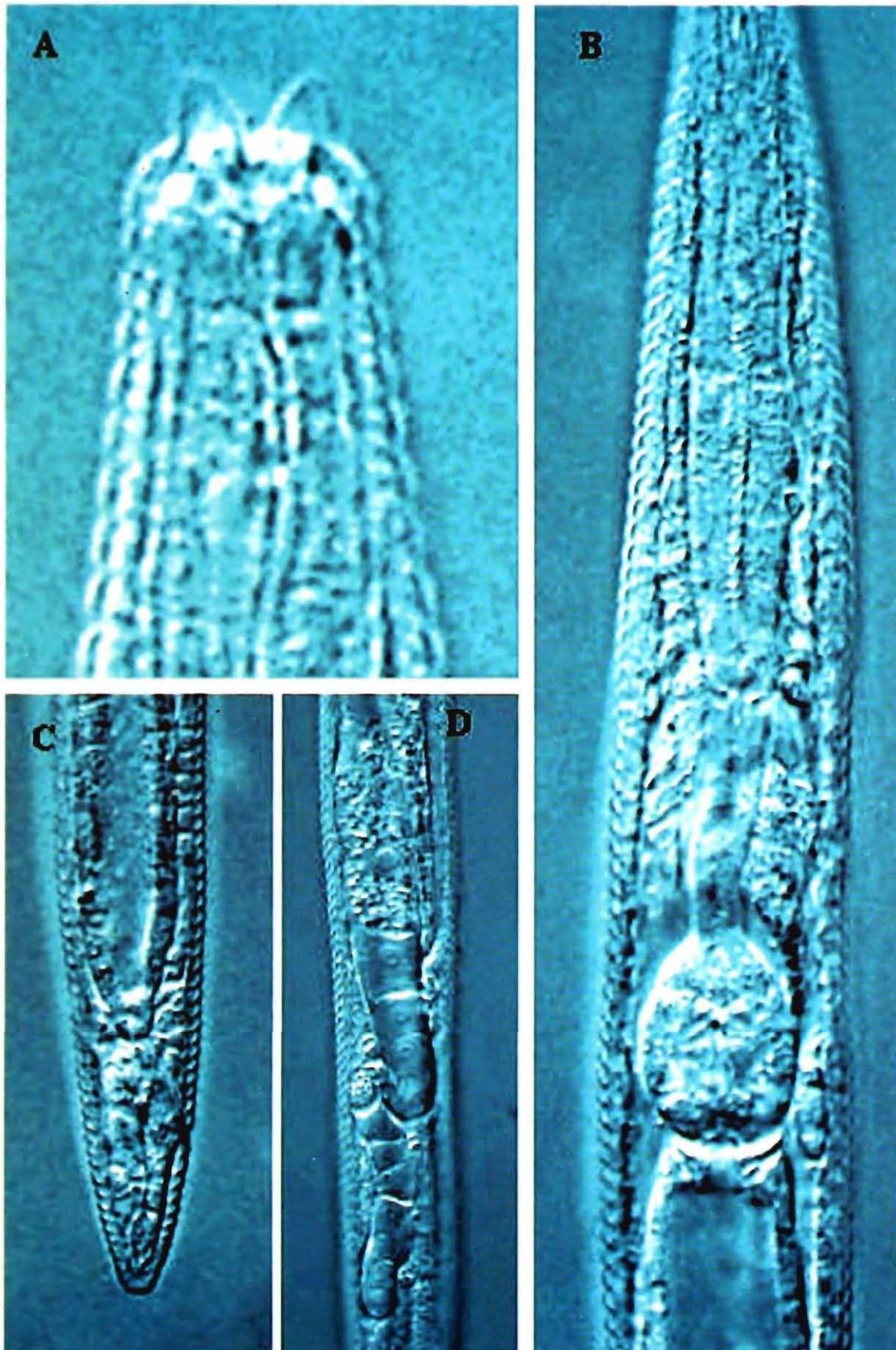
**Plate 8.** *Pseudacrobelus pauciannulatus* (Female) **A.** Head region **B.** Pharynx **C.** Tail **D.** Vulva



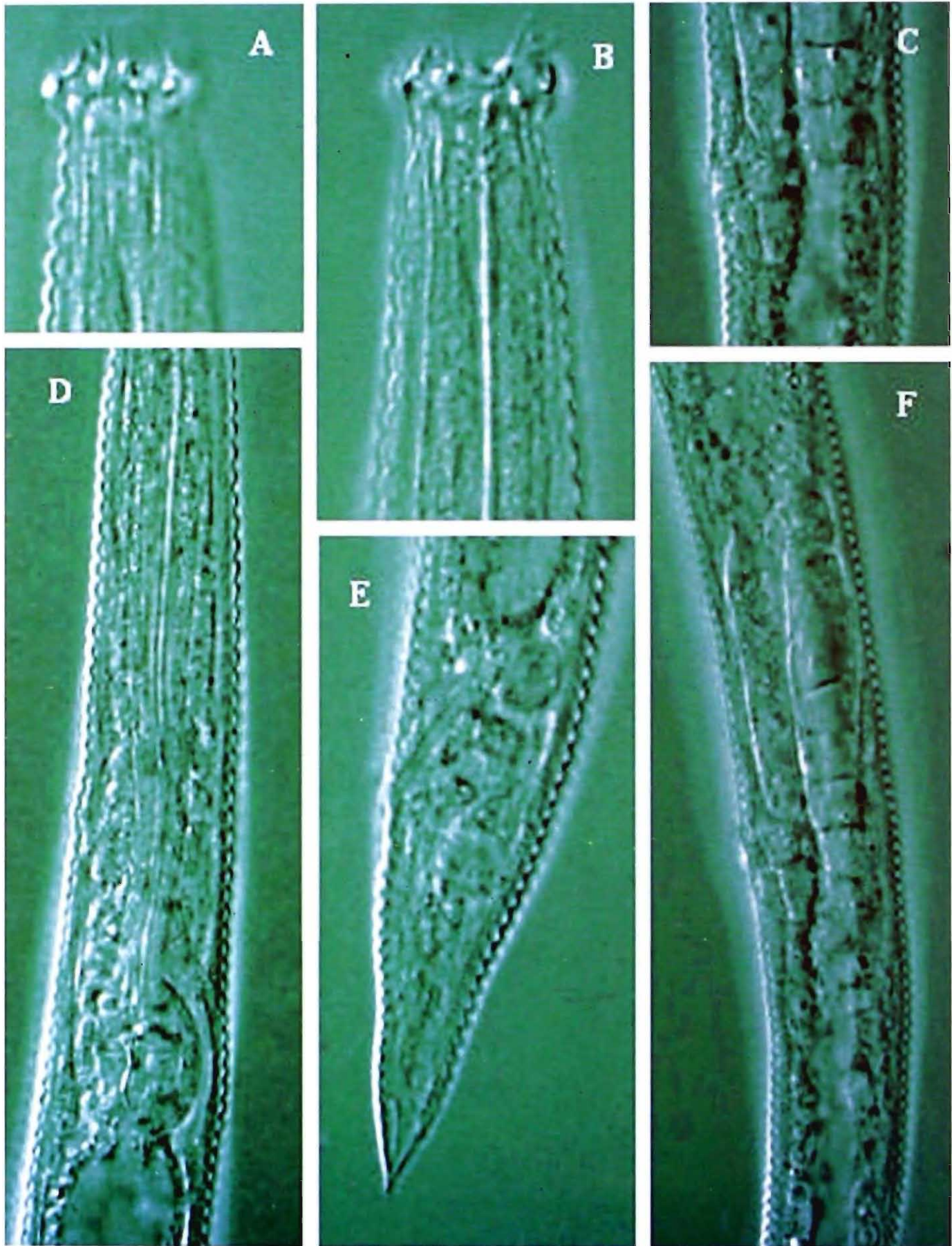
**Plate 9.** *Pseudacrobelus eurystoma* (Female) **A.** Anterior end **B.** Pharynx **C.** Tail **D.** Vulva



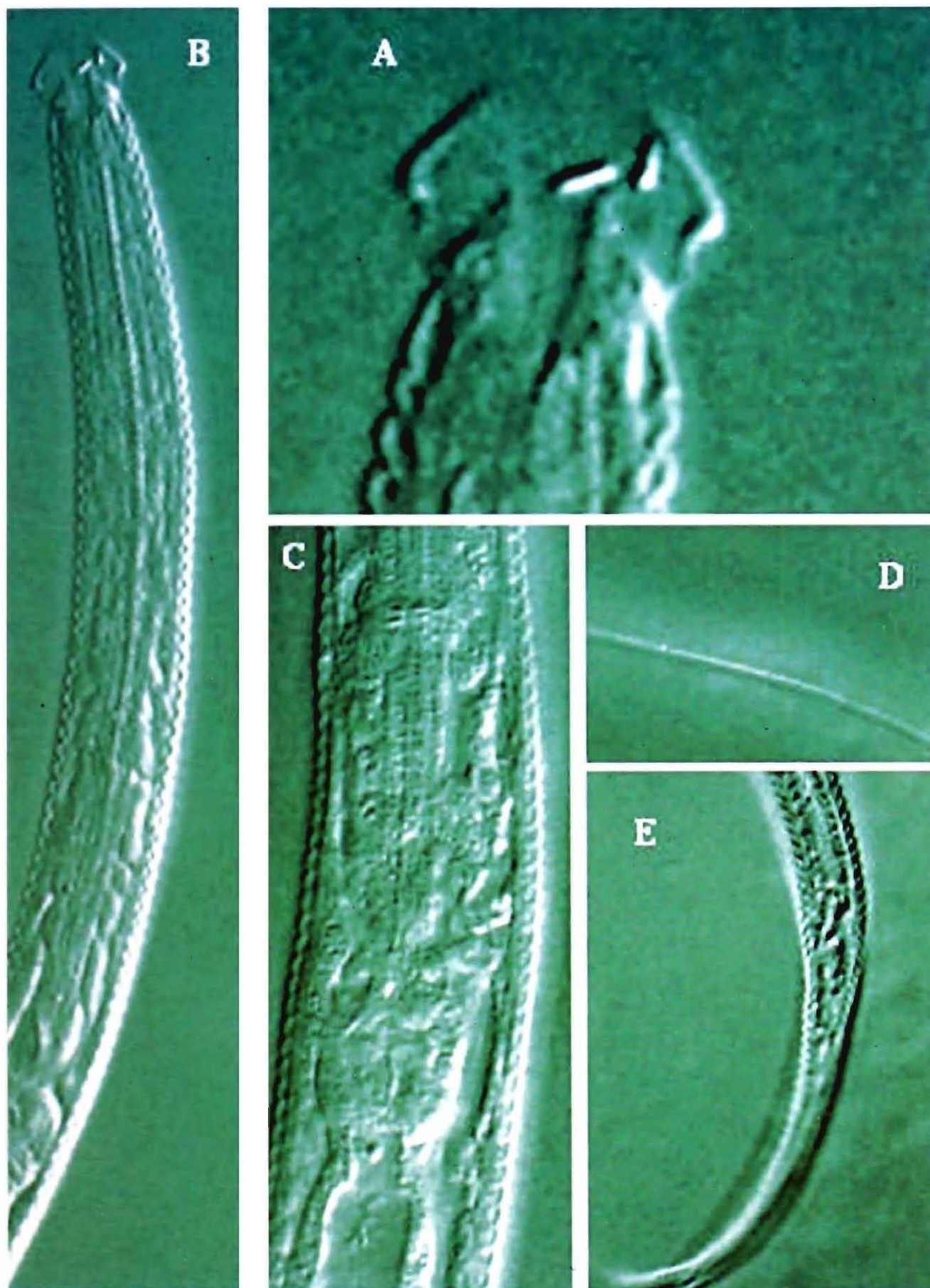
**Plate 10.** *Pseudacrobelus eurystoma* (Male) **A.** Anterior end **B.** Pharynx **C.** Gubernaculum **D.** Spicules



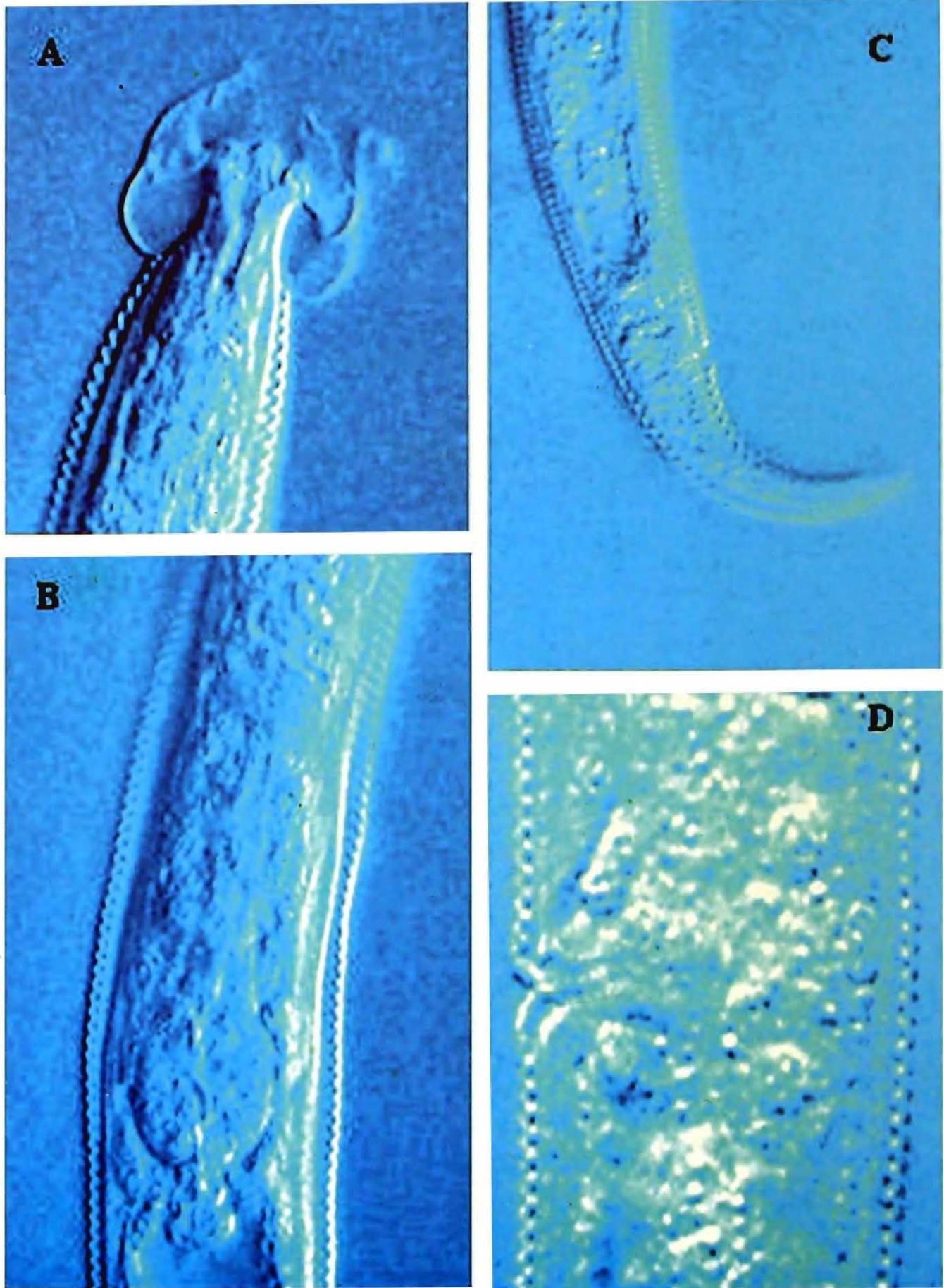
**Plate 11.** *Acrobeloides nanus* (Female) A. Anterior end B. Pharynx C. Tail D. Gonad



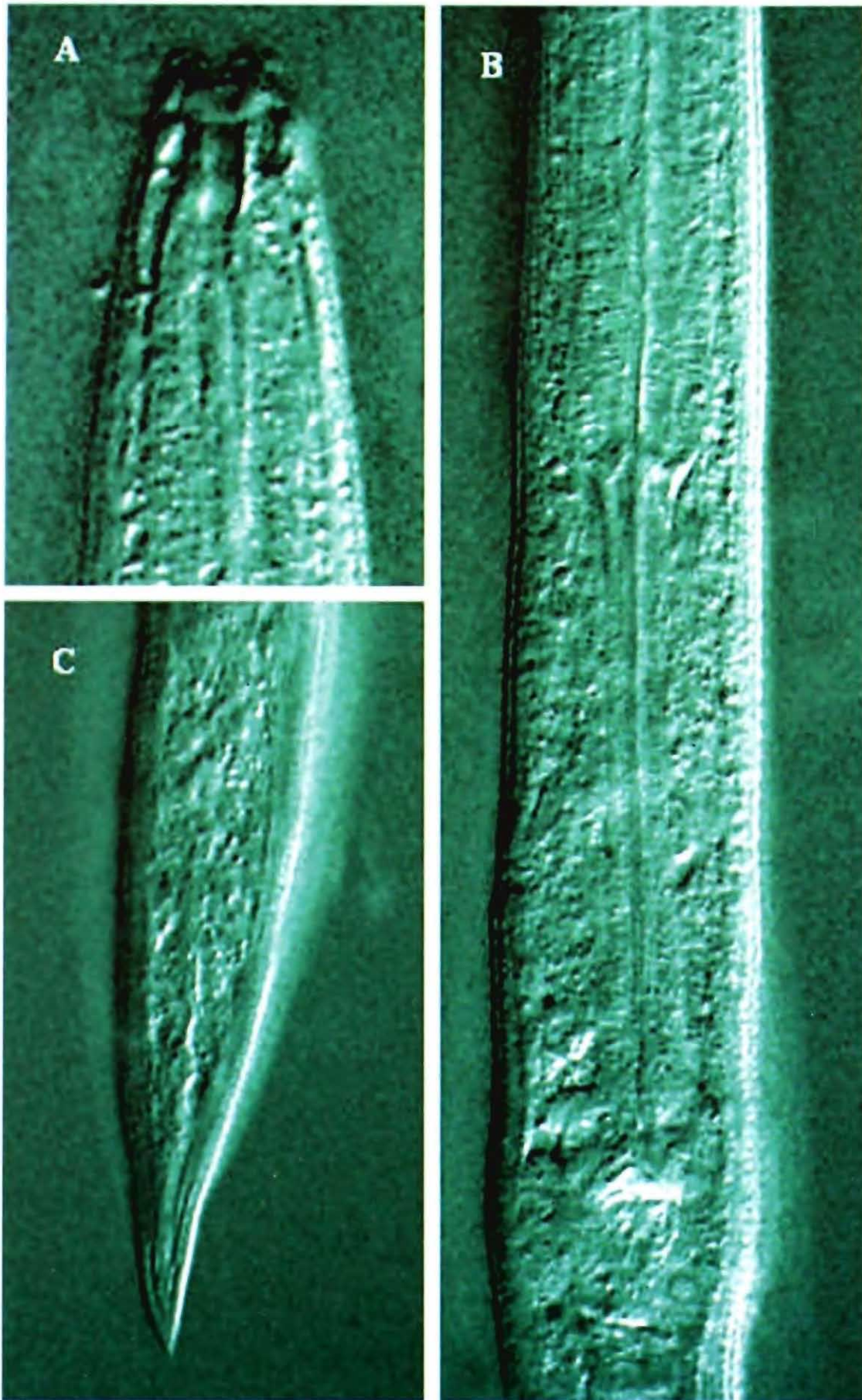
**Plate 12.** *Cervidellus neftasiensis* (Female) A & B. Anterior regions C. Vulva D. Pharynx E. Tail F. Gonad



