FOUR *ROTYLENCHUS* SPECIES NEW FOR ROMANIA WITH A MORPHOLOGICAL STUDY OF DIFFERENT *ROTYLENCHUS ROBUSTUS* POPULATIONS (NEMATODA: HOPLOLAIMIDAE)

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Summary. Specimens of *Rotylenchus lobatus*, *R. buxophilus*, *R. capensis*, *R. cf uniformis* and *R. robustus* were collected primarily from habitats located in the Romanian Carpathians. Brief redescriptions, measurements, illustrations and data referring to the habitat are given for these species. The morphological variation of five populations of *R. robustus* is discussed.

This paper refers to *Rotylenchus* species found in some preserved samples stored at the Institute of Biological Research.

So far, three species of *Rotylenchus* have been reported from Romania. *R. breviglans* Sher, 1965 was reported by Popovici (1989, 1993) from the Retezat Mountains (Southern Romanian Carpathians).

*R. robustus* (de Man, 1876) Filip’ev, 1936 was first found by Micoletzky (1921 quoted by Andrássy, 1959) in Bucovina. The species was later collected by Andrássy (1959) from the Transylvanian Alps. Several papers published by Popovici (1974, 1993, 1998) and Popovici and Ciobanu (1997) reported *R. robustus* from several habitats distributed mostly in the Romanian Carpathians.

More recently, *R. jagatpurensis* Sultan, 1985 was found by Ciobanu et al. (1999) at Bâile Turda salted area, in the Transylvania province. Data on the presence and distribution of the seven species are included in the Romanian nematode database.

MATERIALS AND METHODS

Soil samples were collected between 1985 and 1997 by the third and first author. Twelve sites located in grassland, coniferous and deciduous forests from the Romanian Carpathians and the Someșan Plateau in Transylvania were investigated (Table I). Nematodes were extracted using the centrifugal method of De Grisse (1969), killed and preserved in a 4% formaldehyde solution heated at 65 °C, mounted in anhydrous glycerin (Seinhorst, 1959) and examined by light microscopy.

Soil samples were collected from grassland, coniferous and deciduous forests from the Romanian Carpathians and the Someșan Plateau in Transylvania were investigated (Table I). Nematodes were extracted using the centrifugal method of De Grisse (1969), killed and preserved in a 4% formaldehyde solution heated at 65 °C, mounted in anhydrous glycerin (Seinhorst, 1959) and examined by light microscopy.

Table I. Site locations, vegetation and soil types of a nematological survey in Romania.

<table>
<thead>
<tr>
<th>Site no.</th>
<th>Locality</th>
<th>Altitude (in m)</th>
<th>Geographical position</th>
<th>Plant association</th>
<th>Soil type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Caliman Mts.¹</td>
<td>1000</td>
<td>47°19'N-25°08'E</td>
<td>Campanulo abietinae-Festucetum nigricantis</td>
<td>Brown argilluvic</td>
</tr>
<tr>
<td>2</td>
<td>Caliman Mts.</td>
<td>1150</td>
<td>46°59'N-25°02'E</td>
<td>Leucanthemo Waldsteinii-Fagetum</td>
<td>Brown earth</td>
</tr>
<tr>
<td>3</td>
<td>Caliman Mts.</td>
<td>1790</td>
<td>47°14'N-25°20'E</td>
<td>Rhododendro myrtifolli-Pinetum mugi</td>
<td>Not available</td>
</tr>
<tr>
<td>4</td>
<td>Gurghid Mts.</td>
<td>830</td>
<td>46°45'N-25°01'E</td>
<td>Symphyto cordati-Fagetum</td>
<td>Brown acid</td>
</tr>
<tr>
<td>5</td>
<td>Harghita Mts.</td>
<td>1500</td>
<td>46°35'N-24°23'E</td>
<td>Hieracio rotundati- Piceetum</td>
<td>Brown acid</td>
</tr>
<tr>
<td>6</td>
<td>Maramureș Mts.</td>
<td>1350</td>
<td>47°43'N-24°26'E</td>
<td>Hieracio rotundati- Piceetum</td>
<td>Brown acid</td>
</tr>
<tr>
<td>7</td>
<td>Metaliferi Mts.</td>
<td>1000</td>
<td>46°26'N-23°17'E</td>
<td>Violo declinatae- Nardetum</td>
<td>Brown argilluvic</td>
</tr>
<tr>
<td>8</td>
<td>Parâng Mts.</td>
<td>1750</td>
<td>45°25'N-23°22'E</td>
<td>Hieracio rotundati- Piceetum</td>
<td>Alpine meadow</td>
</tr>
<tr>
<td>9</td>
<td>Parâng Mts.</td>
<td>2050</td>
<td>45°28'N-23°29'E</td>
<td>Violo declinatae- Nardetum</td>
<td>Ferrilluvic podzol</td>
</tr>
<tr>
<td>10</td>
<td>Rodnei Mts.</td>
<td>1560</td>
<td>47°25'N-24°54'E</td>
<td>Hieracio rotundati- Piceetum</td>
<td>Brown acid</td>
</tr>
<tr>
<td>11</td>
<td>Rodnei Mts.</td>
<td>2270</td>
<td>47°25'N-24°54'E</td>
<td>Primulo- Caricetum cursulea</td>
<td>Alpine meadow</td>
</tr>
<tr>
<td>12</td>
<td>Someșan Plateau</td>
<td>320</td>
<td>46°45'N-23°33'E</td>
<td>Jurineo transsilvanicae-Stipetum pulcherimae</td>
<td>Chernozem</td>
</tr>
</tbody>
</table>

