

Plant parasitic nematodes and their population densities in important crops in Hatay province of Türkiye

Türkiye'nin Hatay ilinde yetiştirilen önemli kültür bitkilerinde belirlenen bitki paraziti nematodlar ve popülasyon yoğunlukları

Ahmet Emin YILDIRIM¹, Erdal SERTKAYA¹, İbrahim Halil ELEKÇİOĞLU²

¹Hatay Mustafa Kemal University, Faculty of Agriculture, Department of Plant Protection, Hatay, Türkiye.

²Cukurova University, Faculty of Agriculture, Department of Plant Protection, Adana, Türkiye.

ARTICLE INFO	ABSTRACT
<p>Article history: Recieved / Geliş: 26.03.2025 Accepted / Kabul: 23.05.2025</p> <p>Keywords: Hatay Plant parasitic nematod</p> <p>Anahtar Kelimeler: Hatay Bitki paraziti nematod</p> <p>✉Corresponding author/Sorumlu yazar: Ahmet Emin YILDIRIM aeyildirim@mku.edu.tr</p> <p>Makale Uluslararası Creative Commons Attribution-Non Commercial 4.0 Lisansı kapsamında yayınlanmaktadır. Bu, orijinal makaleye uygun şekilde atıf yapılması şartıyla, eserin herhangi bir ortam veya formatta kopyalanmasını ve dağıtılmasını sağlar. Ancak, eserler ticari amaçlar için kullanılamaz. © Copyright 2022 by Mustafa Kemal University. Available on-line at https://dergipark.org.tr/tr/pub/mkutbd This work is licensed under a Creative Commons Attribution-Non Commercial 4.0 International License.</p> 	<p>This study was conducted between 2017 and 2021 in areas of Hatay province where important crops are grown. A total of 104 soil samples were taken from vineyards, bell pepper, wheat, tomato, corn, cotton, stone fruit and olive orchards throughout the province to reflect agricultural production patterns. Motile nematodes of different morphological types were isolated from the soil samples using the modified Baermann method. The isolated nematodes were fixed in glycerol and morphometric and allometric measurements were performed using a light microscope. Some species were also identified by molecular methods. The identification studies revealed 11 different species of plant-parasitic nematodes belonging to three orders, ten families and eleven genera. The following species were identified: <i>Aphelenchoides</i> sp. and <i>Aphelenchus avenae</i>, belonging to the order <i>Aphelenchida</i>; <i>Ditylenchus</i> sp. <i>Heterodera latipons</i>, <i>Meloidogyne incognita</i>, <i>M. javanica</i>, <i>Merlinius brevidens</i>, <i>M. microdorus</i>, <i>Paratylenchus</i> sp., <i>Pratylenchus neglectus</i>, <i>P. thornei</i>, <i>Rotylenchulus macrosomus</i> and <i>Tylenchulus semipenetrans</i> belonging to the order <i>Tylenchida</i>, as well as the species <i>Xiphinema pachtaicum</i>, which belongs to the order <i>Dorylaimida</i>.</p> <p>ÖZET</p> <p>Bu çalışma Hatay ilinin önemli kültür bitkilerinin yetiştiriciliği yapıldığı alanlarda 2017-2021 yılları arasında yürütülmüştür. Hatay ili genelinde yapılan surveylerde, tarımsal üretim desenini yansıtabilecek şekilde bağ, biber, buğday, domates, mısır, pamuk, taş çekirdekli ve zeytin alanlarından toplam 104 adet toprak örneği alınmıştır. Alınan toprak örneklerinden modifiye Baermann yöntemi kullanılarak farklı morfolojik görünüşte hareketli nematodlar izole edilmiştir. İzole edilen nematodlar gliserin içine fikse edilmiş ve ışık mikroskobu altında morfolojik ve allometrik ölçümlerin yanısıra bazı türler moleküler yöntemler ile tanımlanmıştır. Yapılan tanımlama çalışmaları sonucunda 3 takım, 10 familya, 11 cins'e ait 11 farklı türe ait bitki paraziti nematod belirlenmiştir. Yapılan tanımlama çalışmaları sonucunda <i>Aphelenchida</i> takımına ait <i>Aphelenchoides</i> sp. ve <i>Aphelenchus avenae</i>; <i>Tylenchida</i> takımına ait <i>Ditylenchus</i> sp., <i>Heterodera latipons</i>, <i>Meloidogyne incognita</i>, <i>M. javanica</i>, <i>Merlinius brevidens</i>, <i>M. microdorus</i>, <i>Paratylenchus</i> sp., <i>Pratylenchus neglectus</i>, <i>P. thornei</i>, <i>Rotylenchulus macrosomus</i> ve <i>Tylenchulus semipenetrans</i>; <i>Dorylaimida</i> takımına ait <i>Xiphinema pachtaicum</i> türleri tespit edilmiştir.</p>
Cite/Atf	Yıldırım, A.E., Sertkaya, E., & Elekçioğlu, İ.H. (2025). Plant parasitic nematodes and their population densities in important crops in Hatay province of Türkiye. <i>Mustafa Kemal Üniversitesi Tarım Bilimleri Dergisi</i> , 30 (2), 560-579. https://doi.org/10.37908/mkutbd.1663127

INTRODUCTION

Many crops are cultivated in Hatay province that play a locomotive role in Turkey's domestic and foreign markets. Hatay ranks first for parsley and dill production, second for tangerine production, and third for overall citrus production in Turkey (Anonymous, 2023). According to Turkey's 2023 agricultural production data, the following crops were produced in Hatay: 176,751 tons of wheat, 210,257 tons of corn, 189,126 tons of cotton, 45,812 tons of tomatoes, 68,933 tons of peppers, 57,636 tons of stone fruits, 100,674 tons of grapes, and 178,933 tons of olives (Anonymous, 2023). Up till recently previously conducted surveys on widely cultivated agriculturally important crops, such as apricot, brassica species, carrot, citrus, corn, cotton, grapevine, pea, persimmon, pomegranate, tomato, walnut in the Hatay province revealed that many pests, diseases and weeds cause significant losses in quality and yield (Demirel & Çabuk, 2008; Demirel & Yıldırım, 2008; Cengiz, et al., 2010; Soylu & Dervis, 2011; Sertkaya et al., 2013; Bozkurt et al., 2014; Doğanlar et al., 2015; Demirel, 2016; Demirel & Akyol, 2017; Demirel et al., 2018; Demirel, 2019a,b; Kurt et al., 2020a,b; Üremiş et al., 2020; Soylu et al., 2020; Soylu et al., 2022; Bozkurt et al., 2023; Üremiş et al., 2023; Bozdoğan & Demirel, 2024a,b; Soylu et al., 2024; Uysal et al., 2024; Oğuz et al., 2024; Bozdoğan et al., 2025; Kurt et al., 2025). Plant parasitic nematodes (PPNs) constitute an important group of these pests. According to Whitehead (1998), PPNs cause 10% crop loss worldwide, and according to Nicol et al. (2011), 8.8%-14.6% crop loss and 100-157 billion dollars in economic losses incurred by PPNs. However, considering previous studies and comparing with other diseases and pests, PPNs have been studied least, especially in the agricultural areas of Hatay province and their distribution and population densities have not been fully revealed. Although surveys for PPNs covering Hatay province have been conducted before (Elekçioğlu et al., 1994; Elekçioğlu 2000; Özarlıdan & Elekçioğlu, 2010a; İmren et al., 2011), these studies were conducted as Hatay sections of larger-scale projects without directly considering Hatay province and its crop production pattern.

The current study was carried out between 2017-2021 in areas where important cultivated plants were grown in Hatay province. Reflecting the production pattern of Hatay province, 104 soil samples were collected in surveys conducted in vineyard, pepper, wheat, tomato, corn, cotton, stone fruit and olive areas.

MATERIALS and METHODS

Field studies

In this study, field surveys were conducted in April for wheat and greenhouse-grown peppers and tomatoes, and in August for vineyards, corn, cotton, stone fruit, olives and field-grown peppers and tomatoes, covering the entire Hatay province between 2017 and 2019, and a total of 104 soil and root samples were collected. At least 50 steps were taken into the land where the soil sample would be taken, and drawing a W shape samples were taken from a depth of 30±10 cm with the help of a shovel, with at least 3 and at most 5 sub-samples from each location according to the size of the land. Approximately 1-2 kg of thoroughly mixed sub-samples was labeled and placed in double polyethylene bags. Samples from the fruit orchards were taken from tree crown radius as mentioned above. The coordinates of each location and the cultivated crop were also recorded.

Laboratory studies

The modified Baermann extraction method was used to obtain active nematodes from the samples. For this purpose, plastic sieves were placed in 15 cm diameter petri dishes, paper towels were placed inside these sieves, and 100 cm³ of soil measured with a beaker was placed inside these paper towels. Water was added to the petri dish to completely wet the soil sample. After 48 h solutions containing nematodes were transferred to 500 ml measuring cylinders and after 6 hours nematodes settled to the bottom, then solutions were reduced by

siphoning from top. Nematode solutions put into 15 ml Falcon tubes and again solutions reduced to approximately 2 ml by centrifuging the tubes at 3000 rpm for 3 minutes and removing the supernatant. Falcon tubes containing nematode solution were kept in a water bath set at 65°C for 1 minute to ensure the death of nematodes. Then, 1 ml of TAF solution (7 ml 40% formaldehyde + 2 ml triethanolamine + 91 ml distilled water) was added to the falcon tubes and fixed for 2 days. Fixed nematodes were transferred to 5 cm diameter plastic petri dishes and dried at room temperature. In order to replace the water in the structure of the nematodes with alcohol and glycerin, they were passed through Solution I (20 parts of 95% ethanol, 1 part of glycerin and 79 parts of distilled water) and Solution II (95 parts of 95% ethanol and 5 parts of glycerin) and dried at room temperature, and finally the samples were placed in pure glycerin (Seinhorst, 1959). The counting and genus/species identification of nematodes by morphometric and allometric measurements were made by Prof. Dr. İ. Halil Elekçioğlu.