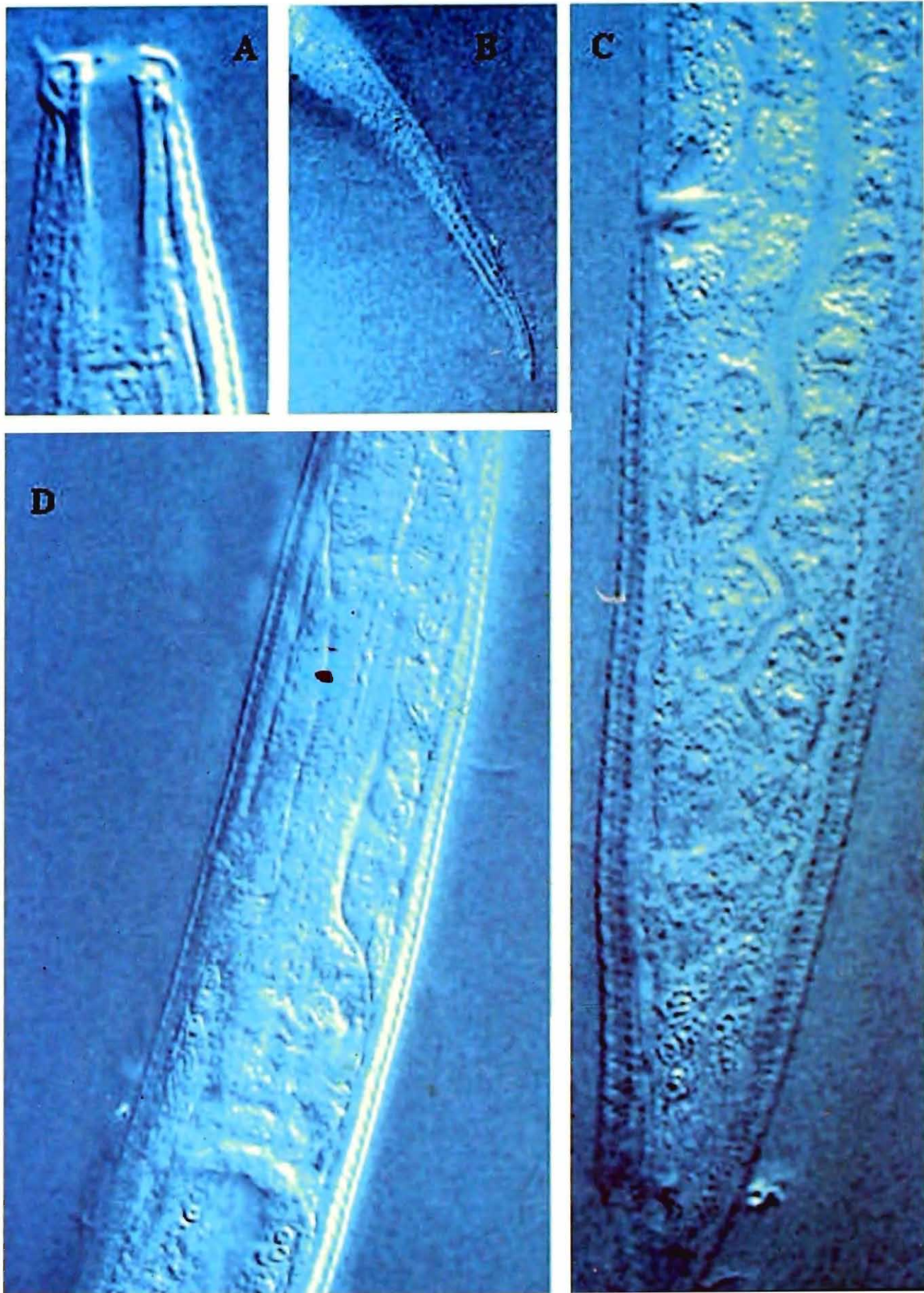
**Plate 13.** *Teratocephalus costatus* (Female) A. Head region B & C. Pharynx D. Lateral Lines E. Tail



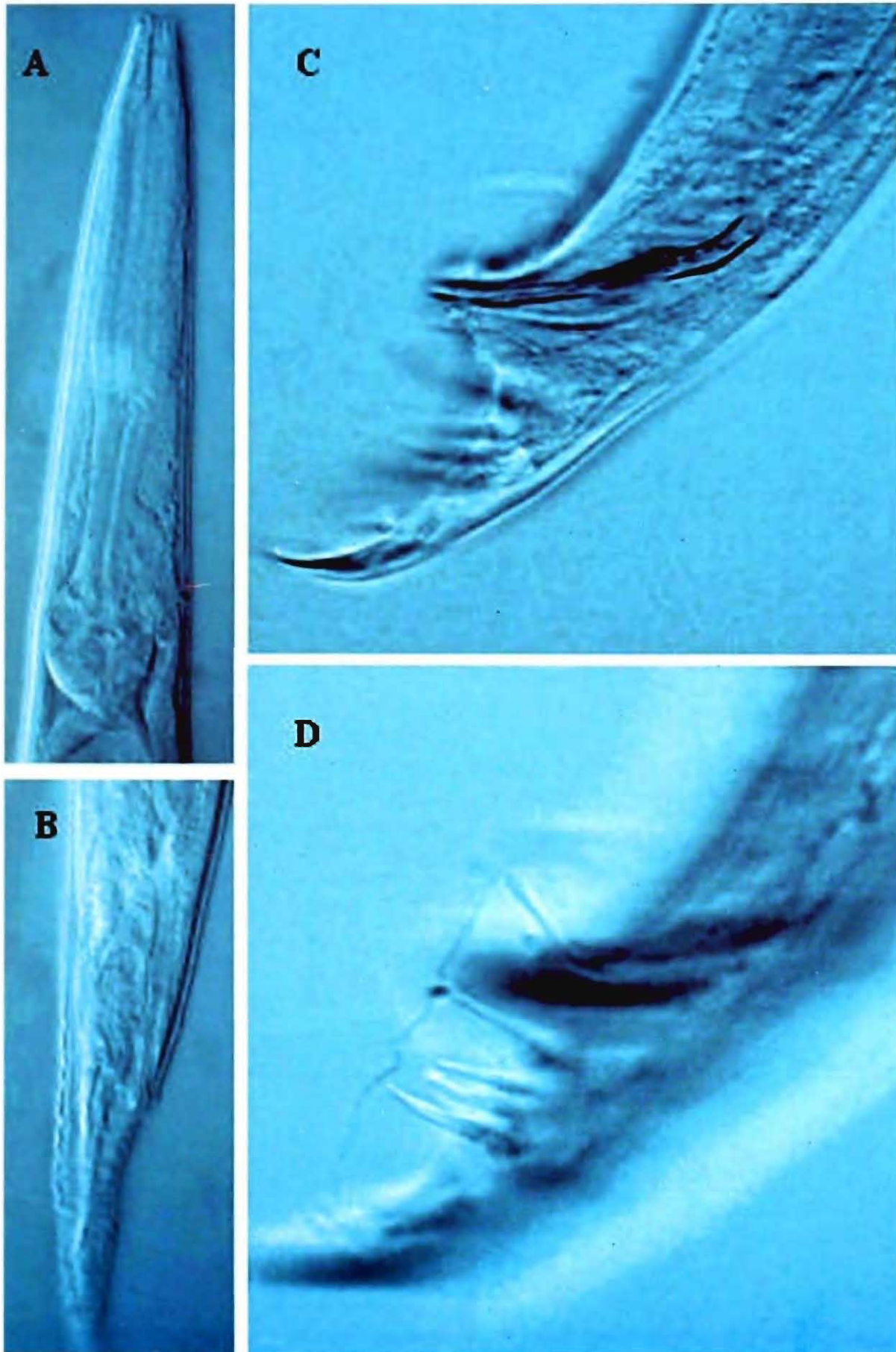
**Plate 14.** *Wilsonema auriculatum* (Female) **A.** Head region **B.** Pharynx **C.** Tail **D.** Vulva



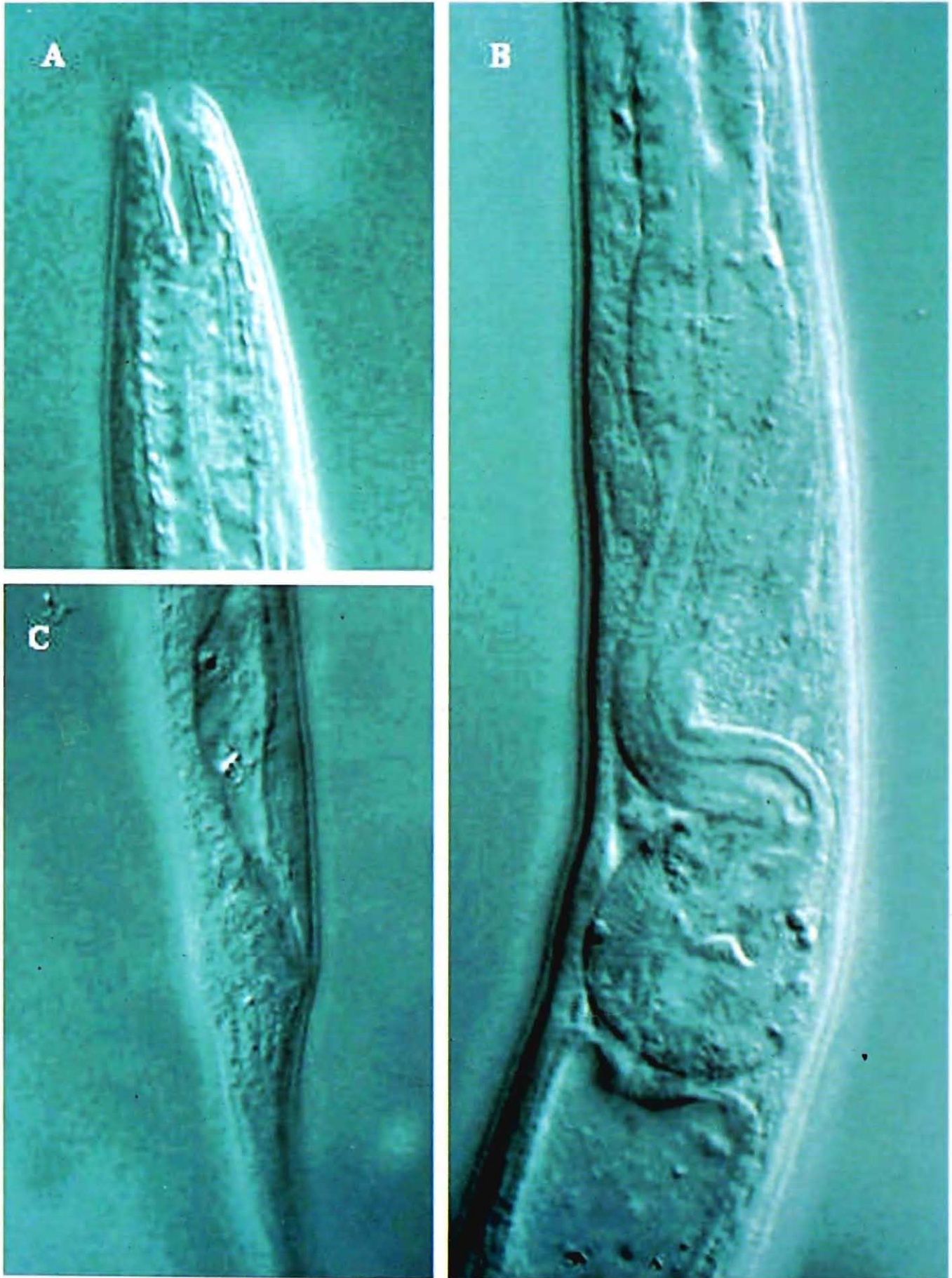
**Plate 15.** *Rhabditolaimus* sp. **A.** Head region **B.** Pharynx **C.** Tail



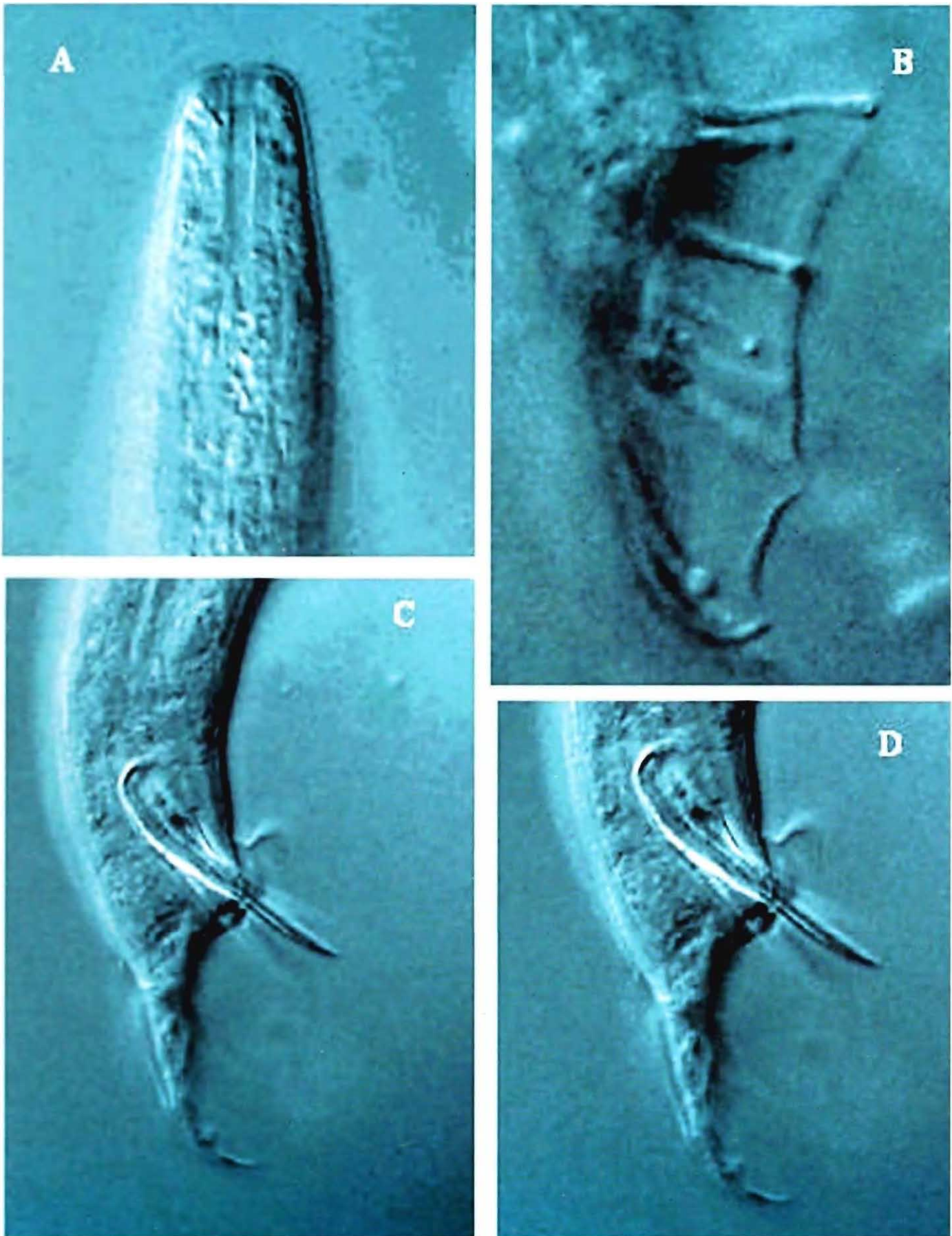
**Plate 16.** *Mesorhabditis spiculigera* (Female) **A.** Head region **B.** Tail **C.** Vulva **D.** Pharynx



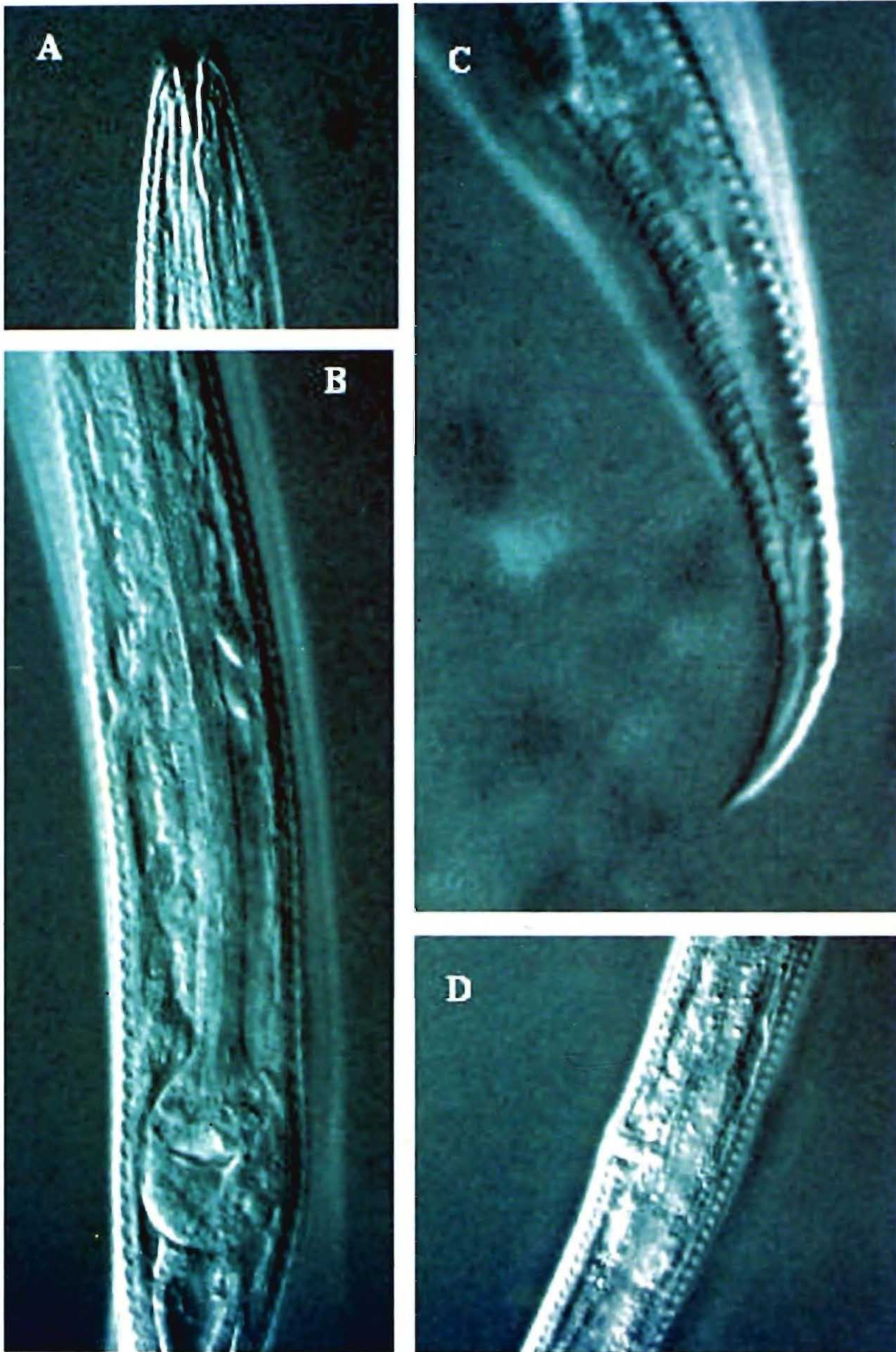
**Plate 17.** *Caenorhabditis elegans* A. Pharynx B. Female tail C. Male spicules D. Male bursal Papillae



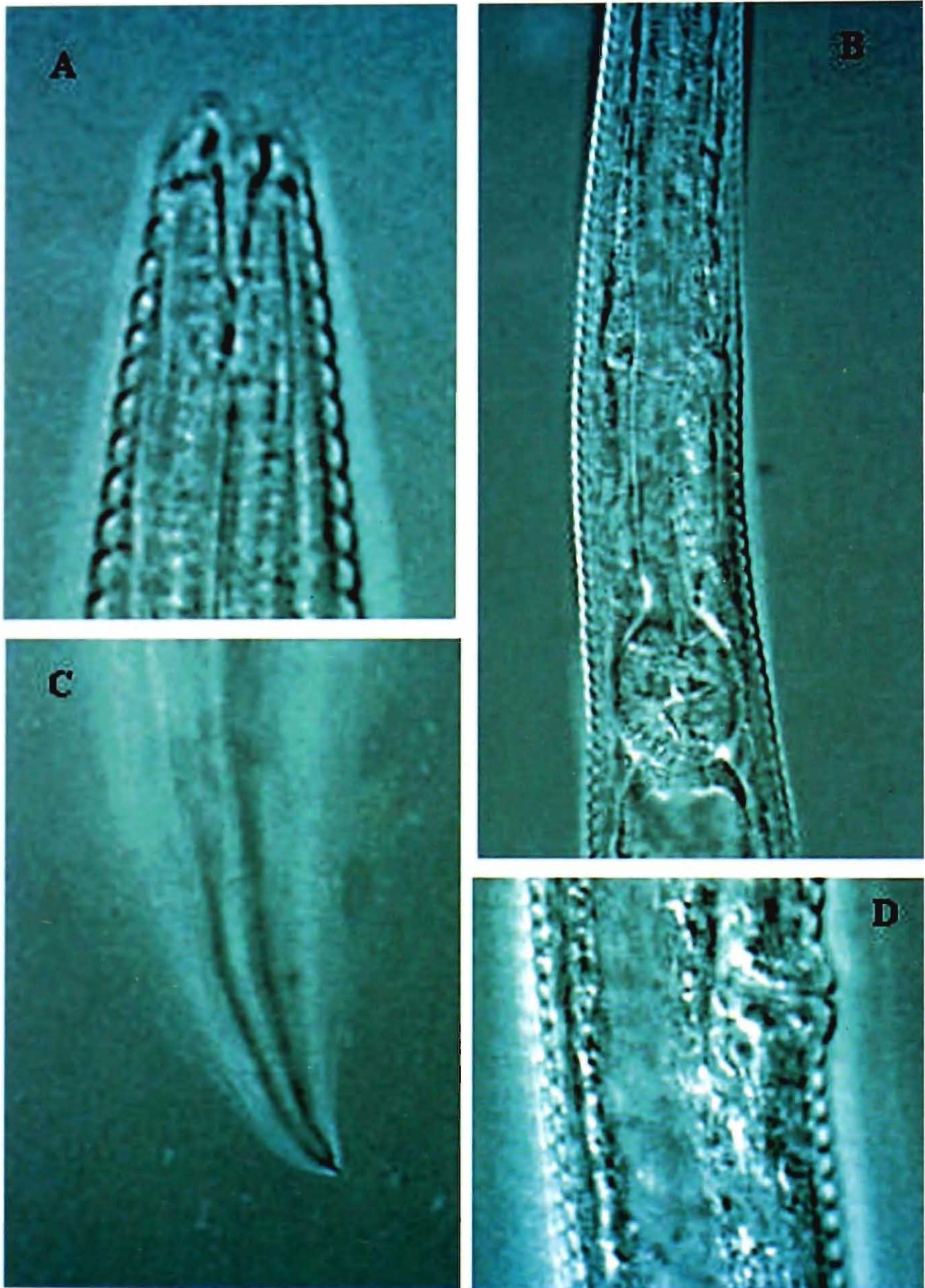
**Plate 18.** *Protorhabditis oxyuroides* (Female) **A.** Anterior end **B.** Pharynx **C.** Tail