¹ Mts.-Mountains.
**DESCRIPTIONS**

**ROTYLENCHUS LOBATUS Sultan, 1984**  
(Table II and III; Fig. 1 A–D)

Female head region continuous, conical with 4-5 annules. Stylet well developed, 26-28 μm long. Lateral field areolated only in the oesophageal region. Uterus containing one egg, although a rounded, offset, empty spermatheca was found. Phasmids situated 0-8 annules anterior to anal level. Tail convex-conoid, with slight to prominent ventral projection, annulated or not.

Male not found.

**Distribution:** Gurghiului Valley (Eastern Romanian Carpathians), site no. 4 (Table I).

**Remarks:** the preliminary identification using the key of Geraert and Barooti (1996) indicated that our specimens probably belong to *R. alpinus* Eroshenko, 1976. By comparing the similarities and differences in the morphological characters and measurements of our specimens with other closely related *Rotylenchus* species, we finally identified them as *R. lobatus* Sultan, 1984 (Table II).

Romanian specimens correspond to the description and illustrations given by Sultan (1984), reported by Castillo et al. (1993). However, our specimens have 4-5 head annules vs. 5-6, and lateral field not areolated near phasmids vs. areolated. This species is remarkably similar to *R. pakistanensis* Maqbool and Shabina, 1986 and probably *R. pakistanensis* is a synonym of *R. lobatus*.

This species was not found in Poland (Brzeski, 1998). This is the first record of *R. lobatus* from Romania and Europe as well.

**ROTYLENCHUS BUXOPHILUS Golden, 1956**  
(Table III; Fig. 2 A–C)

Female head region continuous, hemispherical with four annules. Stylet well developed, 32 μm in length. Lateral field areolated only in the oesophageal region.

