

RESEARCH ARTICLE

## New Records of Nematodes (Nematoda: Dorylaimida) from Govind Wildlife Sanctuary, Uttarakhand, India

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### Abstract

Eighteen species of dorylaims are being recorded from Govind Wildlife Sanctuary, Uttarkashi, Uttarakhand, under 12 genera of 5 families. All the species of nematode were recorded for the first time from Uttarakhand, of which following 3 species; *Eudorylaimus aquilonarius* Tjepkema, Ferris and Ferris, 1971, *Dorylaimellus monticolus* Clark, 1963 and *Belaxellus elegans* Thorne, 1974 are being reported first time from India. The genera *Bexallus* Thorne, 1974 and *Epidorylaimus* Andrassy, 1986 are also added in nematode fauna from India and Uttarakhand respectively.

**Keywords:** Nematodes, Govind wildlife sanctuary, new records, India, Uttarakhand.

### Introduction

This is a well known fact that the study on biodiversity of any conservation or protected area is important because the knowledge gathered serves fundamental and applied purposes. In view of this fact, the scientists of Zoological Survey of India have paid special attention to collect the information on faunal wealth of the protected areas under the jurisdiction of their respective centres. However, the soil fauna has been paid little attention, due to their microscopic size. In soil fauna, the nematodes form an important and highly diversified group which plays an important role either as plant parasite, predator or in maintaining eco-balance. The order Dorylaimida comprises the most diverse and economically important group of terrestrial nematodes; this order represents one of the basal evolutionary lineages within the phylum Nematoda (Mullin, 2004). More than 2500 valid species and more than 250 genera are known worldwide (Jairajpuri and Ahmad, 1992). Despite India being a large country with wide biodiversity, the Indian nematode fauna comprises 890 species of dorylaims (Sharma and Baqri, 2014), while 119 species of dorylaims have been recorded from Uttarakhand state (Sharma, 2011). In the present study 18 species of doylaims, belonging to 12 genera and 5 families, are new records from Uttarakhand. The following three species *Eudorylaimus aquilonarius* Tjepkema, Ferris and Ferris, 1971, *Dorylaimellus monticolus* Clark, 1963 and *Belaxellus elegans* Thorne, 1974 are being first time reported from India.

### Materials and methods

Field surveys were carried out during 2012-13 in different localities of Govind Wildlife Sanctuary. Soil samples were collected around the roots of forest trees.

Extraction of plant and soil nematodes from soil samples was made through modified Baermann funnel technique. The nematodes were fixed in hot FAA and dehydrated in glycerin-alcohol (5: 95 parts) by slow method (Seinhorst, 1959). The dehydrated nematodes were mounted in anhydrous glycerin. The slides were sealed with wax. Identification and photography of nematodes were taken under Compound Microscope (Olympus 51X). All the specimens have been registered and deposited in National Zoological Collection, NRC, ZSI, Dehradun.

### Results and discussion

A total 18 species of nematode belonging to 12 genera and 5 families are being recorded from GWLS of which 17 species are free living and 1 species of *Xiphinema* is plant parasitic. All nematode species have been recorded for the first time from Uttarakhand, of which 3 species are found first time from India. The genus *Belaxellus* Thorne, 1974 is reported for the first time from India. The systematic list of identified nematode species is as follows.

#### Order Dorylaimida

##### Family Aporcelaimidae Heyns, 1965

1. *Aporcelaimellus invisus* Tjepkema, Ferris & Ferris, 1971\*
2. *Aporcelaimellus laevis* Tjepkema, Ferris & Ferris, 1971\*
3. *Aporcelaimellus adoxus* Tjepkema, Ferris & Ferris, 1971\*

##### Family Qudsianematidae Jairajpuri, 1965

4. *Eudorylaimus aquilonarius* Tjepkema, Ferris and Ferris, 1971\*\*
5. *Eudorylaimus meridionalis* Tjepkema, Ferris and Ferris, 1971\*