**Plate 19.** *Protorhabditis oxyuroides* (Male) **A.** Anterior end **B.** Bursa **C & D.** Tail region



**Plate 20.** *Pseudacrobelus tabacum* (Female) **A.** Head region **B.** Pharynx **C.** Tail **D.** Vulva



**Plate 21.** *Pseudacrobelus multicinctus* (Female) **A.** Anterior end **B.** Pharynx **C.** Tail **D.** Vulva

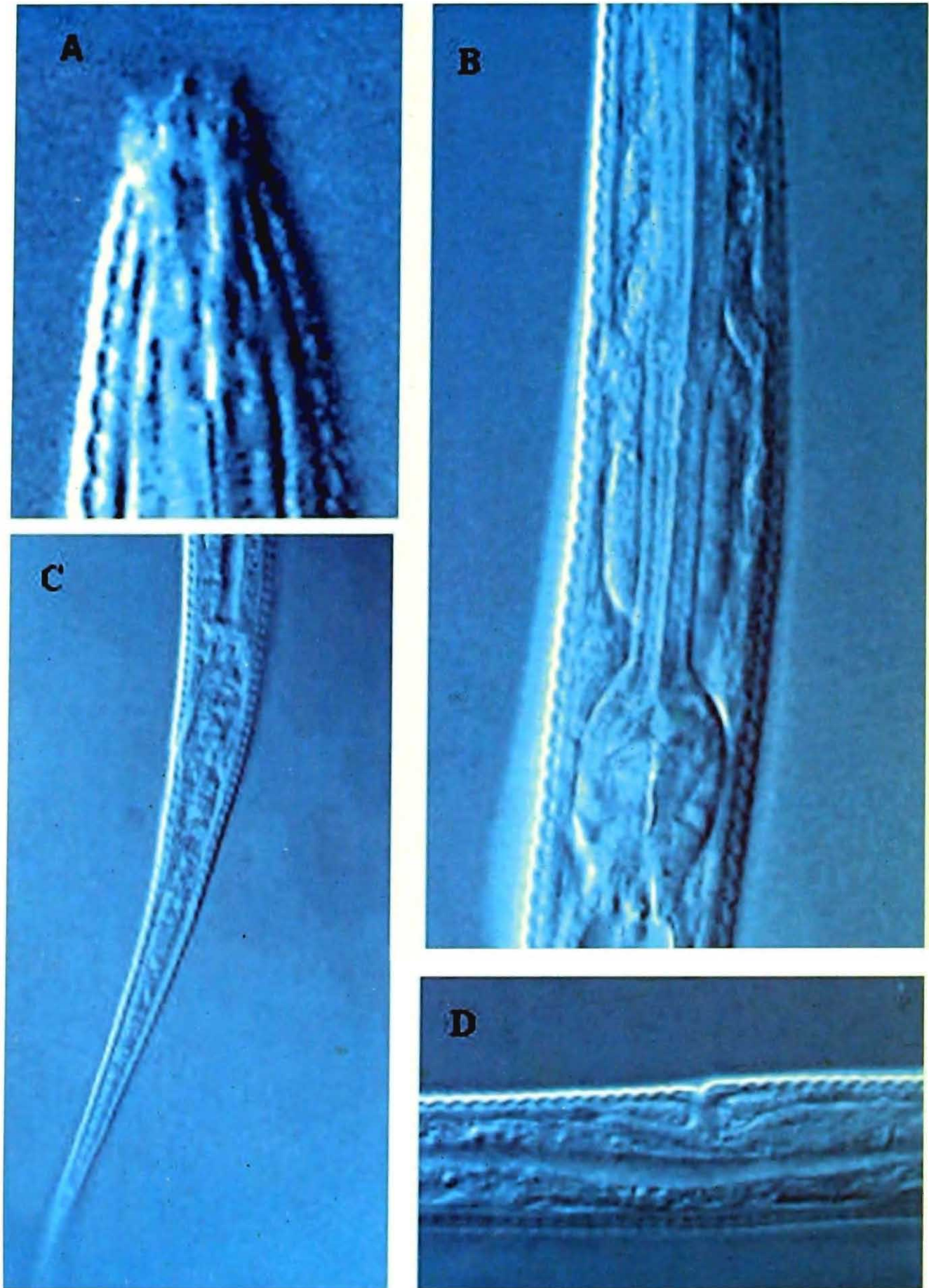
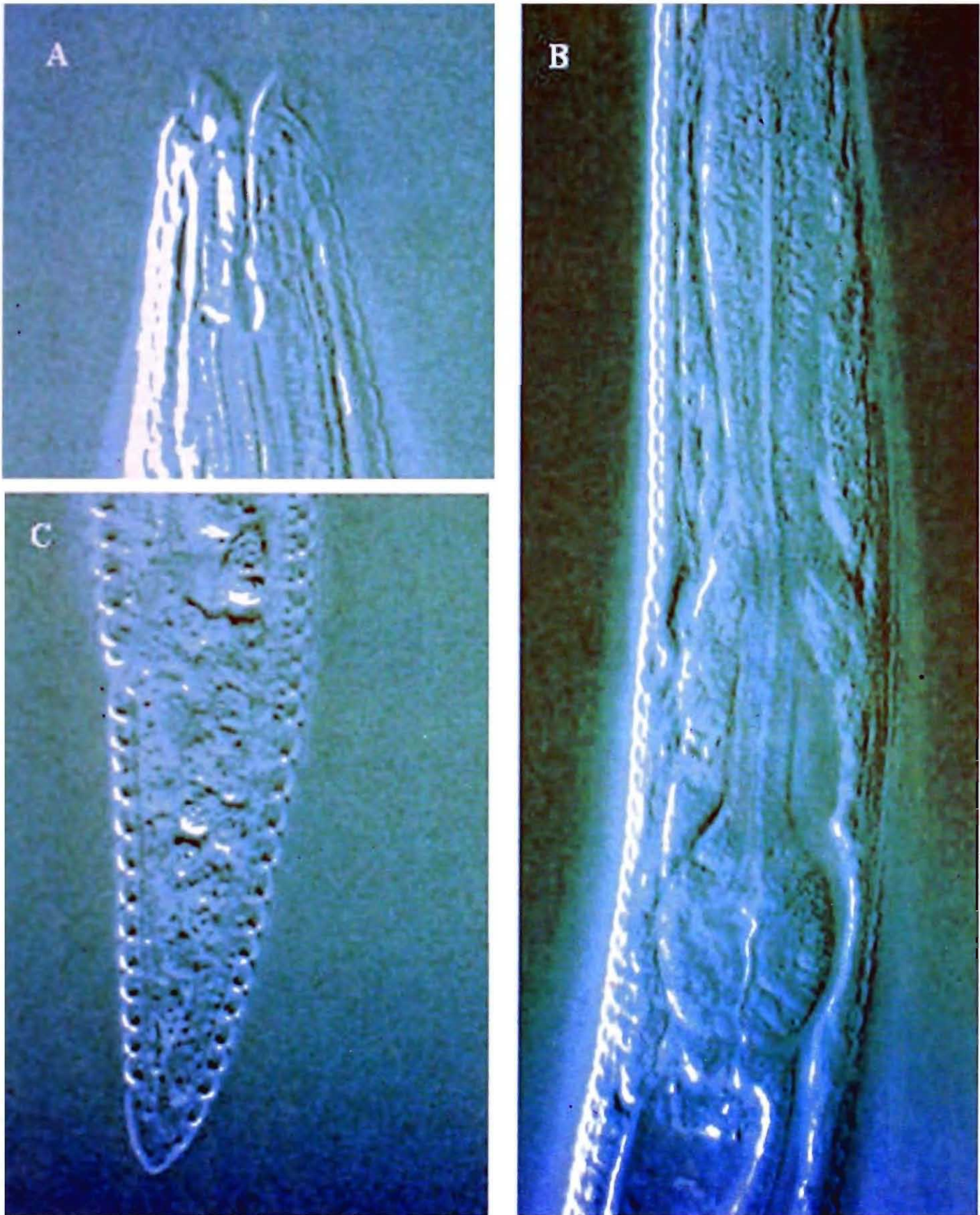
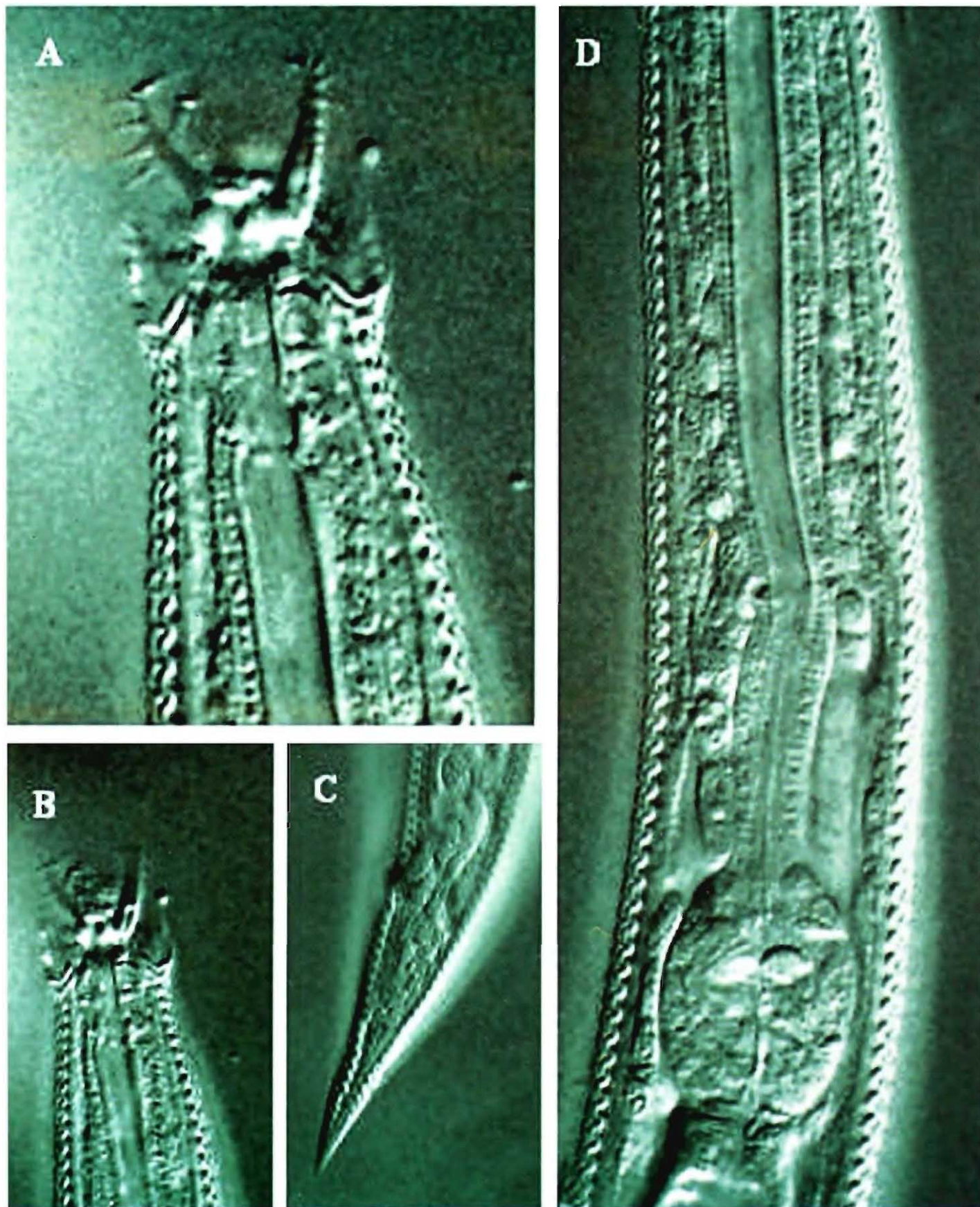


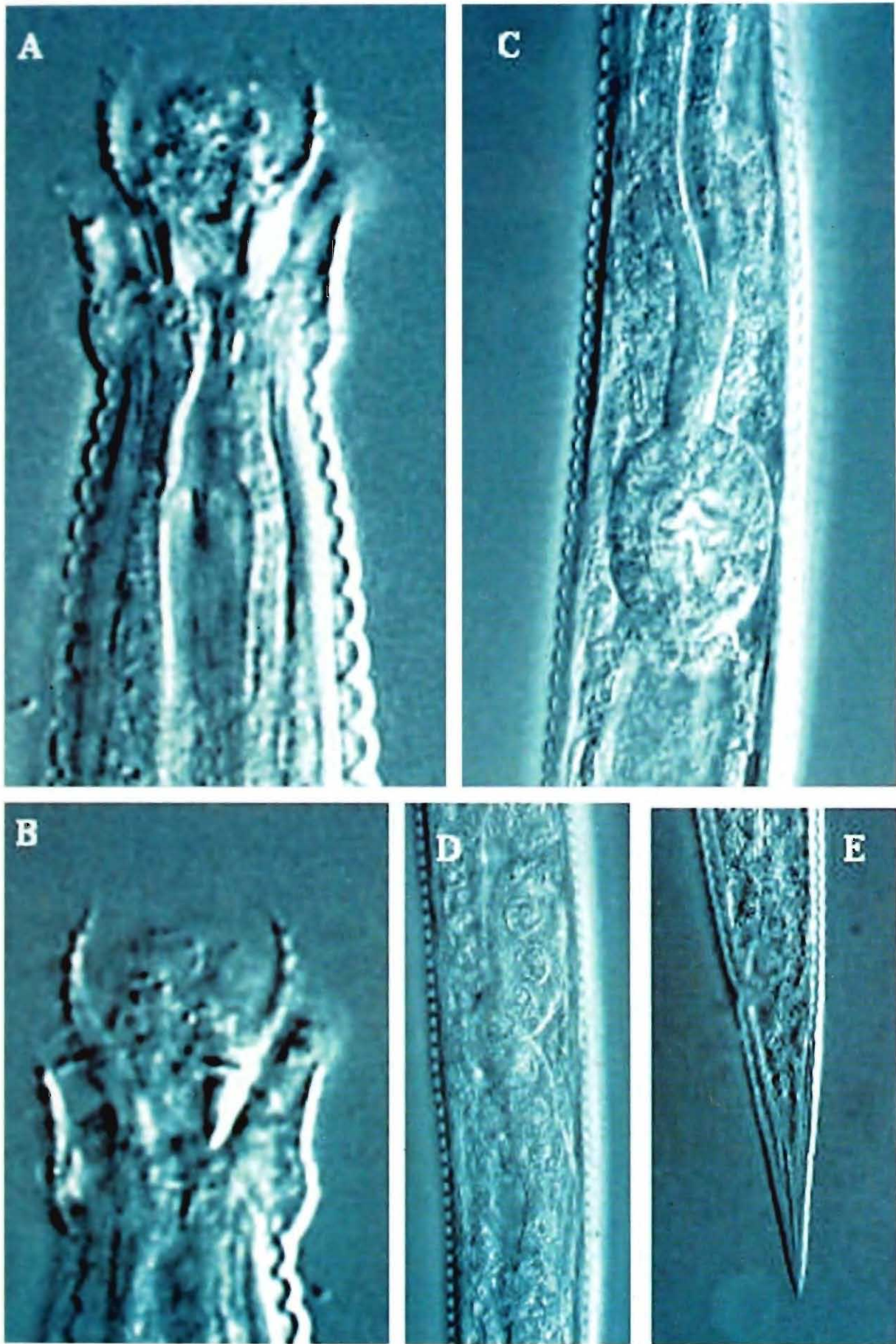
Plate 22. *Eucephalobus oxyuroides* (Female) A. Head region B. Pharynx C. Tail D. Vulva



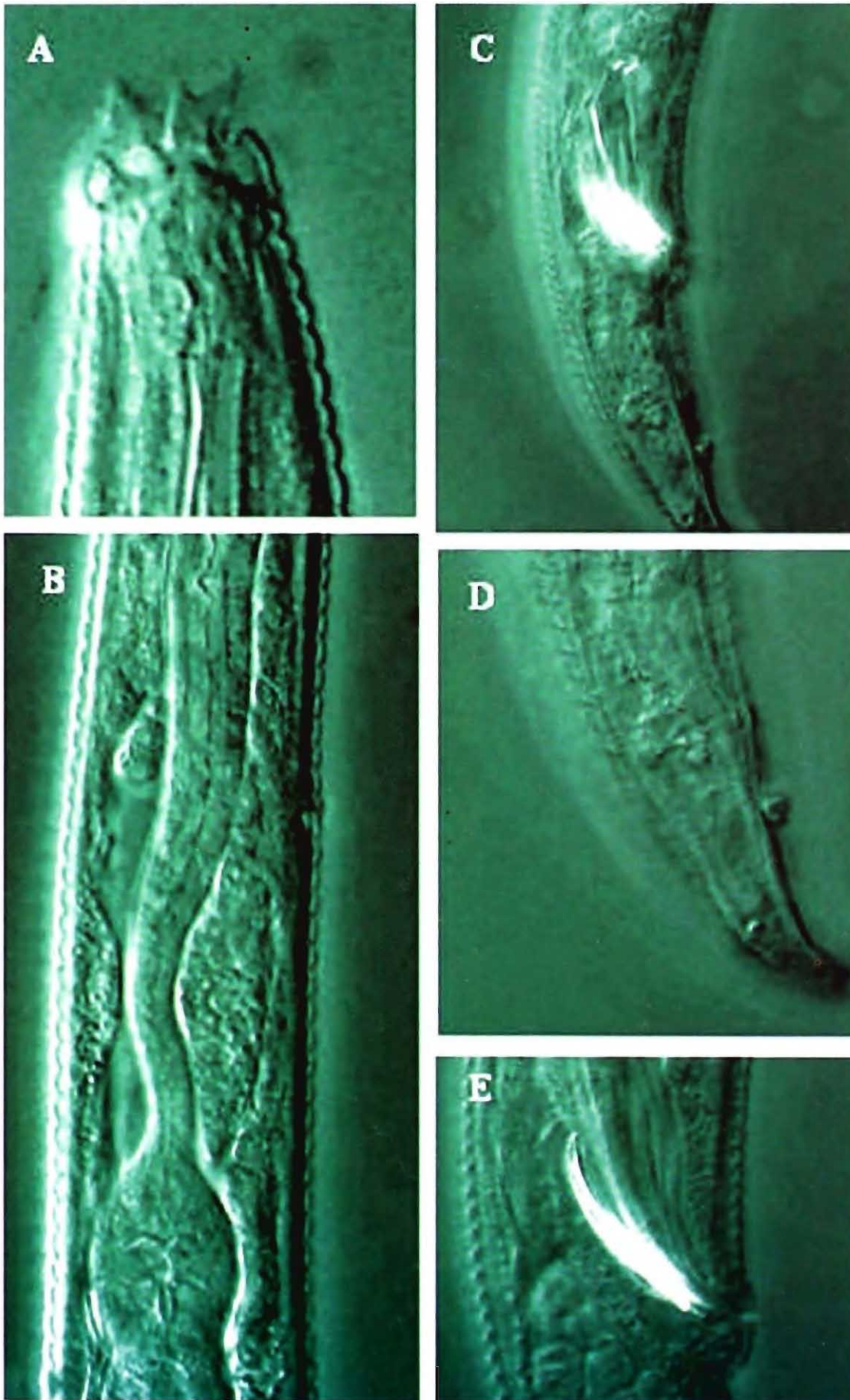
**Plate 23.** *Acrobleoides buetschlii* (Female) **A.** Head region **B.** Pharynx **C.** Tail



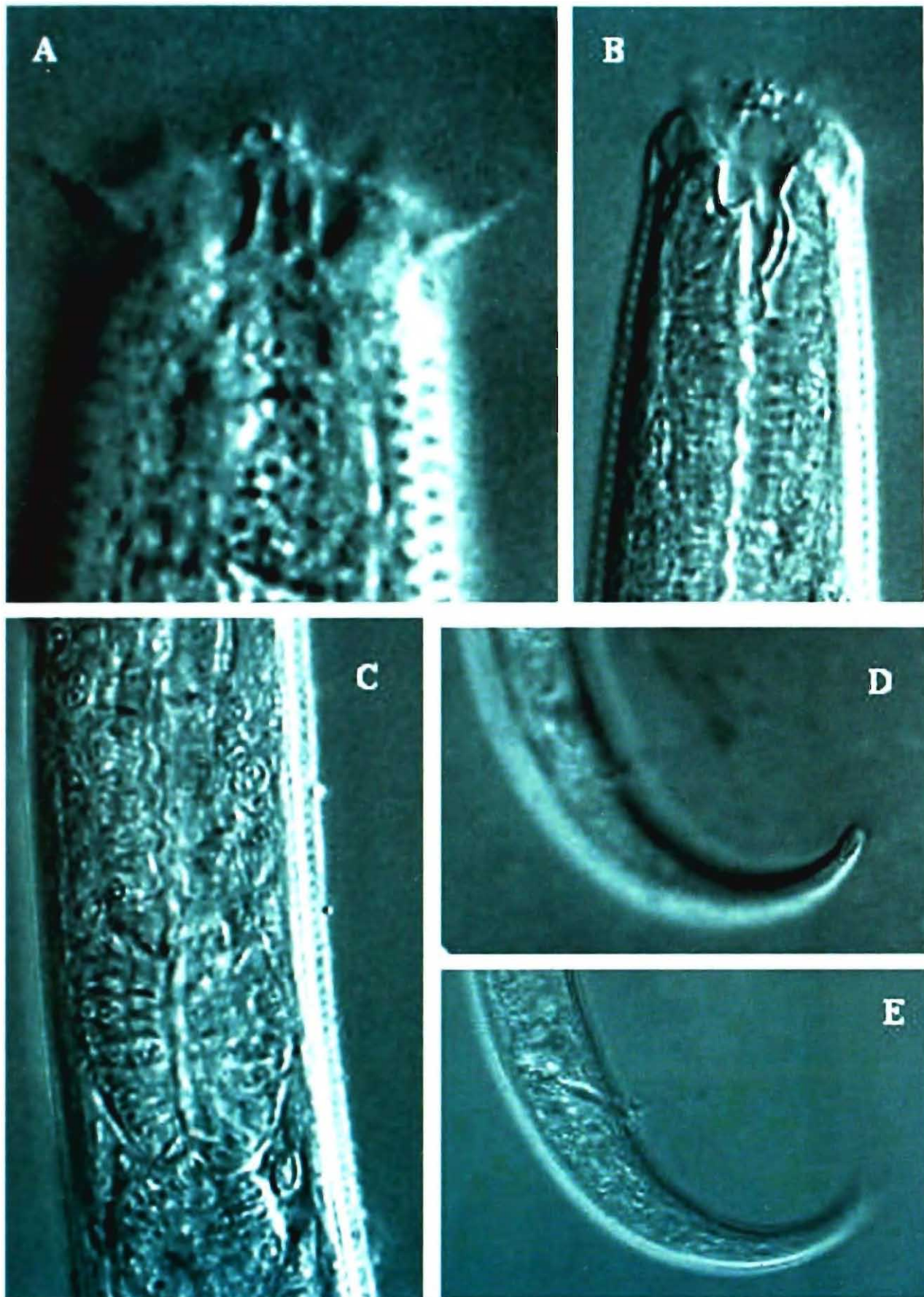
**Plate 24.** *Acrobelus timmi* (Female) A & B. Head region C. Tail D. Pharynx



