

**PLANT-PARASITIC NEMATODES ASSOCIATED WITH CABBAGES  
(*BRASSICA OLERACEA*) IN SAMSUN (MIDDLE BLACK SEA REGION), TURKEY**

Sevilhan Mennan<sup>1\*</sup> and Zafar A. Handoo<sup>2</sup>

<sup>1</sup>Ondokuz Mayıs University, Agricultural Faculty, Plant Protection Department, 55139, Samsun, Turkey, <sup>2</sup>United States Department of Agriculture, Agricultural Research Service, Henry A. Wallace Beltsville Agricultural Research Center, Plant Sciences Institute, BARC-West, Bldg. 011A, Rm. 165B, Beltsville, MD 20705-2350, USA, e-mail: handooz@ba.ars.usda.gov. \*Corresponding author: smennan@omu.edu.tr

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ABSTRACT

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A survey was conducted in Samsun (Middle Black Sea Region), Turkey to study the occurrence of plant-parasitic nematodes associated with cabbage varieties (*Brassica oleracea*). A total of 101 soil and root samples containing mixed populations of 10 genera and 11 species belonging to 7 families of the order Tylenchida were analyzed. Lesion (*Pratylenchus thornei*), spiral (*Helicotylenchus* sp.) and cyst forming (*Heterodera cruciferae* and *Heterodera mediterranea*) nematodes were the most frequently encountered nematode plant pests. Cyst forming nematodes were detected in 45 (45%) soil samples collected from 101 cabbage fields. The majority of these samples 78% (35) were infested with *Heterodera cruciferae* and 20% (9) with *H. mediterranea* and a single sample had a mixed population of both *H. mediterranea* and *H. cruciferae*. This survey yielded the first report of *H. mediterranea* in Turkey and the first record of white and red head cabbages being hosts for this and two lesion nematodes (*Pratylenchus thornei* and *P. neglectus*).

*Key words:* *Brassica oleracea*, *Helicotylenchus* sp., *Heterodera cruciferae*, *H. mediterranea*, kale, nematode survey, *Pratylenchus thornei*, Turkey, Tylenchida.

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RESUMEN

Mennan, S., and Z. A. Handoo. 2006. Nematodos fitoparásitos asociados con coles (*Brassica* spp.) en Samsun (Región Central del Mar Negro), Turquía. *Nematropica* 36:99-104.

Se realizó un censo en Samsun (Región Central del Mar Negro), Turquía para estudiar la presencia de nematodos fitoparásitos asociados con variedades de coles (*Brassica oleracea*). Se analizaron 101 muestras de suelo y raíces con poblaciones mixtas de 10 géneros y 11 especies pertenecientes a 7 familias del orden Tylenchida. Los nematodos fitoparásitos más frecuentemente hallados fueron el nematodo lesionado (*Pratylenchus thornei*), espiral (*Helicotylenchus* sp.) y formadores de quistes (*Heterodera cruciferae* y *Heterodera mediterranea*). Se detectaron nematodos formadores de quistes en 45 (45%) de las muestras de suelo colectadas en 101 cultivos de repollo. La mayoría de estas muestras 78% (35) contenía *Heterodera cruciferae* y 20% (9) contenía *H. mediterranea*, con una sola muestra que contenía mezclas de ambas especies. Este censo arrojó el primer registro de *H. mediterranea* en Turquía y el primer registro de repollo blanco y rojo como hospedantes de este nematodo y de dos nematodos lesionadores (*Pratylenchus thornei* and *P. neglectus*).

*Palabras claves:* *Brassica oleracea*, censo de nematodos, coles, *Helicotylenchus* sp., *Heterodera cruciferae*, *H. mediterranea*, *Pratylenchus thornei*, Turquía, Tylenchida.