6. *Microdorylaimus rapsus* Heyns, 1963\*
  7. *Epidorylaimus andrassyi* Mushtaq & Ahmad, 2006\*+
  8. *Allodorylaimus didamatus* (Cobb in Throne and Swanger, 1936) Andrassy, 1986\*
  9. *Allodorylaimus irritans* (Cobb in Throne & Swanger, 1936) Andrassy, 1986\*
  10. *Discolaimus tenax* Siddiqi, 1964\*
  11. *Discolaimoides loofi* Andrassy, 1990\*
  12. *Moshajia idiofora* Siddiqi, 1982\*
- Family Actinolaimidae Thorne, 1939**
13. *Egitatus itanagrus* Khan, Ahmad & Jairajpuri, 1994\*
- Family Xiphinematidae Dalmasso, 1969**
14. *Xiphinema brevicolle* Sch-Stekhoven and Teunissen, 1938\*

**Family Belondoridae Thorne, 1935**

15. *Dorylaimellus demani* Siddiqi, 1964\*
16. *Dorylaimellus longus* Bohra & Sultana, 2010\*
17. *Dorylaimellus monticolus* Clark, 1963\*\*
18. *Belaxellus elegans* Thorne, 1974\*\*++

\*New Record from Uttarakhand

\*\* New Record from India

+ New Record of genus from Uttarakhand

++ New Record of genus from India

**1. *Aporcelaimellus invisus*** Tjepkema, Ferris & Ferris, 1971 (Plate 1E-F)

*Measurements: Females (4):* L=1.7-2.2 mm; a=26-29; b=3.5-4.1; c=52-64; c'=0.7-0.9; V=53-56; Odontostyle=19-23  $\mu$ m; Odontophore=55-57  $\mu$ m; Prerectum=80-100  $\mu$ m.

*Description: Females:* Body ventrally curved upon fixation. Lip region set off from body, lips angular. Amphids stirrup-shaped. The expanded part of oesophagus occupies 51-53% of total oesophageal length. Vulva labia with triangular sclerotized pieces. Reproductive system amphidelphic. Tail dorsally convex with blunt tip.

*Habitat and Locality:* Collected from soil around the roots of *Araucaria columnaris*, *Pinus wallichiana* and *Cedrus deodara* at Sunkundi, Satta Tarai and Sond Sankri.

*Remarks:* New record from Uttarakhand.

**2. *Aporcelaimellus laevis*** Tjepkema, Ferris & Ferris, 1971 (Plate 1C-D)

*Measurements: Females (2):* L=1.7-1.8 mm; a=25-31; b=3.5-3.9; c=51-52; c'=0.9-1.1; V= 55-56; Odontostyle=19  $\mu$ m; Odontophore=31-36  $\mu$ m.

*Description: Females:* Body ventrally curved upon fixation. Lip region set off from body by deep constriction, Lips rounded. Amphids stirrup-shaped. Cardia bluntly conical. The expanded part of oesophagus occupies 51% of total oesophageal length. Vulva labia with triangular sclerotized pieces. Reproductive system amphidelphic. Tail dorsally convex with blunt tip.

*Habitat and Locality:* Collected from soil around the roots of *Pinus* sp., *Araucaria columnaris* at Satta Tarai, Pragati Nagar.

*Remarks:* New record from Uttarakhand.

**3. *Aporcelaimellus adoxus*** Tjepkema, Ferris & Ferris, 1971 (Plate 1A-B)

*Measurements: Female (1):* L=2.4 mm; a=27; b=4.0; c=67; c'=0.7; V=48; Odontostyle=21  $\mu$ m; Odontophore=40  $\mu$ m.

*Description: Female:* Body ventrally curved posteriorly upon fixation. Lip region set off from body by deep constriction, lips angular with blunt papillae. Amphids funnel-shaped, weakly duplex. Cardia conical, disc present between oesophagus and intestine. Reproductive system amphidelphic. Tail dorsally convex with fairly blunt tip.

*Habitat and Locality:* Collected from soil around the roots of *Pinus* sp. near Nooranoo village.

*Remarks:* New record from Uttarakhand.

**4. *Eudorylaimus aquilonarius*** Tjepkema, Ferris and Ferris, 1971 (Plate 1M-N)

*Measurements: Female (1):* L=1.1 mm; a=36; b=3.6; c=15; c'=3.9; V=55; Odontostyle=15  $\mu$ m; Prerectum=75  $\mu$ m.

*Description: Female:* Body curved ventrally upon fixation. Lip region moderately set off, lips angular with blunt papillae. Odontophore obscure. The expanded part of oesophagus occupies 48% of total oesophageal length. Reproductive system amphidelphic; vulva labia with strongly pointed triangular sclerotized pieces. Tail arcuate conical with acute tip.