**Plate 25.** *Acrobelus ciliatus* (Female) **A & B.** Head region **C.** Pharynx **D.** Vulva **E.** Tail



**Plate 26.** *Chiloplacus magnus* (Male) **A.** Head region **B.** Pharynx **C.** Spicules **D.** Caudal Papillae **E.** Gubernaculum



**Plate 27.** *Achromadora ruricola* (Female) **A.** Head region **B.** Stoma **C.** Pharynx **D & E** Tail

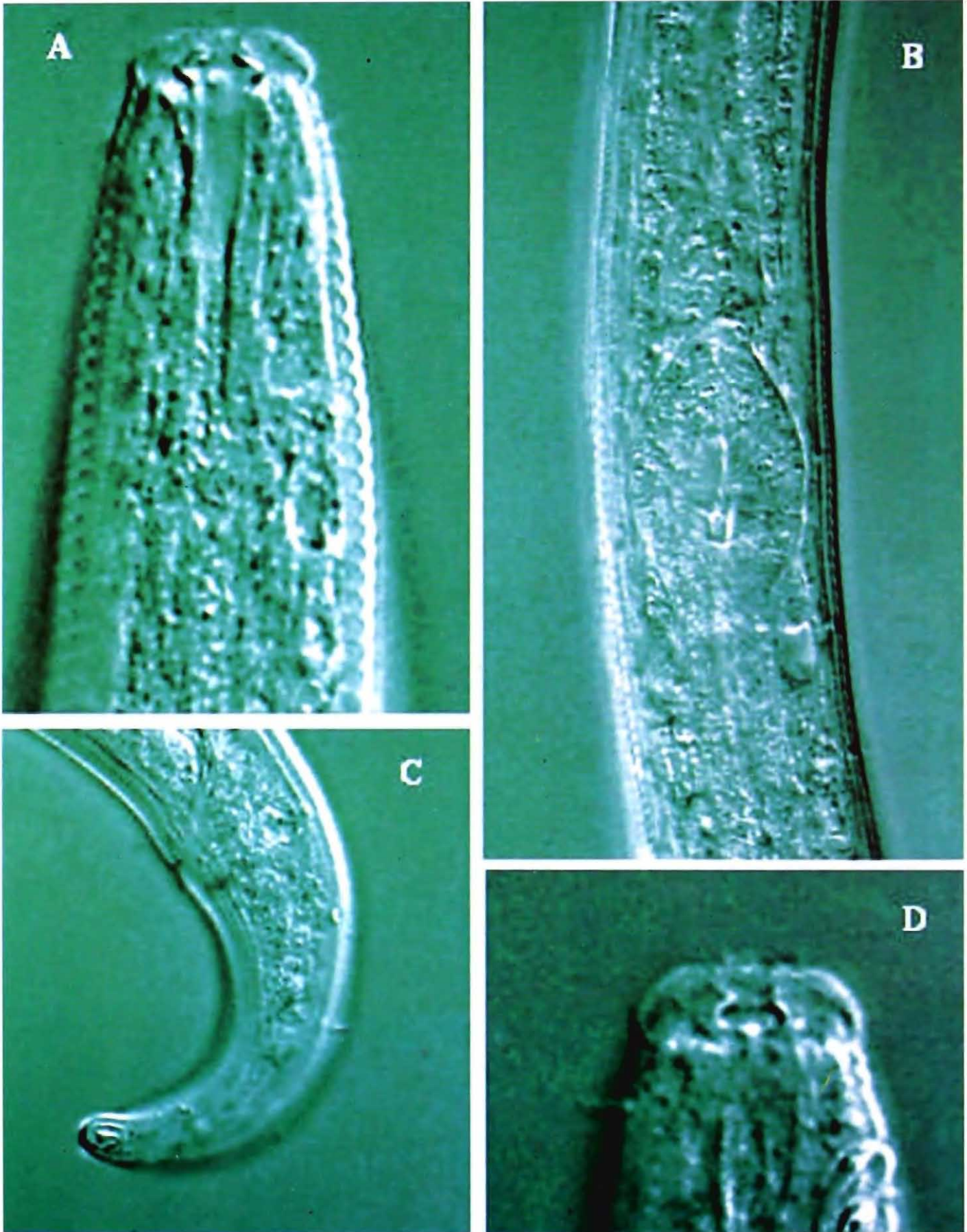
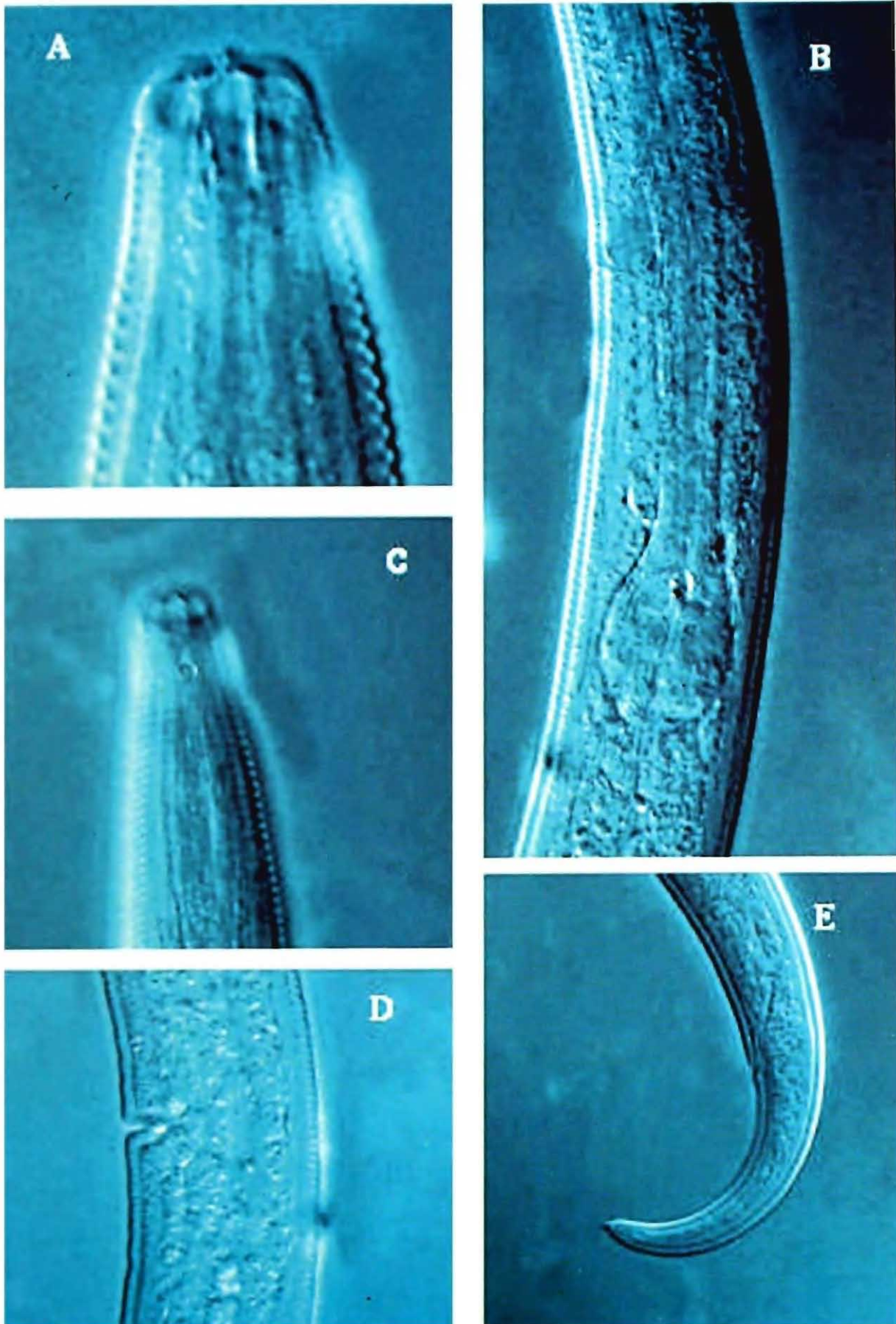
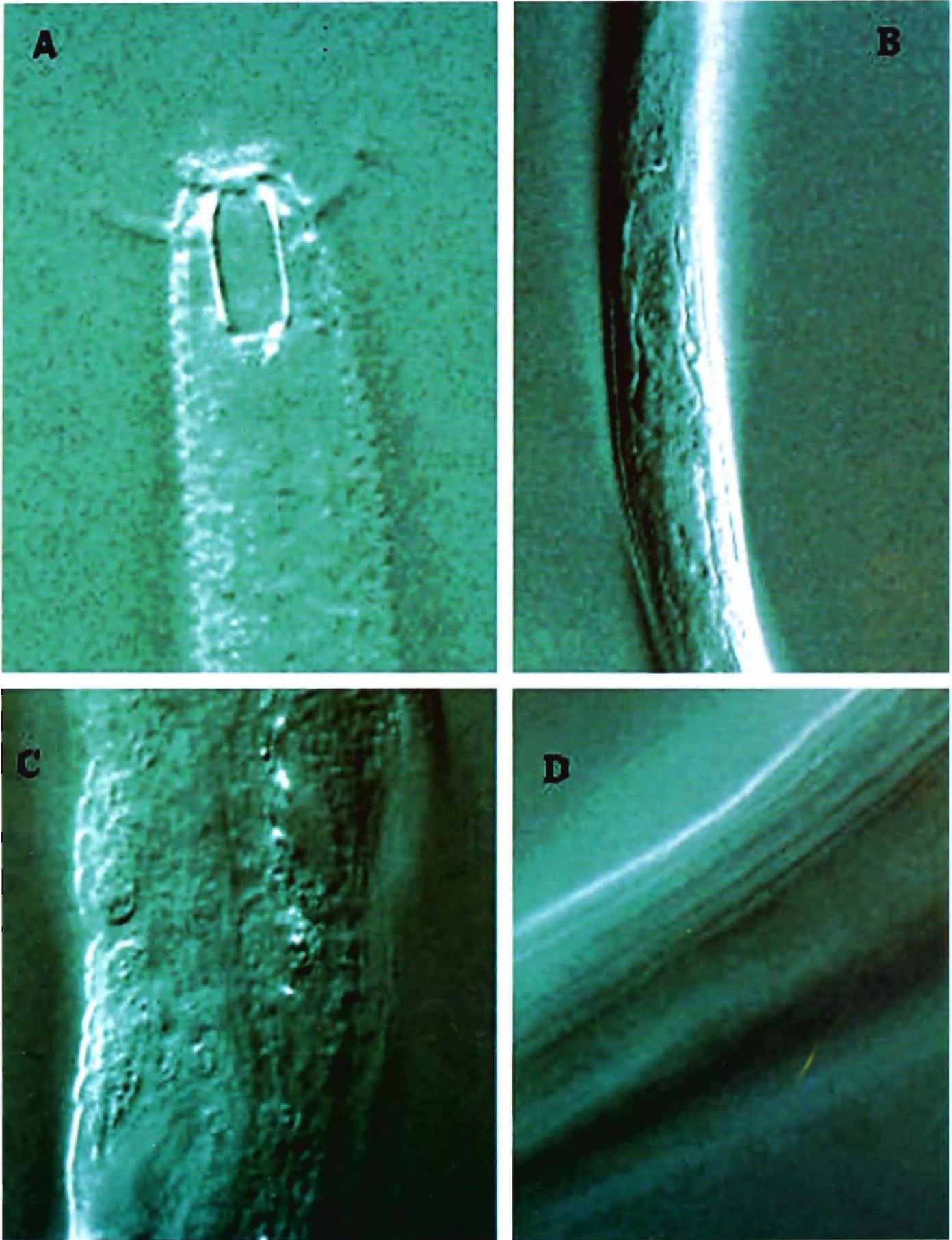


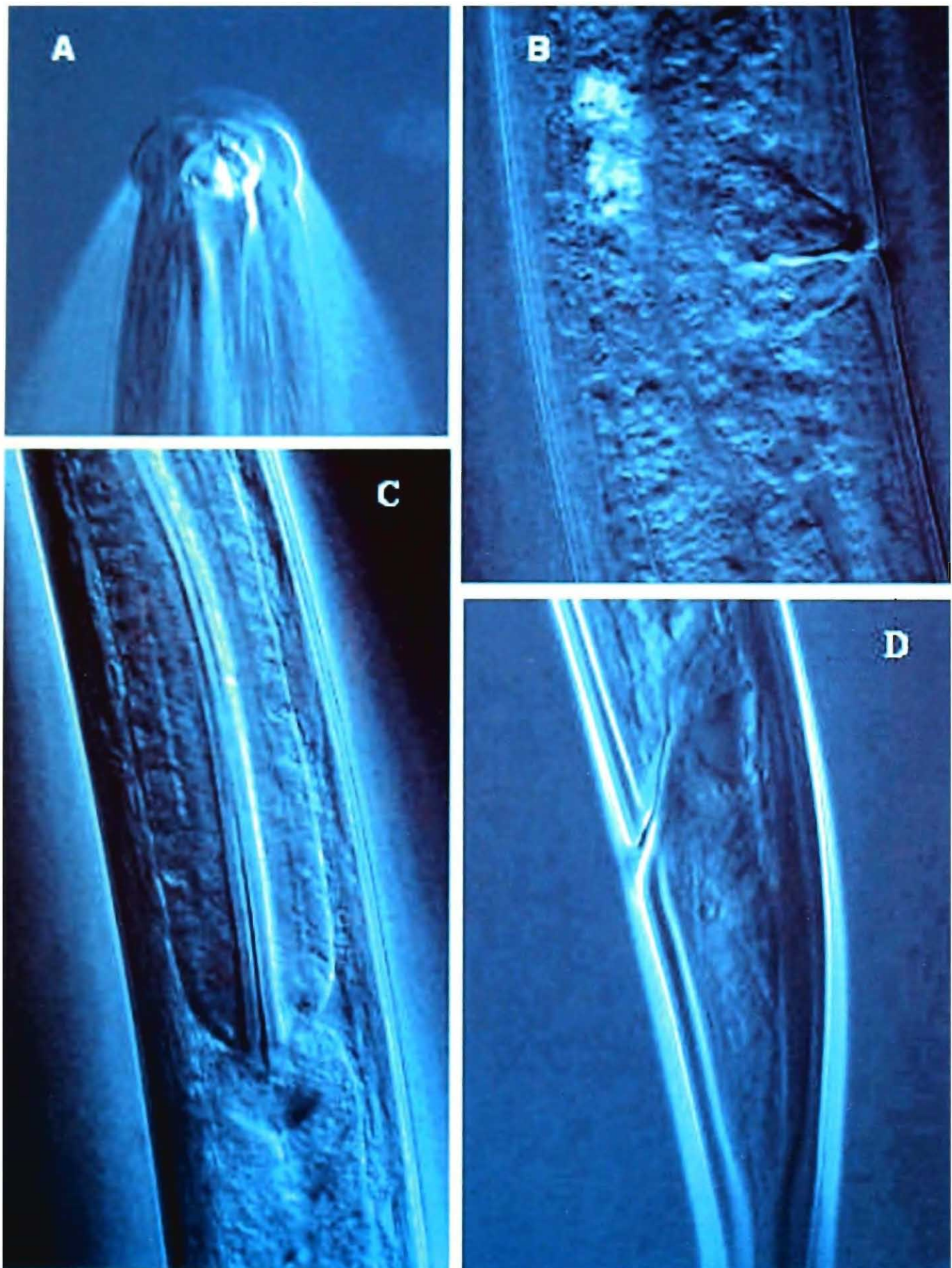
Plate 28. *Plectus thornei* (Female) A. Stoma B. Pharynx C. Tail D. Head end



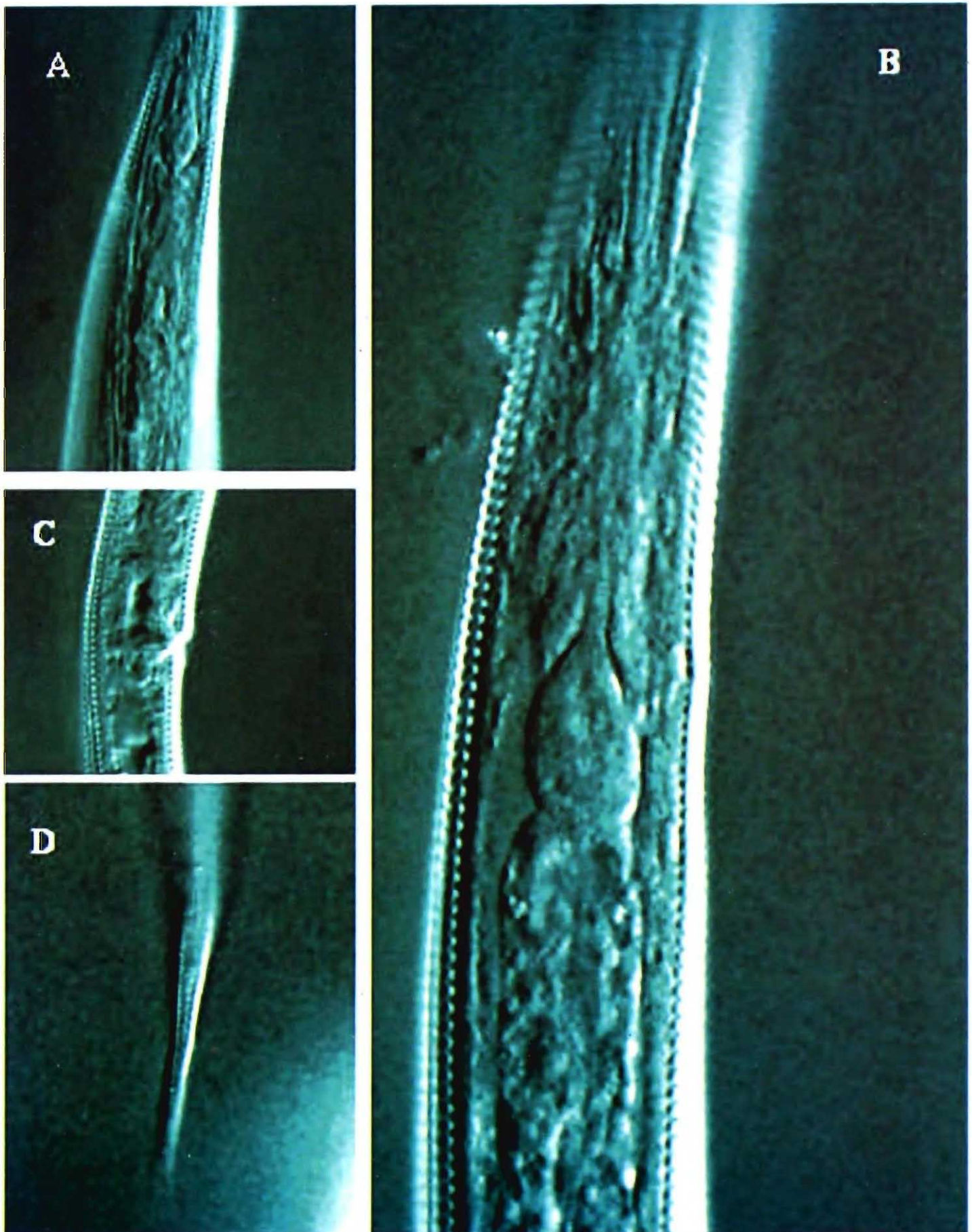
**Plate 29.** *Chiloplectus indicus* (Female) **A.** Head region **B.** Pharynx **C.** Amphid **D.** Vulva **E.** Tail