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**Table II.** Comparison of the Romanian specimens considered as *Rotylenchus lobatus* Sultan, 1984 with other closely related *Rotylenchus* species.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Similar</th>
<th>Different</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>R. alii</em> Maqbool and Shabina, 1986</td>
<td>Head width and height, c', vulva position,</td>
<td>Stylet length 26-28 μm vs. 22-24 μm</td>
<td>Pakistan</td>
</tr>
<tr>
<td></td>
<td>phasmid position</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>R. alpinus</em> Eroshenko, 1976</td>
<td>Head annules, c', vulva position</td>
<td>Stylet length 26-28 μm vs. 28-30 μm, tail</td>
<td>Russia, Tajikistan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>convex-conoid, with slight to prominent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ventral projection, annulated or not vs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>tail terminus rounded, annulation continuous</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>to tip</td>
<td></td>
</tr>
<tr>
<td><em>R. capsiciami</em> Firoza and Maqbool, 1991</td>
<td>Stylet length, c', phasmid position</td>
<td>Head height 4.0-4.5 μm vs. 9.10 μm, V=60.8-66.6%</td>
<td>Pakistan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vs. 59.61%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>R. caudophasmidius</em> Sher, 1965</td>
<td>Stylet length, c', vulva position</td>
<td>4.5 μm vs. 5-6 head annules, tail</td>
<td>Peru, South Africa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>convex-conoid, with slight to</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>prominent ventral projection,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>annulated or not vs. tail tip</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>hemispherical, phasmid situated</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0-8 annules anterior to anal level vs. phasmid</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>on tail</td>
<td></td>
</tr>
<tr>
<td><em>R. pakistanensis</em> Maqbool and Shabina, 1986</td>
<td>Head annules, head width and height, c',</td>
<td>Tail with slight to prominent</td>
<td>Pakistan</td>
</tr>
<tr>
<td></td>
<td>styler length, phasmid position, tail shape</td>
<td>ventral projection, annulated or not vs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>slight ventral projection ventrally</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>curved</td>
<td></td>
</tr>
<tr>
<td><em>R. phalirum</em> Siddiqi and Pinochet, 1979</td>
<td>Head annules, styler length, vulva position,</td>
<td>Tail convex-conoid, with slight to</td>
<td>Costa Rica</td>
</tr>
<tr>
<td></td>
<td>c'</td>
<td>prominent ventral projection,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>annulated or not vs. smoothly</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>rounded tail terminus, terminal annules</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>greatly enlarged, phasmid situated</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0-8 annules anterior to anal level vs. phasmid</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>on tail</td>
<td></td>
</tr>
<tr>
<td><em>R. puntilus</em> (Perry in Perry, Darling and Thorne, 1959) Sher, 1961</td>
<td>Head annules, styler length, vulva position</td>
<td>Oesophageal lobe with 5 nuclei, tail more</td>
<td>USA, Austria, Poland,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hemispherical, phasmid on tail</td>
<td>Hungary, Sweden,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Great Britain,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bulgaria, Tajikistan,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Russia</td>
</tr>
</tbody>
</table>
Fig. 1. Rotylenchus lobatus: females; A, head; B, anterior end; C, tail; D, reproductive system.
Table III. Measurements of *Rotylenchus lobatus*, *R. buxophilus*, and *R. capensis*.

<table>
<thead>
<tr>
<th>Species</th>
<th>R. lobatus</th>
<th>R. buxophilus</th>
<th>R. capensis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site location:</td>
<td>Gurghiu Mts.</td>
<td>Someșan Plateau</td>
<td>Someșan Plateau</td>
</tr>
<tr>
<td>N</td>
<td>7.9</td>
<td>3.9</td>
<td>9.7</td>
</tr>
<tr>
<td>L</td>
<td>603 (526-711)</td>
<td>864 (852-876)</td>
<td>810</td>
</tr>
<tr>
<td>A</td>
<td>27.3 (25.5-29.2)</td>
<td>31.2 (29.2-33.2)</td>
<td>25.3125</td>
</tr>
<tr>
<td>B</td>
<td>5.0 (3.8-6.7)</td>
<td>6.5 (6.0-7.0)</td>
<td>6.0</td>
</tr>
<tr>
<td>C</td>
<td>40.5 (35.1-51.1)</td>
<td>49.5 (46.1-53.3)</td>
<td>67.5</td>
</tr>
<tr>
<td>′</td>
<td>1.0 (0.8-1.4)</td>
<td>1.0 (0.8-1.1)</td>
<td>0.6</td>
</tr>
<tr>
<td>W%</td>
<td>63.7 (60.8-66.6)</td>
<td>56.6 (54.7-58.5)</td>
<td>57.4</td>
</tr>
<tr>
<td>Conus</td>
<td>13.9 (13.5-14.0)</td>
<td>15.6 (15.0-16.0)</td>
<td>15.0</td>
</tr>
<tr>
<td>Shaft</td>
<td>13.4 (12.5-14.0)</td>
<td>16.4 (16.0-17.0)</td>
<td>14.0</td>
</tr>
<tr>
<td>m %</td>
<td>50.9 (50.0-51.9)</td>
<td>48.6 (46.9-50.0)</td>
<td>51.7</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>122.0 (106.0-153.0)</td>
<td>133.7 (123.0-143.0)</td>
<td>128.0</td>
</tr>
<tr>
<td>MB</td>
<td>57.7 (47.7-64.2)</td>
<td>56.9 (54.5-59.3)</td>
<td>57.0</td>
</tr>
<tr>
<td>Excretory pore</td>
<td>103.2 (96.0-116.0)</td>
<td>114.1 (111.0-118.0)</td>
<td>119.0</td>
</tr>
<tr>
<td>Head - vulva</td>
<td>384.0 (330.0-441.0)</td>
<td>489.0 (479.0-498.0)</td>
<td>465.0</td>
</tr>
<tr>
<td>Tail</td>
<td>15.0 (12.0-17.0)</td>
<td>17.6 (16.0-19.0)</td>
<td>12.0</td>
</tr>
<tr>
<td>Tail annules</td>
<td>(7-10)</td>
<td>(7-11)</td>
<td>10</td>
</tr>
<tr>
<td>Body width</td>
<td>22.1 (19.0-25.0)</td>
<td>27.9 (26.0-30.0)</td>
<td>32.0</td>
</tr>
<tr>
<td>Anal body width</td>
<td>14.8 (11.0-19.0)</td>
<td>18.0 (17.0-19.0)</td>
<td>20.0</td>
</tr>
<tr>
<td>Head width</td>
<td>7.9 (7.5-8.5)</td>
<td>8.8 (8.3-9.0)</td>
<td>10.0</td>
</tr>
<tr>
<td>Head height</td>
<td>4.2 (4.0-4.5)</td>
<td>5.0 (5.0-5.0)</td>
<td>6.0</td>
</tr>
<tr>
<td>O</td>
<td>24.8 (22.6-28.6)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Rounded offset spermatheca contained ovoid, not elongated, sperms. Phasmids located 6-12 annules anterior to anal level. Tail convex-conoid, tail tip annulated or not.