*Habitat and Locality:* Collected soil around the roots of *Cedrus deodara* at Sond Sankri.

*Elsewhere:* United States.

*Remarks:* The measurements of present specimens fit well with the specimen described by Tjepkema, Ferris and Ferris, 1971 except odontophore (length obscure in type). This species is reported for the first time from India.

**5. *Eudorylaimus meridionalis*** Tjepkema, Ferris and Ferris, 1971 (Plate 1I-J)

*Measurements: Females (2):* L=0.9-1.0 mm; a=25-28; b=3.7-3.9; c=18-19; c'=2.2-2.4; V=52-56; Odontostyle=14-15  $\mu$ m; Prerectum=50  $\mu$ m.

*Description: Females:* Body ventrally curved upon fixation. Lip region set off from body and lips fairly separated. Amphids funnel shaped. Reproductive system amphidelphic. Tail arcuate conical with narrow rounded tip.

*Habitat and Locality:* Collected from soil around the roots of *Prunus domestica* and *Pinus* sp. at Kot Village.

*Remarks:* New record from Uttarakhand.

**6. *Microdorylaimus rapsus*** Heyns, 1963 (Plate 1O-P)

*Measurement: Female (1):* L=2.7 mm; a=29; b=3.4; c=16; c'=3.5; V=54; Odontostyle=12  $\mu$ m; Prerectum=25  $\mu$ m.

*Description: Female:* Body slightly ventrally curved upon fixation. Lip region set off from body by weak constriction, lips angular and moderately separated. Amphids cup shaped.

Plate 1. *Aporcelaimellus adoxus* A-B. A. Head, B. Tail; *Aporcelaimellus laevis* C-D. C. Head, D. Tail; *Aporcelaimellus invisus* E-F. E. Head, F. Tail; *Moshajia idiofora* G-H. G. Head, H. Tail; *Eudorylaimus meridionalis* I-J. I. Head; J. Tail; *Epidorylaimus andrassyi* K-L. K. Head; L. Tail; *Eudorylaimus aquilonarius* M-N. M. Head, N. Tail; *Microdorylaimus rapsus* O-P. O. Head, P. Tail; *Allodorylaimus irritans*; Q-R. Q. Head, R. Tail; *Allodorylaimus didamatus* S-T. S. Head; T. Tail (Scale bars: 10  $\mu$ m).

