

# Plant Parasitic Nematode Species of Tylenchida (Nematoda) Associated with Sesame (*Sesamum indicum* L.) Growing in the Mediterranean Region of Turkey

İlker KEPENEKCI

Plant Protection Central Research Institute, 06172 Yenimahalle, Ankara - TURKEY

Received: 02.04.2001

**Abstract:** Plant parasitic nematodes (Tylenchida: Nematoda) found on sesame (*Sesamum indicum* L.) growing in the Mediterranean region of Turkey were examined faunistically and taxonomically. This study was carried out in two provinces (Antalya and İçel) important for the cultivation of sesame during the summer of 1998. Samples were taken from 20 different sesame fields and examined in the laboratory. By the end of our research 23 species were identified. Two of these (*Helicotylenchus abunaamai* Siddiqi and *Paratylenchus rotundicephalus* Bajaj) are species which have never been recorded in Turkey. Their identification, distribution in the Mediterranean region, and morphological and morphometric characteristics are described. The hosts and regions of plant parasitic nematodes previously determined in the sesame cultivation areas in Turkey were collected as literature records. No record was found on the plant parasitic nematodes occurring in sesame cultivation areas in Turkey. In this first research the most common species are *Tylenchorhynchus tritici* Golden, Maqbool & Hondoo, *Scutylenchus lenorus* Brown and *Pleciortylenchus striaticeps* Volvas, Castillo & Lamberti.

**Key Words:** Nematoda, Tylenchida, Nematofauna, Sesame, Mediterranean region, Turkey

## Akdeniz Bölgesi'nde Susam (*Sesamum indicum* L.) Ekiliş Alanlarında Saptanan Tylenchida (Nematoda) Takımına Ait Bitki Paraziti Nematod Türleri

**Özet:** Bu çalışmada Akdeniz Bölgesi'nde susam (*Sesamum indicum* L.) ekiliş alanlarında saptanan Tylenchida (Nematoda) takımına ait bitki paraziti nematod türleri faunistik ve taksonomik olmak üzere iki bölümde incelenmiştir. Çalışma Akdeniz Bölgesi'nde susam ekilişi açısından önemli bir yere sahip iki il (Antalya ve İçel)'de yürütülmüştür. Bu amaçla 1998 yılının yaz aylarında toplam 20 susam tarlasından örnekler alınmış ve laboratuvarında incelenmiştir.

Çalışma sonucunda 23 tür saptanmış olup; tespit edilen türlerden *Helicotylenchus abunaamai* Siddiqi ve *Paratylenchus rotundicephalus* Bajaj Türkiye faunası için yeni kayıt niteliğindedir. Türkiye faunası için yeni olan bu türlerin tanımları, morfolojik ve morfometrik özellikleri ile literatür kayıtlarına göre konukçuları ve yayılış alanları verilmiştir. Çalışma kapsamına giren susam ekiliş alanlarında tespit edilen diğer bitki paraziti nematod türlerinin Türkiye'de daha önce tespit edilen konukçuları ve saptandığı bölgeler literatür kayıtlarına göre derlenmiştir. Ülkemizde susam ekiliş alanlarında bulunabilecek bitki paraziti nematodlarla ilgili herhangi bir kayda rastlanmamış olup; bu ilk çalışmada tespit edilen türlerden en yaygın olanların sırasıyla *Tylenchorhynchus tritici* Golden, Maqbool & Hondoo, *Scutylenchus lenorus* Brown ve *Pleciortylenchus striaticeps* Volvas, Castillo & Lamberti olduğu belirlenmiştir.

**Anahtar Sözcükler:** Nematoda, Tylenchida, nematod faunası, Susam, Akdeniz Bölgesi, Türkiye

## Introduction

Plant parasitic nematodes cause yield losses for many crops, but the economic significance of the damage caused by these parasites is generally not well understood or recognised by growers. Basic information about plant parasitic nematodes, their host associations, and occurrence in different localities in Turkey was recently described by Ökten et al. (2000), who found 172 nematode species associated with 59 plants from different localities in the country.