Cyst nematodes were also isolated from soil samples taken from wheat fields. For this purpose, approximately 250 ml of soil was placed in a 10 L plastic bucket and the bucket was filled with water until it was 2/3 full. The soil-water mixture in the bucket was mixed thoroughly by hand and passed through 60 mesh sieve. The cysts remaining in the 60 mesh sieve were collected into a petri dish with the help of a washing bottle. Molecular diagnosis of cysts obtained from four locations (Gökdere/Erzin, Kırıkhan, Hassa and Yayladağı) representing Hatay province was made by Prof. Dr. Mustafa İmren according to Maafi et al. (2003) and Waeyenberge et al. (2009). Species-specific primers as forward (Hlat-actF ATGCCATCATTATTCCTT) and reverse (Hlat-actR ACAGAGAGTCAAATTGTG) reported by Toumi et al. (2013) for *Heterodera latipons* were used for species identification. The obtained PCR products were run in 1% agarose gel and their sizes were determined with 100 bp (Fermentas) DNA ladder.

RESULTS and DISCUSSIONS

In this study, 11 species of PPNs belonging to 3 orders, 10 families and 11 genera were identified in important cultivated plants of Hatay province. The list of these nematodes is given in Table 1.

Table 1. Plant parasitic nematodes detected in important crop plants in Hatay province and sampling locations
Çizelge 1. Hatay ilinde önemli ürünlerde belirlenen bitki paraziti nematodlar ve örnekleme yerleri

Genus/Species	Order	Host Plant	Location
<i>Aphelenchoides sp.</i>	Aphelenchida	Vineyard, Pepper, Wheat, Tomato, Corn, Cotton, Stone fruit, Olive	Altınözü, Antakya, Arsuz, Dörtüyük, Erzin, Hassa, Kırıkhan, Reyhanlı, Samandağ, Yayladağı
<i>Aphelenchus avenae</i>	Aphelenchida	Vineyard, Pepper, Wheat, Tomato, Corn, Cotton, Stone fruit, Olive	Altınözü, Antakya, Arsuz, Dörtüyük, Erzin, Hassa, Kırıkhan, Reyhanlı, Samandağ
<i>Ditylenchus sp.</i>	Tylenchida	Pepper, Tomato, Corn, Cotton, Stone fruit, Olive	Altınözü, Antakya, Hassa, Kırıkhan, Reyhanlı, Samandağ
<i>Heterodera latipons</i>	Tylenchida	Wheat	Erzin, Hassa, Kırıkhan, Yayladağı

Table 1 (continued). Plant parasitic nematodes detected in important crop plants in Hatay province and sampling locations

Çizelge 1 (devamı). Hatay ilinde önemli ürünlerde belirlenen bitki paraziti nematodlar ve örnekleme yerleri

<i>Meloidogyne incognita</i>	Tylenchida	Tomato	Hassa, Samandağ
<i>Meloidogyne javanica</i>	Tylenchida	Pepper, Tomato	Altınözü, Antakya, Hassa, Samandağ
<i>Merlinius brevidens</i>	Tylenchida	Corn, Stone fruit, Olive	Altınözü, Antakya, Arsuz, Hassa, Kırıkhan, Kumlu
<i>Merlinius microdorus</i>	Tylenchida	Corn, Stone fruit, Olive	Altınözü, Antakya, Hassa, Kırıkhan, Kumlu
<i>Paratylenchus sp.</i>	Tylenchida	Buğday	Altınözü, Antakya, Hassa, Kırıkhan, Kumlu
<i>Pratylenchus neglectus</i>	Tylenchida	Buğday	Antakya, Arsuz, Hassa, Kırıkhan, Reyhanlı
<i>Pratylenchus thornei</i>	Tylenchida	Wheat, Pepper, Corn, Cotton	Altınözü, Antakya, Arsuz, Hassa, Kırıkhan, Kumlu, Reyhanlı
<i>Rotylenchulus macrosomus</i>	Tylenchida	Wheat, Cotton	Altınözü, Antakya, Erzin, Hassa, Kırıkhan, Reyhanlı
<i>Tylenchulus semipenetrans</i>	Tylenchida	Citrus fruits	Erzin, Dört Yol, Payas, İskenderun, Arsuz, Samandağ
<i>Xiphinema pachtaicum</i>	Dorylaimida	Vineyard	Hassa

Systematic status and morphometric and allometric measurements of some of the PPN species as follows.

Aphelenchoides sp.

Order: Aphelenchida Siddiqi, 1980

Suborder: Aphelenchina Geraert, 1966

Superfamily: Aphelenchoidoidea Skarbilovich, 1947 (Siddiqi, 1980)

Family: Aphelenchoididae Skarbilovich, 1947 (Paramonov, 1953)

Subfamily: Aphelenchoidinae Skarbilovich 1947

Genus: *Aphelenchoides* Fischer 1894

More than 200 nominal species belonging to this genus have been reported worldwide (Sánchez-Monge et al., 2015; Esmali et al., 2017), and 182 species have been described (Handoo et al., 2020). Many of these species are fungivorous and facultative fungivorous, and there are also important PPN species such as *A. besseyi* Christie, 1942, *A. fragariae* (Ritzema Bos, 1890) Christie, 1932 and *A. ritzemabosi* (Schwartz, 1911) Steiner and Buhner 1932. Göksel (1948) reported *A. fragariae* species for the first time in strawberries in Türkiye. In later studies, Bora (1970) reported that strawberry nematode was quite common in Karadeniz Ereğlisi and Bartın, and Kepenekçi and Öztürk (2002) was wide spread in Silifke. Rice white tip nematode, *A. besseyi*, was first reported in Türkiye by Öztürk and Enneli (1997). Tülek et al. (2014) reported in their study that *A. besseyi* caused damage in rice at rates ranging from 5.4% to 57.9%. In another study, *A. clarus* and *A. confusus* from Nevşehir and Karaman

vineyards were reported for the first time for Türkiye (Kepenekçi et al., 2014). In this study conducted in Hatay province, although samples belonging to this genus were obtained from all sampling locations, identification at species level was not made. The highest populations detected were in wheat 8 individuals in Enek (Altınözü), 7 individuals in Madenboyu (Antakya), 6 individuals in Varışlı (Reyhanlı) and 6 individuals in Şenköy (Yayladağı) and 5 individuals in vineyard in Haydarlar (Hassa).

Aphelenchus avenae

Order: Aphelenchida Siddiqi, 1980

Suborder: Aphelenchina Geraert, 1966

Superfamily: Aphelenchoidea Fuchs, 1937 (Thorne, 1949)

Family: Aphelenchidae Fuchs, 1937 (Steiner, 1949)

Subfamily: Aphelenchinae Fuchs, 1937

Genus: *Aphelenchus* Bastian, 1865

Species: *Aphelenchus avenae* Bastian, 1865

Synonym: (Hooper, 1974) *Aphelenchus agricola* 1881; *Paraphelenchus agricola* (1881) Filipjev, 1934; *Aphelenchus* (*Paraphelenchus*) *maupasi* Micoletzky, 1922; *Paraphelenchus maupasi* (Micoletzky, 1922) Bally Et Reydon, 1931; *Paraphelenchus micoletzkyi* Steiner, 1941; *Metaphelenchus micoletzkyi* (Steiner, 1941) Steiner, 1943; *Metaphelenchus rhopalocercus* Steiner, 1943; *Aphelenchus cylindricaudatus* (Cobb in Steiner, 1926) Steiner, 1931; *Tylenchus cylindricaudatus* Cobb in Steiner, 1926; *Aphelenchus macrobolbus* Steiner, 1942; *Aphelenchus maximus*, 1960; *Aphelenchus mirzai*, 1960; *Aphelenchus radicolus* (Cobb, 1913) Steiner 1931, *Isonchus radicolus* Cobb, 1913; *Aphelenchus solani* (Steiner, 1935) Goodey, 1951; *Aphelenchoides solani* Steiner, 1935.

Aphelenchus avenae is commonly found in soils as a fungivorous organism, however, it has also been reported to be detected in the root collar, leaf sheath and root cortex tissue of plants (Hooper, 1974; Hunt, 1993). It has been rarely reported as a pathogen in higher plants (Barker & Darling, 1965). Decker (1988) argued that the pathogenicity of this species in plants is negligible but that it may carry other disease agents such as fungi and bacteria and that it is not certain whether they infect healthy root tissues by themselves or attack roots injured or weakened by other pathogens. In previous studies conducted in Turkey, it was reported on hemp in the Black Sea Region (Tunçdemir, 1983), on rice in Çankırı and Çorum provinces (Eken-Karataş et al., 2007), on wheat, vegetable, tobacco and vineyard areas in Diyarbakır province (İmren, 2007), on hops in Bilecik province and on potatoes in the Marmara Region provinces (Erdoğuş, 2009), on vineyards in Karaman province (Kepenekçi et al., 2014), on wheat, apricot, vineyard, peanut, cotton, soybean, pepper, plum and corn in Adana province (Kasapoğlu et al., 2014), on barley, grape, melon, pistachio and wheat in Adıyaman and Mardin provinces (Kasapoğlu-Uludamar et al., 2018), and on almond and walnut in Adıyaman province (Tan et al., 2018). In this study, this species was found in all locations where sampling was performed, and the highest population densities detected on maize were 18 individuals in Dedeçınar, 13 individuals in Kamışlar (Kırıkhan), 12 individuals in Alaattin (Antakya) and 11 individuals on Kumlu, and 12 individuals on cotton in Alaattin (Antakya).