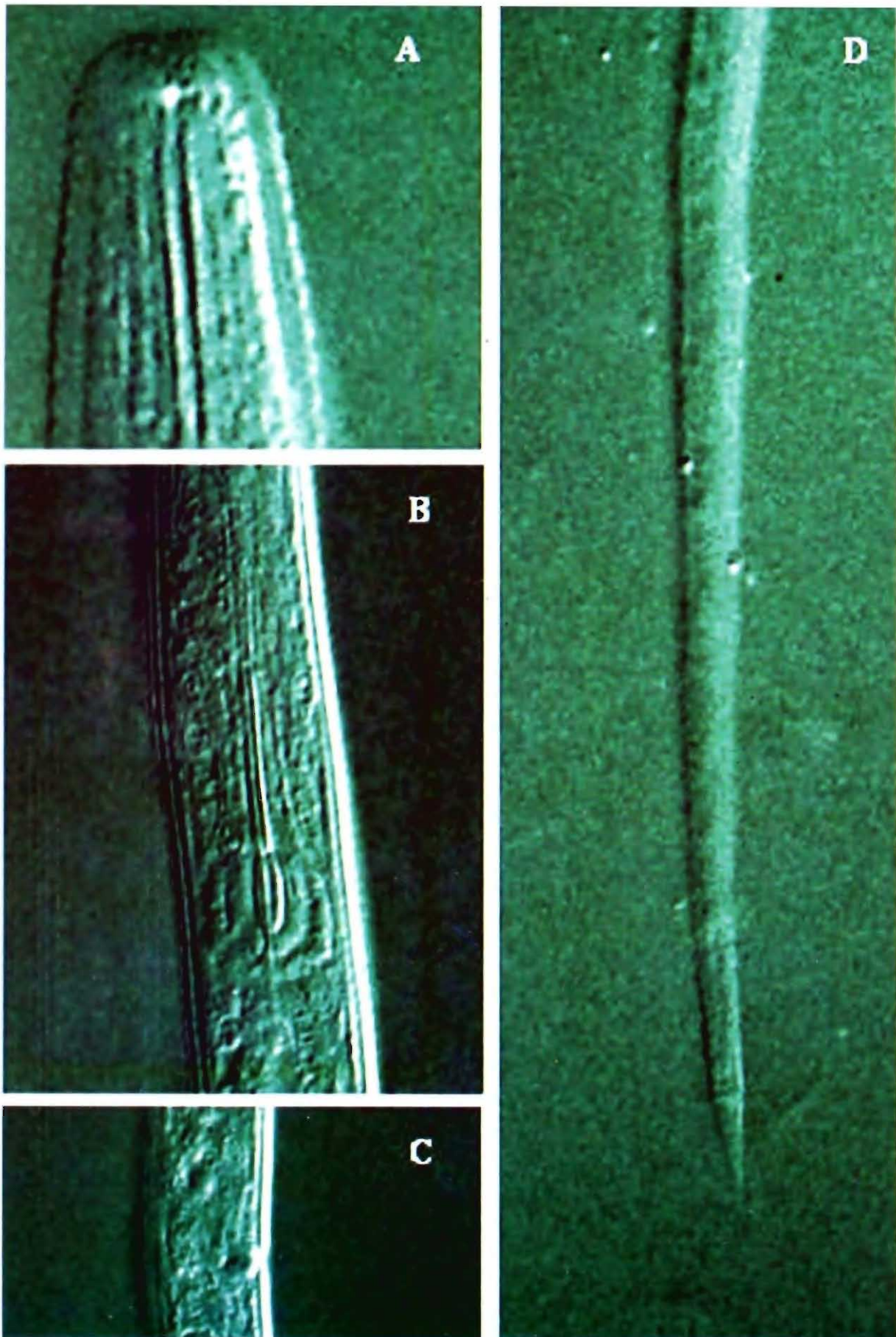
**Plate 30.** *Pristomatolaimus andrassyi* (Female) A. Stoma B. Pharynx C. Vulva D. Lateral Lines



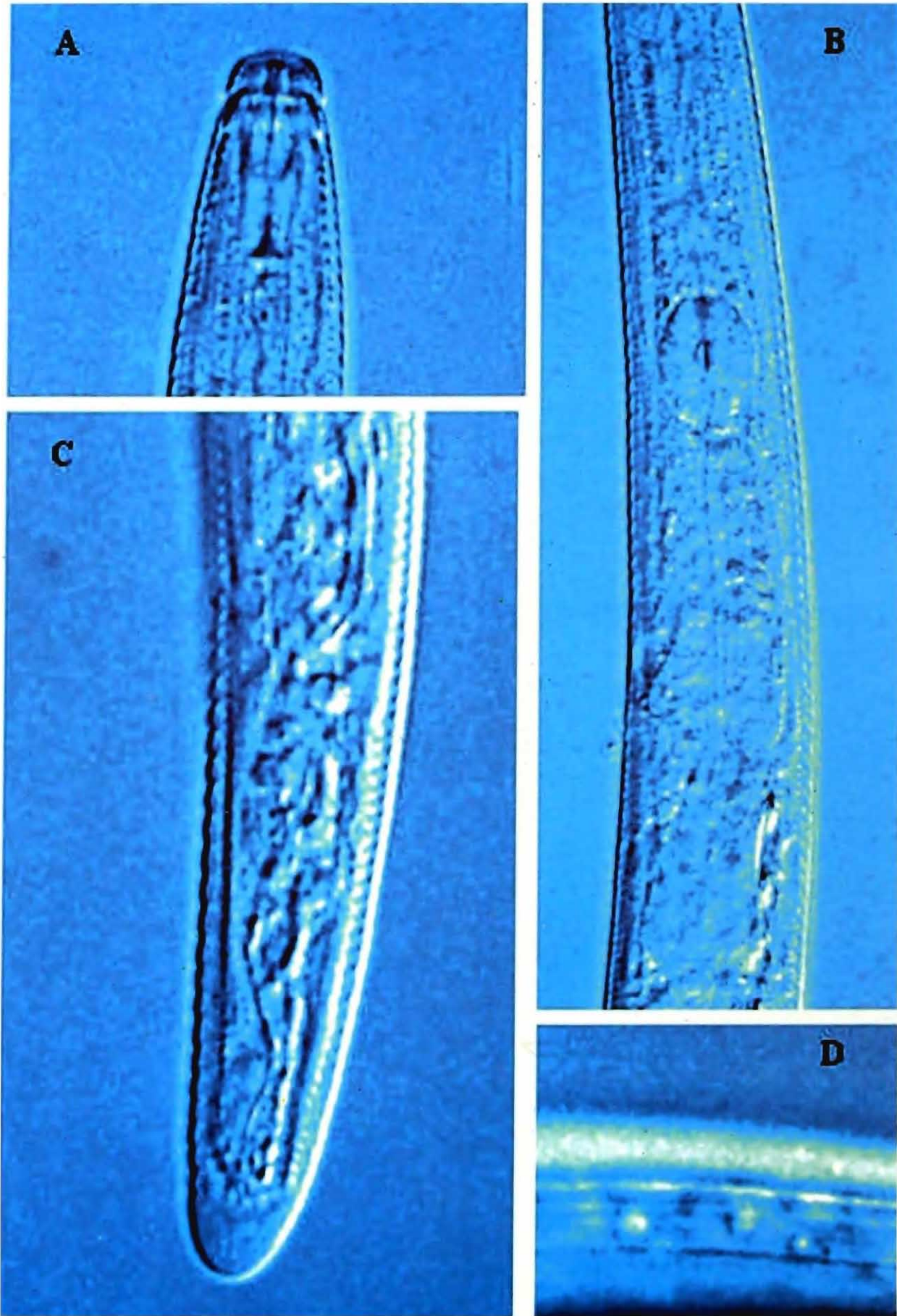
**Plate 31.** *Ironus longicaudatus* (Female) **A.** Head region **B.** Vulva **C.** Pharynx **D.** Tail region



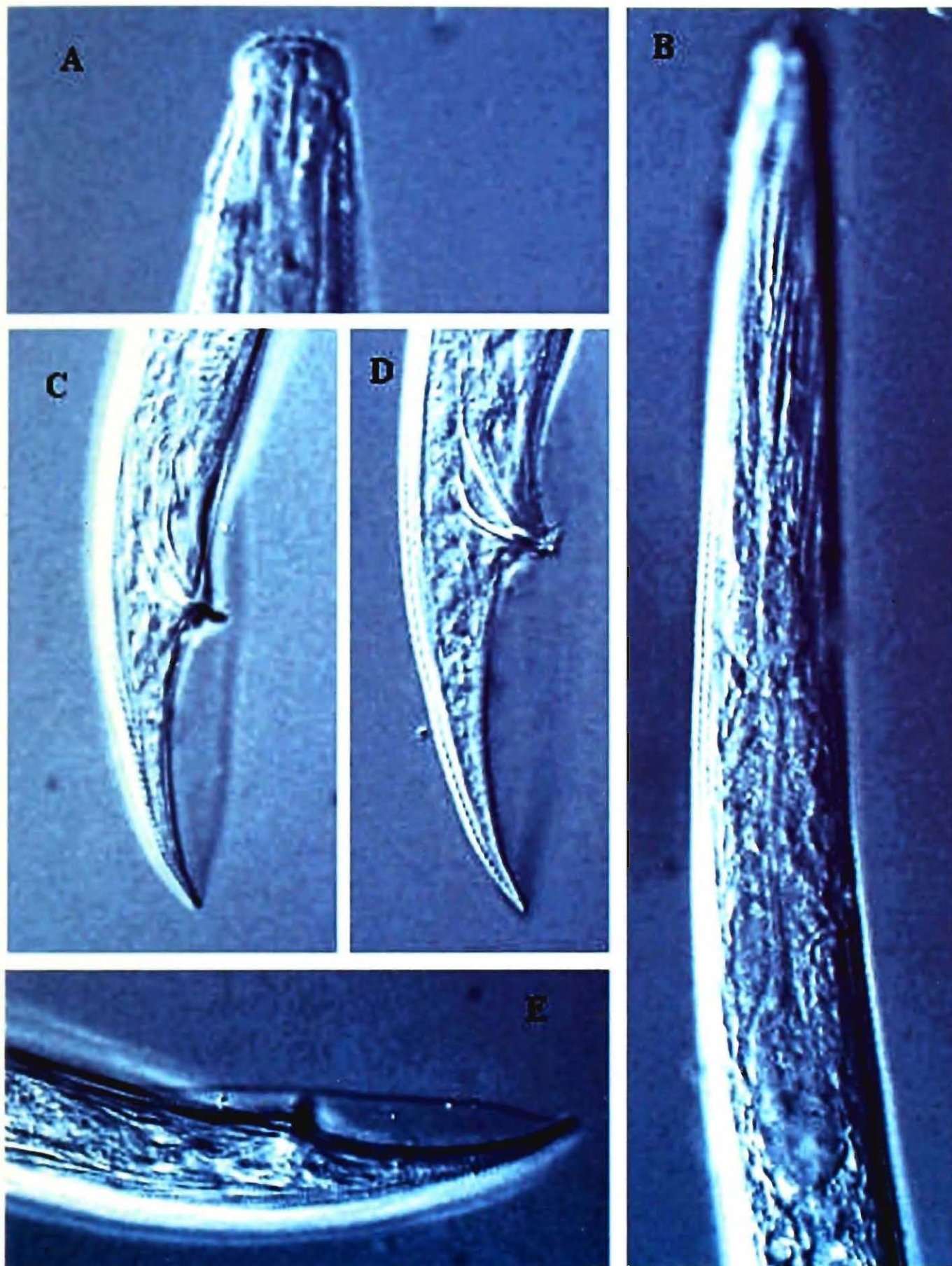
**Plate 32.** *Tylenchus filiformis* (Female) A & B. Pharynx C. Vulva D. Tail region



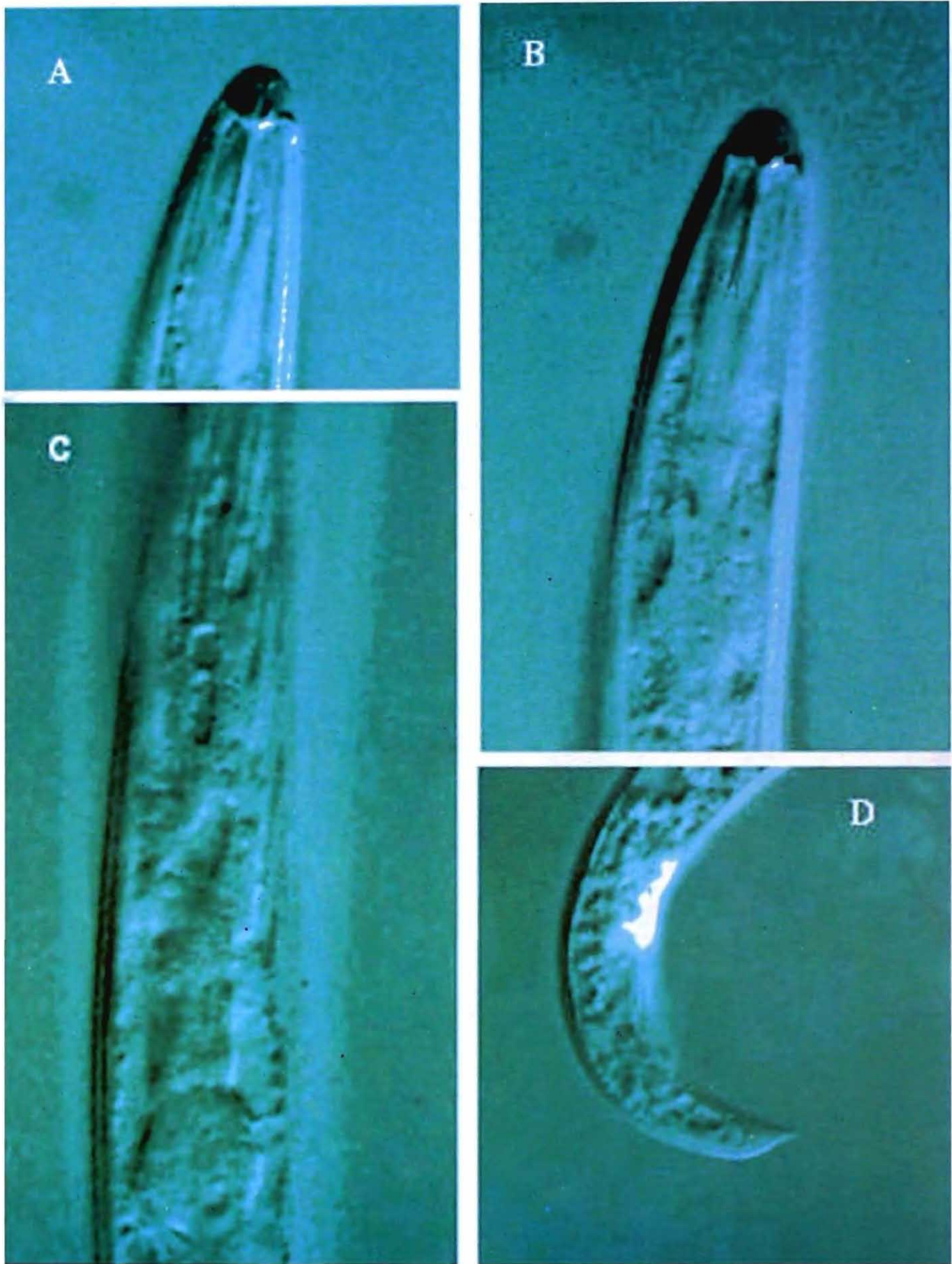
**Plate 33.** *Psilenchus minor* (Female) **A.** Head region **B.** Pharynx **C.** Vulva **D.** Tail



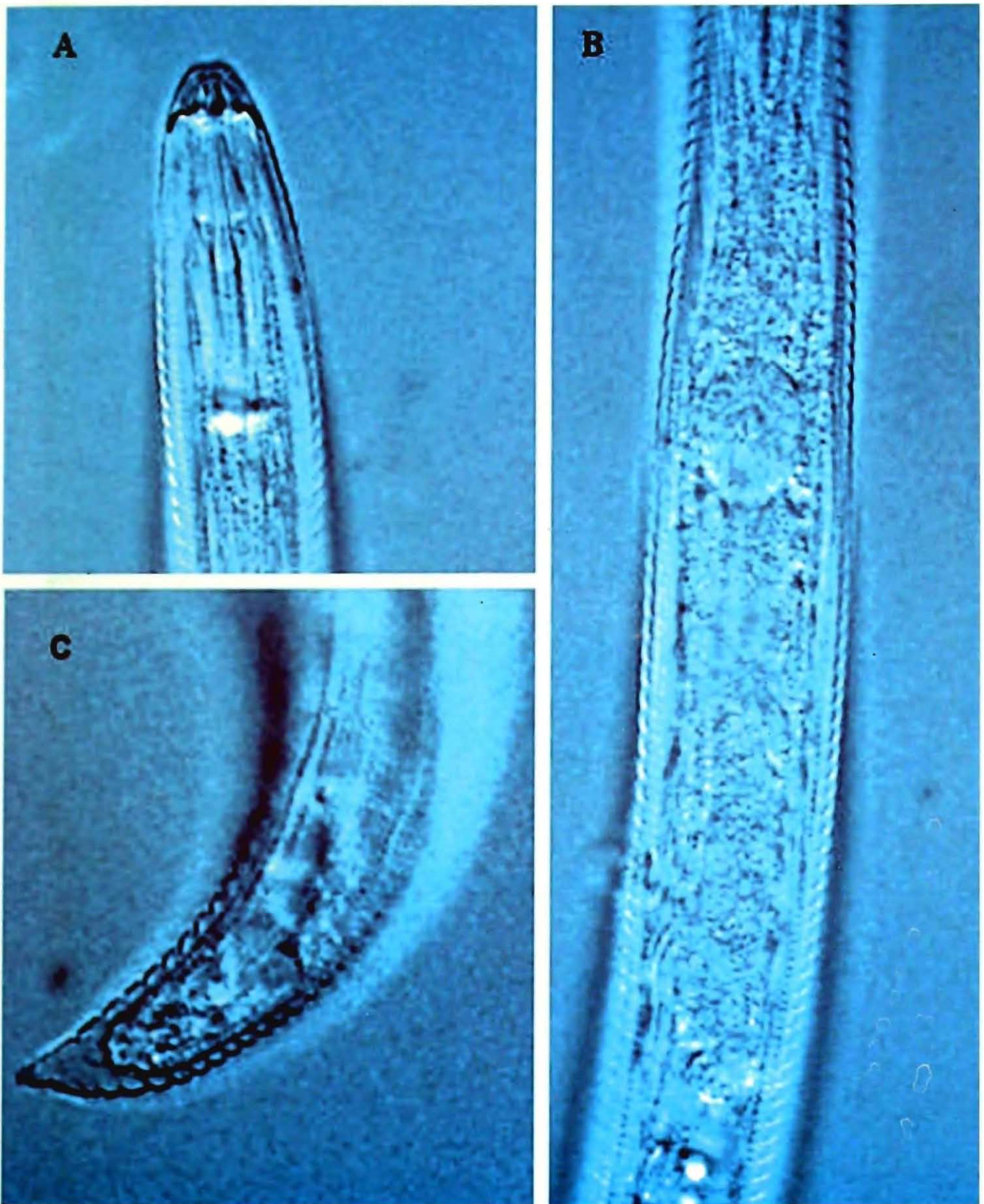
**Plate 34.** *Tylenchorhynchus mashoodi* (Female) A. Head region B. Pharynx C. Tail D. Lateral lines



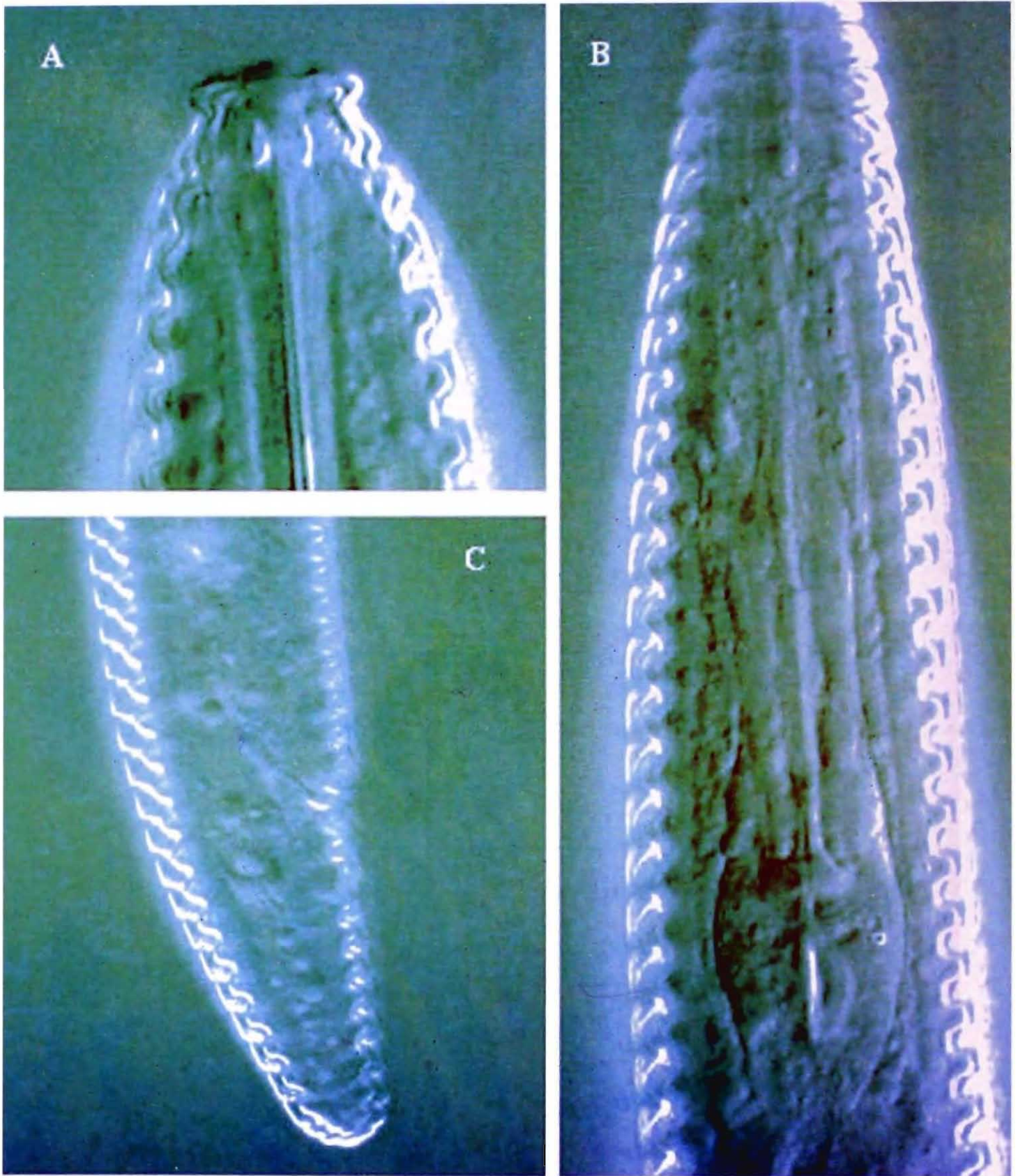
**Plate 35.** *Tylenchorhynchus mashoodi* (Male) **A.** Head region **B.** Pharynx **C & D.** Caudal regions **E.** Bursa