Male not found.

Distribution: Fănațele Clujului (scientific botanical reserve), site no. 12 (Table I).

Remarks: the characters and morphometrics of our specimens correspond well with those of the original description given by Golden (1956) quoted in Castillo et al. (1993) and with those given by Brzeski (1998). In our specimens spermatheca was found containing sperms vs. an empty one as reported in the original description (Fig. 2 C).

**ROTYLENCHUS CAPENSIS** Van den Berg and Heyns, 1974

(Tables III; Fig. 3 A-D)

Female head region distinctly offset, hemispherical with five annules. Stylet well developed, 29 μm long in female and 28 μm in male. Lateral field areolated only in the oesophageal region. Spermatheca large, offset, rounded with elongated packed sperms. Phasmids located on the seventh annule anterior to anal level. Tail rounded with annulated tip.

Male slightly shorter than female, spicule about 29 μm long.

Distribution: Fănațele Clujului (scientific botanical reserve), site no. 12 (Table I).

Remarks: the characters and morphometrics of the two specimens collected (one female and male) are similar with those of the original description given by Van den Berg and Heyns (1974) reported by Castillo et al. (1993).

**R. capensis** was not reported from Poland (Brzeski, 1998). This is the first record of the species from Romania and Europe.

**ROTYLENCHUS cf. UNIFORMIS** (Thorne, 1949)

Loof and Oostenbrink, 1958

(Table IV; Fig. 4 A-F)


Male slightly shorter than female, spicule 33-34 μm in length.

Distribution: five populations collected only from the Eastern Romanian Carpathians at 1150-1790 m above sea level, in three types of ecosystems: mixed forest on brown earth (site no. 2, Tihu Valley); spruce forests on brown acid soils: sites no. 5 (Harghita-Mădăraș), 6 (Bârjababa Valley), 10 (Pietrosul Rodnei); subalpine scrub: site no. 3 (Negoiul Românesc, Rățitiș Peak) (Table I).
Fig. 2. *Rotylenchus buxophilus*: females; A, anterior end; B, tail; C, reproductive system.
Fig. 3. Rotylenchus capensis: A-C female: A, anterior end; B, tail; C, reproductive system; D, male cloacal region.