***Ditylenchus* sp.**

Order : Tylenchida Thorne, 1949

Suborder : Tylenchina Chitwood, Chitwood and Chitwood, 1950

Superfamily : Anguinoidea Nicol, 1935 (1926)

Family: Anguinidae Nicoll, 1935 (1926)

Subfamily: Anguininae Nicoll, 1935 (1926)

Genus: *Ditylenchus* Filipjev, 1936

It has been reported that there are 80 species of this genus identified worldwide (Brzeski, 1991). In previous studies conducted in Türkiye, *D. dipsaci* was reported on onion in Ankara province (Yüksel, 1958), on strawberry in the Black Sea region (Enneli & Öztürk, 1989), on alfalfa in the Central Anatolia region (Öztürk & Enneli, 1994), on onion in Amasya (Suluova) (Mennan, 2001); on strawberry in Silifke (Kepenekçi & Öztürk, 2002); on anise in Burdur (Kepenekçi 2003); on strawberry in Bursa (Akgül, 2004); on potato in the Aegean region (Mısırlıoğlu & Ulutaş, 2011); on onion in Karaman (Yavuzaslanoğlu et al., 2015); on wheat in Mardin (Kasapoğlu Uludamar et al., 2018) and from all major onion cultivation areas of Turkey in a later study (Yavuzaslanoğlu et al., 2019). *Ditylenchus destructor* has been reported on potato in Erzurum province (Yüksel, 1978), in Kütahya, Uşak, Isparta and Burdur provinces (Mısırlıoğlu & Ulutaş, 2011), and on greenhouse vegetables in the Southeastern Anatolia Region (Tan & Kılıç, 2011). *Ditylenchus equalis* has been reported on potato in the Marmara Region (Akgül et al. 2010), *D. myceliophagus* on kiwi in the Eastern Black Sea Region (Kepenekçi & Öztürk, 1999), on corn in Adana (Kasapoğlu et al., 2014), on almond and walnut in Adıyaman (Tan et al., 2018) and on barley, wheat and tobacco in Adıyaman (Kasapoğlu Uludamar et al., 2018). *Ditylenchus longicauda* was reported for the first time in barley in Adıyaman, Turkey (Kasapoğlu Uludamar et al., 2018). In this study, individuals belonging to this genus were isolated from almost all locations and other cultivated plants except vineyards, and the highest population densities detected were 12 individuals on maize in Demirköprü (Antakya) and in Kamışlar (Kırıkhan), 12 individuals on cotton in Narlıhopur and 9 individuals in Kızılkaya (Kırıkhan), and 9 individuals on pepper in Madenboyu (Antakya).

Heterodera latipons

Order: Tylenchida Thorne, 1949

Suborder: Tylenchina Chitwood, Chitwood and Chitwood, 1950

Superfamily: Tylenchoidea Örley, 1880

Family: Heteroderidae Filipjev and Schuurmans Stekhoven, 1941

Subfamily: Heteroderinae Filipjev and Schuurmans Stekhoven, 1941

Genus: *Heterodera* Schmidt, 1871

Species: *Heterodera latipons* Franklin 1969

Synonym: *Bidera latipons* (Franklin, 1969) Krall and Krall, 1978; *Ehippiodera latipons* (Franklin, 1969) Shagalina and Krall, 1981

There are 80 species reported belonging to the genus *Heterodera* (Subbotin et al., 2010). Among these, *H. avenae* (Wollenweber, 1924), *H. filipjevi* (Madzhidov, 1981) Stelter and *H. latipons* (Franklin, 1969) are considered to be the most economically important cyst nematodes (Rivoal & Cook, 1993). The first cyst nematode reported in our country was *H. cruciferae* (Yüksel, 1966). Yüksel (1973) later identified *H. avenae* as the first cereal cyst nematode in Türkiye. In a later study, Rumpfenhorst et al. (1996) detected *H. latipons*, *H. avenae* and *H. filipjevi* in wheat fields in the Central Anatolia Region. In another study, İmren et al. (2012) reported *H. filipjevi* from the Southeastern Anatolia Region. İmren et al. (2013) later studied the populations obtained from Sarıçam-Adana, Kırıkhan and Reyhanlı-Hatay to determine the Eastern Mediterranean pathotype of *H. avenae*. In this study, cysts were obtained from 11 locations and cysts from Erzin (15 cysts), Hassa (11 cysts), Kırıkhan (9 cysts) and Yayladağı (17 cysts) were identified as *H. latipons* by using species-specific primers.

***Meloidogyne* spp.**

Order: Tylenchida Thorne, 1949

Suborder: Tylenchina Chitwood, Chitwood and Chitwood, 1950

Superfamily: Hoplolaimoidea Filipjev, 1934 (Paramonov, 1967)

Family: Meloidogynidae Skarbilovich, 1959

Subfamily: Meloidogyninae Skarbilovich, 1959

Genus: *Meloidogyne* Goeldi, 1892

Species: *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949

Synonym: *Oxyuris incognita* Kofoid and White, 1919; *Heterodera incognita* (Kofoid & White, 1919) Sandground, 1923; *M. incognita incognita* (Kofoid & White, 1919) Chitwood, 1949; *M. acrita* Chitwood, 1949; *M. incognita acrita* Chitwood, 1949; *M. elegans* da Ponte, 1977; *M. grahami* Golden and Slana, 1978; *M. incognita grahami* Golden and Salana, 1978 (Jepson, 1987); *M. incognita inornata* Lordello, 1956; *M. inornata* Lordello, 1956; *M. kirjanovae* Terenteva, 1965 (syn. by Karssen & Hoenselaar, 1998); *M. wartellei* Golden and Birchfield, 1978; *M. incognita wartellei* Golden and Birchfield, 1978

Species: *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949

Synonym: *Heterodera javanica* Treub, 1885; *Tylenchus (Heterodera) javanicus* (Treub, 1885) Cobb, 1890; *Anguillula javanica* (Treub, 1885) Lavergne, 1901; *M. javanica javanica* (Treub, 1885) Chitwood, 1949; *M. javanica* Lordello, 1956; *M. bauruensis* Lordello, 1956; *M. lordelloi* da Ponte, 1969; *M. lucknowica* Singh, 1969

Although 105 identified root-knot nematode (RKN) species have been reported (Ghaderi & Karssen, 2020; Maleita et al., 2021), the four most common species, especially in vegetable growing areas in the world, are reported to be *M. incognita* (Kofoid and White, 1919) Chitwood, *M. javanica* (Treub, 1885) Chitwood, 1949, *M. arenaria* (Neal, 1889) Chitwood, 1949 and *M. hapla* (Chitwood, 1949) (Coyne et al., 2018). However, *M. incognita* is considered the most important RKN species due to its worldwide prevalence, wide host range and aggressiveness (Sikora & Fernández, 2005). *Meloidogyne incognita*, first detected in Turkey by Alkan (1962), was later reported on vegetables between Sinop and the Georgian border (Yüksel, 1966), on vegetables and tobacco in the Black Sea region (Bora, 1970), and in vineyards (Ertürk & Özkut, 1973), fruit, vegetable and cotton areas in the Aegean region (Ertürk et al., 1973). In the study conducted by Ağdacı (1978), it was reported that *M. incognita*, *M. javanica* and *M. arenaria* were observed intensively in vegetables such as tomatoes, peppers and eggplants in the Eastern Mediterranean region. In another study conducted in the Eastern Mediterranean region, *M. incognita* and *M. javanica* were reported in vegetables and bananas (Elekçioğlu et al., 1994). In Türkiye, *M. incognita*, *M. arenaria* and *M. javanica* are reported as the most common and economically important species (Özarslandan & Elekçioğlu, 2010a; Çetintaş & Çakmak, 2016). It was reported in tomato and cucumber in Hatay province (Özarslandan & Elekçioğlu, 2010b), and in another study, again in tomato (Aslan & Elekçioğlu, 2022). In this study, *M. incognita* was detected on tomatoes in Hassa (35 individuals) and Samandağ (27 individuals). *M. javanica* was detected on peppers in Avsuyu (16 individuals), Boşşin (Antakya) (15 individuals) and Samandağ (12 individuals), and on tomatoes in Hassa (12 individuals).

***Merlinius* spp.**

Order: Tylenchida Thorne, 1949

Suborder: Tylenchina Chitwood, Chitwood and Chitwood, 1950

Superfamily: Tylenchoidea Örley, 1880

Family: Dolichodoridae Chitwood in Chitwood and Chitwood, 1950

Subfamily: Merliniinae Siddiqi, 1971

Genus: *Merlinius* Siddiqi, 1979

Species: *Merlinius brevidens* (Allen, 1955) Siddiqi, 1970

Synonym: *Tylenchorynchus brevidens* Allen, 1955, *Geocenamus brevidens* (Allen) Brzeski, 1991

In previous studies conducted in Türkiye, Saltukoğlu et al. (1976) detected it on pepper in Istanbul; Tunçdemir (1983) on hemp in Samsun; Kepenekçi and Ökten (1996) on carrots in Ankara; Elekçioğlu (1996) on wheat in Adana; Mısırlıoğlu and Pehlivan (2007) on wheat in the Aegean and Marmara regions; Yıldız and Elekçioğlu (2011) on wheat, lentils and cotton in Şanlıurfa, and Kasapoğlu et al. (2014) on wheat and cotton in Adana. In this study, the highest populations of *M. brevidens* were detected on corn in Kırıkhan (12 individuals), Demirköprü (6 individuals) and Alaattin (Antakya) (6 individuals), on olive in Avsuyu (Antakya)(6 individuals) and on stone fruit in Özsoğuksu (Kırıkhan) (3 individuals).

Species: *M. microdorus* (Geraert, 1966) Siddiqi, 1970

Synonym: *Geocenamus microdorus* Geraert, 1966

The locations and cultivated plants where the highest *M. microdorus* populations were detected were corn in Demirköprü (4 individuals), Alaattin (Antakya)(3 individuals) and Kamışlar (Kırıkhan)(3 individuals), stone fruit in Hassa (3 individuals) and olive in Narlıhopur (Kırıkhan) (4 individuals). Comparison of morphometric and allometric measurement values of adult females belonging to different populations of *Merlinius microdorus* is given in Table 2.