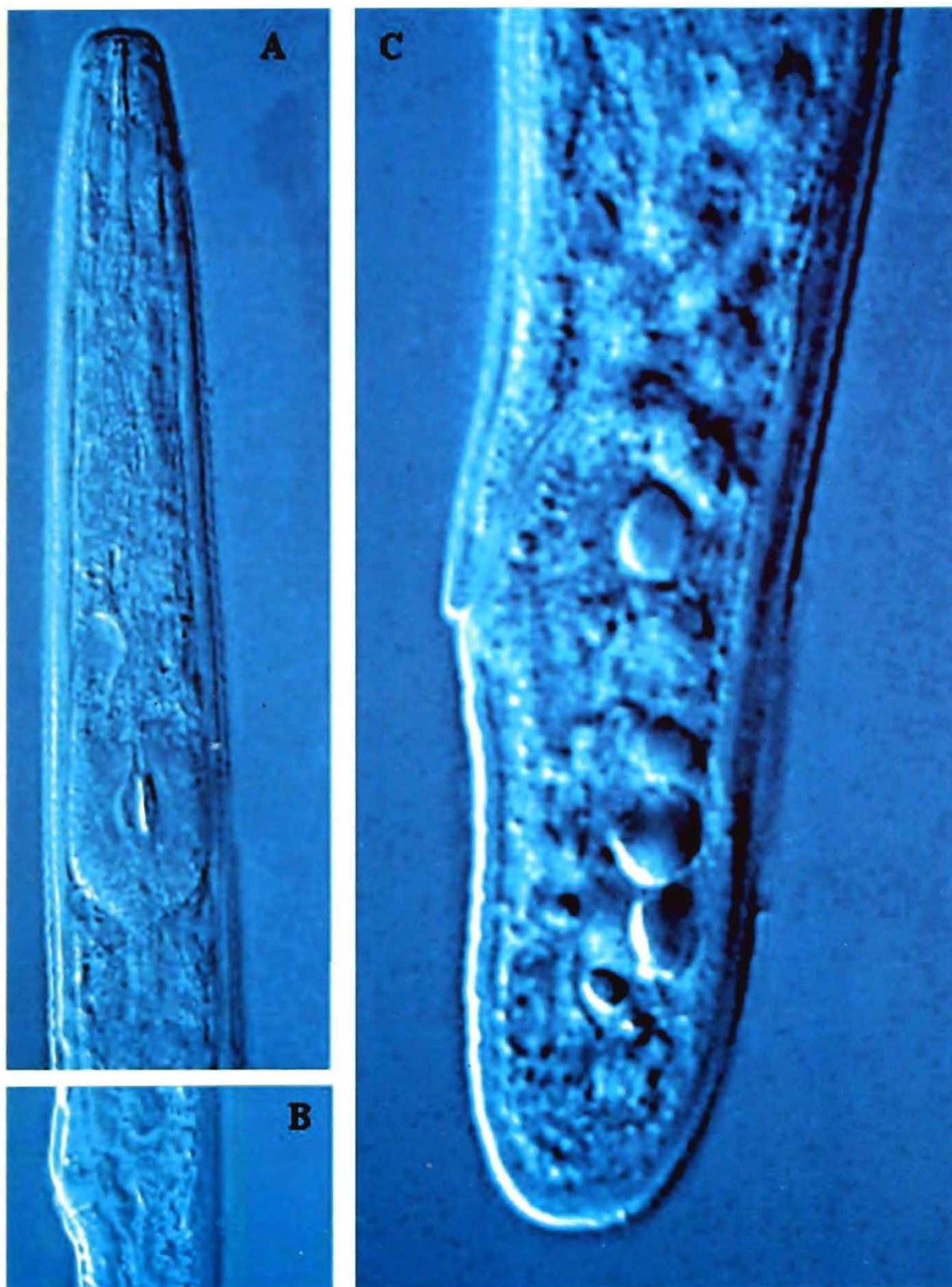
**Plate 36.** *Helicotylenchus dihystra* (Female) **A & B.** Anterior end **C.** Pharynx **D.** Tail



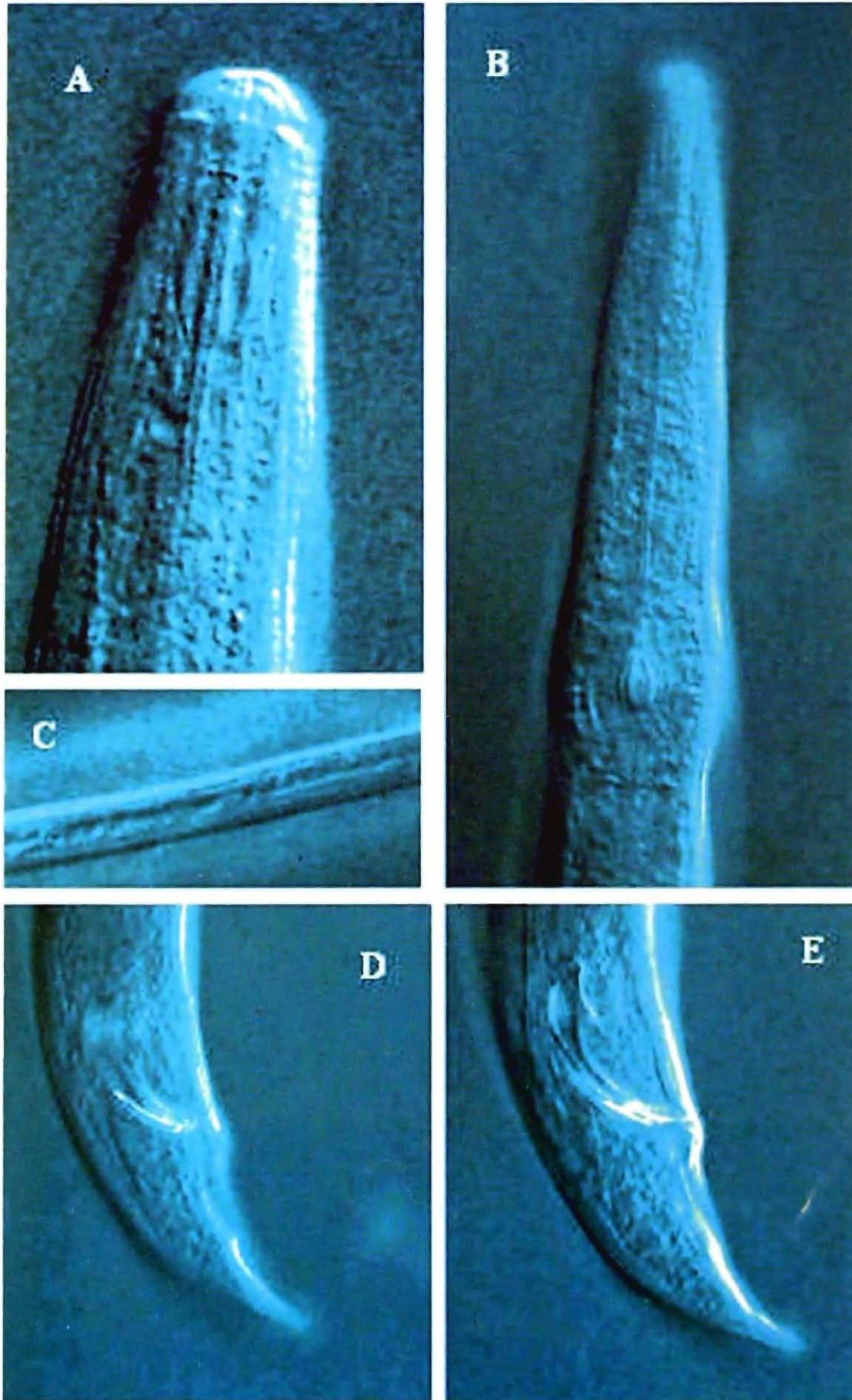
**Plate 37.** *Pratylenchus neglectus* (Female) **A.** Head region **B.** Pharynx **C.** Tail



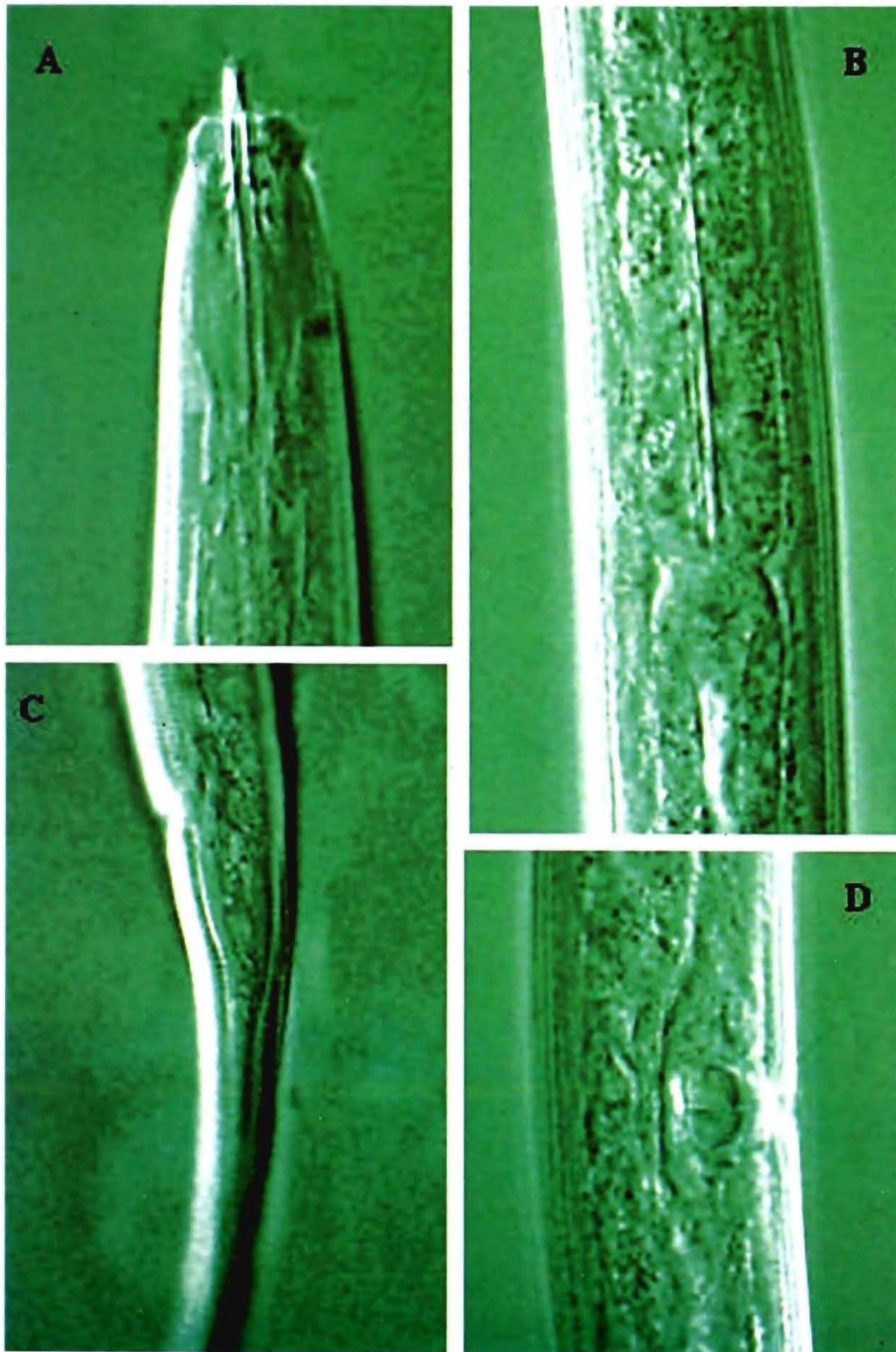
**Plate 38.** *Hemicriconemoides mangifera* (Female) **A.** Head region **B.** Pharynx **C.** Tail



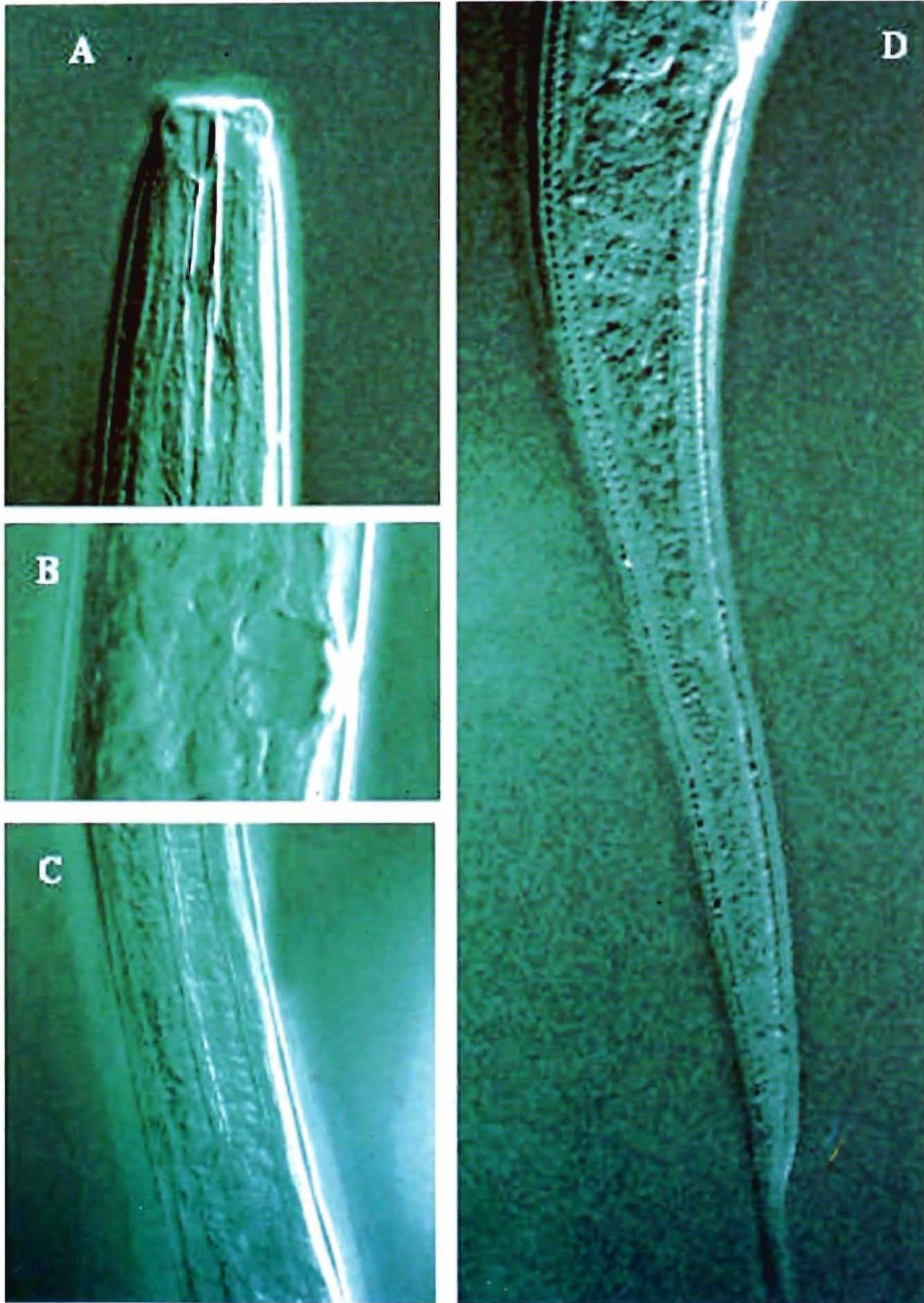
**Plate 39.** *Aphelenchus avenae* (Female) A. Pharynx B. Vulva C. Tail region



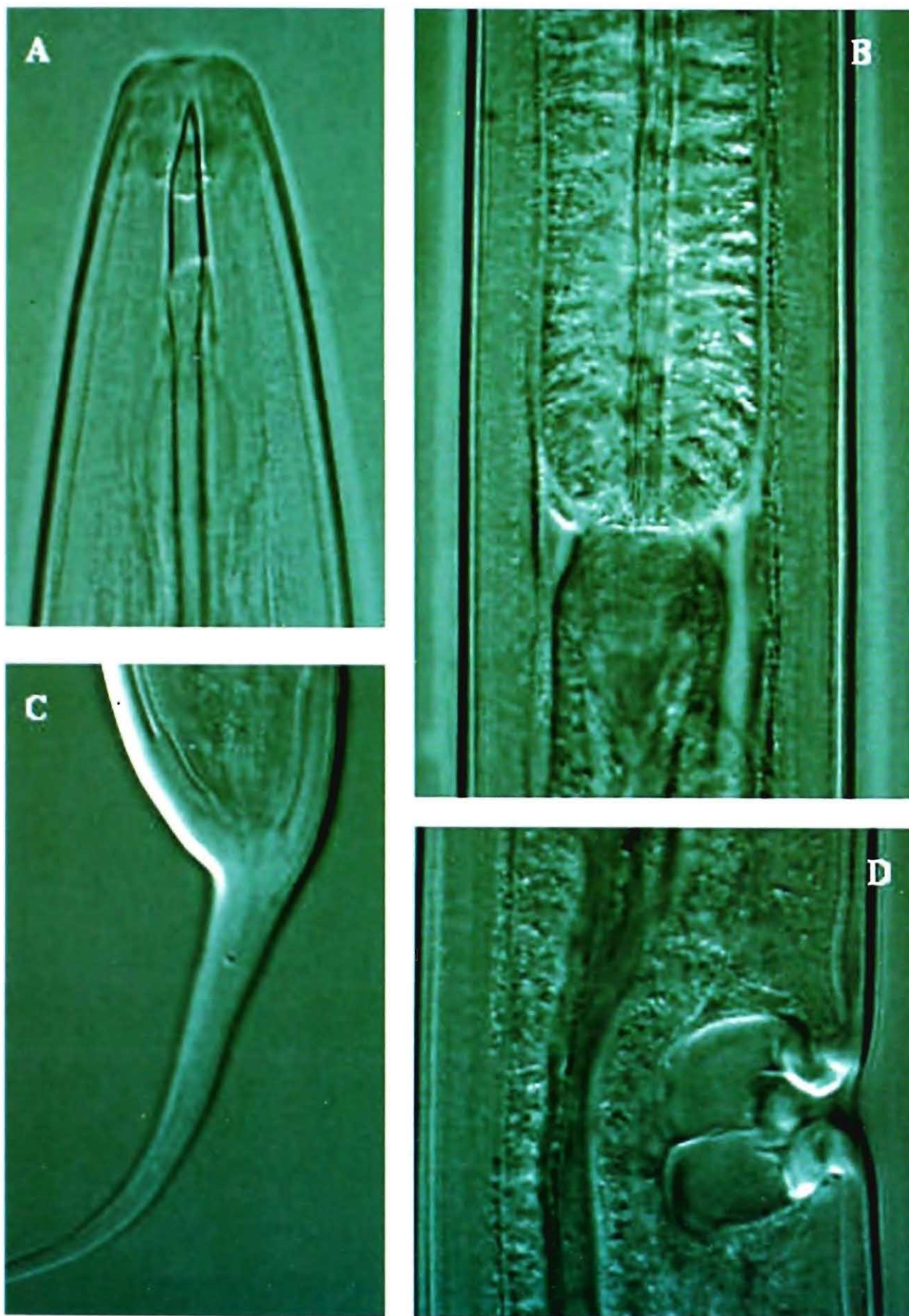
**Plate 40.** *Aphelenchus avenae* (Male) **A.** Head region **B.** Pharynx **C.** Lateral lines **D & E.** Caudal region