Sesame (*Sesamum indicum* L.) is cultivated in over 68,000 ha in Turkey (Anonymus, 1999), with the Mediterranean region of Antalya and İçel being the most important production areas.

Worldwide there is little knowledge about the plant parasitic nematodes (Tylenchida: Nematoda) associated with sesame. A review of the presence of plant parasitic nematodes on groundnuts, sunflowers, castor (*Ricinus communis*), rape, mustard, sarson, sesame and flax indicates that *Meloidogyne* spp., *Aphelenchoides*

*arachidis*, *Pratylenchus* spp., *Belonolaimus longicaudatus*, *Scutellonema cavenessi*, *Macroposthonia ornate* and *Tylenchulus brevilineatus* are commonly found (Chhabra et al., 1992). In the Federal District of Brazil during April 1993, a nematode survey was conducted in an experimental area of Embrapa Cerrados and Planaltina where 21 genotypes of sesame (*S. indicum*) were sampled for nematode presence. Four composite soil and root samples were collected from the rhizospheres of each genotype before harvest. The plant parasitic nematodes found in frequency of occurrence in genotypes were *Pratylenchus brachyurus* (100%), *Aphelenchoides* sp. (100%), *Ditylenchus* sp. (100%), *Helicotylenchus dihystera* (67%), *Paratrichodorus minor* (67%) and *Criconemalle ornate* (48%) (Sharma and Amabile, 1998).

To date no record of plant parasitic nematodes on sesame has been recorded in Turkey, hence this study was performed to determine the Tylenchida species in sesame fields of the Mediterranean region.

### Materials and Methods

The main materials of the study were soil and sesame root samples collected from 20 sesame fields in Antalya and İçel in the summer of 1998 (Figure 1), with 12 fields being in Antalya and 8 in İçel. Five root samples (50 g/sample) were collected from each sesame field. Soil samples were obtained using a spade or boring tool with a half-cylindrical blade to excavate soil to a depth of 20-30 cm. Ten soil samples (400-750 cm<sup>3</sup>/sample) were

