

# Innovations

## Survey of Plant-Parasitic Nematodes in Jerash Province of Jordan

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### **Abstract**

*Nematodes are devastating to crop plants in agricultural production and certainly contribute significantly to net reductions in crop yield. A general survey to the whole country of Jordan was done, and only one comprehensive survey in one province (Karak Province) was previously done. Therefore, this study aimed to conduct a comprehensive survey of plant-parasitic nematodes in Jerash Province in the northern part of Jordan. The results revealed a widespread distribution of different nematode species throughout the Jerash province, and only 5.4% of the soil samples were not infested with the plant-parasitic nematodes. All percentages of symptoms of cereal hosts were lower than those of the other hosts. Root galling in vegetables was 68% compared to cereals with only 9%. Several genera of nematodes were identified in this study, in which *Meloidogyne* and *Pratylenchus* were detected in almost all samples collected, with 92% for *Meloidogyne* spp. and 81% for *Pratylenchus* followed by *Helicotylenchus*, *Xiphinema*, and *Longidorus*. The outcomes of this investigation are relevant by enhancing the basic knowledge of plant parasitic nematodes in Jerash.*

**Keywords:** *Jordan, Jerash, Biodiversity, Host range, Nematode genera, Occurrence.*

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### **Key message:**

- A comprehensive survey was conducted, and the results revealed a widespread distribution of different nematode species throughout Jerash Province, and only 5.4% of the soil samples were not infested with plant-parasitic nematodes.
- All percentages of symptoms of cereal hosts were lower than those of the other hosts. Root galling in vegetables was higher than that in cereals.
- *Meloidogyne* and *Pratylenchus* were detected in 92% and 81% of patients, respectively.

## 1. Introduction

Nematodes are microscopic roundworms that live in many habitats. Most attack roots and underground parts of plants, but some are able to feed on leaves and flowers. Over 4100 species of plant-parasitic nematodes have been identified (Decreamer and Hunt, 2006). Plant-parasitic nematodes are of great economic importance. However, because most of them live in the soil, they represent one of the most difficult pest problems to identify, demonstrate and control (Stirling *et al.*, 1998). Nematodes are successful in different environments than parasites due to their protective cuticle.

Nematodes are devastating to crop plants in agricultural production and certainly contribute significantly to net reduction in yield (Sasser and Frekman, 1987). It has been estimated that the overall yield loss due to nematodes averages 12.3% annually; this figure approaches 20% for some crops, such as banana. In 2011 (Nicol *et al.*), they found that nematodes cause damage to crops at \$80-\$118 billion per year. In Jordan, Abu-Gharbieh (1994) estimated the average annual losses of irrigated vegetable crops due to root knot nematodes (RKNs) alone in Jordan Valley to be approximately 15%. Most of this damage is caused by a small number of nematode genera, principally sedentary RKNs (*Meloidogyne spp.*), cyst nematodes (*Heterodera spp.*) and migratory endoparasitic nematodes, including *Pratylenchus spp.*

Few genera of plant-parasitic nematodes have been reported in Jordan, including *Meloidogynespp.*, *Heterodera spp.*, *Ditylenchus spp.*, *Tylenchulus semipetrans* and some other genera (Abu-Gharbieh, 1994; Yousef and Jacob, 1994; Abu-Gharbieh and Al-Azzeh, 2004; Abu-Gharbieh *et al.*, 2005; Karajeh *et al.*, 2005; Karajeh and Al-Ameiri, 2010). The previously conducted surveys of plant-parasitic nematodes were not comprehensive and covered the whole country without concentrating in each district except the survey conducted in Karak Province by Karajeh and Al-Ameiri (2010). In Jerash, the average annual temperature is 17.6 °C. The annual rainfall is 370 mm. Some agricultural areas are rain fed, while others are irrigated. A wide variety of field and vegetable crops and fruit trees are grown in Jarash. Many crops and trees showed symptoms of diseases that might be caused by plant-parasitic nematodes. Therefore, this study aimed to conduct a comprehensive survey of plant-parasitic nematodes in the Jerash Province of Jordan, characterizing nematodes to genera and some species that attack vegetables, field crops and fruit trees using common diagnostic keys.