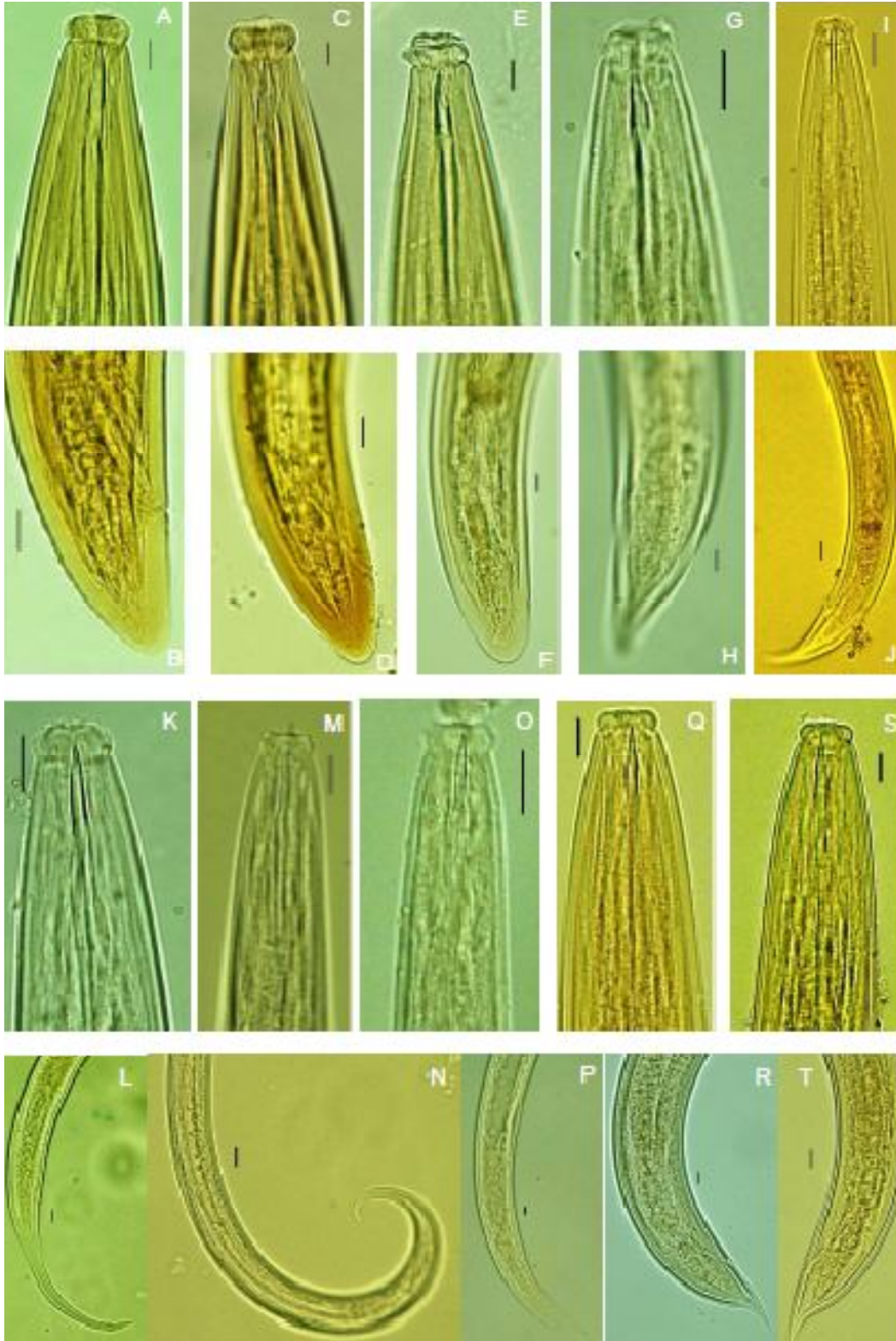
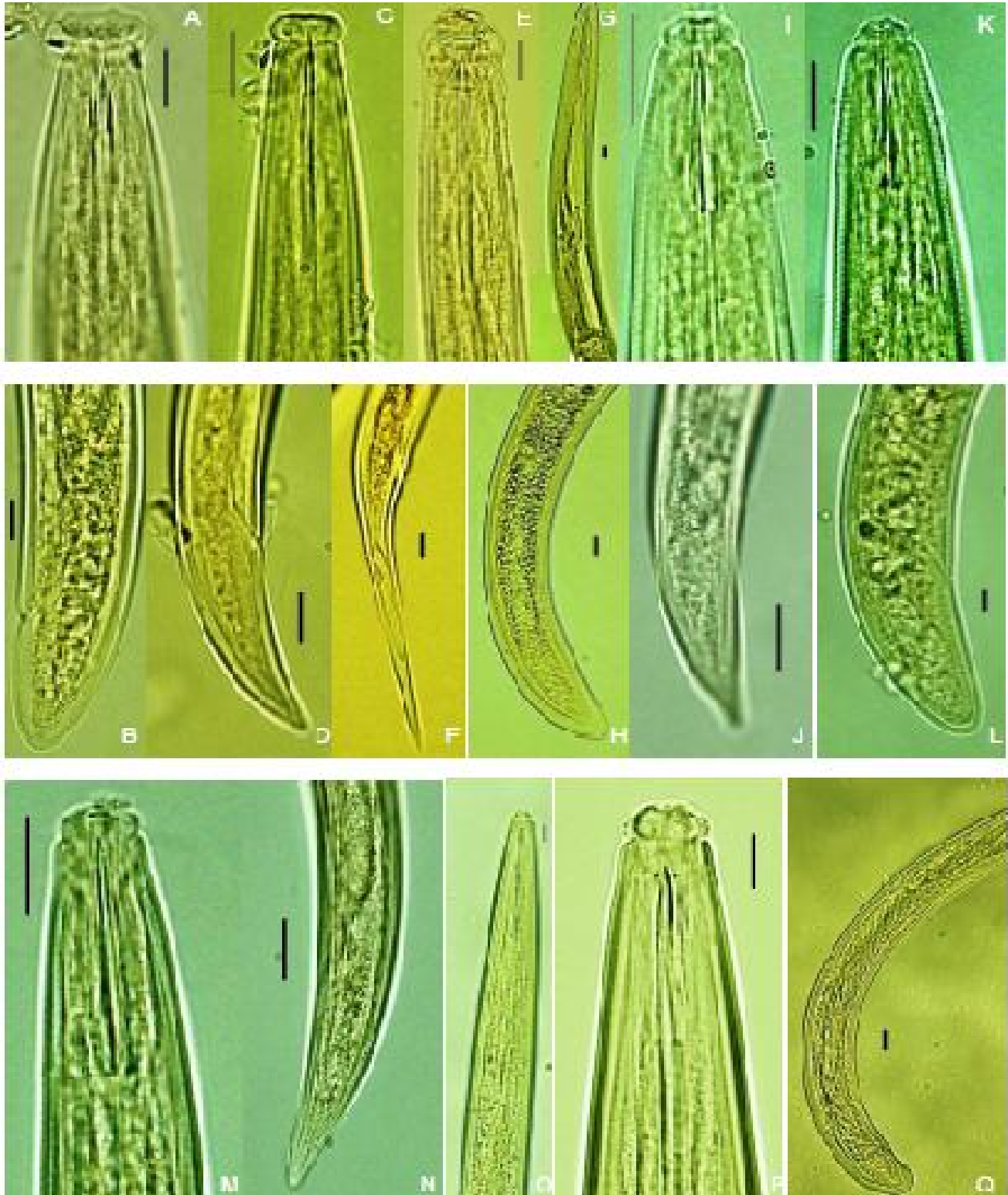