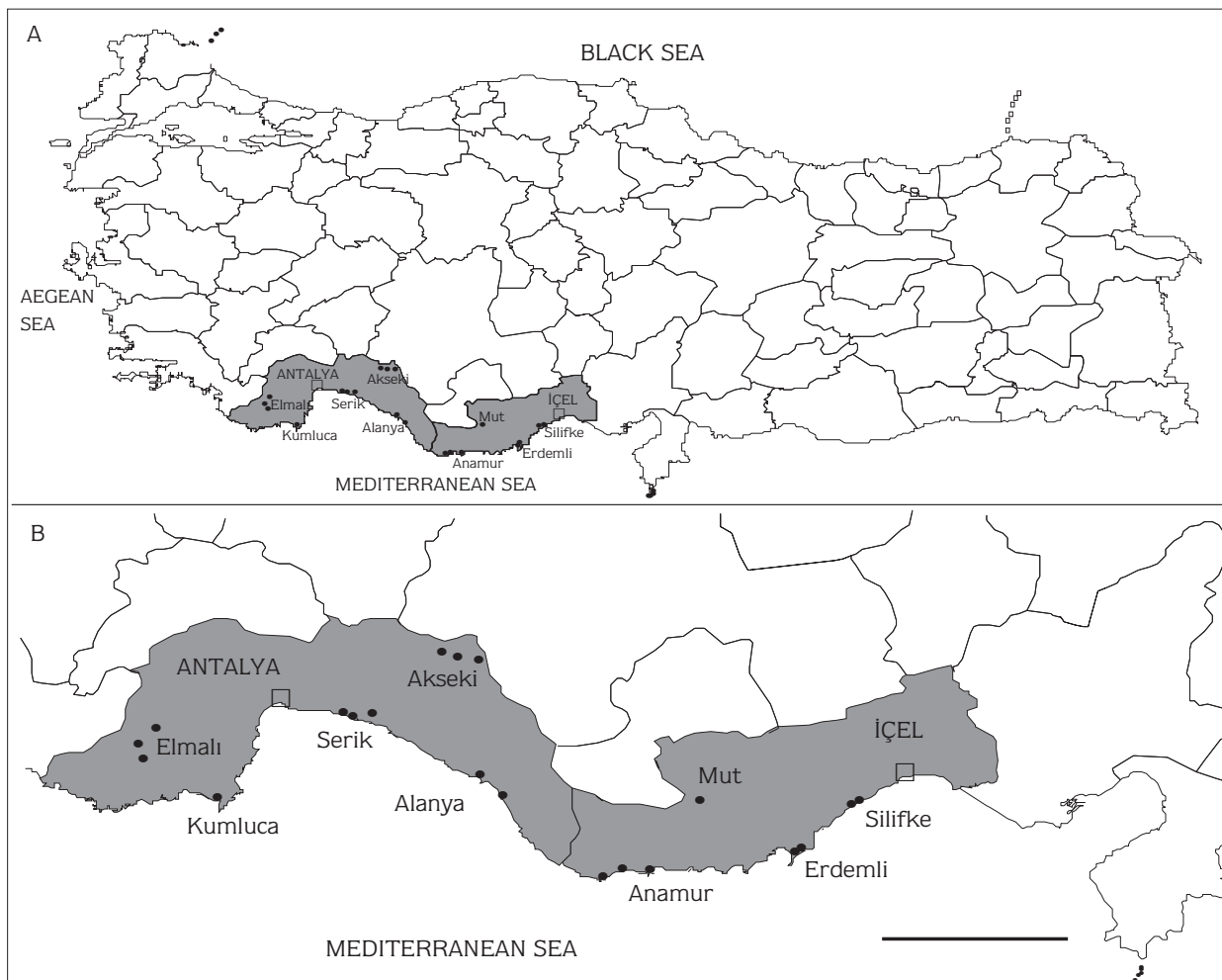


Figure 1. A) Complete map of Turkey indicating sample sites. B) Enlarged map of region indicating sample sites in İçel and Antalya (Each bar represents 100 km).

taken from each sesame field. In total, 300 root and soil samples were processed.

In laboratory studies, active nematodes were extracted from soil using a combination of sieving (nested 850, 250, 150, 75 and 45 µm-opening sieves) and Baermann funnel methods (Christie and Perry, 1951). Material collected on the two sieves with the largest openings was discarded, and material from the remaining sieves was extracted on Baermann funnels. An incubation method was used to extract the nematodes from plant roots (Young, 1954). For identification, nematodes were killed at 60 °C and fixed in TAF. Specimens were mounted

in glycerol as described by Seinhorst (1959). The slides used were prepared according to the ring method of Hooper (1986). Measurement and taxonomic identification were done according to the formula and key cited by Siddiqi (1986).

## Results and Discussion

Twenty-three species within the families Tylenchidae, Dolichodoridae, Hoplolaimidae, Pratylenchidae, Criconematidae, Hemicycliophoridae, Paratylenchidae and Anguinidae were identified (Table 1); all of them are new

Table 1. Species of Tylenchida (Nematoda) fauna on sesame (*Sesamum indicum* L.) in the Mediterranean region of Turkey and documented host range reported from Turkey.