## Materials and methods

An observational study was conducted in which a total of 94 soil and root samples were collected from the rhizosphere. The samples were collected between March and August (2017, 2018) from different regions of Jerash Province. Nineteen common host plant species and economically important crops were selected. Collection of samples was carried out according to the method used by Speijer and De Waele (1997). Several holes of (20x20x20) cm<sup>3</sup> were dug

in the plant rhizosphere, and soils were collected and placed in a marked plastic bag. The top 5 cm soil was discarded. The samples were stored at 4°C until used. Nematodes were identified using morphological characters (CAB International, UK) on the genera and some species. In some samples, species identification was impossible due to the recovery of a limited number of adults and the presence of mostly juveniles. Roots were washed free of soil and examined for galling and other symptoms. Root-knot nematodes were isolated from galled roots and identified by the examination of the morphology of different nematode developmental stages, including the characters of the second-stage juveniles (Taylor and Sasser, 1978; Hartman and Sasser, 1985). Soil extraction was performed as reported by Fenwick (1949). Two hundred grams of soil was placed in the funnel, and then water was slowly added to moisten the soil and left for extraction. After 24 hours, the sieve containing soil was removed, water was collected into a measuring beaker, and the volume of water was recorded. The presence of nematodes in each sample was identified based on taxonomic characters and morphological measurements under a light microscope (Hooper and Ibrahim, 1994; Ibrahim and Hooper, 1994). During the survey plant, symptoms were notes of the above ground, for example, stunting and chlorosis/yellowing, as well as belowground symptoms, root necrosis and galling as nematode infections.

**3. Results**

A total of 94 soil and root samples were collected from the rhizosphere, and four out of 74 soil samples (5.4%) were not infested with nematodes. The major shoot system symptom of nematode damage was stunting and chlorosis (yellowing), which occurred, while the major root system symptom was root necrosis and galling symptoms on cereals, trees and vegetables (Table 1).

**Table 1.** Percentage of occurrence of plant-parasitic nematode symptoms on cereals, trees and vegetables during 2017.

<b>Plant-parasitic nematodes symptoms</b>				
<b>Hosts</b>	<b>Shoot system</b>		<b>Root system</b>	
	<b>Stunting</b>	<b>Yellowing</b>	<b>Galling</b>	<b>Necrosis</b>
<b>Cereals</b>	18	34	9	15
<b>Trees</b>	25	33	47	73
<b>Vegetables</b>	27	42	68	61

All symptom percentages of cereal hosts were lower than those of the other hosts; vegetables had more symptoms, especially root galling. Galling in vegetables was 82% compared with only 9% for cereals. Several genera were identified based on morphological characters, including root-knot nematodes (*Meloidogyne spp.*), Spiral (*Helicotylenchus*), *Tylenchulus*, *Pratylenchus*

and Longidorus, Pratylechus, Meloidogyne spp. and Pratylechus were detected in almost all the samples collected from all crops (Table 2).

**Table 2.** Occurrence and population densities of plant-parasitic nematodes associated with hostplants and collection sites in Jerash Province of Jordan during 2017.

Host-plant species	Nematode species	Collection site	Nematode density *
<b>Triticum durum</b>	<i>Aphelenchoides</i>	Al-kvear, Atabeh, Jaba, Gafgafa	271
	<i>Ditylenchus spp. avenae</i> Bastain	Um Rameh, Balela, Balela, Rahmaniya, Gafgafa, Nahleh, Jebah, Aerkf, Msherfrh	185 238
	<i>Helicotylenchus dihystrera</i> Perry, Darling & Thorne, 1959	Al-kfear, Al-mustaba, Kaver kal, Al-Mustaba,	356 321
	<i>Meloidogyne spp.</i>	Sakeb, Atabeh, Al-rya, Jaba, Balela	
	<i>Pratylenchus brachyurus</i> (Godfrey, 1929)	Um Rameh, Raya, Jebah, Um Rameh Kfear, Balela,	298 182
	<i>Filipjev &amp; Stekhoven, 1941</i>	Nahleh, Jebah, Kfear, Kaferhal	
	<i>Pratylenchus scribneri</i> Steiner, 1943		
<b>Hordeum vulgare L</b>	<i>Scutellonema sp.</i>		
	<i>Helicotylenchus sp</i>	Al-kfear, Atbah, Um Rameh, Mostabah Um	287 325
	<i>Helicotylenchus dorobustus</i> (Steiner, 1914) Golden, 1956	Rameh, Joba, Rahmania	265
	<i>Ditylenchus sp.</i>	Um Rameh, Atbah, Balela, Kfear, Kaferha	387
	<i>Pratylenchus neglectus</i> (Rensch, 1924)	Atabeh, Al-rya, Joba, Um Rameh	370
	<i>Tylenchorhynchus hordei</i> Khan, 1972	Al-kfear, Atbah, Gafgafa, Raya, Msherfeh	410
<b>Mules pumila</b>	<i>Meloidogyne spp</i>	Al-Rashydeh, Balela, Nahleh	
	<i>Aphelenchoide sp</i>	Soof, Sakeb, Atbah	375
	<i>Paratylenchus</i>	Um Rameh, Balela, Remomn, Al	325