Cabbages are cultivated over 7058.5 ha in Samsun (Northern part of Turkey) (Fig. 1). White head cabbage (*Brassica oleracea* L. var. *capitata* L. subvar. *alba*), red head cabbage (*Brassica oleracea* L. var. *capitata* L. subvar. *rubra*), and kale (*Brassica oleracea* L. var. *acephala*) are the most common varieties, which produced in 2004, 87.6, 60.1 and 41.1 tons respectively (Anonymous, 2005, Balkaya and Yanmaz, 2005). According to Potter and Olthof (1993), several species of plant-parasitic nematodes have been found associated with cabbages in different countries.

However, no information is available on nematodes associated with cabbages in Samsun, especially on subvarieties (white head, red head and kale). Okten *et al.* (2000) reported the presence of the following plant-parasitic nematodes on cabbages in Turkey: *Filenchus thornei* (Andrassy, 1954) Andrassy, 1963, *Tylenchus davanei* Bastian, 1865, *Basiria graminophila* Siddiqi, 1959, *Merlinius bavaricus* (Sturhan, 1966) Siddiqi, 1970, and *M. brevidens* (Allen, 1955) Siddiqi, 1970. Saltukoğlu (1974) had earlier observed *M. pseudobaviricus* Saltukoğlu, Geraert & Coomans, 1976, on *B. oleracea* var. *capitata* in the Istanbul area (Fig. 1). *Merlinius nanus* (Allen, 1955), Siddiqi, 1970, was identified by Okten *et al.* (2000) on *B. oleracea* var. *capitata* in Ankara (Middle Anatolia) and *Heterodera cruciferae* had been identified on *B. oleracea* var. *capitata* in Erzurum (Eastern Part of Turkey) by Yüksel (1966; 1973), Ecevit (1975) and Bora (1970). There are no records of nematodes found on kale in Turkey.

The identification of nematode plant pests occurring in crop growing areas is essential for forecast of crop losses induced by these organisms. Hence, the purpose of this study was to determine the plant-parasitic nematodes that are associated with cabbages in Samsun (Northern part of Turkey), that may have a significant impact on agriculture in that production area.

Surveys were carried out in Samsun (Middle Black Sea Region) during 2002, 2004 and 2005 (Fig. 1). A total of 101 soil and root samples were collected to a depth of approximately 20 cm, from the root zone of cabbage crops. Plants were selected among stunted and wilted ones, and a minimum of five plants were taken as representing 1 field according to field size. Soil samples were obtained by using a spade and approximately twelve liters of soil were obtained by compositing samples from 5-10 locations within an area of 1 ha at each field (Young, 1990). All subsamples were mixed thoroughly, and divided appropriately to obtain a representative sample of 1000 ml of soil and roots. The soil was immediately placed in plastic bags and transported to the laboratory. The roots of at least three cabbage plants were taken also representing one surveyed field.

Vermiform nematodes were extracted from 15 samples with five representative samples each of white and red head cabbages and kale from the surveyed areas. The nematodes were recovered from 100 ml soil by Cobb's sieving and decanting technique followed by a modified Baermann funnel method (Hooper, 1986a). For identification, specimens were killed in 60°C hot water, fixed in TAF and mounted in glycerol by using the ring method (Hooper, 1986b). An incubation method was used to extract the nematodes from cabbage roots (Young, 1954). Nematode identifications were confirmed with taxonomic keys (Siddiqi, 2000; Handoo and Golden, 1989).

Root-knot nematodes were extracted from roots which were washed free of soil and examined for galling and root-knot infection. Root-knot nematodes were isolated from galled roots and identified by the examination of perineal patterns of adult females as well as the characters of the second-stage juveniles (Eisenback *et al.*, 1981).