Nematode species, Identified on sesame (Family)	Host association, Common name- species name (distribution in Turkey) <sup>1</sup>	Reference <sup>2</sup>
<i>Coslenchus diversus</i> Lal & Khan (Tylenchidae)	Rice- <i>Oryza sativa</i> L. (3,6); Walnut- <i>Juglans regia</i> L. (20); Peach- <i>Prunus persica</i> (L.) Batch. (16,4); Olive- <i>Olea europaea</i> L. (16); Hazelnut- <i>Corylus</i> sp. (7,10, 34) Sesame- <i>Sesamum indicum</i> L. (16)	i; n; o; ö; ş This study
<i>Basiria dublexa</i> Hagemeyer & Allen (Tylenchidae)	Bean- <i>Phaseolus vulgaris</i> L. (3,33); Peach (8); Olive (15,8) Sesame (4)	i; o; ö This study
<i>Neopsilenchus peshawarensis</i> Shahina & Maqbool (Tylenchidae)	Tobacco- <i>Nicotiana</i> sp. (29,30); Plum- <i>P. domestica</i> L. (4); Walnut (20); Apricot- <i>P. armeniaca</i> L. (1); Olive (8); Sunflower- <i>Helianthus annuus</i> L. (21) Sesame (4)	i; r; n; o; ö; p This study
<i>Tylenchorhynchus claytoni</i> Steiner (Dolichodoridae)	Bean (3, 24); Olive (34,32,8,4,16) Sesame (4)	i; ö This study
<i>T. cylindricus</i> Cobb (Dolichodoridae)	Vegetables (13); Bean (3,33,2); Tomato- <i>Lycopersicum esculentum</i> Mill. (3); Walnut (34,26); Chestnut- <i>Castanea sativa</i> Miller (34); Peach (16); Olive (4); Sainfoin- <i>Onobrychis sativa</i> Lam. (3); Hazelnut (7) Sesame (16)	c; i; h; n; n; o; ö; g; ş This study
<i>T. tritici</i> Golden, Maqbool & Hondoo (Dolichodoridae)	Barley- <i>Hordeum vulgare</i> L. (13); Wheat- <i>Triticum aestivum</i> L. (13); Chestnut (20); Apricot- <i>P. armeniaca</i> L. (4); Olive (1) Sesame (4,16)	f; f; n; o; ö This study
<i>Bitylenchus goffarti</i> Sturhan (Dolichodoridae)	Potato- <i>Solanum tuberosum</i> L. (9,18); Ornamental plant (17); Onion- <i>Allium cepa</i> L. (24,19); Corn- <i>Zea mays</i> L. (1,23,4); Tomato (1,23,4); Groundnut- <i>Arachis hypogaea</i> L. (1,23,4); Chickpea- <i>Cicer arietinum</i> L. (33,25); Olive (1,4) Sesame (4)	ğ; e; u; ç; ç; i; ö This study
<i>Quinisolcius acutus</i> Allen (Dolichodoridae)	Tomato (3); Walnut (26,20); Apricot (8); Peach (15); Olive (16) Sesame (4)	h; n; o; o; ö This study
<i>Amplimerlinius dubius</i> Steiner (Dolichodoridae)	Watermelon- <i>Citrullus vulgaris</i> Schrad. (17); Onion (19); Bean (3); Chestnut (14); Peach (4) Sesame (4)	ü; u; i; n; o This study
<i>Scutylenchus lenorus</i> Brown (Dolichodoridae)	Kiwi fruit- <i>Actinidia deliciosa</i> cv Hayward (14); Walnut (26); Apricot (16); Olive (14); Hazelnut (7,10,34); Apple- <i>Pyrus malus</i> L. (8,15) Sesame (4,16)	m; n; o; ö; ş; t This study

Table 1. Continued.

