MJAVL
Manas Journal of Agriculture Veterinary and Life Sciences
ISSN/e-ISSN 1694-7932
Volume 13 (Issue II) (2023) Pages 108-118

Research Article

Nematode Fauna Associated with Weeds in Vineyards in Aegean region of Türkiye

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ABSTRACT

Surveys were carried out between the years 2021-2022 to determine the nematode hosts of weeds in the vineyard areas of Izmir and Manisa provinces in the Aegean Region. Fifty-five weeds belonging to different families, Asteraceae, Apiaceae, Brassicaceae, Fabaceae, Geraniaceae, Lamiaceae, and Poaceae, were identified in vineyards. In the study, 19 genera of free-living and 17 genera of plant feeder nematode species were extracted from the roots and rhizosphere soil of weeds. The detected nematode species were divided into herbivores, fungivores, omnivores, bacterivores, and predators. The majority of plant parasitic nematodes consisted of ectoparasitic species. On the other hand, *Meloidogyne* species were prominent among the plant parasitic nematode genera detected, and *Amaranthus retroflexus* L., *Anagallis arvensis* L., *Cynodon dactylon* (L.) Pers., *Chenopodium album* L., *Eleusine indica* (L.) Gaertn, *Gallium aparine* L., *Heliotropium europaeum* L., *Lepidium draba* L., *Lamium amplexicaule* L., *Lactuca serriola* L., *Portulaca oleracea* L. were identified as hosts. *Pratylenchus neglectus*, *P. thornei*, *Longidorus elongatus*, and *Ditylenchus dipsaci* were other economically important nematode species identified from the root zone of weeds. Bacterial feeder *Cephalobus*, omnivore *Mesodorylaimus*, and plant-parasitic *Geocenamus brevidens* had the highest populations counted as 61, 81, and 22 in 100 cm^3 soil in survey areas, respectively.

Keywords: *Nematode, Weed hosts, Vineyards, Türkiye*

ARTICLE INFO

Received: 20.03.2023
Accepted: 15.09.2023

Cite this article as: Şin, B., & Öztürk, L. (2023). Nematode Fauna Associated with Weeds in Vineyards in Aegean region of Türkiye. *Manas Journal of Agriculture Veterinary and Life Sciences*, *13*(2), 108-118. https://doi.org/10.53518/mjavl.1267844

INTRODUCTION

Grapevine (*Vitis vinifera* L.) is a perennial herb with more than 6000 species from the Vitaceae family (Agulheiro-Santos et al. 2021). The grapevine, which can adapt to different climatic conditions, is among the world's most widely grown cultivated plants due to being not selective regarding soil requirements and easily reproduced and consumed in different ways. In addition to being consumed fresh, its fruit is used to make jam, fruit juice, jelly, vinegar, wine, and various herbal extracts and oil from its seeds. Fifty-seven percent of the grapes produced on earth are used in winemaking, 36% are consumed fresh, and 7% are dried. Grape production constitutes 28% of fruit production in our country, and vineyards account for 15% of the regions where horticulture is carried out (Çelik 2013).

Weeds are one of the biotic factors affecting production in vineyards. They comprise 8.000 of the 250.000 plants diagnosed on Earth (Holm et al. 1979). Weeds are undesirable plants whose seeds can maintain vitality in the soil for years, germinate under suitable conditions, and weed seeds can quickly disperse to non-infested areas (Davies and Sheley, 2007). Without environmental intervention in the newly infected areas, they can multiply quickly and invade the whole area.

Weeds compete with crop plants for water and nutrients necessary for survival (Wisler and Norris 2005). Weed infestation poses a significant problem in newly established vineyard areas. Newly planted seedlings with under-developed roots may be more prone to weed competition in vineyards that are generally not irrigated. Several species can reach deeper soil depths than vine species, take nutrients and water from the depths that seedling roots cannot reach, grow faster than young seedlings and cover them and reduce the valuable sunlight they can receive.

Soils around weeds are host plants for several nematode species. Soils contain wide species of fungivores, predators, omnivores, herbivores, and bacterivore nematodes. Bacterivore and fungivore nematodes play a significant role in organic waste decomposition. By decomposing organic material, releasing elements like C, N, and P, and aerating, nematodes improve soil nutrient and food web conditions. This condition indirectly promotes crop plant growth and weed growth in soils with rich content. An increase in weed growth will also increase weed-induced damage in cultivated plants.