Plate 2. *Discolaimus tenax* A-B. A. Head, B. Tail; *Discolaimoides loofi* C-D; C. Head; D. Tail; *Egitatus itanagrus* E-F. E. Head, F. Tail; *Xiphinema brevicolle* G-H. G. Head, H. Tail; *Dorylaimellus demani* I-J. I. Head, J. Tail; *Dorylaimellus longus* K-L. K. Head; L. Tail; *Dorylaimellus monticolus*; M-N. M. Head, N. Tail; *Belaxellus elegans*. O-Q. O&P. Anterior Region. Q. Posterior Region (Scale bars: 10  $\mu$ m).



The expanded part of oesophagus occupies 60% of total oesophageal length. Reproductive system amphidelphic. Tail bent ventrally.

*Habitat and Locality:* Collected from soil around the roots of *Pinus* sp. at Devra, Gainch Village.

*Remarks:* New record from Uttarakhand.

**7. *Epidorylaimus andrassyi*** Mushtaq and Ahmad, 2006 (Plate 1K-L)

*Measurements: Female (1):* L=1.4 mm; a=33; b=4.4; c=9.7; c'=5.7; V=44; Odontostyle=14  $\mu$ m; Odontophore=20  $\mu$ m.

*Description: Female:* Body slightly ventrally curved upon fixation. Lip region set off from body by weak constriction, lips angular and well separated. Amphids beaker shaped. The expanded part of oesophagus occupies 37% of total oesophageal length. Cardia elongate conoid. Vulva longitudinal. Reproductive system amphidelphic. Tail elongate ventrally arcuated.

*Habitat and Locality:* Collected from soil around the roots of *Prunus domestica* at Kot Village.

*Remarks:* New record from Uttarakhand.

**8. *Allodorylaimus didamatus*** (Cobb in Throne and Swanger, 1936) Andrassy, 1986 (Plate 1S-T)

*Measurements: Female (1):* L=1.7 mm; a=30; b=3.6; c=30; c'=1.4; V= 52; Odontostyle=22  $\mu$ m; Odontophore=28  $\mu$ m.

*Description: Female:* Body ventrally curved upon fixation. Lip region offset, angular, cephalic papillae distinct. Reproductive system amphidelphic. Tail dorsal convex, tip acute.

*Habitat and Locality:* Collected from soil around the roots of *Pinus wallichiana* at Sunkundi.

*Remarks:* New record from Uttarakhand.

**9. *Allodorylaimus irritans*** (Cobb in Throne and Swanger, 1936) Andrassy, 1986 (Plate 1Q-R)

*Measurements: Females (3):* L=1.3-1.6 mm; a=27-29; b=3.6-3.8; c=21-23; c'=2.3-2.5; V= 51-52; Odontostyle=20-22  $\mu$ m; Odontophore=38-40  $\mu$ m.

*Description: Females:* Body ventrally curved upon fixation. Lip region set off from body with constriction, lips angular. Gland like body connected dorsally to cardia and base of esophagus. Reproductive system amphidelphic. Tail dorsal-convex weakly concave dorsally, tip acute.