	<p><i>projectus</i>, Jenkins, 1955 <i>Meloidogyne javanica</i> (Treub, 1885) Chitwood, 1949 <i>Tylenchus spp</i> <i>Longidorus sp.</i> <i>Pratylenchus scribneri</i> Steiner, 1943</p>	<p>Mustaba  Al-Rashydeh, Soof, Atbah, Balela, Sail-Jarash  Al keteh, Sakeb, Al-kfear, Atbah Soof, Atbah, Balela, Sail-Jarash, Remoon Al-roya, Joba, Soof, Al Mustaba, Dear Alyaat</p>	<p>480  286 419 461</p>
<p><b>Prunus armenia ca</b></p>	<p><i>Tylenchorhynchus clarus</i>Allen1955 <i>Meloidogyne javanica</i> (Treub, 1885) Chitwood, 1949 <i>Pratylenchus scribneri</i> Steiner, 1943 <i>Xiphinema sp</i></p>	<p>Atabeh , Al-roya, Joba, Um Rameh, Soof, Al-Rashydeh  Al-Rashydeh, Soof, Atbah, Balela, Seal-Jarash Um Rameh,Remmon,Joba,Atbah Al Keteh, Al-roya, Joba, Um Rameh, Soof, Al-Rashydeh  Seal Jarash,Remoon, Sakeb, Nehleh</p>	<p>380  512 396 185</p>
<p><b>Prunus persica</b></p>	<p><i>Tylenchorhynchus clarus</i>Allen1955 <i>Meloidogyne javanica</i> (Treub, 1885) Chitwood, 1949 <i>Pratylenchus scribneri</i> Steiner, 1943 <i>Xiphinema sp.</i></p>	<p>Seal-Jarash,Al-Rashydeh, Soof ,Remmon, Al-Mshrfeh  Soof, Atbah, Balela, Seal-Jarash, Joba,UmRameh  Remmon, Joba, Atbah, Borma, Al keteh, Soof, Balela Al-Roya, Joba, Remoon, Um Rameh, Soof, Al-Rashydeh, Remoon, Sakeb, Nehleh</p>	<p>372  526 412 167</p>
<p><b>Prunus amigtalus</b></p>	<p><i>Tylenchorhynchus clarus</i>Allen1955 <i>Meloidogyne javanica</i> (Treub, 1885) Chitwood1949 <i>Meloidogyne spp</i> <i>Xiphinema index</i> Therne</p>	<p>Borma, SealJasaseh, Atabeh, Remmon, Joba,  Atbah, Balela, Seal, Soof, Atbah, Seal Jarash, Remoon, Sakeb, Nehleh Joba , Soof, Atbah Jarash ,Remoon, Sakeb ,Nehleh Rayeh,,Joba, Um Rameh, Soof, Sakeb, Remoon Seal Jarash,Remoon, Sakeb, Nehleh</p>	<p>385  526 463 142 364</p>