Remarks: our preliminary identification following the key of Geraert and Barooti (1996) suggested that the specimens might belong to *R. uniformis* (Thorne, 1949) Loof and Oostenbrink, 1958. In this key, the distinctive character between *R. robustus* and *R. uniformis* is an irregularly areolated lateral field at mid-body in *R. robustus* vs. not areolated in *R. uniformis*. Brzeski (1998) on the contrary, described and illustrated *R. uniformis* with the lateral field (sparsely) areolated on the entire body, but *R. robustus* with the lateral field areolated only anteriorly. In all of our specimens the lateral field is areolated only anteriorly. The specimens have continuous, con-
Table IV. Measurements of *Rotylenchus cf. uniformis*.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>80.9</td>
<td>59.9</td>
<td>19</td>
<td>20.9</td>
<td>40.9</td>
</tr>
<tr>
<td>L</td>
<td>1045 (937-1131)</td>
<td>1006 (854-1113)</td>
<td>91.1</td>
<td>1018 (1008-1027)</td>
<td>1041 (933-1089)</td>
</tr>
<tr>
<td>A</td>
<td>283.3 (255-317.1)</td>
<td>30.0 (27.4-33.9)</td>
<td>26.6</td>
<td>34.5 (33.6-35.4)</td>
<td>29.1 (24.3-31.4)</td>
</tr>
<tr>
<td>B</td>
<td>5.7 (4.9-6.5)</td>
<td>6.2 (5.6-6.8)</td>
<td>5.2</td>
<td>6.4 (6.3-6.6)</td>
<td>6.2 (5.8-6.5)</td>
</tr>
<tr>
<td>C</td>
<td>61.4 (45.1-79.1)</td>
<td>69.0 (63.6-75.7)</td>
<td>84.6</td>
<td>53.6 (53.1-54.1)</td>
<td>52.5 (48.5-58.3)</td>
</tr>
<tr>
<td>%</td>
<td>0.8 (0.6-1.2)</td>
<td>0.7 (0.6-0.7)</td>
<td>0.6</td>
<td>0.9 (0.9-1.0)</td>
<td>0.9 (0.9-1.0)</td>
</tr>
<tr>
<td>V</td>
<td>39.8 (56.7-62.6)</td>
<td>62.3 (60.4-64.3)</td>
<td>62.0</td>
<td>62.2 (61.3-63.0)</td>
<td>61.7 (60.6-63.7)</td>
</tr>
<tr>
<td>Stylet</td>
<td>40.4 (38.0-43.0)</td>
<td>40.2 (38.0-42.0)</td>
<td>39.5</td>
<td>40.5 (39.0-42.0)</td>
<td>43.0 (40.0-45.0)</td>
</tr>
<tr>
<td>Conus</td>
<td>20.6 (19.0-23.0)</td>
<td>21.0 (19.0-23.5)</td>
<td>20.0</td>
<td>20.0</td>
<td>22.1 (20.0-24.0)</td>
</tr>
<tr>
<td>Shaft</td>
<td>19.8 (18.0-21.0)</td>
<td>19.2 (18.5-20.0)</td>
<td>19.5</td>
<td>20.5 (19.0-22.0)</td>
<td>20.9 (20.0-21.5)</td>
</tr>
<tr>
<td>% m</td>
<td>51.1 (47.5-53.5)</td>
<td>52.2 (50.0-56.0)</td>
<td>50.6</td>
<td>49.5 (47.6-51.3)</td>
<td>51.4 (50.0-53.3)</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>185.0 (137.0-210.0)</td>
<td>164.6 (130.0-183.0)</td>
<td>180.0</td>
<td>160.0</td>
<td>161.8 (153.0-169.0)</td>
</tr>
<tr>
<td>MB</td>
<td>5.4 (57.6-60.5)</td>
<td>66.4 (60.1-76.9)</td>
<td>57.2</td>
<td>66.5</td>
<td>64.3 (62.1-68.8)</td>
</tr>
<tr>
<td>Excretory pore</td>
<td>143.2 (140.0-145.0)</td>
<td>141.8 (134.0-150.0)</td>
<td>147.0</td>
<td>140.5 (140.0-141.0)</td>
<td>150.3 (145.0-155.0)</td>
</tr>
<tr>
<td>Head + vulva</td>
<td>624.4 (555.0-671.0)</td>
<td>626.6 (540.0-680.0)</td>
<td>577.0</td>
<td>632.5 (630.0-685.0)</td>
<td>642.5 (565.0-680.0)</td>
</tr>
<tr>
<td>Tail</td>
<td>17.5 (13.0-25.0)</td>
<td>14.6 (13.0-16.0)</td>
<td>11.0</td>
<td>19.0</td>
<td>20.0 (16.0-22.0)</td>
</tr>
<tr>
<td>Tail annules</td>
<td>(8-14)</td>
<td>(8-10)</td>
<td>8</td>
<td>11</td>
<td>(11-13)</td>
</tr>
<tr>
<td>Body width</td>
<td>37.1 (33.0-42.0)</td>
<td>33.6 (30.0-38.0)</td>
<td>35.0</td>
<td>29.5 (29.0-30.0)</td>
<td>36.3 (30.0-44.0)</td>
</tr>
<tr>
<td>Anal body width</td>
<td>23.0 (21.0-27.0)</td>
<td>21.8 (19.0-24.0)</td>
<td>20.0</td>
<td>21.0 (20.0-22.0)</td>
<td>23.3 (21.0-26.0)</td>
</tr>
<tr>
<td>Head width</td>
<td>10.0 (9.5-10.5)</td>
<td>9.2 (9.0-9.5)</td>
<td>8.5</td>
<td>9.3 (9.0-9.5)</td>
<td>9.5</td>
</tr>
<tr>
<td>Head height</td>
<td>5.5 (5.0-6.0)</td>
<td>5.0 (5.0-5.0)</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>O</td>
<td>3.0</td>
<td>12.8 (11.8-14.6)</td>
<td>-</td>
<td>13.1</td>
<td>12.9 (12.2-14.0)</td>
</tr>
<tr>
<td>Phasmid</td>
<td>0.6</td>
<td>0.4</td>
<td>2</td>
<td>0.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