Table 2. Comparison of morphometric and allometric measurement values of adult females belonging to different populations of *Merlinius microdorus*

Çizelge 2. *Merlinius microdorus*'un farklı popülasyonuna ait ergin dişilerinin morfometrik ve allometrik ölçüm değerlerinin karşılaştırılması

	Current Study	Brzeski (1991)	Elekçioğlu (1992)	Kasapoğlu (2012)
n	6	5	2	3
L (µm)	0.56±0.04 (0.50-0.62)	4.85-7.23	0.60-0.65	0.60-0.64
a	26.31±1.27 (25.07-29.95)	23-39	28-29	27-29
b	5.04±0.18 (4.16-5.18)	3.9-5.6	5.0-5.2	5.0-5.2
c	13.04±1.40 (11.67-15.48)	12.8-15.2	10-11	10.0-13.5
c'	3.12±0.25 (2.58-3.24)	2.2-2.9	4.2-4.3	4.1-4.3
V(%)	56.06±1.71 (53.05-58.03)	56-60	52-54	52-60
Styilet (µm)	12.47± 0.81(11.06-14.08)	12.5-14.0	13	12-13
Tail (µm)	46.09±5.04 (39.07-56.07)	32-56	54-55	54-55

L = Total body length (head to tail tip); a = Total body length divided by maximum body width; b = Total body length divided by oesophageal length; c = Total body length divided by tail length; c' = Tail length divided by anal/cloacal body width; V = Position of vulva from anterior end expressed as percentage of body length

***Paratylenchus* sp.**

Order: Tylenchida Thorne, 1949

Suborder: Tylenchina Chitwood, Chitwood and Chitwood, 1950

Superfamily: Criconematoidea Taylor, 1936 (1914)

Family: Tylenchulidae Skarbilovich, 1947

Subfamily: Paratylenchinae Thorne, 1949

Genus: *Paratylenchus* Micoletzky, 1922

Ghaderi et al. (2014) reported 117 species belonging to the genus *Paratylenchus*. In previous studies in Türkiye, *P. rotundicephalus* was reported on sesame in Antalya and İçel (Kepenekçi, 2002); *P. nawadus* on pear in Ankara (Evlice & Ökten, 2010); *P. italiensis* on strawberry in Bursa (Akgül, 2004); *P. israelensis* on wheat, barley and lentil in Şanlıurfa (Yıldız & Elekçioğlu, 2011); *P. (Gracilacus) straeleni* on hazelnut in Ordu (Akyazı et al., 2015). In this study, species identification was not made and populations were detected on wheat in Şenköy (Yayladağı)(3 individuals), Telkaiş (Reyhanlı)(2 individuals), Narlıhopur (Kırıkhan)(2 individuals), Kumlu (1 individual) and Arpahan (Antakya)(1 individual).

***Pratylenchus* spp.**

Order: Tylenchida Thorne, 1949

Suborder: Tylenchina Chitwood, Chitwood and Chitwood, 1950

Superfamily: Criconematoidea Taylor, 1936 (1914)

Family: Pratylenchidae Thorne, 1949 (Siddiqi, 1963)

Subfamily: Pratylenchinae Thorne, 1949

Genus: *Pratylenchus* Filipjev, 1936

Species: *P. neglectus* (Rensch, 1924) Filipjev and Schuurmans-Stekhoven 1941

Synonym: *Aphelenchus neglectus* Rensch, 1924; *Tylenchus neglectus* (Rensch, 1924) Steiner, 1928; *Anguillulina (Pratylenchus) neglecta* (Rensch, 1924) Schneider, 1939; *Pratylenchus minyus* Sher and Allen, 1953; *Pratylenchus capitatus* Ivanova, 1968; *Pratylenchus similis* Khan and Singh, 1975

Due to their wide host range and their distribution in almost all climatic zones, they are considered the third most economically important group of PPNs after root-knot and cyst nematodes (Castillo & Vovlas, 2007). Mokri et al. (2019) stated that *P. neglectus* and *P. thornei* species of this genus are the most important species that cause damage to cereals all over the world. Yüksel (1974) determined *P. thornei*, *P. neglectus*, *P. penetrans* and *P. crenatus* species in cereal, corn and meadow areas as a result of his study in the Eastern Anatolia Region of Türkiye. In subsequent studies, Saltukoğlu et al. (1976) reported *P. neglectus* on potato and pepper in Istanbul, Tunçdemir (1983) reported *P. neglectus* on hemp in Samsun, Elekçioğlu (1996) reported *P. thornei* on wheat in Adana, Kasapoğlu et al. (2014) reported *P. thornei* on wheat and cotton again in Adana, and Yıldız and Elekçioğlu (2011) reported both species on barley, wheat and cotton. In this study, *P. neglectus* populations were detected on wheat in Şenköy (Yayladağı)(5 individuals), Saylak (Kırıkhan)(3 individuals), Madenboyu (Antakya)(3 individuals), Gülcihan (Arsuz)(2 individuals) and Kıcı (Belen)(2 individuals).

Species: *P. thornei* (Sher and Allen 1953), (Sher, 1948)

Pratylenchus thornei was detected on cotton in Reyhanlı (8 individuals) and Suluköy (Reyhanlı)(7 individuals), on wheat in Yörükler (7 individuals) and Karacaagıl (Kırıkhan) (7 individuals), and on pepper in Üzümdalı (Antakya)(6 individuals). Comparison of morphometric and allometric measurement values of adult females belonging to different populations of *P. thornei* given in Table 3.

Table 3. Comparison of morphometric and allometric measurement values of adult females belonging to different populations of *Pratylenchus thornei*Çizelge 3. *Pratylenchus thornei*'nin farklı popülasyonuna ait ergin dişilerinin morfolometrik ve allometrik ölçüm değerlerinin karşılaştırılması

	Current Study	SherandAllen (1953)	Elekcioglu (1992)	Kepenekci (1999)	Osmanoğlu (Tan) (2006)	İmren (2007)
n	16	?	20	20	8	14
L (mm)	0.53 ± 0.07 (0.42-0.71)	0.45-0.77	0.46-0.62	0.48-0.63	0.50-0.68	0.48-0.60
a	31.04± 2.25 (25.96-35.90)	26-36	24-30	26.9-34.4	33.28-38.83	29.9-36.6
b	6.16 ± 0.42 (5.02-7.02)	5.5-8	6.4-6.9	4.7-5.9	4.26-6.18	4.8-6.2
b'	5.24 ± 0.38 (4.10-5.94)	?	4.1-5.8	4.2-5,1	6.16-8.26	?
c	22.01±2.16 (19.17-26.00)	18-22	18-24	16.6-21.0	16.64-25,5	16.0-26.6
c'	2.34 ± 0.32 (1.79-2.91)	?	1.7-2.4	2.3-2.9	2.07-3.36	2.01-2.72
MB(%)	50.90 ± 4.04 (42.03-58.98)	?	?	51.7-57,6	40.51-51.30	?
Stylet (µm)	15.15 ± 0.42 (14.00-15.90)	17-19	15-17	16-18	15.68-16.90	16.2-18.5
Tail (µm)	25.90 ± 2.75 (21.06-31.90)	?	21-24	25-36	21.56-36.26	22.5-30.00
V(%)	76.05 ± 1.55 (74.22-81.02)	73-80	76-80	73.8-79.2	73-77	71.6-79
Ran	26.32 ± 2.86 (18-31)	?	?	19-27	16-33	?

L = Total body length (head to tail tip); a = Total body length divided by maximum body width; b = Total body length divided by oesophageal length; b' = Total body length divided by distance from anterior end of body to posterior end of oesophageal gland lobes; c = Total body length divided by tail length; c' = Tail length divided by anal/cloacal body width; MB = Distance of median bulb from anterior end expressed as a percentage of total oesophageal length; V = Position of vulva from anterior end expressed as percentage of body length; Ran = Number of annules from posterior end to anus

Rotylenchulus macrosomus

Order: Tylenchida Thorne, 1949

Suborder: Tylenchina Chitwood, Chitwood and Chitwood, 1950

Superfamily: Hoplolaimidae (Filipjev, 1934)

Family: Rotylenchulidae Husain and Khan 1967, (Husain, 1976)
 Subfamily: Rotylenchulinae Husain and Khan, 1967
 Genus: *Rotylenchulus* (Linford & Oliveira, 1940)
 Species: *Rotylenchulus macrosomus* Dasgupta, Raski and Sher, 1968

This species was isolated from olives in Israel and studied by Cohn and Mordechai (1988). Castillo et al. (2003) reported it on olive, Palomares-Rius et al. (2021a,b) in many European and Mediterranean countries on corn, pea, wheat and almond-peach rootstocks, chickpea, hazelnut, peanut; in Turkey, Elekçioğlu et al. (1994) on soybean, Yıldız and Elekçioğlu (2011) on cotton, Kasapoğlu et al. (2014) on cotton, vineyard, wheat, corn, citrus, sunflower plants. In this study, it was detected on wheat in Yeşiltepe (Erzin) (2 individuals), Arpahan (Antakya)(2 individuals) and Güventaş (Kırıkhan)(1 individual), and on cotton in Akpınar (Kumlu)(2 individuals) and Reyhanlı (1 individual).

Tylenchulus semipenetrans

Order: Tylenchida Thorne, 1949
 Suborder: Tylenchina Chitwood, Chitwood and Chitwood, 1950
 Superfamily: Criconematoidea Taylor, 1936
 Family: Tylenchulidae Skarbitovich, 1947
 Subfamily: Tylenchulinae Skarbitovich, 1947
 Genus: *Tylenchulus* (Cobb, 1913)
 Species: *T. semipenetrans* Cobb, 1913

Duncan and Cohn (1990) reported that this species was widespread in all citrus-producing areas of the world. It was first reported in Türkiye by Kiray (1963), and in subsequent studies it was also reported from the Black Sea region (Yüksel, 1966), the Eastern Mediterranean region (Elekçioğlu et al., 1994; Elekçioğlu, 1995), the Aegean region (Mısırlıoğlu & Ulutaş, 2009), Adana (Kasapoğlu et al., 2014), and İzmir (Emre & Kaşkavalcı, 2015). In this study, it was observed that *T. semipenetrans* was infested in all sampled orchards.

Xiphinema pachtaicum

Order: Dorylaimida Pearse, 1942
 Suborder: Dorylaimina Pearse, 1942
 Superfamily: Dorylaimoidea Thorne, 1935
 Family: Longidoridae Thorne, 1935
 Subfamily: Xiphineminae
 Genus: *Xiphinema* Cobb, 1913
 Species: *X. pachtaicum* (Tulaganov, 1938) Kirjanova, 1951
 Synonym: *Longidorus pachtaicus* (Tulaganov, 1938); *Xiphinema mediterraneum* Martelli and Lamberti 1967

Jones et al. (2013) acknowledged that nematodes belonging to this genus are the eighth most economically important PPNs in the world. Archidona-Yuste et al. (2016) reported 260 species belonging to this genus. The species *X. pachtaicum* is considered to be widespread in the Mediterranean basin (Brown & Taylor, 1987; Taylor & Brown, 1997; Lamberti et al., 2000; Getaneh et al., 2015; Archidona-Yuste et al., 2016). In previous studies conducted in Turkey, it was reported in the Aegean region (Arınç, 1982), in the Eastern Mediterranean region (Elekçioğlu & Uygun, 1994), on vineyards in the Marmara region (Nogay et al., 1995), on barley, wheat and lentils in Şanlıurfa (Yıldız & Elekçioğlu, 2011), on vineyards in Adana (Kasapoğlu et al., 2014), on hazelnuts in Ordu (Akyazı et al., 2017). In this study, *X. pachtaicum* was detected in vineyard areas in Aktepe (Hassa)(17 individuals).