Moreover, plant parasitic nematodes damage plant roots and cause up to 80% reduction in yield in grapevine (Askary et al., 2018). In contrast, predators are vital natural enemies that can reduce populations of plant-damaging pests. For instance, predator dorylaimid nematodes can feed on several *Meloidogyne* species (Timper et al. 2021).

Weeds maintain many of these nematode species inside their roots or soils around their roots. A high rate of nematode-susceptible weeds can host many, especially plant parasitic nematodes. Additionally, nematodes feeding on weeds may increase their population. The increase of nematodes in fields may cause a decrease in nematode resistance in crop plants resistant to nematodes (Davis and Webster, 2005). The genera richness of nematodes varies depending on weed species. Some weeds may secrete allelochemicals that suppress nematode reproduction (Yeates and Williams, 2001). Some of them may have strong root structures and may not allow nematode feeding and thus cannot increase the nematode population that cannot be fed. However, weeds are not only host for nematodes but also are known to protect them from toxic chemical damage by absorbing pesticides, thus survived nematodes may cause new nematode damage (Rocha et al., 2021). Furthermore, the life span of weeds also affects the nematode population. Thus the fauna of nematodes in fields may vary depending on weed diversity and need to be identified.

Izmir and Manisa are one of the biggest producers of grapevine. Viticulture is carried out on 103.851 decares in Izmir and 866.496 in Manisa. In Izmir, table grapes are grown in 41,383 decares of area, wine grapes in 16.399, and dried grapes in 46.212 (Anonymous, 2022). The vineyard area in two provinces constitutes 23% of the country's production area and 41.4% in production amount (Yasan-Ataseven, 2021). While most producers in Izmir are small-scale producers, viticulture is carried out in more extensive areas in Manisa, especially for raisin production, for commercial purposes. Vineyards have a vital position in agricultural production regarding the area they cover. Thus, it is important to determine weeds and nematode fauna associated with these weeds. The present study mainly focuses on determining weed hosts of plant-parasitic nematodes, considered significant grapevine pests. The finds will reveal how important weed control, especially nematode hosts, is in vineyards.

MATERIAL AND METHODS

Study Area Information

The study area covers Izmir and Manisa provinces. During the surveys, the highest temperature in Izmir was measured as 36°C and the lowest temperature as 14°C, and the annual precipitation in the province was approximately 700 mm. In Manisa, the temperature was 34 °C, and the lowest was 17 °C. Rainfall was 713 mm per year. Most vineyards in Izmir were not irrigated, and irrigation was carried out at regular intervals with drip irrigation in the vineyard areas in Manisa. The investigated vineyards located in Kemalpaşa, Menemen, and Torbalı districts in Izmir and Salihli, Saruhanlı, Akhisar, Turgutlu, and Şehzadeler districts in Manisa (Table 1, Figure 1).

Table 1. *The information on surveyed vineyards in Manisa and Izmir (Tuik, 2021).*

Provinces	Districts	Total production area (ha)	Surveyed area (da)	Number of sampled vineyards
Izmir	Kemalpaşa	2.840	77	9
	Menemen	3.075	84	7
	Torbalı	677	32	6
Manisa	Akhisar	1.9905	198	6
	Şehzadeler	8.665	51	3
	Yunusemre	2.555	14	1
	Saruhanlı	10.500	152	6
	Turgutlu	7.079	67	5
	Salihli	13.033	276	13

Figure 1. *Surveyed area in the map of Türkiye*

Collection and Identification of Weeds in Vineyards

While selecting the vineyards in the survey, the rule of at least a 1 km distance between them was followed, and the vineyards were chosen randomly. The vineyard area sizes ranged from 2-30 da in Izmir and 10-45 da in Manisa. Observations on weeds in each vineyard were conducted and recorded. Weed samples were collected and transferred to Sakarya University of Applied Sciences for identification. Weed density was evaluated by counting weeds at a 1 m^2 frame. The weeds in quadrate size 1m x 1m were measured five times and then averages count were used to determine the number of weeds in m^2. The frequency of occurrence (f%) of species was calculated as the number of vineyards where the species was recorded divided by the total number of vineyards visited (Sırma et al., 2001). Density (plant/m^2) was calculated by dividing the number of plants in total m^2 by the number of vineyards sampled.

Each species' herbarium was prepared by slowly drying the plant samples at room temperature. Dried samples were attached to cardboard and labeled. Weeds were identified from the plant morphology. At the final stage, weeds were divided into annual, biennial, and perennial according to life span, geophyte, chamaephyte, therophyte, and phanerophyte according to life form (Raunkiaer, 1937), monocotyledon, dicotyledon and parasite.