	<i>Trichodorus sp</i>			
<b>Ficus carica</b>	<i>Helicotylenchus pseudorobustus</i> (Steiner, 1914) Golden, 1956	SealJarash, Remoon, Sakeb, Nehleh ,Mustabah, Soof	387 423	
	<i>Pratylenchus scribneri</i> Steiner, 1943	Remoon, Um Rameh, Al-Rashydeh, Seal Jarash, Soof	382	
	<i>P. neglectus</i> (Rensch, 1924) Filipjev and Stekhoven, 1941	Al-Rashydeh, Seal Jarash, Soof, Mostabah, Rahmaniyah	367	
	<i>Meloidogyne javanica</i> (Treub, 1885) Chitwood, 1949	Seal Jarash,Soof ,Mostabah, Remmon, Nehleh, Al-Keteh	286 417	
	<i>Tylenchus spp</i>	Remmon, Nehleh, Rayeh, Mostabah, Soof, Al Keteh	385	
	<i>Tylenchorhynchus clarus</i> Allen1955	Seal Jarash, Soof ,Mostabah, Remoon, Jobah ,Sakeb DearAAlyat, jbarat, Borma, Nehleh, Mshrfeh, Daheralsro	128	
	<i>Paratrichodorus minor</i> (Colbran, 1956) Siddiqi, 1974	Rahmaniyah, Mostabah, Soof, Al-Keteh, Soof, Sakeb, Rayeh		
	<i>Xiphinema index</i> Therne1917			
	<b>Punica granatum</b>	<i>Meloidogyne pp</i>	Joba, Soof, Atbah, Mshrfeh, Daheralsro Seal Jarash, Remoon, Sakeb, Nehleh	482
		<i>Xiphinema. index</i> Therne 1917	Rayeh,, Mshrfeh ,Daheralsro, SealJarash, Um Rameh, Soof, Sakeb, Remoon Soof, Atbah ,Mshrfeh, Daheralsro, SealJarash, Remoon, Sakeb,	138 465
<i>Pratylenchus spp</i>		Nehleh		
<i>Trichodorus sp.</i>		Seal Jarash,, Soof, Mostabah, Remoon Seal Jarash	216	

		<i>Sakeb, Mshrfeh, Daheralsro, Nehleh</i>	
<b>Olea europaea</b>	<i>Aphelenchus avenae</i> (Bastain)	Borma, Mustabah, Sakeb, Jbarat, Keteh, Soof, , Al-Rashydeh Seal Jarash,	362 406
	<i>Helicotylenchus pseudorobustus</i> (Steiner, 1914)	Remoon, Sakeb, Nehleh, Mustabah, Soof, Rayeh	359
	Golden, 1956	ustabah, Sakeb, Gafgafa, Borma, Keteh, Jazazeh, Jobah, Mshrfeh.	426
	<i>Helicotylenchus digonicus</i> Perry, Darling & Thorne, 1959	Jbarat, Dearlayat, Mshrfeh, Rashaydeh, Jobah, Remon, Sakeb UmRameh, Al-Rashydeh Koferhal, Jobah, Remon	368
	<i>Paratylenchus projectus</i> Jenkins, 1956		432 452
	<i>Pratylenchus neglectus</i> (Rensch, 1924)	Rahmaniyah, Ketah, Rashaydeh, ,Sakeb, Nehleh, Jazazeh, Rayeh Borma, Seal Jarash ,Remoon, Sakeb, Nehleh, Mustabah, Ketah	468 385
	<i>Filipjev and Stekhoven, 1941)</i>	Sakeb, Nehleh, Mustabah, Seal Jarash, Gafgafa, Dearlayat, Jbarat	368
	<i>P. penetrance</i> Cobb 1914	Nehleh, Jazazeh, Borma, Mshrfeh, Rashaydeh, Jobah, Remoon Mostabah,	172
	<i>Meloidogyne incognita</i> (Kofoid and White, 1919)	A l-Keteh, Soof, Sakeb, Jbarat, Keteh, koferhal	
	Chitwood, 1949	Mostabah, Al-Keteh, Dearlayat, Jbarat, Soof, Sakeb, Rayeh	
	<i>M. javanica</i> (Treub, 1885)		
	Chitwood, 1949		
	<i>Tylenchorhynchus clarus</i> Allen 1955		
	<i>Tylenchulus semipenetrans</i> Cobb 1914		
<i>Xiphinema index</i> Thorne 1917			