Nematode species, Identified on sesame (Family)	Host association, Common name- species name (distribution in Turkey) <sup>1</sup>	Reference <sup>2</sup>
<i>Hoplolaimus galeatus</i> (Cobb) (Hoplolaimidae)	Vegetables (13); Kidney bean- <i>Dolichos lubia</i> Fornk (15); Plum (15); Chestnut (30); Peach (15); Olive (32,15); Sunflower (21); Apple (15) Sesame (16)	c; i; r; n; o; ö; p; t  This study
<i>Rotylenchus cypriensis</i> Antoniou (Hoplolaimidae)	Vine- <i>Vitis vinifera</i> L. (16); Tomato (3); Rose- <i>Rosa damascana</i> Mill. (15); Olive (16,4,1); Rice (3); Apple (8) Sesame (4)	ç; h; a; ö; g; t  This study
<i>Helicotylenchus abunaamai</i> Siddiqi (Hoplolaimidae) <sup>3</sup>	Sesame (16)	This study
<i>H. tunisiensis</i> Siddiqi (Hoplolaimidae)	Tomato (3); Chickpea (3,33); Bean (8); Tomato (3); Kidney bean (15); Walnut (26); Peach (8,15); Olive (16) Sesame (4)	h; i; i; i; i; n; o; ö  This study
<i>Pleciorotylenchus striaticeps</i> Volvas, Castillo & Lamberti (Hoplolaimidae)	Vine (27); Wheat (1,23,22); Citrus- <i>Citrus</i> sp. (1,23,22); Olive (4,1,16) Sesame (4,16)	y; d; d; ö This study
<i>Pratylenchus mediterraneus</i> Corbett (Pratylenchidae)	Vine (16); Olive (4) Sesame (4)	ç; ö This study
<i>P. vulnus</i> Allen & Jensen (Pratylenchidae)	Pepper- <i>Capsicum annum</i> L. (17); Rose- <i>Rosa</i> sp. (17); Ornamental plant (18) Sesame (4,16)	v; e; b This study
<i>Pratylenchoides erzurumensis</i> Yüksel (Pratylenchidae)	Mulberry- <i>Morus</i> sp. (12); Plum (4,8,15,34,32); Olive (13); Apple (8,15) Sesame (16)	z; r; ö; t This study
<i>P. ritteri</i> Sher (Pratylenchidae)	Bean (33,3,19); Walnut (26); Peach (8); Olive (15,4,16); Apple (8,15) Sesame (4,16)	i; n; o; ö; t This study
<i>Hemicriconemoides gaddi</i> Loos (Criconeematidae)	Tomato (33); Plum (16,4,34,26,32); Walnut (34); Apricot (16); Olive (34); Sunflower (11); Apple (8) Sesame (4)	i; r; n; o; ö; p; t  This study
<i>Hemicycliophora sturhani</i> Loof (Hemicycliophoridae)	Loquat- <i>Eriobotrya japonica</i> Ldl. (16); Chestnut (20,30); Apricot (16); Olive (16,4); Sunflower (11); Plum (16,32); Hazelnut (34) Sesame (16)	j; n; o; ö; p; r; ş  This study
<i>Paratylenchus rotundicephalus</i> Bajaj (Paratylenchidae) <sup>3</sup>	Sesame (4)	This study
<i>Safianema anchilispoma</i> Tarjan (Anguinidae)	Melon- <i>Cucumis melo</i> L. (17); Rose (15); Tobacco (29,30); Tea- <i>Camellia sinensis</i> L. (28); Plum (14,29,30); Walnut (26); Apricot (8); Olive (15,16,29,32); Sunflower (31); Hazelnut (10) Sesame (4)	v; a; l; k; r; n; o; ö; p; ş  This study

<sup>1</sup>Distribution: 1 = Adana, 2 = Afyon, 3 = Ankara, 4 = Antalya, 5 = Aydın, 6 = Balıkesir, 7 = Bartın, 8 = Burdur, 9 = Çanakkale, 10 = Düzce, 11 = Edirne, 12 = Erzurum, 13 = Eskişehir, 14 = Giresun, 15 = Isparta, 16 = İçel, 17 = İstanbul, 18 = İzmir, 19 = Karaman, 20 = Kastamonu, 21 = Kırklareli, 22 = Konya, 23 = Mersin, 24 = Nevşehir, 25 = Niğde, 26 = Ordu, 27 = Osmaniye, 28 = Rize, 29 = Samsun, 30 = Sinop, 31 = Tekirdağ, 32 = Trabzon, 33 = Yozgat, 34 = Zonguldak.

<sup>2</sup>Reference: a = Akgül (1996), b = Borazancı (1977), c = Ediz and Enneli (1978), ç = Elekçioğlu (1992), d = Elekçioğlu (1996), e = Ercan (1976), f = Erentuğ (Akyol) (1997), g = Erkol (2002), ğ = Ertürk et al. (1973), h = Kepenekci (1994), ı = Kepenekci et al. (1998), i = Kepenekci (1999a), j = Kepenekci (1999b), k = Kepenekci and Akgül (1999), l = Kepenekci and Ökten (1999), m = Kepenekci and Öztürk (1999), n = Kepenekci (2001a), o = Kepenekci (2001b), ö = Kepenekci (2001c), p = Kepenekci (2001d), r = Kepenekci et al. (2001), s = Kepenekci (2002), ş = Kepenekci and Öztürk (2002), t = Kepenekci and Zeki (2002), u = Öztürk (1990), ü = Saltukoğlu (1973), v = Saltukoğlu (1974), y = Volvas et.al. (1993), z = Yüksel (1977).