Extraction and Identification of Nematodes Associated with Weeds in Vineyards

Root samples and rhizosphere soil, basically from 0-30 cm, were also collected to identify nematode species. Additionally, weed roots were examined for nematode galls. Nematodes in soil were extracted by combining Cobb's (1913) decanting-sieving and centrifuge flotation of Jenkins (1964). In this method, 100 cm^3 soil was mixed with 300 ml water, stirred well, and sieved through 100 and 400 mesh sieves. Nematodes on 400 mesh sieve were centrifuged at 1.750 rpm for 5 minutes, and adding 50 sugar solution was centrifuged again for 1 minute. The centrifuged mixture was passed through a 400 mesh sieve, and juvenile, female, and male nematodes were collected. Nematodes from roots were collected with the Modified Baermann method. Nearly 50 g of the root was washed and placed on funnels containing filter paper. Roots were kept for two days in water, and migrated nematodes were collected. When root galling was observed, females of nematodes inside the roots were hand-picked, and perineal patterns of these females were prepared and identified (Hartmann and Sasser, 1985). Nematodes were counted from 1 ml of the extracted suspension under the microscope at 10X magnification. By examining the morphological characteristics of female individuals, such as stylet shape, vulva position, tail shape, and longitudinal lines, free-living nematodes were identified at the genus level, and plant parasites at the species level. Slides of nematodes were prepared from heat-killed and in TAF (7 ml 40% formaldehyde + 2 ml triethanolamine + 91 ml), Seinhorst 1 (1 part glycerin + 79 parts distilled water), and Seinhorst II (5 parts glycerin). + 95 parts of ethanol) solutions processed females. Treated nematodes were fixed on a slide with glycerin dripping using the wax ring method (Seinhorst, 1959). Plant-parasitic species have been identified according to keys such as Loof and Luc (1990), Brezski (1991), and Handoo et al. (2007).

RESULTS

Fifty-five weed species were determined in the vineyard areas of Izmir and Manisa. While 55 species were found in Izmir province, 52 were in Manisa province. Among all, one species was parasitic, eight were narrow-leaved, and 45 were broad-leaved. According to the life span, weeds were grouped as annual and perennial, and no weeds with a two-year age were found. According to life form, it is divided into four groups' chamaephyte, therophyte, hemicryptophyte, and geophyte. Therophyte species were prominent in terms of number in the vineyard areas. Forty-six weeds detected in Izmir province were dicotyledonous, one parasitic, and eight monocotyledonous weeds. In Manisa province, 44 weeds were dicotyledonous, and eight were monocotyledonous. None of the parasitic species were found in the vineyard areas of Manisa province. The number of annual weeds was 41 in Izmir and 8 in Manisa. Among the perennial weeds, 17 were found in Izmir and 16 in Manisa. According to life form, therophyte weeds stood out in both provinces and chamaephyte was in the last place with a small number of taxons (Figure 2).