<i>Vitis vinifera</i>	<i>Helicotylenchus pseudorobustus</i> (Steiner, 1914)	Seal Jarash, Remoon, Sakeb, Nehleh, Jbarat, Keteh, koferhal	485
	Golden, 1956	Seal Jarash ,Mshrfeh, Rashaydeh, Jobah, Remoon, Sakeb	480
	<i>Meloidogyne javanica</i> (Treub, 1885)	<i>Borma</i> ,Al-Keteh,Soof,Sakeb,Jbarat,Keteh, Seal Jarash,koferhal	384
	Chitwood, 1949	koferhal,Rahmaniyah,Ketah,Jbarat,Dear layat, Remoon,Sakeb,Nehleh,Borma	435
	<i>Pratylenchus scribneri</i> Steiner, 1943	,SealJarash,earlayat,Jbarat,Soof Mshrfeh Mostabah,Al-Keteh,	417
	<i>Tylenchorhynchus clarus</i> Allen1955	Soof,Sakeb, Jbarat,Keteh, Seal Jarash,, koferhal	392
	<i>Paratylenchus projectus</i> Jenkins, 1956	koferhal,Al-Keteh, Dearlayat,Jbarat,Soof,Sakeb,Rayeh	450
	<i>Paratrichodorus minor</i> Colbran,956)	Mostabah,Jbarat,Al-Keteh,Soof,Sakeb,Rayeh	142
	Siddiqi, 1974		
	<i>Tylenchulus semipenetrans</i> Cobb, 1914		
<i>Xiphinema</i> sp			
<b>Citrus spp.</b>	<i>Helicotylenchus pseudorobustus</i> (Steiner, 1914)	Borma, Mostabah,Al-Keteh ,Soof, Sakeb, Seadtalal, Seal Jarash	452
	Golden, 1956	Borma, Mostabah, Al-Keteh, Soof, Sakeb, Sead talal Seal Jarash Borma,	490
	<i>Meloidogyne incognita</i> (Kofoid and White, 1919)	Mostabah, Sakeb, Sead talal, Jbarat , Dearlayat, Ketah	552
	Chitwood, 1949	Jazazeh, Dearlayat, Jbarat, Soof, Sakeb, Sead talal, ,Al-Rashydeh Seal Jarash	470
	<i>M. javanica</i> (Treub, 1885)	Dearlayat, Jbarat, Soof, Sakeb, Sead talal Seal Jarash,, Borma, Al-Rashydeh	480
	Chitwood, 1949		
	<i>Pratylenchus scribneri</i> Steiner, 1943	Seadtalal,, Al-Rashydeh, SealJarash, Darlayat ,Jbarat, Soof, Jazaah	465
	<i>Tylenchorhynchus</i>	Al-Rashydeh Seal Jarash, Jbarat, Dearlayat, Borma, Sead Talal	163



	<p><i>clarus</i> Allen1955</p> <p><i>Tylenchulus semipenetrans</i> Cobb, 1914</p> <p><i>Xiphinema sp</i></p>		
<b>Solanum longena</b>	<p><i>Helicotylenchus multicinctus</i> (Cobb, 1893) Golden, 1956</p> <p><i>Meloidogyne incognita</i> (Kofoid and White, 1919) Chitwood, 1949</p> <p><i>M. javanica</i> (Treub, 1885) Chitwood, 1949</p> <p><i>Pratylenchus neglectus</i> (Rensch, 1924) Filipjev and Stekhoven, 1941</p> <p><i>Pratylenchus scribneri</i> Steiner, 1943</p> <p><i>Tylenchusspp.</i></p> <p><i>Xiphinema index</i> Therne1917</p> <p><i>Paratrichodorus minor</i> (Colbran, 1956) Siddiqi, 1974</p> <p><i>Trichodorus sp</i></p>	<p>Um Rameh, Al-Rashydeh, Seal Jarash, Alsanah, Al-kfear, Atbah</p> <p>Mostabah, Alsanah, Al-Rashydeh, Sead talal, Seal Jarash</p> <p>Mostabah, Alsanah, Al-Rashydeh,Sead Talal Seal Jarash</p> <p>Sead Talal,Jazazeh ,Al-Rashydeh,Joba SealJarash Alsanah</p> <p>Sead Talal,Jazazeh, Alsanah,Al-Rashydeh Seal Jarash,</p> <p>Kfear Al-Rashydeh,Sead Talal Seal Jarash, Alsanah</p> <p>Al-Rashydeh, Seal Jarash,Soof , Al-kfear,Alsanah Atbah</p> <p>Sead talal,Jazazeh ,Al-Rashydeh,Joba Seal Jarash</p> <p>Sead talal,Al-Rashydeh,Joba, Alsanah Seal Jarash</p>	<p>320</p> <p>572</p> <p>595</p> <p>390</p> <p>430</p> <p>268</p> <p>151</p> <p>295</p> <p>364</p>
<b>Solanum lycopersicum</b>	<p><i>Aphelenchoides sp</i></p> <p><i>Leptonchus sp</i></p> <p><i>Helicotylenchus</i></p>	<p>Al-Rashydeh, Seal Jarash,Soof ,Al-kfear,SeadTalal, Alsanah Al-Rashydeh, Seal Jarash,SoofAl-kfear,SeadTalal,Alsanah</p>	<p>410</p> <p>362</p> <p>368</p>