<sup>3</sup> Species determined for the first time in Turkey.

records for sesame in Turkey. The distribution of the determined species in Turkey and the other host associations are given in Table 1. Two species of root-lesion nematodes (*Pratylenchus mediterraneus* and *P. vulnus*), one species of pin nematodes (*Paratylenchus rotundicephalus*), one species of sheathoid nematodes (*Hemicriconemoides gaddi*) and one species of sheath nematodes (*Hemicycliophora sturhani*) were found in sesame fields, but symptoms of nematode infestation were not evident. Other nematodes found in the soil were species of *Coslenchus*, *Basiria*, *Neopsilenchus*, *Tylenchorhynchus*, *Bitylenchus*, *Quinisulcius*, *Amplimerlinius*, *Scutylenchus*, *Hoplolaimus*, *Rotylenchus*, *Helicotylenchus*, *Pleiorotylenchus*, *Pratylenchoides* and *Safianema*. Plant parasitic nematodes, such as root-knot, sting, stem and ring nematodes reported in other studies in sesame fields (Chhabra et al., 1992; Sharma and Amabile, 1998), were not found in the present survey. Of

the 23 species of plant parasitic nematodes found in Turkey, the species *Helicotylenchus abunaamai* and *Paratylenchus rotundicephalus* were determined for the first time in our study of sesame. The identification and distribution of these two new Turkish nematofauna species in the areas of this study, including their habitat, literature records, and morphological and morphometric characteristics are given.

#### Identification and distribution of two new Turkish nematofauna species

Species: *H. abunaamai* Siddiqi, 1972 (Figure 2A and Table 2.)

Taxonomic status: Order: Tylenchida; Suborder: Tylenchina; Superfamily: Hoplolaimoidea; Family: Hoplolaimidae; Subfamily: Rotylenchoidinae; Genus: *Helicotylenchus* Steiner, 1945