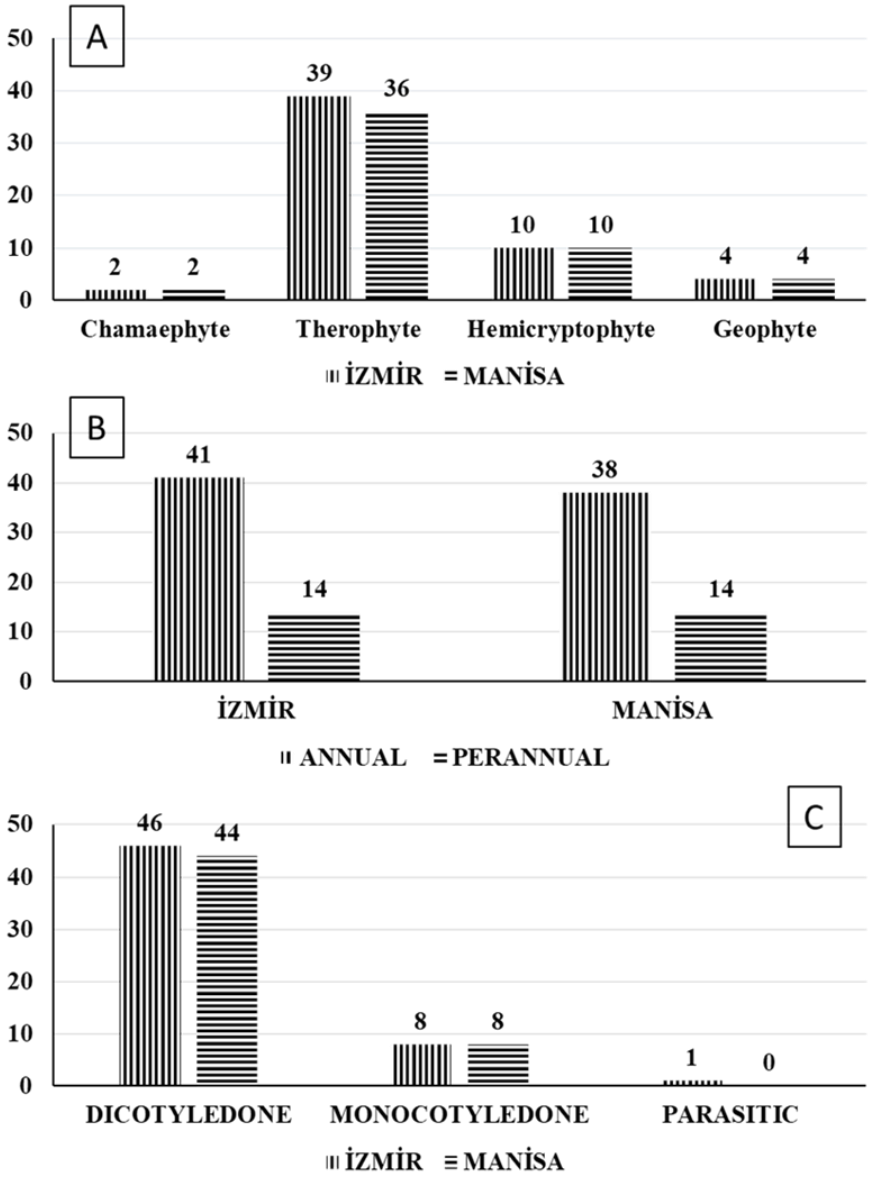

Figure 2. *The number of weeds classified by A. Morphotypic character B. Life cycle C. Raunkiaer life form*

Identified weeds in the vineyards belonged to 30 families. The families with the most taxon in vineyard areas were determined as Asteraceae (11 species), Brassicaceae (6 species), and Poaceae (7 species). All individuals in these families were identified in both provinces. On the other hand, two taxons were determined from Boraginaceae, Fabaceae, Lamiaceae, Primulaceae, and Solanaceae families (Table 2, Figure 3).

Table 2. *The list of weed species found in vineyards in Izmir and Manisa*

Family	**Scientific name**	**Life form**	**Life cycle**	**Izmir**	**Manisa**
Amaranthaceae	*Amaranthus retroflexus* L.	Th	A	+	+
Asteraceae	*Calendula arvensis* L.	Th	A	+	+
	Centaurea solstitialis L.	Th	A	+	+
	Cirsium arvense (L.) Scop.	G	P	+	+
	Conyza canadensis (L.) Cronquist	Th	A	+	+
	Cichorium intybus L.	H	P	+	+
	Matricaria chamomilla L.	Th	A	+	+