Comparison of morphometric and allometric measurement values of adult females belonging to different populations of *Xiphinema pachtaicum* are given in Table 4.

Table 4. Comparison of morphometric and allometric measurement values of adult females belonging to different populations of *Xiphinema pachtaicum*

Çizelge 4. *Xiphinema pachtaicum*'un farklı popülasyonuna ait ergin dişilerinin morfometrik ve allometrik ölçüm değerlerinin karşılaştırılması

	Current study	LambertiandMartelli (1971)	Elekcioğlu (1992)	İmren (2007)
n	7	10	10	4
L (mm)	1.67±0.10 (1.58-1.90)	1.5-2.1	1.55-1.85	1.47-1.96
a	59.05 ±4.26 (50.90-64.84)	50-63	61-79	56-69
b	5.42 ±0.32 (5.02-6.24)	4.7-7.5	5.6-8.3	4.6-7.8
c	57.80 ± 6.00 (46.90-66.14)	47-67	54-67	50-64
c'	1.82 ±0.15 (1.59-2.15)	1.5-2.1	1.6-2.1	1.5-2.0
Odontostylet (µm)	79.38±4.08 (71.00-84.90)	70-99	70-88	78-86
Odontophore (µm)	45.8±1.5 (43-49)	42-51	37-50	44-48

L = Total body length (head to tail tip); a = Total body length divided by maximum body width; b = Total body length divided by oesophageal length; c = Total body length divided by tail length; c' = Tail length divided by anal/cloacal body width.

In conclusion, more than 4100 PPNs have been identified worldwide (Decraemer & Hunt, 2006). Although it is reported that PPNs cause a loss of 80-118 billion US Dollars worldwide (Nicol et al., 2011), many farmers have little or no knowledge about PPNs and it should not be ignored that the actual damage may be much higher than reported (Jones et al., 2013). Vegetable producers in particular are familiar with RKNs and know that they can suffer major economic losses if they do not control the pest. Farmers should be informed that PPNs can also cause damage to other crops, or that they can facilitate the transmission of soil-borne fungal and bacterial diseases, leading to economic losses. In this study, 11 species of PPNs belonging to 3 orders, 10 families and 11 genera were identified in economically important cultivated plants of Hatay province. The varying densities of PPNs detected in this study depend on many factors such as plant resistance/tolerance, soil structure, fertilization, irrigation and other growing conditions. The damage levels of the identified nematodes, their economic damage thresholds, and the investigation of different methods of combating these nematodes are important for both Hatay and Türkiye's agriculture and, accordingly, its economy.

ACKNOWLEDGEMENTS

We thank Prof. Dr. Mustafa İMREN for his invaluable support for the molecular analysis of *Heterodora latipons*. This study was financially supported by Mustafa Kemal University Coordinatorship of Scientific Research Projects (9601).

STATEMENT OF CONFLICT OF INTEREST

The authors declare that there is no conflict of interest between them.

AUTHOR'S CONTRIBUTIONS

All author contributed equally for analyses, writing and interpretation of the article. The authors read and approved the final version of the manuscript.

STATEMENT OF ETHICS CONSENT

This article does not require ethical approval as there are no experiments with human or animal subjects.

REFERENCES

- Ağdacı, M. (1978). Güney Anadolu Bölgesi'nde yetiştirilen kabakgillerde (Cucurbitaceae) zarar yapan kök-ur nematodu türleri (*Meloidogyne* spp.)'nin tespiti ile zarar oranları ve yayılışları üzerine araştırmalar. *Adana Bölge Zirai Mücadele Araştırma Enstitüsü Müdürülüğü Teknik Bülten*, No: 47. A
- Akgül, H.C. (2004). Plant parasitic nematode species found in strawberry fields in Northwestern Anatolia. *Japanese Journal of Nematology*, 34 (2), 73-78. https://doi.org/10.3725/JJN1993.34.2_73
- Akgül, H.C., Bayram, Ş., & Erdoğan, F.D. (2010). Two new records of Turkish nematode fauna: *Ditylenchus equalis* and *Pratylenchus pseudopratensis*. *Pakistan Journal of Nematology*, 28, 285-293. <http://142.54.178.187:9060/xmlui/handle/123456789/17784>
- Akyazı, F., Aydınlı, G., & Mennan, S. (2017). Ectoparasitic root nematode *Xiphinema pachtaicum* Tulaganov 1938 Kirjanova 1951 from hazelnut orchards in Turkey. *IX. International Congress on Hazelnut*, 15-19.08.2017, Samsun.
- Akyazi, F., Felek, A., Cermak, V., Majeska C.M., Foit, J., Yildiz, S., & Háněl, L. (2015). Description of *Paratylenchus (Gracilacus) straeleni* (De Coninck, 1931) Oostenbrink, 1960 (Nematoda: Criconelematoidea, Tylenchulidae) from hazelnut in Turkey and its comparison with other world populations. *Helminthologia*, 52, 270-279. <http://doi.org/10.1515/helmin-2015-0042>
- Alkan, B. (1962). Türkiye'nin zararlı nematod faunası üzerinde ilk incelemeler. *Bitki Koruma Bülteni*, 2 (12), 17-25.
- Anonymous (2023). TÜİK Bitkisel Üretim İstatistikleri. Available at: tuik.gov.tr/bitkiselapp/bitkisel.zul (January 25, 2025).
- Archidona-Yuste, A., Navas-Cortés, J.A., Cantalapiedra-Navarrete, C., Palomares-Rius, J.E., & Castillo, P. (2016). Cryptic diversity and species delimitation in the *Xiphinema americanum*-group complex (Nematoda: Longidoridae) as inferred from morphometrics and molecular markers. *Zoological Journal of the Linnean Society*, 176, 231-265. <http://dx.doi.org/10.1111/zoj.12316>
- Arınç, Y. (1982). Ege Bölgesi bağ alanlarında zararlı olan *Xiphinema* türleri (Nematoda: Longidoridae), yayılışı, konukçuları ve zararları üzerinde araştırmalar. *İzmir Bölge Zirai Mücadele Araştırma Enstitüsü, Araştırma Eserleri Serisi*. İzmir, 01, pp 83.
- Aslan, A., & Elekcioğlu, İ.H. (2022). Biochemical and molecular identification of root-knot nematodes in greenhouse vegetable areas of Eastern Mediterranean Region (Turkey). *Turkish Journal of Entomology*, 46, 115-127. <https://doi.org/10.16970/entoted.1055181>

- Barker, K.R., & Darling, H.M. (1965). Reproduction of *Aphelenchus avenae* on plant tissues in culture. *Nematologica*, 11, 162-166. <https://colab.ws/articles/10.1163%2F187529265x00023>
- Bora, A. (1970). Karadeniz Bölgesi bitki parazit nematodlarının tür ve yayılış alanlarının tespiti ve ilaçlı mücadele imkânları üzerinde araştırmalar. *Bitki Koruma Bülteni*, 10 (1), 53-71.
- Bozkurt, İ.A., Soylu, S., Mirik, M., Serce, C.U., & Baysal O. (2014). Characterization of bacterial knot disease caused by *Pseudomonas savastanoi* pv. *savastanoi* on pomegranate (*Punica granatum* L.) trees: A new host of the pathogen. *Letters in Applied Microbiology*, 59, 520-527. <https://doi.org/10.1111/lam.12309>
- Bozkurt, İ.A., Soylu S., Kara, M., Doksöz, S.F., Altan, B., & Çarpar, H. (2023). Molecular characterisation of stem gall disease caused by *Agrobacterium tumefaciens* (= *Agrobacterium* biovar 1) on Citrus trees as a new host, in the Eastern Mediterranean region of Turkey. *Journal of Plant Diseases and Protection*, 130, 13-21. <https://doi.org/10.1007/s41348-022-00678-5>
- Bozdoğan, İ.E., & Demirel, N. (2024a). Determination of population dynamics of Cicadellidae (Hemiptera) species and their relationship with climatic parameters in organic cotton fields in Hatay province, Türkiye. *KSU J. Agric Nat.*, 27 (6), 1356-1366. <https://doi.org/10.18016/ksutarimdogra.vi.1458561>
- Bozdoğan, İ.E., & Demirel, N. (2024b). Population dynamics of cotton leafhoppers [*Asymmetrasca decedens* and *Empoasca decipiens* (Hemiptera: Cicadellidae)] in conventional cotton production areas of Hatay province, Türkiye. *Mustafa Kemal Üniversitesi Tarım Bilimleri Dergisi*, 29 (3), 791-803. <https://doi.org/10.37908/mkutbd.1484745>
- Bozdoğan, İ.E., Demirel, N., Konuşkan, Ö., & Asil, H. (2025). Assessment of larval density and damage by lepidopteran species complex in some sweet and dent maize cultivars in Hatay province. *BSJ Agri*, 8 (4), 548-555. <https://doi.org/10.47115/bsagriculture.1706723>
- Brown, D.J.F., & Taylor, C.E. (1987). Comments on the occurrence and geographical distribution of longidorid nematodes in Europe and the Mediterranean region. *Nematologia Mediterranea*, 15, 333-373. <https://journals.flvc.org/nemamedi/article/view/85637>
- Brzeski, M.W. (1991). Review of the genus *Ditylenchus* Filipjev, 1936 (Nematoda: Anguinidae). *Revue de Nematologie*, 14 (1), 9-59.
- Castillo P., & Vovlas N. (2007). *Pratylenchus* (Nematoda: Pratylenchidae): diagnosis, biology, pathogenicity and management. Hunt, D.J. & Perry, R.N. (Eds), *Nematology Monographs and Perspectives* 6. Leiden, The Netherlands, Brill, 529 pp.
- Castillo, P., Vovlas, N., & Troccoli, A. (2003). The reniform nematode, *Rotylenchulus macrosoma*, infecting olive in southern Spain. *Nematology*, 5, 23-29. <https://doi.org/10.1163/156854102765216650>
- Cengiz, F.C., Demirel, N., Sagiroglu, E.I., Toshova, T., & Subchev, M. (2010). Employing pheromone traps to establish the distribution and seasonal activity of *Theresimima ampellophaga* in Turkey. *Phytoparasitica*, 38 (3), 217-222. <https://doi.org/10.1007/s12600-010-0098-4>
- Cohn, E., & Mordechai, M. (1988). Morphology and parasitism of the mature female of *Rotylenchulus macrosomus*. *Revue de Nématologie*, 11, 385-389.
- Coyne, D.L., Cortada, L., Dalzell, J.J., Claudius-Cole, A.O., Haukeland, S., Luambano, N., & Talwana, H. (2018). Plant-parasitic nematodes and food security in Sub-Saharan Africa. *Annual Review of Phytopathology*, 56, 381-403. <https://doi.org/10.1146/annurev-phyto-080417-045833>
- Çetintaş, R., & Çakmak, B. (2016). *Meloidogyne* species infesting tomatoes, cucumbers and eggplants grown in Kahramanmaraş Province, Turkey. *Turkish Journal of Entomology*, 40 (4), 355-364. <http://dx.doi.org/10.16970/ted.40839>
- Decker, H. (1988). Plant nematodes and their control (phytonematology). Brill, The Netherlands.
- Decraemer, W., & Hunt, D.J. (2006). Structure and classification. Perry, R.N. and Moens, M. (Ed) *Plant Nematology* 3-32 pp. Wallingford, Oxfordshire, CAB International.