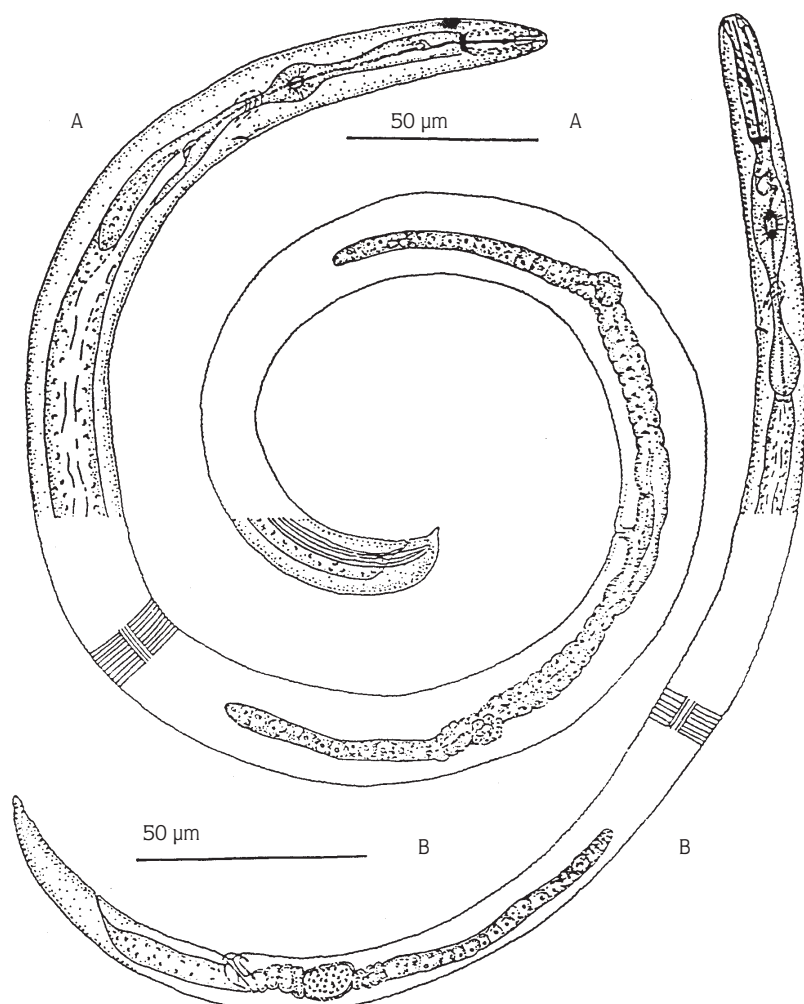


Figure 2. A. *Helicotylenchus abunaamai*. B. *Paratylenchus rotundicephalus*.

Morphology:

Female: After fixation, body in loose spiral shape. Lip region hemispheroidal, continuous, with 4-5 distinct annules. Stylet  $21.2 \pm 0.8$  (20-22)  $\mu\text{m}$  long, with basal knobs flattened to slightly concave anterior surfaces. Dorsal oesophageal gland opening about  $10.4 \pm 0.09$ (9-11)  $\mu\text{m}$  behind stylet base. Neck length  $115.6 \pm 4.8$  (108-135)  $\mu\text{m}$ . Median oesophageal bulb developed, oval, muscular, valves and its center  $65.4 \pm 3.1$  (59-72)  $\mu\text{m}$  from the anterior end. Nerve ring in the centre of isthmus. Excretory pore opening at level of beginning of oesophageal gland,  $72.4 \pm 2.8$  (65-81)  $\mu\text{m}$  from the anterior end. Hemizonid 2-3 annules long and two annules anterior to excretory pore. Reproductive system didelphic, oocytes in single row except at multiplication region. Spermatheca rounded, empty and dorsally offset. Phasmids  $6.5 \pm 1.1$  (5-8) annules anterior to anus. Tail end tapers regularly up to distal third then becomes ventrally convex and dorsally concave appearing smooth and subdigitate with a narrow, hemispheroidal terminus;  $7.8 \pm 0.9$  (4-9) annules on tail ventrally; phasmids  $4.8 \pm 0.9$  (3-7) annules anterior to anal level.

Male: Not found.

Discussion: This description of *H. abunaamai* agrees with the original description of the species from Sudanese specimens (Siddiqi, 1972) (Table 2) as well as a later description from Malaysian specimens (Sauer and Winoto, 1975) and Ethiopian specimens (Abebe and Geraert, 1995). This is the first report of this species from Turkey.

Habitat and Locality: The species was detected at first by Siddiqi (1972) in Abu Naama and the northern Fung area (Central Sudan) from the soil around roots of *Citrus paradisi*. It was also found around the roots of *Psidium guajava*, *Vitis vinifera* and *Gossypium hirsutum* in the same locality. In this study, it was found in soil samples from fields with sesame (*S. indicum*) in Silifke, Erdemli and Anamur (İçel) in Turkey.

Species: *P. rotundicephalus* Bajaj, 1987 (Figure 2B and Table 2.)

Taxonomic status: Order: Tylenchida; Suborder: Criconematina; Superfamily: Tylenchuloidea; Family: Paratylenchidae; Subfamily: Paratylenchinae; Genus: *Paratylenchus* Micoletzky, 1922

Table 2. Comparisons of some measurements of females belonging to different populations of *Helicotylenchus abunaamai* and *Paratylenchus rotundicephalus*.