	Senecio vulgaris L.	Th	A	+	+
	Sonchus arvensis L.	Th	P	+	+
	Taraxacum officinale F.H.Wigg	H	P	+	+
	Xanthium strumarium L.	Ch	A	+	+
	Xanthium spinosum L.	Th	A	+	+
Apiaceae	*Daucus carota* L.	Th	A	+	+
Apocynaceae	*Cynanchum acutum* L.	Ch	P	+	+
Aristolochiaceae	*Aristolochia clematitis* L.	G	P	+	+
Boraginacea	*Echium vulgare* L.	H	P	+	+
	Heliotropium europaeum L.	Th	A	+	+
Brassicaceae	*Capsella-bursa pastoris* (L.) Medik	Th	A	+	+
	Lepidium draba L.	H	A	+	+
	Raphanus raphanistrum L.	Th	A	+	+
	Sisymbrium altissimum L.	Th	A	+	+
	Sinapis arvensis L.	Th	A	+	+
	Thlaspi arvense L.	Th	A	+	+
Caryophyllaceae	*Stellaria media* (L.) Vill	Th	A	+	+
Chenopodiaceae	*Chenopodium album* L.	Th	A	+	+
Convolvulaceae	*Convolvulus arvensis* L.	H	P	+	+
Cucurbitaceae	*Ecballium elaterium* (L.) A. Rich.	H	P	+	+
Cuscutaceae	*Cuscuta* spp.	Th	A	+	-
Cyperiaceae	*Cyperus rotundus* L.	G	P	+	+
Euphorbiaceae	*Euphorbia helioscopia* L.	Th	A	+	+
Fabaceae	*Trifolium arvense* L.	Th	P	+	+
Fumariaceae	*Medicago sativa* L.	Th	P	+	+
	Fumaria officinalis L.	Th	A	+	+
Geraniaceae	*Geranium dissectum* L.	Th	A	+	+
Lamiaceae	*Lamium purpureum* L.	Th	A	+	+
	Lamium amplexicaule L.	Th	A	+	+
Malvaceae	*Malva neglecta* Wallr.	Th	A	+	+
	Malva sylvestris L.	Th	A	+	+
Papaveraceae	*Papaver rhoeas* L.	Th	A	+	+
Plantaginaceae	*Plantago major* L.	H	P	+	+
Poaceae	*Elymus repens* (L.) Gould	H	A	+	+
	Alopecurus myosuroides Huds.	H	A	+	+
	Avena fatua L.	Th	A	+	+
	Cynodon dactylon (L.) Pers.	G	P	+	+
	Echinochloa crus-galli (L.) P.Beauv.	Th	A	+	+
	Poa annua L.	Th	A	+	+
	Sorghum halepense (L.) Pers	H	A	+	+
Polygonaceae	*Polygonum aviculare* L.	Th	A	+	+
Portulacaceae	*Portulaca oleracea* L.	Th	A	+	+
Primulaceae	*Anagallis arvensis* L.	Th	A	+	+
Ranunculaceae	*Consolida regalis* Gray.	Th	A	+	-
Solanaceae	*Datura stramonium* L.	Th	A	+	+
	Solanum nigrum L.	Th	A	+	+
Urticaceae	*Urtica urens* L.	Th	A	+	-
Zygophyllaceae	*Tribulus terrestris* L.	Th	A	+	+

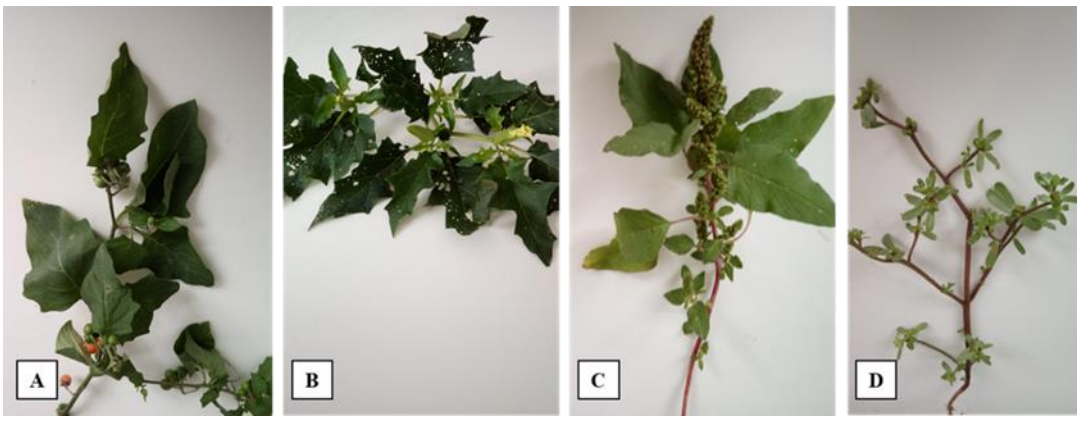

Figure 3. A.*Chenopodium album* L. B.*Datura stramonium* L. C.*Amaranthus retroflexus* L. D.*Portulaca oleracea* L.

In Manisa province, *Amaranthus retroflexus* L. (69%), *Capsella-bursa pastoris* (L.) Medik (49%), *Portulaca oleracea* L. (59%), *Convolvulus arvensis* L. (66%), *Tribulus terrestris* L. (88%), *Raphanus raphanistrum* L. (57%), *Chenopodium album* L. (56%), species are common. In contrast, in Izmir province, *Avena fatua* L. (85%), *Chenopodium album* L. (52%), *Centaurea solstitialis* L. (56%), the prevalence of *Heliotropium europaeum* L. (60%) weeds were found to be remarkably high. Two vineyard areas in Manisa were heavily infested with *Datura stramonium* L. However, *Cuscuta* spp. was not seen. Regarding density per 1 m^2 in vineyard areas, *Stellaria media* (L.) Vill (23), *Avena fatua* L. (13), *Sorghum halepense* (L.) Persian (8) stood out.