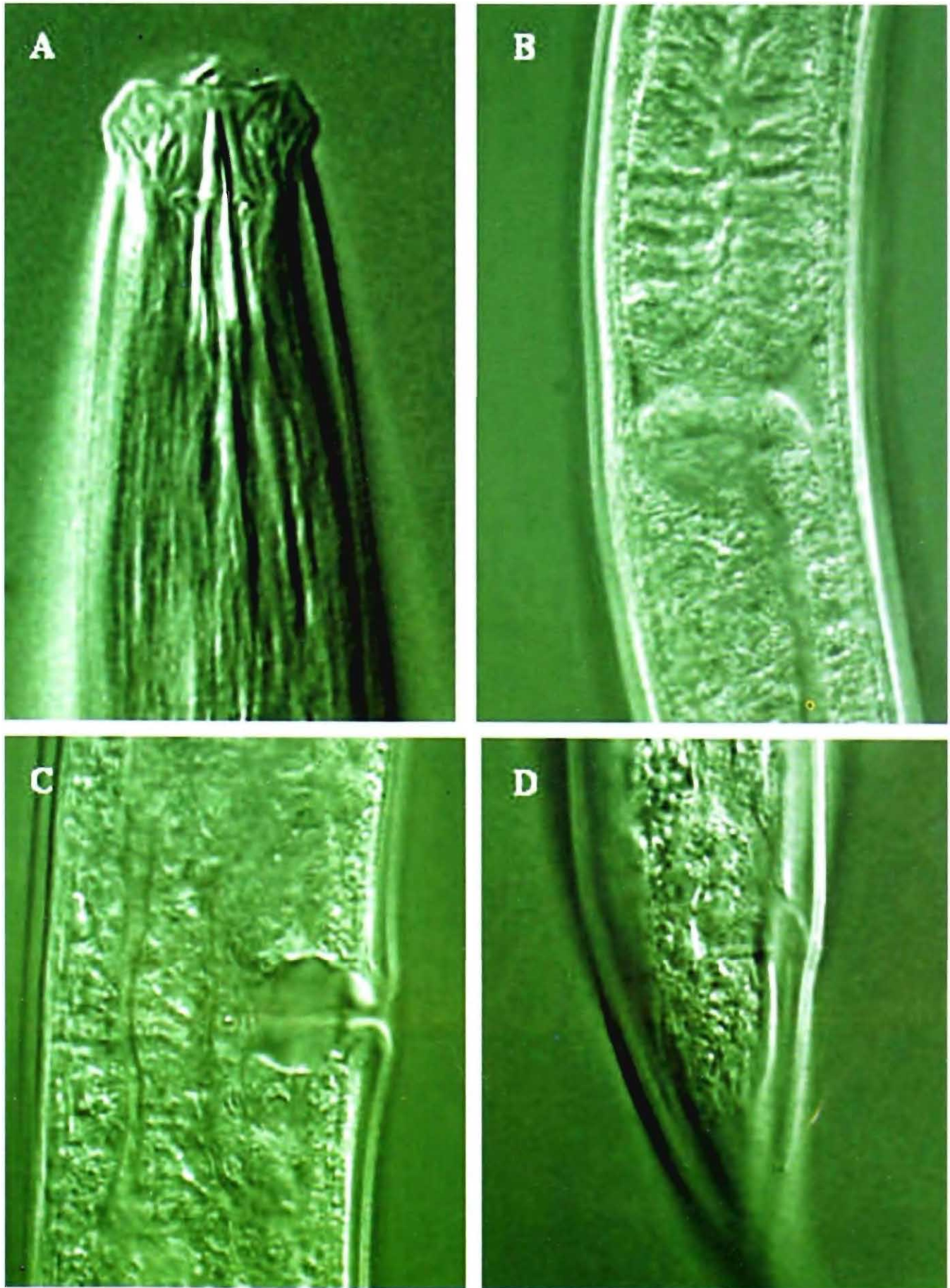
**Plate 41.** *Amphidorylaimus infecundus* (Female) **A.** Head region **B.** Pharynx **C.** Tail **D.** Vulva



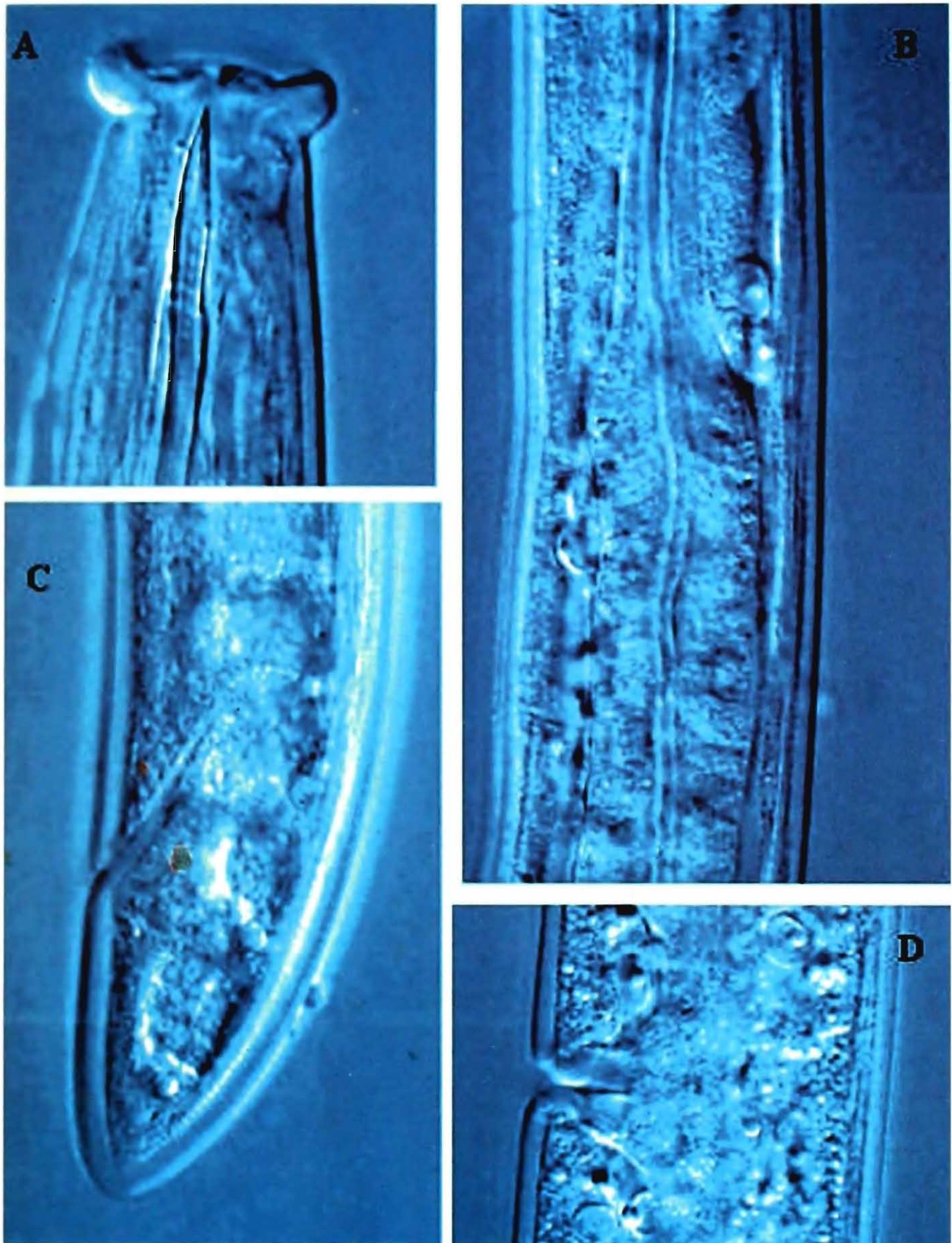
**Plate 42.** *Mesodorylaimus chamoliensis* (Female) **A.** Head region **B.** Vulva **C.** Pharynx **D.** Tail



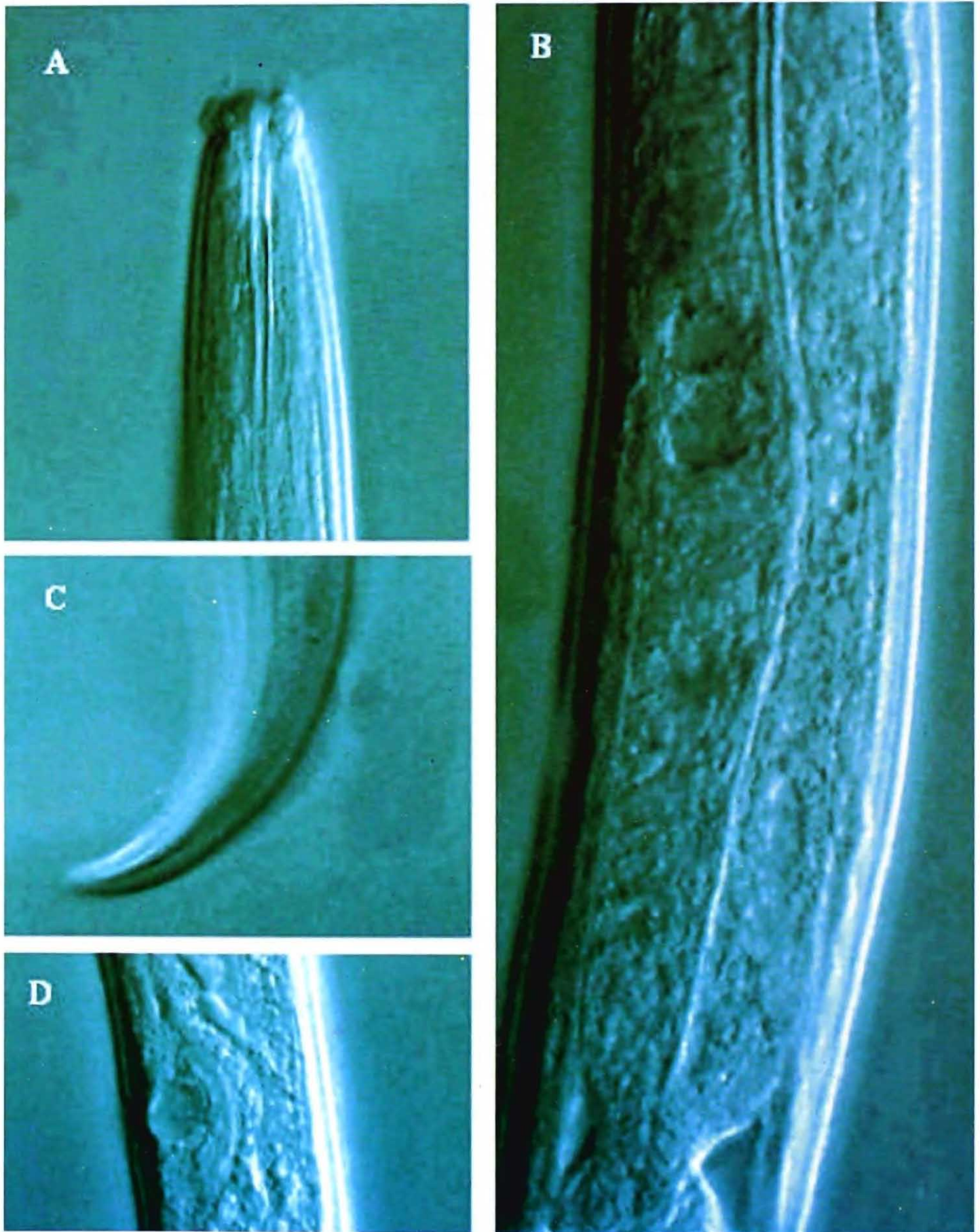
**Plate 43.** *Opisthodorylaimus caudatus* (Female) **A.** Head region **B.** Pharynx **C.** Tail **D.** Vulva



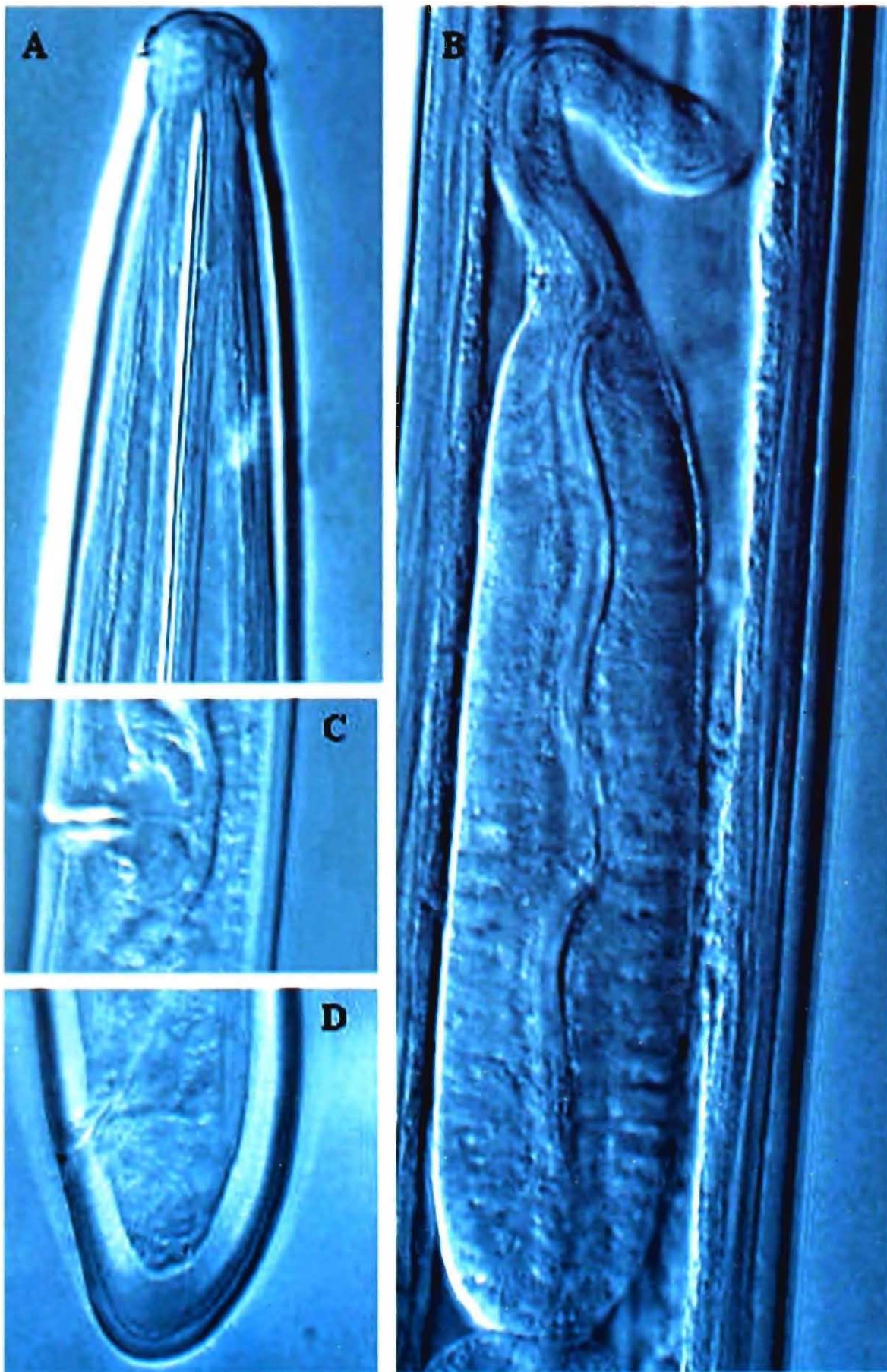
**Plate 44.** *Eudorylaimus himalus* (Female) **A.** Head region **B.** Pharynx **C.** Vulva **D.** Tail



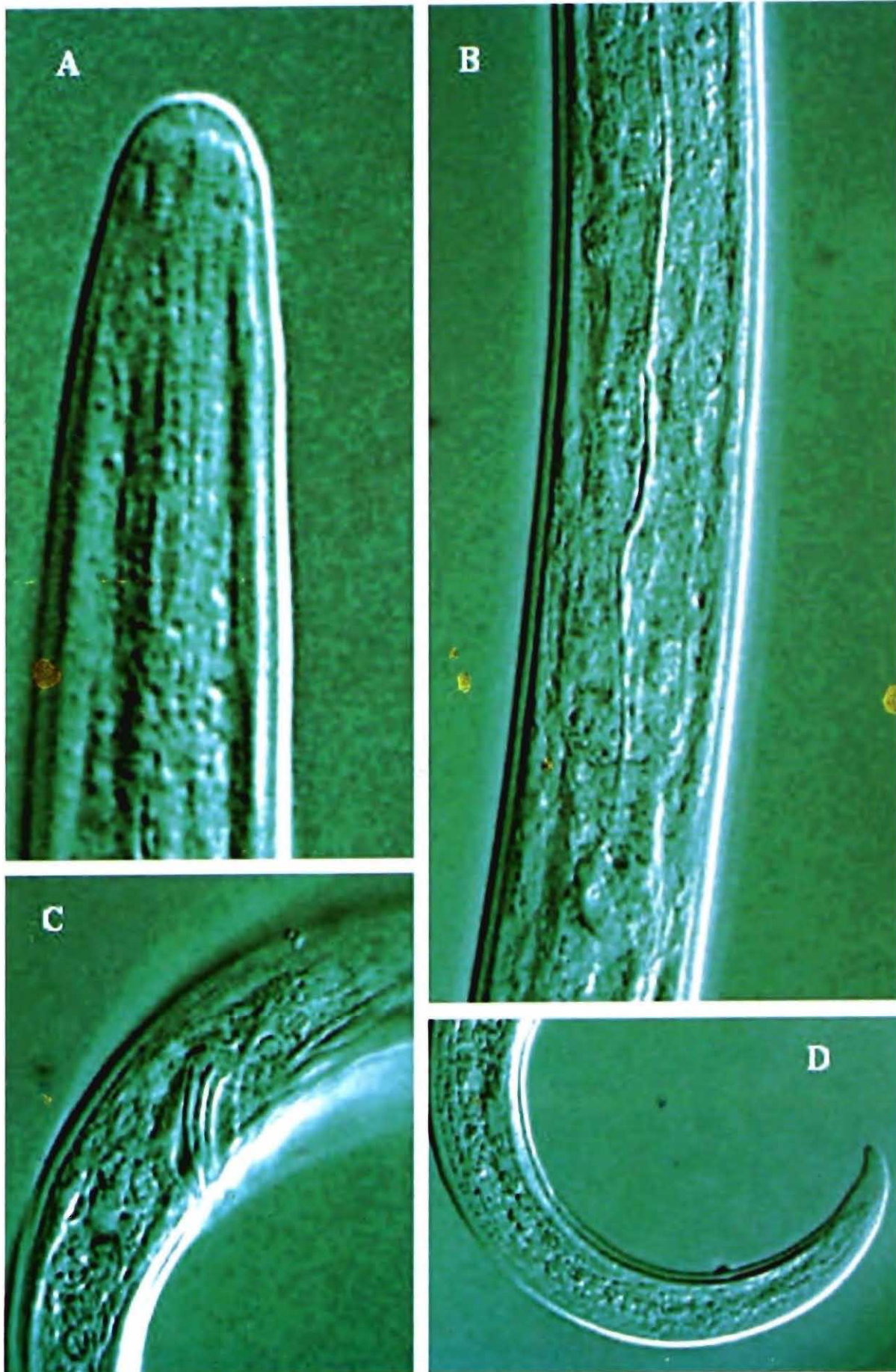
**Plate 45.** *Discolaimus tenax* (Female) **A.** Head region **B.** Pharynx **C.** Tail **D.** Vulva



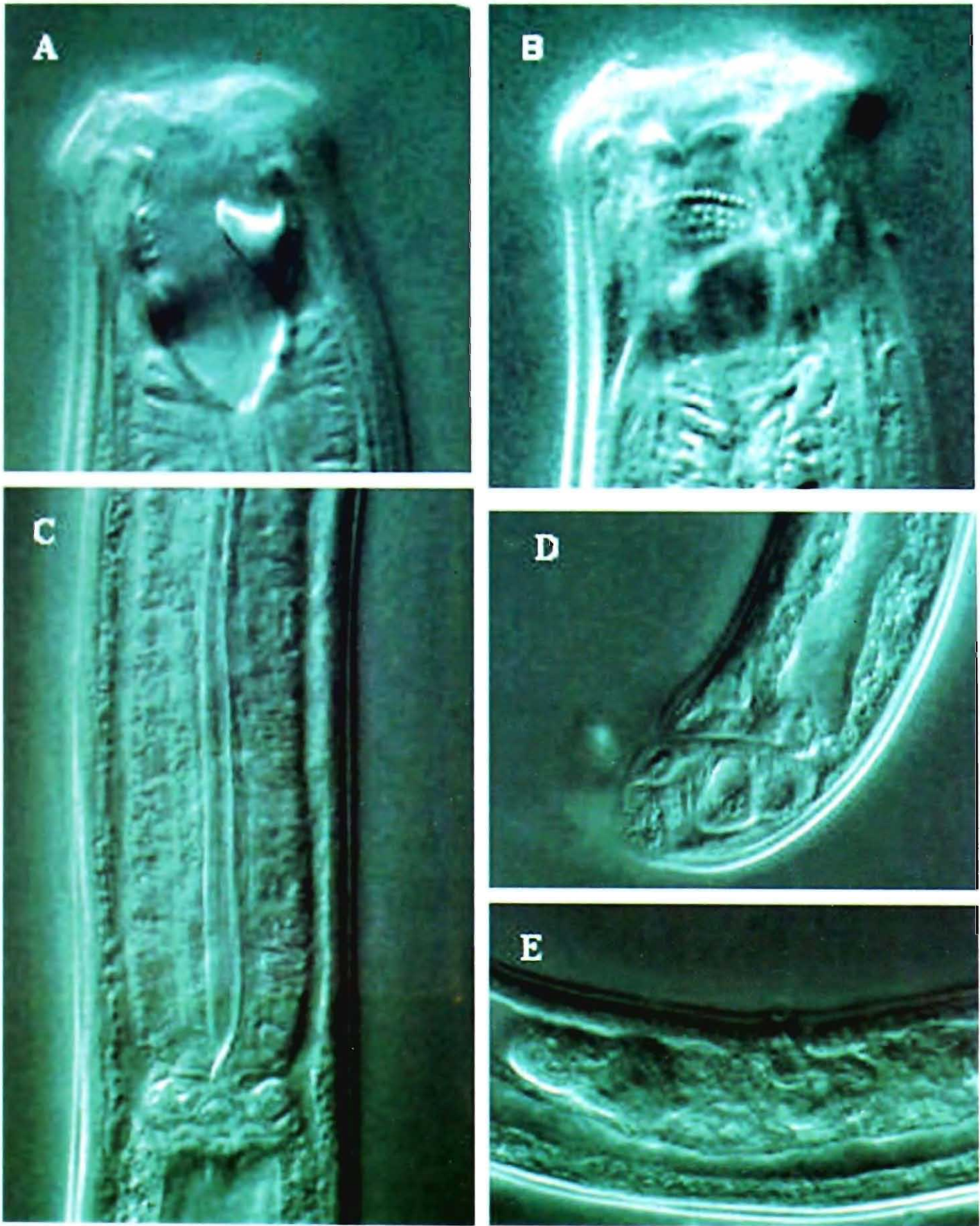
**Plate 46.** *Oriverutus labiatus* (Female) **A.** Head region **B.** Pharynx **C.** Tail **D.** Vulva