- Demirel, N. (2019a). Efficacy of various attractants to Mediterranean fruit fly, *Ceratitidis capitata* (Wiedemann) (Diptera: Tephritidae) on persimmon fruits in Turkey. *Fresenius Environmental Bulletin*, 28 (7), 5390-5397.
- Demirel, N. (2019b). Trapping genders of *Ceratitidis capitata* (Diptera: Tephritidae) and other Dipteran with various attractants on pomegranate fruits in Turkey. *Fresenius Environmental Bulletin*, 28 (4), 2937-2941.
- Demirel, N. (2016). A study on occurrence and population trends of the carob moth *Ectomyelois ceratoniae* Zeller (Lepidoptera Pyralidae) in pomegranate orchards by using pheromone traps. *Entomology and Applied Science Letters*, 3 (1), 26-31. <http://www.easletters.com/issues.html>
- Demirel, N., Yıldırım, A.E., & Kılıç, G. (2018). Effectiveness of various attractants for Mediterranean fruit fly, *Ceratitidis capitata* (Wiedemann) (Diptera: Tephritidae) on pomegranate fruits in Turkey. *Fresenius Environmental Bulletin*, 27 (5), 3191-3198.
- Demirel, N., & Akyol, E. (2017). Evaluation of mass trapping for control of Mediterranean fruit fly, *Ceratitidis capitata* (Wiedemann) (Diptera: Tephritidae) in Satsuma mandarin in Hatay province of Turkey. *International Journal of Environmental Agriculture Research*, 3 (12), 32-37.
- Demirel, N., & Çabuk, F. (2008). Population trends of two spotted spider mite *Tetranychus urticae* Koch Acari Tetranychidae on cotton nearby soil and asphalt road. *Journal of Entomology*, 5 (2), 122-127. <https://doi.org/10.3923/je.2008.122.127>
- Demirel, N., & Yıldırım, A.E. (2008). Attraction of various sticky color traps to *Thrips tabaci* Lindeman Thysanoptera Thripidae and *Empoasca decipiens* Paoli Homoptera Cicadellidae in cotton. *Journal of Entomology*, 5 (6), 389-394. <https://doi.org/10.3923/je.2008.389.394>
- Doğanlar, M., Yıldırım A.E., & Yiğit A. (2015). Domates güvesi, *Tuta absoluta* (Meyrick) (Lepidoptera, Gelechiidae) mücadelesinde *Bacillus thuringiensis* var. *kurstaki* ve bazı çevre dostu pestisitlerin etkileri. *Türkiye Biyolojik Mücadele Dergisi*, 6 (1), 13-24.
- Duncan, L.W., & Cohn, E. (1990). *Nematode parasites of citrus*. Luc, M., R. A. Sikora and J. Bridge (Eds). Plant parasitic nematodes in subtropical and tropical agriculture. CAB International, UK pp. 321-346.
- Eken-Karataş, S., Aktaş, M., & Kepenekci, İ. (2007). Çankırı ve Çorum illeri çeltik (*Oryza sativa* L.) ekim alanlarındaki bitki paraziti nematod türlerinin taksonomik özellikleri, yoğunlukları ve yaygınlıkları üzerine araştırmalar. // *Bitki Koruma Kongresi*, Isparta, 253 p.
- Elekçioğlu, İ.H. (1995). Plant Parasitic nematodes associated with citrus in the East Mediterranean Region of Turkey. *Journal of Turkish Phytopathology*, 24, 29-37.
- Elekçioğlu, İ.H. (1996). Türkiye ve Doğu Akdeniz Bölgesi için yeni bitki paraziti nematod türleri. *Türkiye III. Entomoloji Kongresi Bildirileri*, Ankara. pp 502-509.
- Elekçioğlu İ.H., Ohnesorge, B., Lung, G., & Uygun N. (1994). Plant parasitic nematodes in the Mediterranean region of Turkey. *Nematologia Mediterranea*, 22, 59-63.
- Elekçioğlu, İ.H. (2000). Türkiye'de ilk kez saptanan bir zararlı, *Rotylenchulus reniformis* Linford & Oliveira (Nemata, Rotylenchulinae). *Türkiye 4. Entomoloji Kongresi*, 12-15 Eylül 2000, Kuşadası-Aydın.
- Elekçioğlu, İ.H., & Uygun N. (1994). Occurrence and distribution of plant parasitic nematodes in cash crop in Eastern Mediterranean Region of Turkey, *Proceedings of 9th Congress of the Mediterranean Phytopathological Union*, Kuşadası, Aydın, Türkiye, pp 409-410.
- Emre E., & Kaşkavalcı G. (2015). Determination of distribution and population densities of citrus nematode [*Tylenchulus semipenetrans* (Cobb, 1913) (Tylenchida: Tylenchulidae)] in satsuma mandarin growing areas of Izmir Province. *Journal of Agriculture Faculty of Ege University*, 52 (3), 269-276.
- Enneli S., & Öztürk, G. (1989). Zonguldak ilinin çilek yetiştirilen alanlarında bulunan bitki paraziti nematodların saptanması ve önemli olanların yoğunluklarının belirlenmesi üzerinde çalışmalar. *Bitki Koruma Bülteni*, 29, 153-163.

- Erdoguş, F.D. (2009). Marmara Bölgesi şerbetçiotu (*Humulus lupulus* L.) ve patates (*Solanum tuberosum* L.) ekiliş alanlarında bulunan nematoda türleri üzerinde taksonomik araştırmalar. Doktora Tezi, Ankara Üniversitesi Fen Bilimleri Enstitüsü, Ankara, 163 s.
- Ertürk, H., & Özkut, S. (1973). Ege Bölgesi şartlarında kök-ur nematodlarına (*Meloidogyne* spp.) dayanıklı asma anacı araştırması. IV. Bilim Kongresi, Ankara.
- Ertürk, H., Özkut, S., & Borazancı, N. (1973). Chemical control of root-knot nematodes on cotton by DBCP. *Phytopathology*, 2 (3), 113-118.
- Esmaili, M., Heydari, R., Tahmoures, M., & Ye, W. (2017). *Aphelenchoides salixae* n. sp. (Nematoda: Aphelenchoididae) isolated from *Salix alba* in western Iran. *Nematology*, 19, 697-707. <https://doi.org/10.1163/15685411-00003081>
- Evlice, E., & Ökten, M. (2010). Plant parasitic nematodes of Tylenchida (Nematoda) associated with pear (*Pyrus communis* L.) orchards in Ankara district. *Plant Protection Bulletin*, 48, 1-8.
- Getaneh, G., Bert, W., & Decraemer, W. (2015). First report, morphological and molecular characterization of *Xiphinema elongatum* and *X. pachtaicum* (Nematoda, Longidoridae) from Ethiopia. *ZooKeys*, 489, 1-13. <http://dx.doi.org/10.3897/zookeys.489.8629>
- Ghaderi, R., & Karssen, G. (2020). An updated checklist of *Meloidogyne* Göldi, 1887 species, with a diagnostic compendium for second-stage juveniles and males. *Journal of Crop Protection*, 9 (2), 183-193. <http://jcp.modares.ac.ir/article-3-35347-en.html>
- Göksel, N. (1948). Çilek paraziti *Aphelenchoides fragariae*. *Mahsul Hekimi Dergisi*, 6, 8-9.
- Handoo, Z., Kantor, M., & Carta, L. (2020). Taxonomy and identification of principal foliar nematode species (Aphelenchoides and Litylenchus). *Plants*, 9 (11), 1490. <https://doi.org/10.3390/plants9111490>
- Hooper, D.J. (1974). *Aphelenchus avenae*. C.I.H. *Descriptions of Plant-Parasitic Nematodes*, 4, 193-196.
- Hunt, D.J. (1993). Aphelenchida, Longidoridae and Trichodoridae: Their systematics and bionomics. CABI, UK.
- İmren, M. (2007). Diyarbakır ili buğday, sebze ve bağ alanlarında önemli bitki paraziti nematod türlerinin belirlenmesi. Yüksek Lisans Tezi, Çukurova üniversitesi, Fen bilimleri Enstitüsü, Adana, Türkiye.
- İmren, M., Toktay, H., Özarlıdan, A., Nicol, J.M., & Elekcioglu, İ.H. (2012). Güneydoğu Anadolu Bölgesi tahıl alanlarında tahıl kist nematodu, *Heterodera avenae* group türlerinin belirlenmesi. *Turkish Journal of Entomology*, 36 (2), 265-275.
- İmren, M., Toktay, H., Bozbuğa, R., Dababat, A., & Elekcioglu, İ.H. (2013). Tahıl kist nematodu, *Heterodera avenae'nin* Doğu Akdeniz Bölgesi patotipinin belirlenmesi. *Türkiye Entomoloji Dergisi*, 37 (1), 13-19.
- İmren, M., Toktay, H., Özarlıdan, A., Öcal, A., & Elekcioglu, İ.H. (2011). Doğu Akdeniz Bölgesi buğday alanlarında tahıl kist nematodu (*Heterodera avenae* group) türlerinin belirlenmesi. IV Bitki Koruma Kongresi, 28-30 Haziran 2011, Kahramanmaraş, Bildiri Özetleri, 10 s.
- Jones, J.T., Haegeman, A., Danchin, E.G.J., Gaur, H.S., Helder, J., Jones, M.G.K., Kikuchi, T., Manzanilla-López, R., Palomares-Rius, J.E., Wesemael, W.M.L., & Perry, R.N. (2013). Top 10 plant-parasitic nematodes. *Molecular Plant Pathology*, 14, 946-961. <http://dx.doi.org/10.1111/mpp.12057>
- Kasapoğlu Uludamar, E.B., Yıldız, Ş., İmren, M., Öcal, A., & Elekcioglu, İ.H. (2018). Occurrence of plant parasitic nematode species in important crops in the Southeast Anatolia Region of Turkey. *Turkish Journal of Entomology*, 42 (1), 63-74. <https://doi.org/10.16970/entoted.359616>
- Kasapoğlu, E.B., İmren, M., & Elekcioglu, İ.H. (2014). Plant parasitic nematode species found on important cultivated plants in Adana. *Turkish Journal of Entomology*, 38 (3), 333-350. <https://doi.org/10.16970/ent.06172>
- Kepenekçi, İ. (2002). Plant parasitic nematodes species of Tylenchida (Nematoda) associated with sesame (*Sesamum indicum* L.) growing areas in the Mediterranean region of Turkey. *Turkish Journal of Agriculture and Forestry*, 26 (6), 323-330.