1 site no. 2; 2 site no. 3.

Inclined, sloping head versus clearly offset, hemispherical as in *R. uniformis* (Fig. 4 B, C). A more posterior vulva position in the Romanian individuals can also be noted (V=56.7-64.3% vs. V=50-60%). Although these differences make the final identification difficult, we consider our populations temporarily as *R. uniformis*.

**ROTYLENCUS ROBUSTUS (de Man, 1876)**

Filip’ev, 1936

(Table V and VI; Fig. 5 A-F)

Female head region hemispherical, offset (but sometimes continuous with adjacent body), with 6-8 distinct annules. Cephalic framework strongly refractive. Stylet robust, 30-42 μm long. Lateral field areolated only in the oesophageal region. Spermatheca rounded, empty. Vulva with distinct epitygma. Phasmids located on the 0-12 annule anterior to anal level. Tail rounded, more curved on dorsal side, with annulated tip.

Male not found.

Distribution: five populations collected from locations distributed along the whole range of the Romanian Carpathians at 1000-2270 m above sea level, as follows: Eastern Carpathians (two locations) sites no. 1 (Șendroia) and 11 (protected alpine grassland in the area of the Pietrosul Rodnei Biosphere Reserve); Southern Carpathians (two locations) sites no. 8 (Coasta lui Rus) and 9 (Păpușa Peak); Western Carpathians (one location) site no. 7 (Ghețar-Scărișoara) (Table I).

Remarks: by comparing the similarities and differences in the morphological characters and measurements of our specimens with other closely related *Rotylenchus* species, we finally identified them as *R. robustus* (de Man, 1876) Filip'ev, 1936 (Table V). The Romanian specimens have the lateral field areolated only anteriorly, very similar to *R. fallorobustus* as illustrated by Sher (1965) and *R. robustus* described by Brzeski (1998).