Nematodes Associated with Weeds in Vineyards of Manisa and Izmir

During the surveys, 19 genera of free-living nematodes were identified in the root of weeds. Bacterial feeder (9 genera), fungal feeder (3 genera), omnivore (4 genera), predator (3 genera), and plant feeder nematode species (17 genera) were detected in the soils collected from the root zone of weeds in the vineyard areas (Table 3).

Table 3. *Taxonomic classification of nematode genera and species found in Izmir and Manisa vineyards.*

Genus	Order	Family	Feeding habitat	Izmir	Manisa
Achromadora Cobb, 1913	Chromadorida	Achromadoridae	bacterivore	+	-
Acrobeloides Cobb, 1924	Rhabditida	Cephalobidae	bacterivore	+	+
Acrobeles von Linstow, 1877	Rhabditida	Cephalobidae	bacterivore	+	+
Alaimus De Man, 1880	Dorylaimida	Alaimidae	bacterivore	+	+
Aphelenchus Bastian, 1865	Aphelenchida	Aphelenchoididae	fungivore	+	+
Aphelenchoides Fischer, 1894	Aphelenchida	Aphelenchoididae	fungivore	-	+
Aporcelaimus Thorne and Swanger, 1936	Dorylaimida	Aporcelaimidae	omnivore	+	+
Basiria Siddiqi, 1959	Tylenchida	Tylenchidae	plant-parasitic	+	+
Boleodorus Thorne, 1941	Tylenchida	Boleodorinae	plant-parasitic	+	+
Cephalobus Bastian, 1865	Rhabditida	Cephalobidae	bacterivore	+	+
Clarkus Jairajpuri, 1970	Mononchida	Mononchidae	predator	+	-
Ditylenchus, Flipjev,1936	Tylenchida	Anguinidae	fungivore	+	+
Dorylaimus Dujardin, 1845	Dorylaimida	Dorylaimidae	omnivore	+	+
Eudorylaimus Andrássy, 1959	Dorylaimida	Dorylaimidae	omnivore	+	+
Filenchus Andrassy, 1954	Tylenchida	Tylenchidae	plant-parasitic	+	+
Geocenamus Thorne and Malek, 1968.	Tylenchida	Merliniidae	plant-parasitic	+	+
Helicotylenchus Steiner, 1945	Tylenchida	Hoplolaimidae	plant-parasitic	+	+
Longidorus Micoletzky, 1922	Dorylaimida	Longidoridae	plant-parasitic	+	+
Macroposthonia de Man, 1880	Tylenchida	Criconematidae	plant-parasitic	+	+
Meloidogyne Goeldi, 1892	Tylenchida	Heteroderidae	plant-parasitic	+	+
Mesodorylaimus Andrassy 1959	Dorylaimida	Dorylaimidae	omnivore	+	+
Mesorhabditis Osche, 1952	Rhabditida	Rhabditidae	bacterivore	+	+

Paratylenchus Micoletzky, 1922	Tylenchida	Paratylenchidae	plant-parasitic	+	+
Plectus Bastian, 1865	Plectida	Plectidae	bacterivore	+	-
Pratylenchoides Winslow, 1958	Tylenchida	Pratylenchidae	plant-parasitic	+	+
Pratylenchus Filipjev, 1936	Tylenchida	Pratylenchidae	plant-parasitic	+	+
Psilenchus de Man, 1921	Tylenchida	Tylenchidae	plant-parasitic	+	+
Rhabditis Dujardin, 1845	Rhabditida	Rhabditidae	bacterivore	+	+
Rotylenchus Filipjev, 1936	Tylenchida	Hoplolaimidae	plant-parasitic	+	+
Rotylenchulus Filipjev, 1936	Tylenchida	Rotylenchulidae	plant-parasitic	-	+
Seinura Fuchs, 1931	Aphelenchida	Aphelenchoididae	predator	-	+
Tripyla Bastian, 1865	Triplonchida	Tripylidae	predator	+	+
Tylenchus Bastian, 1865	Tylenchida	Tylenchidae	plant-parasitic	+	+
Tylenchorhynchus, Cobb, 1913	Tylenchida	Telotylenchidae	plant-parasitic	+	+
Xiphinema Cobb, 1913	Dorylaimida	Longidoridae	plant-parasitic	+	+
Wilsonema Cobb, 1913	Plectida	Plectidae	bacterivore	+	-

While bacterial feeder *Cephalobus* and omnivore *Mesodorylaimus* were the most common, the highest populations in 100 g soil were 61 and 81, respectively. *Dorylaimus* from omnivorous species, *Acrobeles, Acrobeloides, Alaimus*, bacterivorous species, and *Rhabditis* from fungivore species were also common across the weeds in vineyards.