*Habitat and Locality:* Collected from soil around the roots of *Pinus* sp. and *Cedrus deodara* at Devra and Satta.

*Remarks:* New record from Uttarakhand.

**10. *Discolaimus tenax*** Siddiqi, 1964 (Plate 2A-B)

*Measurements: Female (1):* L=1.2 mm; a=42; b=3.8; c=47; c'=1.3; V=42; Odontostyle= 14  $\mu$ m; Odontophore=21  $\mu$ m.

*Description: Female:* Body ventrally arcuate upon fixation. Lip region set off by slight constriction. The expanded part of oesophagus occupies 62% of total oesophageal length. Vulva a transverse slit.

Reproductive system amphidelphic. Tail convex conoid, rounded.

*Habitat and Locality:* Collected from soil around the roots of *Prunus domestica* at Kot Village.

*Remarks:* New Record from Uttarakhand.

**11. *Discolaimoides loofi*** Andrassy, 1990 (Plate 2C-D)  
*Measurements: Female (1):* L=1.6 mm; a=63; b=5.2; c=40; c'=2.2; V=48; Odontostyle=10  $\mu$ m; Odontophore=20  $\mu$ m.

*Description: Female:* Body ventrally curved upon fixation. Body very cylinder, gradually tapering to its both ends. Head sharply set off, wider than adjacent neck region. Amphids large, as wide as corresponding diameter. Guiding ring thin. Cardia hemispheroid. Vulva transfer not sclerotized. Reproductive system amphidelphic. Tail conoid, slightly bent ventrally, tip rounded.

*Habitat and Locality:* Collected from soil around the roots of *Pinus roxburghii* near Nuranoo village.

*Remarks:* New record from Uttarakhand.

**12. *Moshajia idiofora*** Siddiqi, 1982 (Plate 1G-H)

*Measurements Female (1):* L=1.2 mm; a=32; b=4.2; c=32; c'=1.5; V=53; Odontostyle=13  $\mu$ m; Odontophore=20  $\mu$ m.

*Description: Female:* Body slightly curved upon fixation. Body pores distinct. Lip region aporcelainid, with elevated lips. Reproductive system amphidelphic. Tail convex conoid.

*Habitat and Locality:* Collected from soil around the roots of *Euphorbia lathyris* at Satta.

*Remarks:* New record from Uttarakhand.

**13. *Egitatus itanagrus*** Khan, Ahmad and Jairajpuri, 1994 (Plate 2E-F)

*Measurements: Females (2):* L=2.4-2.7 mm; a=56-64; b=3.3-3.4; c=22-23; c'=4.8; V=57-60; Odontostyle=23-24  $\mu$ m; Odontophore=37-40  $\mu$ m; Prerectum=113-115  $\mu$ m

*Description: Females:* Body slightly ventrally curved upon fixation. Lip region rounded, offset by constriction. Oral aperture circular. Amphids cup shaped. Guiding ring double. Vestibular ring corrugated. Basal expanded part is 62-63%. Basal shield of oesophagus is present. Cardia elongated conoid. Reproductive system amphidelphic. Tail gradually tapering to become long filiform.

*Habitat and Locality:* Collected from soil around the roots of *Cedrus deodara* and *Pinus roxburghii* at Dewla and Jakhol.

*Remarks:* New record from Uttarakhand.

**14. *Xiphinema brevicolle*** Sch-Stekhoven and Teunissen, 1938 (Plate 2G-H)

*Measurements: Females (2):* L=2.3-2.4 mm; a=47-50; b=6-7; c=79-80; c'=0.9-1.0; V= 49-50; Guiding Ring=80-85  $\mu$ m; Odontostyle=100-101  $\mu$ m; Odontophore=53-60  $\mu$ m.

**Description:** *Females:* Body C shaped upon fixation. Lip region flattened, continuous with body. Amphids stirrup shaped. Basal bulb of the oesophagus about 24% of neck length. Cardia short and rounded conoid. Reproductive system amphidelphic. Tail short and conoid, its dorsal surface convex and ventral almost straight.

**Habitat and Locality:** Collected from soil around the roots of Orchid near Misri temple.

**Remarks:** New record from Uttarakhand.

**15. *Dorylaimellus demani*** Goodey, 1963 (Plate 2I-J)

**Measurements:** *Female (1):* L=0.8 mm; a=36; b=3.0; c=23; c'=2.3; V=54; Odontostyle= 6  $\mu$ m; Odontophore= 17  $\mu$ m; Prerectum= 110  $\mu$ m.