Slight differences were found regarding the morphological characters of specimens collected from the five locations; they were attributed to geographical variation (Table VI and Fig. 5 B-D). The populations collected from Rodnei and Călimăni Mts. (altitudes 2270 m and 1000 m respectively), which are two neighbouring mountains located in the Romanian Eastern Carpathians, are characterized by moderately thickened labial framework (Fig. 5 B), short body, stylet, tail and low c’ value. On the contrary, individuals collected from Metali ferm Mts. (altitude 1000 m) situated in the Romanian Western Carpathians have a more conspicuous off set head, heavily thickened labial framework (Fig. 5 D), long body, stylet and tail. Specimens collected from Parâng Mts. (altitude above 1700 m) situated in the Romanian Southern Carpathians have intermediary morphological characteristics. This population shows also continuous to slightly off set head and the least thickened labial framework (Fig. 5 C).
Fig. 4. *Rotylenchus cf. uniformis*: females; A, anterior end; B, C, head; D, reproductive system; E, F, tail.
Fig. 5. Rotylenchus robustus: females; A, anterior end; B-D head variation: B (population from Căliman Mts.); C (population from Parâng Mts.); D (population from Metaliferi Mts.); E, tail; F, reproductive system.
Table V. Comparison of the Romanian *Rotylenchus robustus* specimens with closely related *Rotylenchus* species.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Similar</th>
<th>Different</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>R. fallorobustus</em> Sher, 1965</td>
<td>Body length, head region hemispherical, slightly or not off set, head annules, lateral field areolated anteriorly only, tail dorsally more curved, body often bulging 1 or 2 annules at level of anus, vulva position, phasmid position</td>
<td>Stylet length 30-42 μm <em>vs.</em> 33-37, spermatheca conspicuous <em>vs.</em> inconspicuous</td>
</tr>
<tr>
<td><em>R. robustus</em> (de Man, 1876) Filip'ev, 1936 quoted in Castillo <em>et al.</em> (1993)</td>
<td>Body length, head region hemispherical, offset, head annules, stylet length 30.1-50 μm, vulva position</td>
<td>Lateral field areolated anteriorly only <em>vs.</em> irregularly areolated at mid-body, intestine not overlapping rectum <em>vs.</em> partially overlapping, tail rounded, more curved on dorsal side <em>vs.</em> hemispherical, phasmid located on the 0-12 annule anterior to anal level <em>vs.</em> varying from 3 annules posterior to 7 annules anterior to anal level</td>
</tr>
<tr>
<td><em>R. capitatus</em> Eroshenko, 1981</td>
<td>Head annules, lateral field areolated anteriorly only, vulva position</td>
<td>Body length 0.8-1.3 mm <em>vs.</em> 0.6-0.8 mm, stylet length 30-42 μm <em>vs.</em> 26-29 μm, head region hemispherical <em>vs.</em> truncate, oesophageal gland not short <em>vs.</em> short, tail rounded <em>vs.</em> conoid, phasmid located on the 0-12 annule anterior to anal level <em>vs.</em> partially overlapping, tail dorsally more curved, phasmid located on tail</td>
</tr>
<tr>
<td><em>R. incultus</em> Sher, 1965</td>
<td>Head region hemispherical, lateral field areolated anteriorly only, vulva position, tail dorsally more curved, phasmid position</td>
<td>Body length 0.8-1.3 mm <em>vs.</em> 0.5-1.0 mm, head offset <em>vs.</em> not offset, 6-8 head annules <em>vs.</em> 5-6, stylet 30-42 μm <em>vs.</em> 19-31, epitypyma conspicuous <em>vs.</em> inconspicuous</td>
</tr>
</tbody>
</table>