Plant-parasitic nematodes belonging to 17 genera were isolated from roots. The most prominent were *Geocenamus* (67.8% occurrence) and *Filenchus* spp. (88.5 % occurrence). Among the plant-parasitic nematode species detected, *Meloidogyne javanica* and *M. incognita* were prominent in Manisa province. Many hosts of these nematodes, such as *Portulaca oleraceae* L., *Lactuca serriola* L., *Amaranthus retroflexus* L. were identified.

Plant parasitic nematodes such as *Ditylenchus dipsaci*, *Pratylenchus neglectus*, *P. thornei*, and *Longidorus elongatus* were recovered from soil and roots of weeds like *Urtica urens* L. and *Carduus nutans* L. *Calendula arvensis* L. (31 genera), *Lamium amplexicaule* L. (30 genera), *Capsella-bursa pastoris* (L.) Medik (28 genera) and *Taraxacum officinale* L. (27 genera) took first place when the weeds containing the most nematode species (free living+plant parasitic) in the root zone were examined (Table 4).

Table 4. *Some weed hosts of mostly distributed nematode genera and species in Manisa and Izmir*

Nematode genera	Weeds
Aphelenchus avenae Bastian, 1865	All weeds
Aphelenchoides sacchari Fischer, 1894	All weeds
Ditylenchus dipsaci	*Fumaria officinalis* L., *Carduus nutans* L., *Raphanus raphanistrum* L., *Anagallis arvensis* L.., *Portulaca oleracea* L., *Eleusine indica* (L.) Gaertn, *Matricaria chamomilla* L., *Malva sylvestris* L., *Senecio vulgaris* L., *Euphorbia helioscopia* L.
Geocenamus brevidens (Allen, 1955) Siddiqi, 1970	All weeds
Meloidogyne incognita (Kofoid and White, 1919) Chitwood, 1949	*Amaranthus retroflexus* L., *Chenopodium album* L., *Eleusine indica* (L.) Gaertn, *Gallium aparine* L., *Heliotropium europaeum* L., *Lepidium draba* L., *Lamium amplexicaule* L., *Lactuca serriola* L., *Portulaca oleracea* L.
Meloidogyne javanica Treub, 1885	*Amaranthus retroflexus* L., *Anagallis arvensis* L., *Cynodon dactylon* (L.) Pers., *Chenopodium album* L., *Eleusine indica* (L.) Gaertn, *Gallium aparine* L., *Heliotropium europaeum* L., *Lepidium draba* L., *Lamium amplexicaule* L., *Lactuca serriola* L., *Portulaca oleracea* L.
Pratylenchus neglectus Filipjev and Stekhoven, 1941	*Amaranthus retroflexus* L., *Calendula arvensis* L., *Capsella-bursa pastoris* (L.) Medik, *Conyza canadesis* (L.) Cronquist, *Chenopodium album* L., *Euphorbia helioscopia* L., *Stellaria media* (L.) Vill, *Taraxacum officinale* F.H.Wigg,
Pratylenchus thornei Sher and Allen, 1953	*Capsella-bursa pastoris* (L.) Medik, *Lamium amplexicaule* L., *Stellaria media* (L.) Vill, *Taraxacum officinale* F.H.Wigg,
Longidorus elongatus (de Man, 1876) Micoletzky, 1922	*Urtica urens* L., *Fumaria officinalis* L., *Taraxacum officinale* F.H.Wigg, *Lamium amplexicaule* L., *Malva sylvestris* L., *Papaver rhoeas* L., *Senecio vulgaris* L., *Stellaria media* (L.) Vill,

DISCUSSION

Weeds cause direct and indirect crop loss in grapevines by competing for water, light, and nutrients. Most vineyards worldwide need accessible water, and weeds may consume insufficient water in the soil, an essential resource for grapevine growth. Unmanaged weeds could cause yield reductions by up to 37%, cane weight by 68%, number of clusters per vine by 28%, and berry weight by 3% (Byrne and Howell, 1978). Dense weed growth can create humidity conditions that contributing to fungal diseases (Elsner and Hanson 2014).