**Description:** *Female:* Body slightly arcuate upon fixation. Lip region set off by constriction. Odontostyle attenuate, less than lip region width. Odontophore with distinct basal flanges. The expanded part of oesophagus occupies 52% of total oesophageal length. Female reproductive system amphidelphic. Tail conoid, tip rounded.

**Habitat and Locality:** Collected from soil around the roots of Orchid near Misri temple.

**Remarks:** New record from Uttarakhand.

**16. *Dorylaimellus longus*** Bohra and Sultana, 2010  
(Plate 2K-L)

**Measurements:** *Female (1):* L=1.5 mm; a=60; b=8.5; c=43; c'=1.8; V= 51; Odontostyle=6  $\mu$ m; Odontophore= 13  $\mu$ m; Prerectum=35-50  $\mu$ m.

**Description:** *Female:* Body C shaped upon fixation. Lip region set off by constriction. Four cuticularised piece present around stoma. Odontostyle attenuate, less than lip region width. Odontophore with distinct basal flanges. The expanded part of oesophagus occupies 41% of total oesophageal length. Reproductive system amphidelphic. Tail convex-conoid, slightly ventrally curved, with broadly rounded terminus.

**Habitat and Locality:** Collected from soil around the roots of *Pinus roxburghii* at Kot Village.

**Remarks:** New Record from Uttarakhand.

**17. *Dorylaimellus monticolus*** Clark, 1963 (Plate 2M-N)

**Measurements:** *Female (1):* L=0.88 mm; a=35; b=3.4; c=25; c'=2.3; V= 52; Odontostyle=8  $\mu$ m; Odontophore= 15  $\mu$ m; Prerectum=92  $\mu$ m.

**Description:** *Female:* Body ventrally curved upon fixation. Lip region set off by constriction, Lips equal, outer edge rounded with four sclerotised plates. Stylet, Dorylaimoid. Odontophore with three flanges. Oesophagus expanding to form small bulb than narrowing again, continuing as a narrow tube, the expanded part of oesophagus occupies 51% of total oesophageal length and enveloped by a sheath of spiral muscles. Reproductive system amphidelphic. Tail dorsally convex, tip rounded.

**Habitat and Locality:** Collected from soil around the roots of *Cedrus deodara* at Misri Tanda.

**Elsewhere:** United States.

**Remarks:** New record from India.

**18. *Belaxellus elegans*** Thorne, 1974 (Plate 2O-Q)

**Measurements:** *Male (1):* L= 2.6 mm; a=60; b=3.3; c=112; c'=0.6; Odontostyle= 12  $\mu$ m; Odontophore= 16  $\mu$ m; Spicules= 58  $\mu$ m.

**Description:** *Male:* Body almost straight, curved ventrally upon fixation. Lip region angular, set off from body. Oral opening with 4 sclerotised plates. Odontostyle equal to lip region width, broad with wide lumen and aperture. Odontophore simple rod-like. Oesophagus expanded gradually and expanded part enveloped by muscular sheath. Supplements 8 in number, spaced. Tail conoid.

**Habitat and Locality:** Collected from soil around the roots of *Cedrus deodara* at Sond Sankri.

**Elsewhere:** United States.

**Remarks:** The measurements of present specimens [a=60 (vs 46-53 in type); b=3.3 (vs 5.3 in type) c=112 (vs 73 in type)] is differ with the specimen described by Thorne (1974). It is tentatively placed in this species because only one specimen is found. This genus and species is recorded first time from India.

### Conclusion

In this study, the number of nematodes species increased from 43 (Sharma, 2013 and Sharma and Dubey, 2014) to 61 in Govind Wildlife Sanctuary, Uttarkashi. Identified all 18 species of nematodes are being added in Uttarakhand state fauna. The genus *Belaxellus* Thorne, 1974 and 3 species namely *Eudorylaimus aquilonarius* Tjepkema, Ferris and Ferris, 1971, *Dorylaimellus monticolus* Clark, 1963 and *Belaxellus elegans* Thorne, 1974 are being added to nematode fauna of India. The genus *Belaxellus* Thorne, 1974 is being recorded from country after original description. The genus *Epidorylaimus* Andrassy, 1986 as a new record from Uttarakand.

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