	<p><i>multicinctus</i> (Cobb, 1893) Golden, 1956 <i>Meloidogyne incognita</i> (Kofoid and White, 1919) Chitwood, 1949 <i>M. javanica</i> (Treub, 1885) hitwood, 1949 <i>Pratylenchus neglectus</i> (Rensch, 1924) Filipjev and Stekhoven, 1941 <i>Pratylenchus scribneri</i> Steiner, 1943 <i>Ditylenchus dipsaci</i> <i>Pratylenchus hilarulus</i> (Rensch, 1924)  <i>Tylenchorhynchus hordei</i> Khan, 1972 <i>Meloidogyne spp.</i>  <i>Xiphinema sp</i>  <i>Trichodorus sp</i></p>	<p>Al-Rashydeh, Seal Jarash, Soof , Al-kfear, Sead Talal, Alsanah Seal Jarash, Al-kfear, Sead Talal, Joba Alsanah, Atbah Mostabah Sead Talal, Alsanah, Sead, Talal, Joba, Atbah, Mostabah, Al-Rashydeh, Sead Talal, Jazazeh , Al-Rashydeh, Joba Seal Jarash Alsanah Joba Sead Talal, Jazazeh , Al-Rashydeh, Joba Seal Jarash Alsanah Um Rameh, Sead Talal, Jazazeh , Al-Rashydeh, Kfear, Kaferha Sead Talal, Jazazeh , Al-Rashydeh, Al-rya , Joba, Um Rameh Al-kfear Sead Talal , Jazazeh , Al-Rashydeh Msherfeh Al-Rashydeh, Sead Talal, Jazazeh , Al-Rashydeh Al-kfear Sead Talal, Jazazeh , Al-Rashydeh Msherfeh Sead Talal, Jazazeh , Al-Rashydeh, Joba Seal Jarash Alsanah</p>	<p>520 537 385 421 265 387 370 462 165 354</p>
<p><b>Solanum tuberosum</b></p>	<p><i>Leptonchus sp.</i> <i>Helicotylenchus sp</i> <i>Meloidogyne javanica</i> (Treub, 1885) Chitwood, 1949 <i>Pratylenchus spp</i></p>	<p>Al-Rashydeh, Seal Jarash , Soof , Al-kfear, Sead Talal, Alsanah Al-rya , Joba, Um Rameh Al-Rashydeh, Seal Jarash Alsanah Al-Rashydeh, Alsanah, Al-rya , Joba, Um Rameh Al-Rashydeh, Seal Jarash Alsanah</p>	<p>270 325 486 376</p>