1 Considered by Seinhorst (1991) as junior synonym of *R. robustus* (de Man, 1876) Filip'ev, 1936.

Table VI. Measurements of *Rotylenchus robustus*.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>29.0</td>
<td>60.0</td>
<td>60.0</td>
<td>59.0</td>
<td>39.0</td>
</tr>
<tr>
<td>L</td>
<td>978 (860-1095)</td>
<td>972 (868-1090)</td>
<td>1061 (962-1206)</td>
<td>1081 (953-1185)</td>
<td>1255 (1168-1357)</td>
</tr>
<tr>
<td>A</td>
<td>25.6 (23.9-27.4)</td>
<td>263 (23.6-31.1)</td>
<td>28.7 (26.0-31.7)</td>
<td>28.7 (25.8-30.6)</td>
<td>33.9 (32.4-35.7)</td>
</tr>
<tr>
<td>B</td>
<td>6.7 (6.9-6.4)</td>
<td>6.0 (5.6-6.7)</td>
<td>6.7 (6.3-7.1)</td>
<td>6.9 (6.0-7.9)</td>
<td>6.5 (6.3-6.5)</td>
</tr>
<tr>
<td>C</td>
<td>60.5 (66.2-54.8)</td>
<td>62.5 (47.7-78.9)</td>
<td>55.7 (47.7-78.2)</td>
<td>54.1 (50.2-58.1)</td>
<td>48.3 (46.7-49.6)</td>
</tr>
<tr>
<td>C'</td>
<td>0.6 (0.6-0.7)</td>
<td>0.6 (0.5-0.7)</td>
<td>0.8 (0.6-1.0)</td>
<td>0.8 (0.7-1.0)</td>
<td>0.8 (0.8-0.9)</td>
</tr>
<tr>
<td>V%</td>
<td>51.7 (51.9-51.6)</td>
<td>56.5 (54.8-58.2)</td>
<td>55.2 (52.8-57.2)</td>
<td>55.6 (54.6-56.5)</td>
<td>53.6 (52.2-54.8)</td>
</tr>
<tr>
<td>Stylet</td>
<td>31.5 (30.0-33.0)</td>
<td>35.2 (32.0-37.0)</td>
<td>36.9 (36.0-38.0)</td>
<td>37.0 (34.0-41.0)</td>
<td>41.3 (40.0-42.0)</td>
</tr>
<tr>
<td>Conus</td>
<td>14.3 (16.5-12.0)</td>
<td>17.8 (17.0-18.5)</td>
<td>18.4 (17.5-20.0)</td>
<td>18.4 (17.0-21.0)</td>
<td>21.3 (21.0-22.0)</td>
</tr>
<tr>
<td>Shaft</td>
<td>17.3 (16.5-18.0)</td>
<td>17.4 (15.0-18.5)</td>
<td>18.5 (18.0-19.5)</td>
<td>18.6 (17.0-20.0)</td>
<td>20.0 (19.0-21.0)</td>
</tr>
<tr>
<td>m %</td>
<td>45.0 (50.0-40.0)</td>
<td>50.5 (48.6-53.1)</td>
<td>49.9 (48.0-52.6)</td>
<td>49.7 (47.2-51.2)</td>
<td>51.6 (50.0-52.5)</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>147.5 (125.0-170.0)</td>
<td>160.7 (145.0-175.0)</td>
<td>157.8 (145.0-170.0)</td>
<td>156.6 (145.0-180.0)</td>
<td>194.3 (185.0-208.0)</td>
</tr>
<tr>
<td>MB</td>
<td>55.9 (56.0-55.9)</td>
<td>56.6 (54.3-58.6)</td>
<td>59.2 (55.1-62.1)</td>
<td>56.5 (53.8-60.0)</td>
<td>-</td>
</tr>
<tr>
<td>Excretory pore</td>
<td>129.0 (113.0-145.0)</td>
<td>140.0 (120.0-155.0)</td>
<td>135.5 (122.0-160.0)</td>
<td>144.0 (135.0-158.0)</td>
<td>168.7 (153.0-183.0)</td>
</tr>
<tr>
<td>Head – vulva</td>
<td>505.5 (445.0-565.0)</td>
<td>548.2 (505.0-603.0)</td>
<td>585.0 (532.0-637.0)</td>
<td>601.4 (538.0-653.0)</td>
<td>671.8 (627.5-708.0)</td>
</tr>
<tr>
<td>Tail</td>
<td>16.5 (13.0-20.0)</td>
<td>16.0 (11.1-22.0)</td>
<td>19.7 (14.0-25.0)</td>
<td>20.0 (18.0-23.0)</td>
<td>26.0 (25.0-28.0)</td>
</tr>
<tr>
<td>Tail annules</td>
<td>14.0 (13.0-15.0)</td>
<td>12.5 (10.0-17.0)</td>
<td>13.7 (11.0-16.0)</td>
<td>13.4 (11.0-15.0)</td>
<td>20.7 (19.0-24.0)</td>
</tr>
<tr>
<td>Body width</td>
<td>38.0 (36.0-40.0)</td>
<td>37.2 (35.0-43.0)</td>
<td>37.0 (35.0-39.0)</td>
<td>37.6 (37.0-39.0)</td>
<td>37.0 (36.0-38.0)</td>
</tr>
<tr>
<td>Anal body width</td>
<td>25.5 (22.0-29.0)</td>
<td>26.7 (24.0-30.0)</td>
<td>25.7 (25.0-26.0)</td>
<td>25.2 (24.0-27.0)</td>
<td>31.0 (30.0-33.0)</td>
</tr>
<tr>
<td>Head width</td>
<td>10.8 (10.5-11.0)</td>
<td>11.5 (11.0-12.0)</td>
<td>11.8 (11.5-12.0)</td>
<td>11.3 (10.5-12.0)</td>
<td>13.0</td>
</tr>
<tr>
<td>Head height</td>
<td>5.3 (4.5-6.0)</td>
<td>5.6 (5.0-6.0)</td>
<td>5.8 (5.5-6.0)</td>
<td>5.9 (5.5-6.0)</td>
<td>7.0</td>
</tr>
<tr>
<td>O</td>
<td>14.3 (13.6-15.0)</td>
<td>30.6</td>
<td>12.0 (10.7-13.9)</td>
<td>31.8 (27.8-39.7)</td>
<td>-</td>
</tr>
<tr>
<td>Phasmid</td>
<td>0.5</td>
<td>4.12</td>
<td>3.10</td>
<td>4.11</td>
<td>46</td>
</tr>
</tbody>
</table>

1 site no. 10; 2 site no. 11.
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LITERATURE CITED


Geraert E. and Barooti S., 1996. Four Rotylenchus from Iran, with a key to the species. Nematologica, 42: 503-520.


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