In this study, 55 weed species were determined in the vineyard areas surveyed. Species of Asteraceae, Brassicaceae, and Poaceae families were commonly found. In previous studies, thirty-one species were reported in the vineyard areas of Edirne, Kırklareli, and Tekirdağ in the Marmara Region and 68 species in Manisa n the Aegean Region. In both studies, similar to ours, the number of identified species from the Asteraceae, Brassicaceae, and Poaceae families was high (Kaçan and Boz 2015; Ozturk et al. 2017). In a study conducted in Diyarbakır, 168 weed species belonging to 35 families were determined (Kaçar and Özaslandan 2020).

Weeds such as *Amaranthus retroflexus, Chenopodium album,* and *Portulaca oleraceae* were most common in Izmir and Manisa. *Amaranthus retroflexus* and *C. album* can grow in all types of soil conditions, and more than 20,000 seeds can quickly invade the area where it is located (Brijacak et al., 2018).

In our study, 36 species of nematodes were extracted from weed roots and soil. The most common of these, and the vast majority, consisted of bacterivore species. Bacterivorous species contribute to soil fertility by decomposing residues in vineyard soils (Schmidt et al., 2020). On the other hand, 17 genera of plant-parasitics were identified. Of these, the two most important genera, *Meloidogyne javanica*, and *M. incognita*, were found in 11 weed species, and *L. elongatus* in 8 weed species. Although there are few studies on this subject, in a study conducted on nematode fauna in weeds, 43 nematode species belonging to 22 families were found in the roots of 30 weed species and in the soil in Nigeria. Species from genera like *Aphelenchus, Aphelenchoides, Longidorus, Meloidogyne, Plectus, Pratylenchus, Rhabditis, Xiphinema* and *Tylenchorrhynchus* were identified (Eche et al., 2010). In another study conducted by Quénéhervé et al. (2005) in banana growing areas, 24 of the weeds were reported as hosts of *Radopholus similis*, 23 were hosts of *Helicotylenchus* spp., 13 were hosts of *Pratylenchus* spp., 13 were hosts of *Hoplolaimus seinhorsti*, 29 were hosts of *Meloidogyne* spp. and 24 was the host of *Rotylenchulus reniformis*.

Among the detected nematodes in this study in Izmir and Manisa, species such as *Longidorus elongatus*, the vector of tobacco black ringspot and raspberry ringspot viruses, gain importance. This nematode was found in roots of *Urtica urens* L., *Fumaria officinalis* L., *Taraxacum officinale* F.H.Wigg, *Lamium amplexicaule* L., *Malva sylvestris* L., *Papaver rhoeas* L., *Senecio vulgaris* L., *Stellaria media* (L.) Vill. Moreover, most plant-parasitic viruses have a wide host range, including annual and perennial weed species. Eleven weeds identified in this study were reported to maintain grapevine nepoviruses such as arabis mosaic virus, grapevine fanleaf virus, tomato ringspot virus, and tobacco black ringspot virus. For instance, *Stellaria media* (L.) Will. host six nepoviruses. Viruses prefer biennial and perennial weeds to overwinter. Nematodes that lose their infectivity during molting or in the absence of infected vines may re-gain virus particles by feeding on infected weeds. In this way, nematodes can recover the virus from newly germinated weed hosts (Murant and Taylor, 1965). Since only one nematode individual can take the virus from weeds and transfer it to the vine, identifying nematodes in virus-infested vineyards and combating host weeds, if any, gain importance (Ozturk and Şin 2022). This study showed that nematodes found in the rhizosphere soil of grapevine in the vineyards are also present in the weed roots and the surrounding soils. Even if the grapevines are removed from the soil, weeds may serve as a food source for nematodes and nematodes may survive for years.

ACKNOWLEDGEMENTS

Some results of this manuscript were represented as an abstract in 10th Türkiye Viticulture and Technology Symposium, on 03-07 October 2022, Manisa, Türkiye.

Conflict of interest

The authors declared no conflict of interest.

Author contribution

All authors contribute to the survey, species identification, and manuscript preparation.

Ethical Statement

During the writing process of the study titled "**Nematode Fauna Associated with Weeds in Vineyards in Aegean region of Türkiye**", scientific rules, ethical and citation rules were followed; No falsification has been made on the collected data and this study has not been sent to any other academic media for evaluation. Ethics committee approval is not required.

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