- Kepenekçi, İ. (2003). Preliminary list of Tylenchida (Nematoda) associated with anise (*Pimpinella anisum* L.) in Turkey. *Pakistan Journal of Nematology*, 21 (1), 37-40.
- Kepenekçi, İ., & Ökten M.E. (1996). Beypazarı (Ankara) ilçesinde havuç ile münavebeye giren domates ekiliş alanlarında saptanan *Helicotylenchus* (Tylenchida, Hoplolaimidae) cinsine bağlı türler *Türkiye Entomoloji Dergisi*, 20, 137-148.
- Kepenekçi, İ., & Öztürk, G. (2002). Göksu Deltası (İçel)'nda çilek yetiştirilen alanlarda saptanan bitki paraziti nematod türleri. *IV Sebze Tarımı Sempozyumu*, Bursa, p 54.
- Kepenekçi, İ., & Öztürk, G. (1999). Doğu Karadeniz Bölgesi'nde kivi (*Actinidia deliciosa* cv. Hayward) bahçelerinde saptanan Tylenchida (Nematoda) takımına ait bitki paraziti nematodlar. *Türkiye III. Ulusal Bahçe Bitkileri Kongresi*, Ankara, 892-896 pp.
- Kepenekçi, İ., Toktay, H., & Evlice, E. (2014). Plant Parasitic and virus vector nematodes associated with vineyards in the Central Anatolia region of Turkey. *Pakistan Journal of Zoology*, 46 (3), 866-870.
- Kıray, Y. (1963). Turunçgil nematodu (*Tylenchulus semipenetrans* Cobb 1913). Yaşayışı ve mücadelesi. *T. C. Tarım Bakanlığı Zirai Mücadele Enstitüsü Yayınları* No:18.
- Kurt, Ş., Soylu, S., Uysal, A., Soylu, E.M., & Kara, M. (2020a). Ceviz gövde kanseri hastalığı etmeni *Botryosphaeria dothidea*'nın tanılanması ve bazı fungusitlerin hastalık etmenine karşı *in vitro* antifungal etkinliklerinin belirlenmesi. *MKÜ Tarım Bilimleri Dergisi*, 25, 46-56. <https://doi.org/10.37908/mkutbd.686111>
- Kurt, Ş., Uysal, A., Soylu, E.M., Kara, M., & Soylu, S. (2020b). Characterization and pathogenicity of *Fusarium solani* associated with dry root rot of citrus in the eastern Mediterranean region of Turkey. *Journal of General Plant Pathology*, 86, 326-332. <https://doi.org/10.1007/s10327-020-00922-6>
- Kurt, Ş., Uysal, A., Guarnaccia, V., Martino, I., Soylu, E.M., Soylu, S., & Kara, M. (2025). Molecular identification and pathogenicity of Botryosphaeriaceae species associated with citrus wood diseases in the eastern Mediterranean region of Türkiye. *Journal of Plant Pathology*, 107, 1077-1089. <https://doi.org/10.1007/s42161-025-01877-3>
- Lamberti, F., Molinari, S., Moens, M., & Brown, D.J.F. (2000), The *Xiphinema americanum* group. I. Putative species, their geographical occurrence and distribution, and regional polytomous identification keys for the group. *Russian Journal of Nematology*, 8, 65-84.
- Maafi Tanha, Z., Subbotin, S., & Moens, M. (2003). Molecular identification of cyst-forming nematodes (Heteroderidae) from Iran and a phylogeny based on ITS-rDNA sequences. *Nematology*, 5, 99-111.
- Maleita, C., Cardoso, J., Rusinque, L., Esteves, I., & Abrantes, I. (2021). Species-specific molecular detection of the root knot nematode *Meloidogyne luci*. *Biology*, 10 (8), 775. <https://doi.org/10.3390/biology10080775>
- Mennan, S. (2001). Amasya, Suluova ilçesi soğan ekim alanlarında soğan sak nematodu *Ditylenchus dipsaci* (Kühn, 1857) (Nematoda: Tylenchida: Anguinidae) popülasyonunun bitki koruma yönünden araştırılması. Doktora Tezi, Ondokuz Mayıs Üniversitesi, Fen Bilimleri Enstitüsü, Samsun.
- Mısırlıoğlu, B., & Pehlivan, E. (2007). Ege ve Marmara Bölgeleri buğday ekiliş alanlarında bulunan önemli bitki paraziti nematodlar. *II. Bitki Koruma Kongresi*, Isparta. p 250.
- Mısırlıoğlu, B., & Ulutaş, E. (2009). Ege Bölgesi fidan üretim alanlarında bitki paraziti nematodların durumu. *III. Bitki Koruma Kongresi*, Van, 47 s.
- Mısırlıoğlu, B., & Ulutaş, E. (2011). Ege ve Akdeniz Bölgelerinde potansiyel tohumluk patates üretim alanlarının bitki paraziti nematodlar yönüyle incelenmesi. *IV Bitki Koruma Kongresi*, Kahramanmaraş, Bildiri Özetleri, p 249.
- Mokrini, F., Viaene, N., Waeyenberge, L., Dababat, A.A., & Moens, M. (2019). Root-lesion nematodes in cereal fields: importance, distribution, identification, and management strategies. *Journal of Plant Disease and Protection*, 126, 1-11.

- Nicol, J.M., Turner, S.J., Coyne, D.L., den Nijs, L., Hockland, S., & Maafi, Z.T. (2011). Current nematode threats to world agriculture in (Jones, J.T. , Gheysen, G., Fenoll, C. , Eds.) *Genomics and Molecular Genetics of Plant–Nematode Interactions*, Springer, Heidelberg. 21-44 pp.
- Nogay, A., Ağdacı, M., & Gürsoy, Y.Z. (1995). Marmara bölgesinde bağlarda ve Amerikan asma anaçlıklarında görülen virüs hastalıklarının ve vektörlerinin saptanması üzerine araştırmalar. VII. *Türkiye Fitopatoloji Kongresi Bildirileri*, pp 247-251.
- Oğuz, M., Soylu, S., Üremiş, İ., Uysal, A., Soylu, E.M., Kurt, Ş., & Sertkaya, E. (2024). Determination of fungal and bacterial microbiota of broomrape species found in their major host plants grown in Hatay province of Turkey. *MKÜ Tarım Bilimleri Dergisi*, 29 (3), 896-911. <https://doi.org/10.37908/mkutbd.1516441>
- Özarslandan, A., & Elekcioglu, İ.H. (2010b). Investigation on virulence of *Meloidogyne incognita* (Kofoid & White, 1919), *Meloidogyne arenaria* (Neal, 1889) and *Meloidogyne javanica* (Treub, 1885) (Tylenchida: Meloidogynidae) populations on resistant and susceptible tomato cultivars. *Turkish Journal of Entomology*, 34 (4), 495-502.
- Özarslandan, A., & Elekcioglu, İ.H. (2010a). Türkiye'nin farklı alanlarından alınan Kök-ur nematodu türlerinin (*Meloidogyne* spp.) (Nemata: Meloidogynidae) moleküler ve morfolojik tanılama ile belirlenmesi. *Türkiye Entomoloji Dergisi*, 34, 323-335.
- Öztürk, G., & Enneli, S. (1994). Distribution of plant parasitic nematodes in alfa-alfa growing areas in Central Anatolia Region of Turkey. *Proceedings of the 9th Congress of the Mediterranean Phytopathological Union*, September 18-24, 1994, Kusadasi, Aydın, Turkey. pp 537-538.
- Öztürk, G., & Enneli, S. (1997). Determination of *Aphelenchoides besseyi* Christie (Aphelenchida: Aphelenchoididae) (the white tip nematode) harmful on rice for the first time in Türkiye. *Turkish Journal of Entomology*, 21 (2), 129-132.
- Palomares-Rius, J.E., Archidona-Yuste, A., Cantalapiedra-Navarrete, C., Azpilicueta, A., Saborido, A., Tzortzakakis, E.A., Cai, R., & Castillo, P. (2021b). New distribution and molecular diversity of the reniform nematode *Rotylenchulus macrosoma* Dasgupta, Raski and Sher, 1968 (Nematoda: Rotylenchulinae) *European Phytopathology*, 111, 720-730. <https://doi.org/10.1094/PHYTO-04-20-0148-R>
- Palomares-Rius, J.E., Clavero-Camacho, I., Archidona-Yuste, A., Cantalapiedra-Navarrete, C., León-Roper, G., Braun Miyara, S., Karszen, G., & Castillo, P. (2021a). Global distribution of the reniform nematode genus *Rotylenchulus* with the synonymy of *Rotylenchulus macrosoma* with *Rotylenchulus borealis*. *Plants*, 10, 7. <https://dx.doi.org/10.3390/plants10010007>
- Rivoal, R., & Cook, R. (1993). *Nematode pests of cereals*. K. Evans, D. L. Trudgill & J. M. Webster (Eds.) *Plant Parasitic Nematodes in Temperate Agriculture*. CAB International, Wallingford, England, 656 pp.
- Rumpfenhorst, H.J., Elekcioglu, I.H., Sturhan, D., Öztürk, G., & Enneli, S. (1996). The cereal cyst nematode *Heterodera filipjevi* (Madzhidov) in Turkey. *Nematologia Mediterranea*, 24, 135-138.
- Saltukoğlu, M.E., Geraert, E., & Coomans, A. (1976). Some Tylenchida from the İstanbul Area (Turkey). *Nematologia Mediterranea*, 4, 139-153.
- Sánchez Monge, G.A., Flores, L., Salazar, L., Hockland, S., & Bert, W. (2015). An updated list of the plants associated with plant-parasitic *Aphelenchoides* (Nematoda: Aphelenchoididae) and its implications for plant-parasitism within this genus. *Zootaxa*, 4013, 207-224.
- Seinhorst J.W. (1959) A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. *Nematologica*, 4, 67-69.
- Sertkaya, G., Yıldırım A.E., Üremiş, İ., & Sertkaya, E. (2013). Hatay ili bağ alanlarında bazı nepovirüslerin araştırılması. *MKÜ Ziraat Fakültesi Dergisi*, 18 (2), 39-46.
- Sikora, A.R., & Fernández, E. (2005). *Nematode parasites of vegetables*. Luc M, Sikora RA, Bridge J, (Eds). *Plant Parasitic Nematodes in Subtropical and Tropical Agriculture*, CAB International, UK, pp. 319-392.