	<i>Helicotylenchus abunaamai</i>		<i>Paratylenchus rotundicephalus</i>	
	Present study	Siddiqi (1972)	Present study	Bajaj (1987)
n	18	12	15	11
L <sup>1</sup>	624 ± 32(582-697)	520-630(560)	344 ± 58(323-358)	340 ± 16(300-370)
a	28.4 ± 1.8(27-31)	25-29(26.5)	26.5 ± 0.9(25-29)	24.4 ± 1.1(23-27)
b	6.2 ± 0.3(5.8-6.9)	5.5-6.7(5.8)	4.2 ± 0.1(4.0-4.5)	4.15 ± 0.27(3.8-4.6)
b'	4.4 ± 0.9(3.9-5.0)	4.5-5.1(4.65)	-	-
c	44.8 ± 4.4(38-55)	33-44(38)	12.6 ± 0.3(10-14)	12.9 ± 0.7(12-14)
c'	1.27 ± 0.1(1.1-1.4)	1.10-1.42(1.3)	3.8 ± 0.8(3.1-4.5)	3.14 ± 0.34(2.7-3.6)
V <sup>2</sup>	60.4 ± 2.2(57-62)	59-65(61.5)	82.4 ± 1.3(79-85)	82.1 ± 1.1(81-84)
Stylet <sup>1</sup>	21.2 ± 0.8(20-22)	21-22(21.6)	26.8 ± 1.1(26-28)	26.7 ± 0.8(26-27)
Ran	7.8 ± 0.9(4-9)	7-11(9)	-	-
Ex. <sup>3,1</sup>	-	-	71.2 ± 2.3(65-75)	72.3 ± 3.4(66-77)
Phas. <sup>4</sup>	4.8 ± 0.9(3-7)/	1-5(2.5)/	-	-

<sup>1</sup>  $\mu\text{m}$ , <sup>2</sup> %, <sup>3</sup> Distance from anterior end to excretory pore, <sup>4</sup> Anterior/Posterior

L= body length; W= maximum body width; ES= oesophageal length; T= tail length; a= L / W; b= L / ES; b'= L / distance from head end to posterior end of oesophageal glands; c= L / T; c'= T / body width at anus; V%= distance from head end to vulva / L; Ran= number of annules on tail.

**Morphology:**

Female: After fixation, body slightly ventrally curved. Body annules distinct. Lateral field occupying 1/3-1/4 of body width, with four incisures. Head annules 4-5 clearly visible in a few specimens. Stylet  $26.8 \pm 1.1$  (26-28)  $\mu\text{m}$  long with basal knobs indented anteriorly. Dorsal oesophageal gland opening approximately  $7.2 \pm 0.8$  (6-9)  $\mu\text{m}$  posterior to the stylet base. Median oesophageal bulb elongated. Isthmus slender, basal bulb pyriform. Excretory pore 1-2 annules posterior to hemizonid, anterior or at the level of basal oesophageal bulb. Reproductive system monodelphic. Ovary outstretched. Spermatheca rounded-oval, full of sperm. Postvulval uterine sac absent. Lateral vulval membranes present. Vulval flap distinct. Tail conoid and straight with a finely rounded terminus.

Male: Not found

Discussion: This description of *P. rotundicephalus* agrees with the original description of the species from

Indian specimens (Bajaj, 1987) (Table 2). This is the first report of this species from Turkey.

Habitat and Locality: The species was detected at first by Bajaj (1987) in Rawalwas village and Hisar (India) taken from soil around the roots of *Cajonus cajan*. In this study, it was found in soil samples from sesame (*S.indicum*) fields in Serik and Alanya (Antalya) in Turkey.

The most common species of the research areas were *Tylenchorhynchus tritici*, *Scutylenchus lenorus* and *Pleciorotylenchus striaticeps*.

As can be understood from Table 1, *T. tritici* was determined in barley, wheat, chestnut, apricot and olive; *S. lenorus* was determined in kiwi fruit, walnut, apricot, olive and hazelnut; and *P. striaticeps* was determined in vine, wheat, citrus and olive in Turkey previously.

Although the survey cannot be considered exhaustive, it indicates that several nematodes are associated with sesame. More investigations are required to fully elucidate the role that nematodes play in sesame production in Turkey.

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