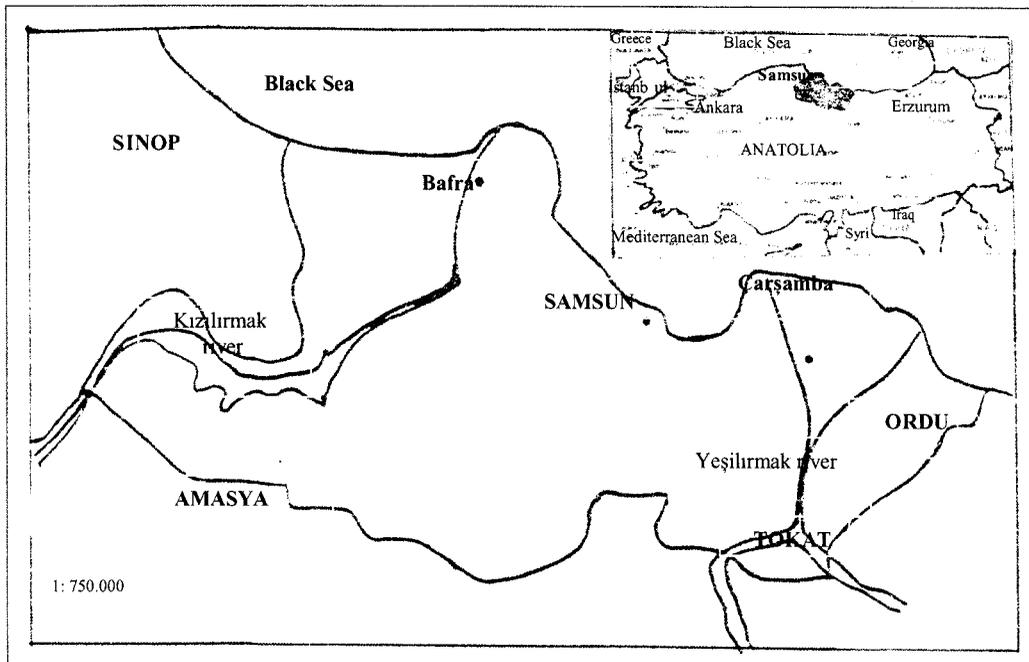


Fig. 1. Surveyed area and map of Turkey.

Cyst forming nematodes were extracted from 101 soil samples: 31 from white head cabbage, 34 from red head cabbage and 36 from kale fields. Cysts were extracted from air-dried soil samples and the roots of two plants by a sieving method (nested 30-60), using the remainder of each composite sample that had been placed in an open paper bag and allowed to air dry thoroughly for about 2 weeks, and then a 1000 ml sub sample of dry soil was used to extract the cysts. A sieving method was used to obtain the cysts, which were counted in 6 cm diameter plastic petri dishes after collection with a coated sable skin brush under a stereo binocular microscope (Leica, S6D). Juveniles for morphological observation were recovered from cysts incubated in water in watch glasses. Juveniles were fixed in 3% formaldehyde solution and processed to glycerine by the formalin-glycerine method (Golden, 1990; Hooper,

1970). Cysts were fixed in 3% formaldehyde solution. The vulval cone region was excised and embedded in a heated drop of glycerine jelly on a cover slip and sealed between cover slips held in aluminum holders. The morphological and morphometric characters were examined with a light microscope, and nematodes were identified through use of taxonomic keys (Mulvey & Golden, 1983; Golden, 1986).

Nematodes in 10 genera and 11 species belonging to 7 families of order Tylenchida were found in association with cabbages (*Brassica oleraceae*) from 15 samples (Table 1). Lesion (*Pratylenchus thornei*), spiral (*Helicotylenchus* sp.), and cyst forming (*Heterodera cruciferae* and *H. mediterranea*) nematodes were the most frequently encountered. Two species of lesion nematode (*Pratylenchus thornei* and *P. neglectus*), one species of root-knot nematode (*Meloidogyne incognita*), and two species of cyst forming nem-

Table 1. Tylenchida species found on *Brassica oleraceae* fields in Samsun, Middle Black Sea Region, Turkey.