- Soylu, S., & Dervis, S. (2011). Determination of prevalence and incidence of fungal disease agents of pea (*Pisum sativum* L.) plants growing in Amik plain of Turkey. *Research on Crops*, 12, 588-592.
- Soylu, S., Kara, M., Kurt, Ş., Soyulu, E.M., & Uysal, A. (2020). Determination of fungal and bacterial disease agents of apricot trees growing in Hatay province. *Acta Horticulturae*, 1290, 111-114. <https://doi.org/10.17660/ActaHortic.2020.1290.20>
- Soylu, S., Kara, M., Uysal, A., Kurt, Ş., Soyulu, E.M., Üremiş, İ., Sertkaya, E., Bozkurt, İ.A., & Öztürk, M. (2022). Amik ovası havuç ekim alanlarında sorun olan fungal ve bakteriyel hastalık etmenlerin belirlenmesi. *KSU Tarım ve Doğa Dergisi*, 25, 1326-1340. <https://doi.org/10.18016/ksutarimdog.vi.1015936>
- Soylu, S., Kara, M., Uysal, A., Gümüş, Y., Soyulu, E.M., Kurt, Ş., Üremiş, İ., & Sertkaya, E. (2024). Determination of fungal and bacterial disease agents on significant *Brassicaceous* vegetable species grown in Hatay Province. *KSU Tarım ve Doğa Dergisi*, 27 (4), 881-891. <https://doi.org/10.18016/ksutarimdog.vi.1383042>
- Subbotin, S.A., Ocampo, M., & Baldwin J.G. (2010). Systematics of cyst nematodes (Nematoda: Heteroderinae) *Nematology monographs and Perspectives 8A. In: Biology and Evolution*. Brill Leiden –Boston. 68 pp.
- Tan, A.N., & Kılıç, M. (2011). Güneydoğu Anadolu Bölgesi (Türkiye)'nde sebze üretim seralarında saptanan bitki paraziti nematodlar. *VI. Bitki Koruma Kongresi, Kahramanmaraş, Bildiri Özetleri*, 296 s.
- Tan, A.N., Öcal, A., Öztürk, L., & Elekçioğlu, İ.H. (2018). Plant parasitic nematodes associated with almond (*Prunus dulcis* Mill.) and walnut (*Juglans regia* L.) orchards in Adiyaman province, Turkey. *International Journal of Molecular Biology*, 3 (6), 295-300. <https://doi.org/10.15406/ijmboa.2018.03.00090>
- Taylor, C.A., & Brown, D.J.F. (1997). *Nematode-transmitted viruses*. Lamberti, F., Taylor, C.E. & Seinhorst, J.W. (Eds.), Nematode vectors of plant viruses. CAB International, Wallingford UK.
- Telli, S., & Üremiş, İ. (2010). Hatay'da maydanoz yetiştiriciliğinde karşılaşılan bitki koruma sorunları ve çözüm önerileri. *MKÜ Ziraat Fakültesi Dergisi*, 15 (1), 39-48.
- Toumi, F., Waeyenberge, L., Viaene, N., Dababat, A., Nicol, J.N., Ogbonnaya, F., & Moens, M. (2013). Development of a species-specific PCR to detect the cereal cyst nematode, *Heterodera latipons*. *Nematology*, 15, 709-717.
- Tunçdemir, U. (1983). Samsun Bölge Zirai Mücadele Araştırma Enstitüsü Bölgesi kenevir (*Cannabis sativa* L.)'lerinde zarar yapan önemli bitki paraziti nematodlar, tanımları, zararları, bulaşma yolları, yayılışları ve konukçuları üzerinde araştırmalar. *Samsun Bölge Zirai Mücadele Araştırma Enstitüsü Araştırma Eserleri Serisi*, 29, 40.
- Tülek, A., Ates, S.S., Akin, K., Sürek, H., Kaya, R., & Kepenekci, İ. (2014). Determining yield losses in rice cultivars resulting from rice white tip nematode *Aphelenchoides besseyi* in field condition. *Pakistan Journal of Nematology*, 32 (2), 149-154.
- Uysal, A., Kurt, Ş., Soyulu, S., Kara, M., & Soyulu, E.M. (2024). Turunçgil bahçelerinde meyve dökümüne neden olan fungal patojenlerin tanısı ve bazı bileşiklerinin antifungal etkileri. *KSU Tarım ve Doğa Dergisi*, 27 (6), 1401-1413. <https://doi.org/10.18016/ksutarimdog.vi.1457700>
- Üremiş, İ., Sertkaya, E., Sertkaya, G., & Yıldırım, A.E. (2013). Hatay ili kayısı bahçelerinde bulunan yabancı ot türlerinin, yaygınlıklarının ve yoğunluklarının belirlenmesi. *MKÜ Ziraat Fakültesi Dergisi*, 18 (2), 47-54.
- Üremiş, İ., Soyulu, S., Kurt, Ş., Soyulu, E.M., & Sertkaya, E. (2020). Hatay ili havuç ekim alanlarında bulunan yabancı ot türleri, yaygınlıkları, yoğunlukları ve durumlarının değerlendirilmesi. *Tekirdağ Ziraat Fakültesi Dergisi*, 17, 211-228. <https://doi.org/10.33462/jotaf.645336>
- Waeyenberge, L., Viaene, N., Subbotin, S., & Moens, M. (2009). Molecular Identification of *Heterodera* spp., an overview of 15 years of research. (I. T. Riley, J. M. Nicol, A. A. Dababat Eds.), Cereal cyst nematodes: status, research and outlook. CIMMYT - International Maize and Wheat Improvement Center. pp. 109-114.
- Whitehead, A.G. (1998). Plant Nematode Control. CAB International, New York, USA.

- Yavuzaslanoglu, E., Dikici, A., Elekcioglu, I.H., & Aydođdu, M. (2015). Distribution of nematodes on onion and their relationship with soil physicochemical characteristics in Karaman Province, Turkey. *Turkish Journal of Entomology*, 39, 251-259.
- Yavuzaslanoglu, E., Ateş Sönmezođlu, O., Genç, N., Akar, Z.M., Öcal, A., Karaca, S.M., Elekçioglu, I.H., Özsoy, V.S., & Aydođdu, M. (2019). Occurrence and abundance of nematodes on onion in Turkey and their relationship with soil physicochemical properties. *Nematology*, 21 (10), 1063-1079.
- Yıldız, Ş., & Elekcioglu, İ.H. (2011). Şanlıurfa ilinde tarımsal ve dođal alanlarda nematod biyoçeşitliliđi. *Turkish Journal of Entomology*, 35 (2), 381-394. <https://dergipark.org.tr/tr/pub/entoted/issue/64049/969263>
- Yüksel, H.Ş. (1958). İç Anadolu'da sođanlarda ilk defa tespit edilen sak ve sođan Nematodu (*Ditylenchus dipsaci* Grup). *Tomurcuk*, 77 (7), 5-6.
- Yüksel, H.Ş. (1966). Dođu Karadeniz Kıyı Bölgesi'nde bulunan *Meloidogyne incognita*, *Heterodera cruciferae*, ve *Tylenchulus semipenetrans*'in bazı önemli devreleri üzerinde morfolojik çalıřmalar. *Atatürk Üniversitesi Ziraat Fakültesi Zirai Arařtırma Enstitüsü Arařtırma Bülteni*, 15, 21.
- Yüksel, H.Ş. (1973). Türkiye'de bulunan *Heterodera* (Nematoda: Heteroderidae) türleri durumu; bunların morfolojik ve biyolojik farklılıkları üzerinde çalıřmalar. *Atatürk Üniversitesi Ziraat Fakültesi Ziraat Dergisi*, 4 (1), 53-71.
- Yüksel, H.Ş. (1974). Dođu Anadolu'da tespit edilen *Pratylenchus* türlerinin dađılıřı ve bunlar üzerinde sistematik çalıřmalar. *Atatürk Üniversitesi Ziraat Fakültesi Dergisi*, 4 (1), 15-20.
- Yüksel, H.Ş. (1978). Patato rot nematode (*Ditylenchus destructor*) in Erzurum province. *Phytopathology*, 7 (1), 19-22.