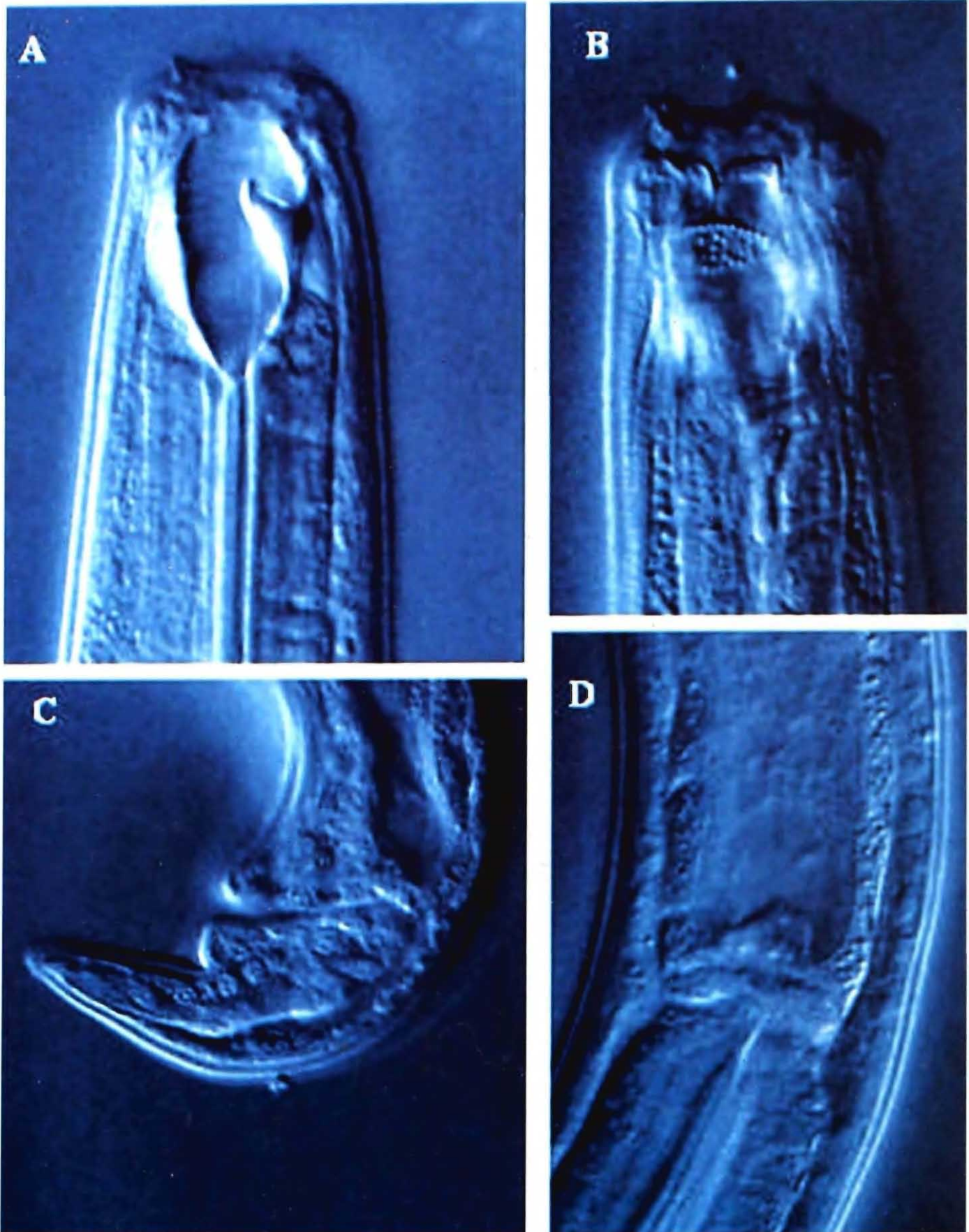
**Plate 47.** *Longidorus doonensis* (Female) **A.** Head region **B.** Pharynx **C.** Vulva **D.** Tail



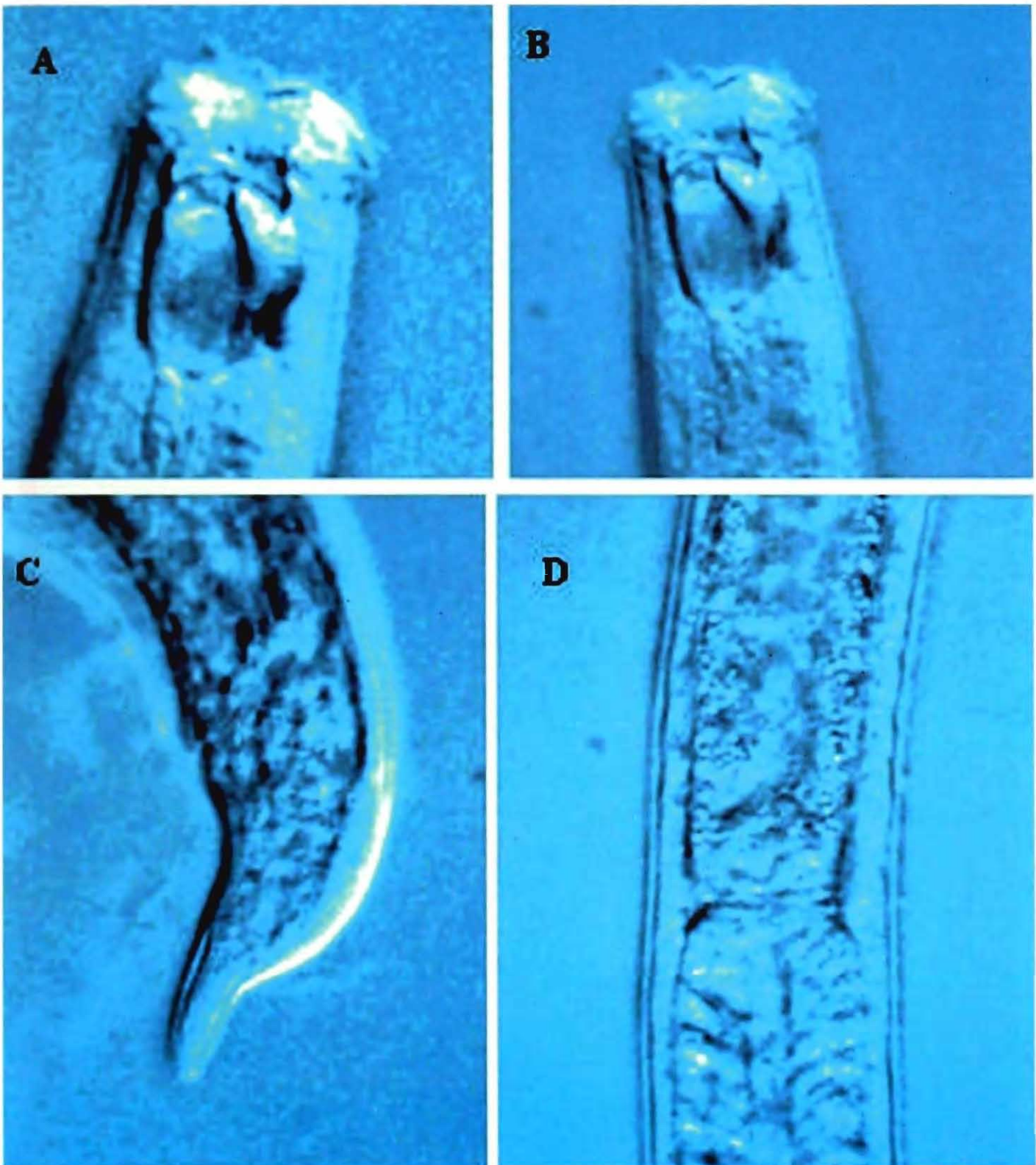
**Plate 48.** *Alaimus jaulasali* (Male) **A.** Head region **B.** Pharynx **C.** Spicules **D.** Tail



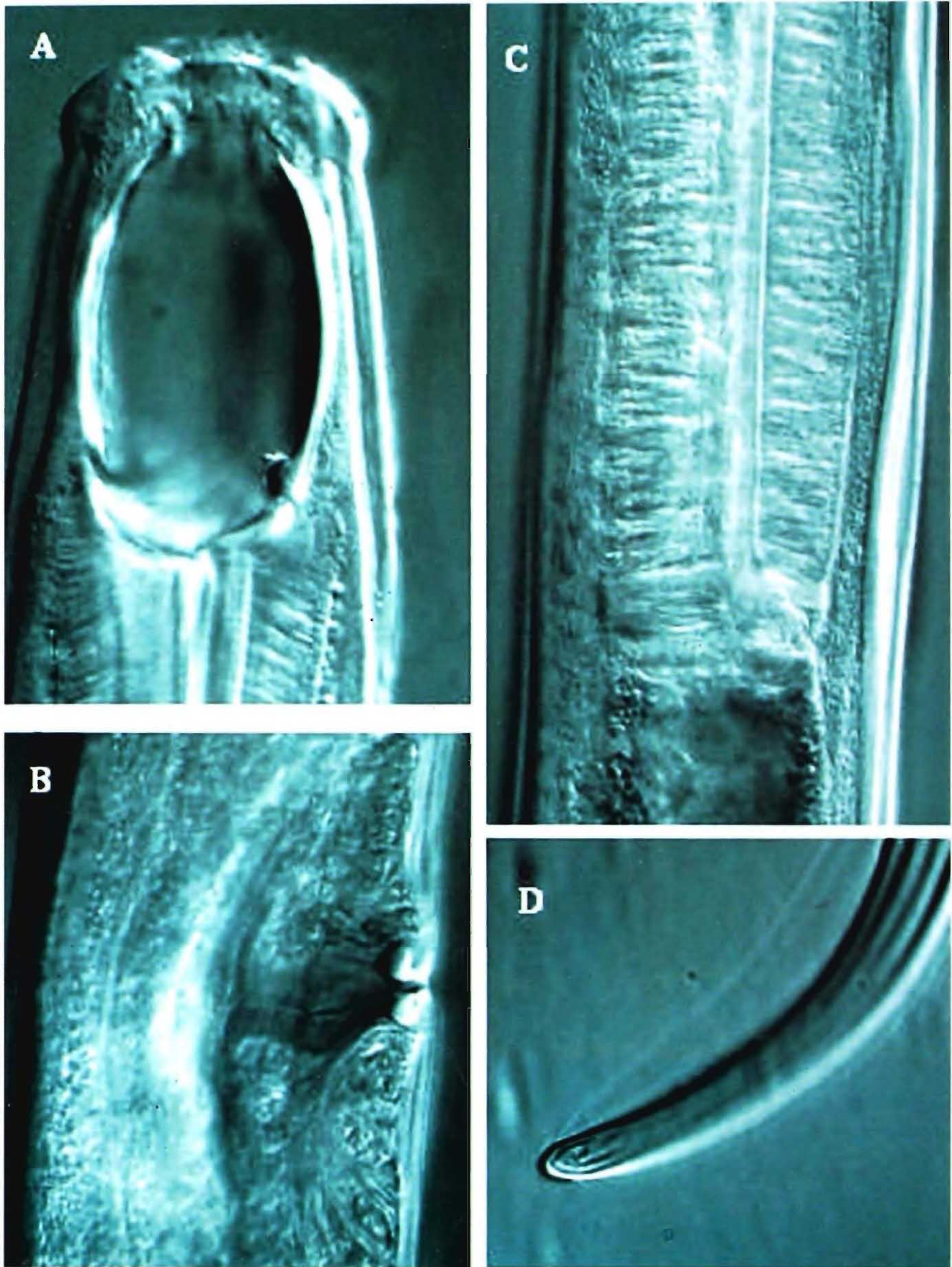
**Plate 49.** *Mylonchulus minor* (Female) **A.** Buccal cavity **B.** Denticles **C.** Pharynx **D.** Tail **E.** Gonad



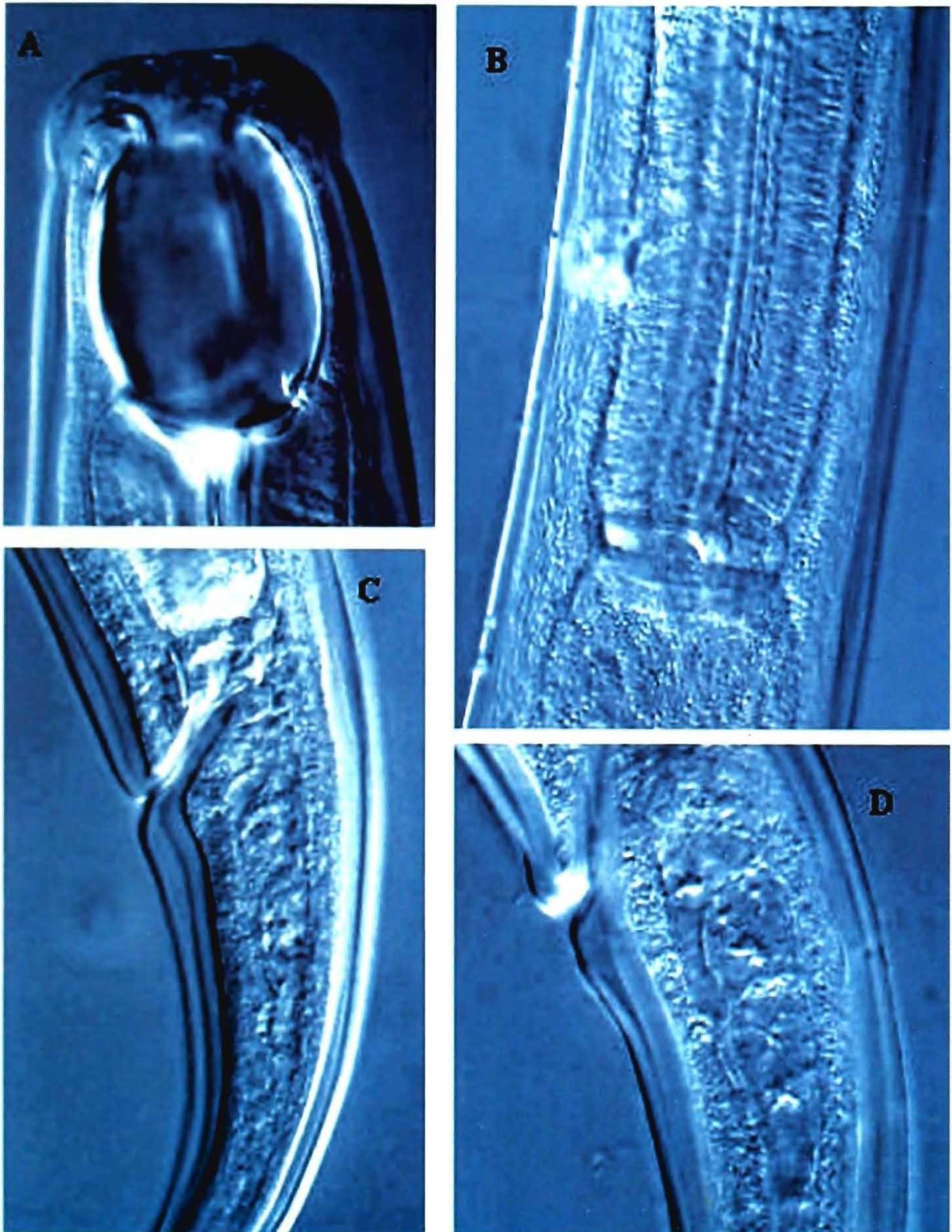
**Plate 50.** *Mylonchulus lacustris* (Female) **A.** Buccal cavity **B.** Denticle **C.** Tail **D.** Pharynx



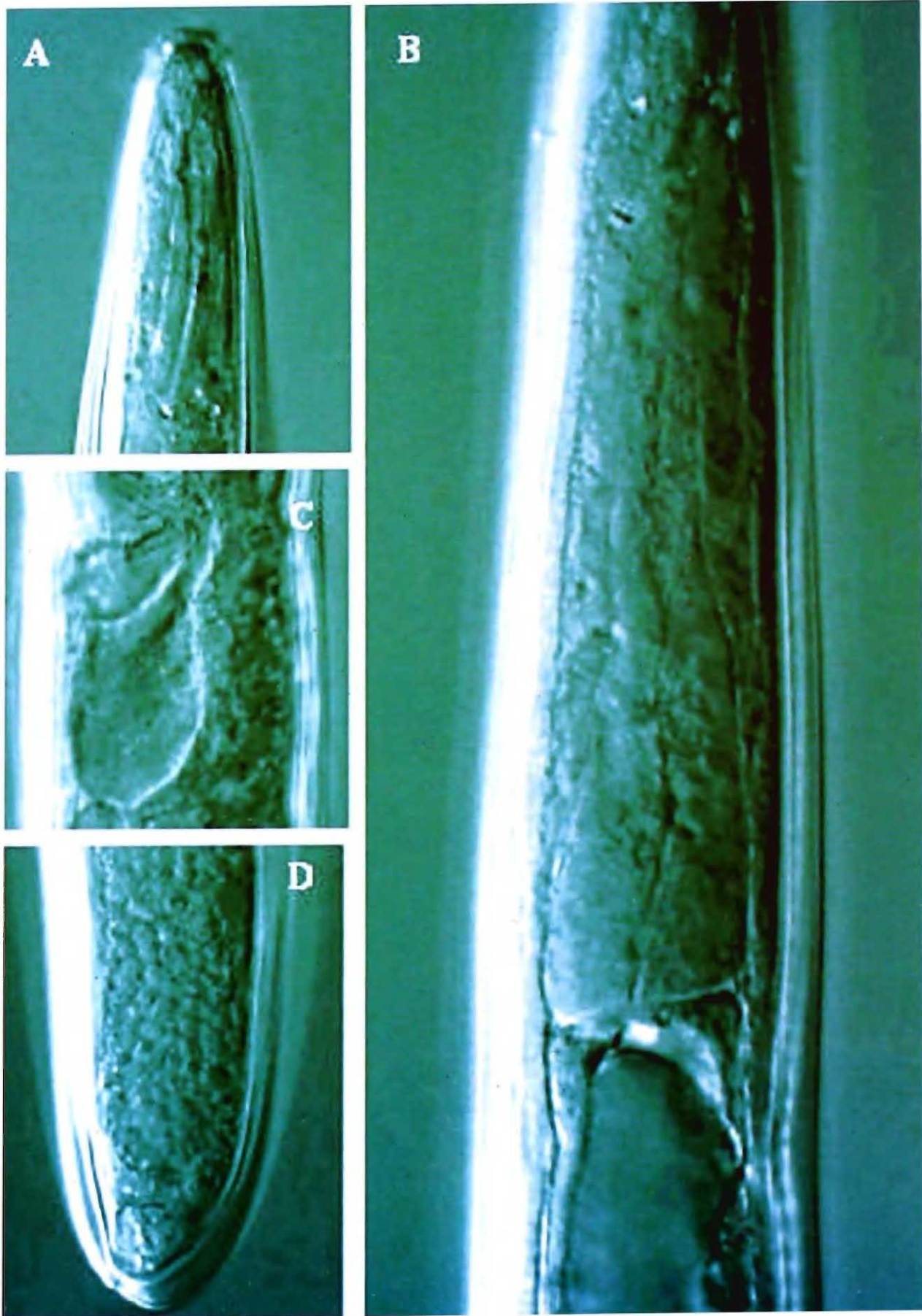
**Plate 51.** *Paramylonchulus mulveyi* (Female) A & B. Buccal cavity C. Tail D. Pharynx



**Plate 52.** *Iotonchus trichurus* (Female) **A.** Buccal cavity **B.** Vulva **C.** Pharynx **D.** Tail



**Plate 53.** *Iotonchus parabasidontus* (Female) **A.** Buccal cavity **B.** Tail region **C.** Pharynx **D.** Rectal glands



**Plate 54.** *Trichodorus Pakistanensis* (Female) **A.** Head end region **B.** Pharynx **C.** Vulva **D.** Tail

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