Nematode species	Family	Frequency of occurrence (%)
<i>Tylenchus</i> sp. Bastian, 1865	Tylenchidae	18
<i>Irantylenchus</i> sp. Kheiri, 1972	Tylenchidae	20
<i>Filenchus thornei</i> (Andrassy, 1954) Andrassy, 1963	Tylenchidae	36
<i>Pratylenchus thornei</i> Sher & Allen, 1953	Pratylenchidae	54
<i>Pratylenchus neglectus</i> (Rensch, 1924) Filipjev & Schuurmans Stekhoven, 1941	Pratylenchidae	31
<i>Zygotylenchus</i> sp. Siddiqi, 1963	Pratylenchidae	12
<i>Helicotylenchus</i> sp. Steiner, 1945	Hoplolaimidae	46
<i>Paratylenchus</i> sp. Micoletzky, 1922 (Siddiqi, 1986)	Paratylenchidae	1
<i>Amplimerlinius</i> sp. Siddiqi, 1976	Telotylenchidae	2
<i>Meloidogyne incognita</i> Kofoid & White, 1945	Meloidogynidae	2
<i>Heterodera</i> spp. A. Schmidt, 1871	Heteroderidae	42

atode (*H. cruciferae* and *H. mediterranea*) were observed in both soil and root samples. Except for cyst forming nematodes, root nematode populations were low in the root samples and did not cause root symptoms. All other nematodes were found only in soil samples. Among extracted nematodes from soil, three of them were not plant pests (*Tylenchus* sp. Bastian, 1865, *Irantylenchus* sp. Kheiri, 1972, and *Filenchus thornei* (Andrassy, 1954) Andrassy, 1963)).

Previously, there was no record of nematodes associated with cabbage subvarieties in Turkey. Thus, all of the species reported here are new records for cabbage on subvarieties (white and red head cabbages, and kale) in Turkey. Among the subvarieties, kale had the lowest number of plant parasitic nematodes both for lowest number of nematode species and total parasitic nematode population.

Cysts were detected in 45 soil samples collected from cabbage fields. Single populations of *H. cruciferae* Franklin, 1945 (Skarbilovich, 1959) and *H. mediterranea* Vovlas, Inserra and Stone, 1981 were

found in 78% (35) and 20% (9) of them, respectively. Only one sample had a mixed population of these species (Table 2). The finding of *H. mediterranea* on white and red cabbage in Turkey represents a new host and country record. It belongs to the *goettingiana* group and is closely related to *H. cruciferae*. However, it differs from *H. cruciferae* by having shorter second-stage juvenile body, tail and hyaline tail portion and by the longer male stylet and different cyst cone morphology. The presence of well developed bullae distinguishes it from *H. goettingiana*.

*Heterodera cruciferae* had been identified on *B. oleracea* var. *capitata* in Erzurum earlier by Yuksel (1966; 1973), Ecevit (1975) and Bora (1970), but not in Samsun. *Heterodera mediterranea* was described on *Pistacia lentiscus* in Southern Italy for the first time by Vovlas *et al.* (1981), Vovlas and Inserra (1983) have shown *H. mediterranea* feeds and multiplies on olive roots and on two species of *Pistacio* (*P. lentiscus* and *P. vera*), and Castillo *et al.*, (1999) described infection of olive trees by *H. mediterranea* in orchards in southern Spain.

Table 2. Cyst forming nematodes found associated with *Brassica oleraceae* fields in Samsun, Middle Black Sea Region, Turkey.

Cabbage variety	Samples collected	Infested samples	<i>Heterodera</i> species		
			<i>H. cruciferae</i> (H.c.)	<i>H. mediterranea</i> (H.m.)	H.c. + H.m.
White head	31	18	16	2	0
Red head	34	24	16	7	1
Kale	36	3	3	0	0

\*Cyst numbers in 1000 ml soil samples.

The maximum number of *H. mediterranea* cysts, (1160/1000 cm<sup>3</sup> soil) was found in an infested red head cabbage field in Bafra plain (Karpuzlu town); a white head cabbage field in the same town had a maximum of 947 cysts of *H. cruciferae*. Only 7 cysts of *H. cruciferae* were recovered from kale, and *H. mediterranea* was not found in kale growing areas. In addition, it was interesting to note that other plant-parasitic nematodes associated with kale were in very low numbers, and this information could be of potential importance for further research for developing effective management strategies, and in evaluating the use of kale as an alternative to chemicals for use in cabbage production in Turkey.

This survey should help in determining which plant-parasitic nematodes may be involved in plant disease problems in Turkey. It also provides a basis for estimating how widespread and severe those problems are.

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