<b>Cucumis sativa</b>	<i>Aphelenchoides sp</i>	Al-kfear, SeadTalal, Alsanah, Al-Rashydeh, Seal Jarash, Soof Al-kfear, SeadTalal, Alsanah, Al-Rashydeh, Seal Jarash, Soof Al-Rashydeh, Seal Jarash, Soof ,Al-kfear, SeadTalal, Alsanah SealJarash, Alsanah,Al-kfear, SeadTalal, Joba, Atbah, Mostabah, SeadTalal,Alsanah,SeadTalal,Joba,Atbah,Mostabah, Al-Rashydeh, Joba Sead Talal,Jazazeh ,Al-Rashydeh,Joba Seal Jarash Alsanah	436 321 382
	<i>Leptonchus sp</i>		
	<i>Helicotylenchus multicinctus</i>		543
	(Cobb, 1893)		
	Golden, 1956		565
	<i>Meloidogyne incognita</i> (Kofoid and White, 1919)		410
	Chitwood, 1949		
	<i>M. javanica</i> (Treub, 1885)		368
	Chitwood, 1949		350
	<i>Pratylenchus neglectus</i>		139
(Rensch, 1924)			
Filipjev and Stekhoven, 1941			
<i>Pratylenchus scribneri</i> Steiner, 1943			
<i>Pratylenchus spp</i>			
<i>Xiphinema index</i> Therne 1917			
<b>Cucurbita pepo</b>	<i>Aphelenchoides sp.</i>	Al-kfear,SeadTalal, Alsanah,,Al-Rashydeh, Seal Jarash,Soof Al-kfear,SeadTalal, Alsanah, Al-Rashydeh, Seal Jarash,Soof Al-Rashydeh, Seal Jarash,Soof ,Al-kfear,SeadTalal, Alsanah SealJarash, Alsanah,Al-kfear, SeadTalal, Joba, Atbah ,Mostabah SeadTalal,Alsanah, SeadTalal, Joba, Atbah, Mostabah, Al-Rashydeh,Joba Sead Talal,Jazazeh ,Al-Rashydeh,Joba Seal Jarash Alsanah Seal Jarash Alsanah Sead	322 290 283
	<i>Leptonchus sp</i>		
	<i>Helicotylenchus multicinctus</i>		420
	(Cobb, 1893)		
	Golden, 1956		436
	<i>Meloidogyne incognita</i> (Kofoid and White, 1919)		326
	Chitwood, 1949		285
	<i>M. javanica</i> (Treub, 1885)		151
	Chitwood, 1949		
	<i>Pratylenchus crenata</i>		
<i>Pratylenchus spp.</i>			

	<i>Xiphinema index</i> Therne 1917		
<b>Faba bean</b>	<i>Helicotylenchus</i> <i>spp</i>	Al-kfear, Sead Talal, Jazazeh ,Al-Rashydeh,, Mostabah um Rameh, Sead Talal, Jazazeh ,Al-	287
	<i>Ditylenchus dipsaci</i>	Rashydeh, Kfear, Kaferha	265
	<i>Pratylenchus hilarulus</i> (Rensch, 1924)	Sead Talal, Jazazeh ,Al-Rashydeh, Al-rya, Joba, Um Rameh	387
	<i>Tylenchorhynchus hordei</i> Khan, 1972	Al-kfear Sead Talal, Jazazeh ,Al-Rashydeh Msherfeh	370
	<i>Meloidogyne spp</i>	Al-Rashydeh, Seal Jarash, Jazazeh Al-kfear Sead Talal, Jazazeh , Al-Rashydeh Msherfeh	462
	<i>Xiphinema sp</i>		162
<b>Pisum sativa</b>	<i>Aphelenchus sp</i>	Sead Talal, Jazazeh Um Rameh, Al-Rashydeh	373
	<i>Helicotylenchus spp</i>	Msherfeh, Seal Jarash Al-kfear, Sead Talal, Jazazeh Al-Rashydeh,,	292
	<i>Ditylenchus dipsaci</i>	Mostabah, Seal Jarash, Sead Talal, Jazazeh ,Al-Rashydeh, Kfear,	294
	<i>Pratylenchus hilarulus</i> (Rensch, 1924)	Kaferha Sead Talal ,Jazazeh ,Al-Rashydeh, Al-rya, Seal Jarash, Um Rameh	410
	<i>Tylenchorhynchus hordei</i> Khan, 1972	Al-kfear Sead Talal, Jazazeh ,Al-Rashydeh Msherfeh, Seal Jarash Al-Rashydeh,	362
	<i>Meloidogyne spp</i>		431
<b>Allium cepa</b>	<i>Aphelenchus sp</i>	Sead Talal, Jazazeh Seal Jarash, Al-Rashydeh, Kfear	325
	<i>Ditylenchus dipsaci</i>	Um Rameh, Sead Talal, Jazazeh ,Al-Rashydeh ,Kfear, Kaferha Sead Talal, Jazazeh , Al-Rashydeh, Al-rya,	265
	<i>Pratylenchus sp</i>	Joba, Um Rameh Al-kfear	325
	<i>Tylenchorhynchus sp</i>	Sead Talal, Jazazeh ,Al-Rashydeh Msherfeh,	370
	<i>Meloidogyne spp.</i>	Al-kfear Sead Talal, Jazazeh , Al-Rashydeh Msherfeh	368
	<i>Xiphinema sp.</i>		123
<b>Lactuca sativa</b>	<i>Aphelenchus sp</i>	Sead Talal, Al-Rashydeh, Seal Jarash	373
	<i>Helicotylenchus - spp</i>	Sead Talal, Al Rashydeh, Alsanah Seal Jarash	268
			345

	<i>Pratylenchus sp</i> <i>Meloidogyne spp.</i>	Sead Talal, Al-Rashydeh, Seal Jarash, Alsanah Sead Talal, Al Rashydeh, Alsanah Seal Jarash	482
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**\* Nematode population density is the average of 1-3 composite samples/field, nematode number/200 cm<sup>3</sup> rhizosphere soil.**

*Meloidogyne spp.* were detected in 92% and *Pratylenchus* in 81% of the samples collected. Many of the observed species are phytopathologically important parasites of plants. Most of the nematode species were present at population densities of 41-478 nematodes/200 g soil. The population densities of the genera *Helicotylenchus*, *Meloidogyne*, *Paratylenchus* and *Pratylenchus* were relatively high on certain host plants, while *Aphelenchoides*, *Tylenchus*, *Pratic odorus*, *Trichodoru s* and *Xiphinema* exhibited low population densities on some host plants. In the fields of cereals, low nematode populations were detected, while in vegetable fields under irrigation and fertilizer addition, the nematode density was not reduced.

#### 4. Discussion

Nematodes are microscopic worm-like organisms that attack plant roots. Plant-parasitic nematodes significantly affected the production of plants, including trees, vegetables and cereal crops. Damaged roots result in a reduced uptake of nutrients, water and plant wind activity. Most plant pathogens are likely to encounter hosts and conditions favoring their development in Jordan provinces due to the wide variety of climate conditions and plant populations. The current field survey revealed for the first time the widespread distribution of different nematodes throughout the surveyed area of Jerash Province.

In the current study, the major shoot system symptoms of nematode damage were stunting and chlorosis (yellowing). All symptom percentages of cereal hosts were lower than those of the other hosts, and galling in vegetables was 82%. The symptoms of cereals were lower due to short life cycles and time of planting during winter seasons, while trees were perennial, and vegetables stayed for a long time, which may be more than two seasons. Plant parasitic nematodes reduce the plant root system's ability to take up water and nutrients; especially when the nematode population density is high at planting, vegetables and trees in Jarash Province planted under irrigation systems, adequate water and fertilizer do not reduce the nematode density but reduce plant stress and thus the symptoms of nematode damage.

In this study, several genera were identified, including root-knot nematodes in which *Meloidogyne spp.* and *Pratylenchus* were detected in almost all the samples collected from all crops. *Meloidogyne spp.* were detected in 92% and *Pratylenchus* in 81% of the samples collected. Many of the observed species are phytopathologically important parasites of plants. The population densities of the

genera *Helicotylenchus*, *Meloidogyne*, *Paratylenchus* and *Pratylenchus* were relatively high on certain host plants, while *Aphelenchoides*, *Tylenchus*, *Pratic odorus*, *Trichodoru s* and *Xiphinema* exhibited low population densities on some host plants, which may be due to their parasites to plant roots. In the fields of cereals, low nematode populations were detected due to crop rotation, and weed control is very important in managing plant parasitic nematodes, while in vegetable fields, irrigation and fertilizer addition did not reduce the nematode density but reduced plant stress and thus the symptoms of nematode damage.

Evidence from this study indicates that nematodes are widespread in Jerash Province, their incidence and distribution do not depend on the kind of crops grown, and environmental, temporal, and behavioral factors that result in aggregated spatial patterns of nematode populations are considered. The population density and spatial dispersal characteristics of a species influence the probability of its detection (Prot and Ferris, 1992). The pathogenicity of many of these nematodes has never been studied in Jordan, and thus, their individual influence on the growth and development of vegetables and trees has yet to be established. The continued planting of some fields during years increases the population of some genera and appearance at all times of collection and increases disease incidence and severity because the cover of the area by plants provides protection from changes in environmental factors. The results of this survey not only provide insight into important nematode species associated with cultivated plants grown in Jerash Province of Jordan but also indicate their frequency of occurrence, geographical distribution and possible potential for crop damage and economic impact. In conclusion, the outcomes of this investigation are relevant by enhancing the basic knowledge of plant parasitic nematodes in Jerash; this knowledge could become essential for the assessment of future control and quarantine strategies.

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