Middle East Journal of Agriculture Research, 3(3): 522-529, 2014
ISSN 2077-4605

A Survey of Plant Parasitic Nematodes Associated with Different Plants in North Sinai

Korayem, A.M., Youssef, M.M.A., Mohamed, M.M.M. and Lashein, A.M.S.

Plant Pathology Department, Nematology Laboratory, National Research Centre, Dokki, Post Code 12622, Cairo, Egypt.

ABSTRACT

This survey was conducted in some villages of North Sinai Governorate and Sahl El-Teina during 2013/2014 to study distribution and dissemination of plant parasitic nematodes associated with vegetables and field crops, fruit tress besides some ornamental and weed plants. Data showed the presence of fourteen plant parasitic nematode genera and species. These were *Criconema* sp., *Criconemoides* sp., *Ditylenchus* sp., *Hemicriconemoides* sp., *Heterodera* sp., *Hoplolaimus* sp., *Longidorus* sp., *Meloidogyne* sp., *Pratylenchus* sp., *Rotylenchulus* reniformis, *Tylenchorhynchus* sp., *Tylenchulus semipenetrans*, *Tylenchus* sp. and *Xiphinema* sp. It is noticed that *Meloidogyne* sp. was more predominant in samples collected from Sahl El-Teina, Beer El-Abd and El-Sheikh Zowaiid with the percentages frequency of 27.6, 48.1 and 33.3%, respectively. Whereas, stunt nematode, *Tylenchorhynchus* sp. was the most predominant in Rafah county with the percentage occurrence of 66.6%. For all surveyed villages, stunt nematode was the first in its general average percentage frequency of occurrence of 29.1% followed by that of root knot nematode (27.3%), stubby nematode (13.9%) and lesion nematode. (12.5%).

***Key words**:* Distribution, plant parasitic nematodes, host plants, North Sinai.

Introduction

Plant parasitic nematodes represent one of the major biotic constraints in world agriculture causing global yield losses estimated to be around US$70 billion in1987 (Sasser & Freckman, 1987). Adjusting for inflation, this figure was revised to US$125 billion in 2003 (Chitwood, 2003). No recent, comprehensive surveys of nematode losses have been carried out and the real figures may be higher than this, as a lack of clear disease symptoms can lead some growers to underestimate yield loss. Yield reductions may also be wrongly attributed to the secondary diseases suffered by crop plants already weakened by nematode attack. Previous studies in Egypt have shown the presence of about 54 genera and 160 species of phytoparasitic nematodes associated with many cultivated plants, weeds and grasses (Ibrahim et al.,2000; Ibrahim and El-Sharkawy,2001 and Oteifa et al., 1997). Many of these nematodes belonging to order Tylenchida e.g. *Meloidogyne* sp., *Pratylenchus* sp., *Rotylenchulus* reniformis, and *Tylenchulus semipenetrans* are considered limiting factors to their hosts production (Ibrahim, 1994 and Korayem and Mohamed, 2010). In spite of strategic importance of North Sinai, there is little information about distribution of plant parasitic nematodes associated with vegetable and field crops, fruit trees and ornamental in this area. Ashoub (2010) showed the presence of eleven plant parasitic nematode genera in association with the previous plants in North Sinai governorate. This work represents an important approach to study the distribution of plant parasitic nematode genera and species, their densities, dissemination and their hosts in North Sinai, Egypt.

Materials and Methods

Collection of samples:

A total of 222 soil and root samples were randomly collected during 2013/2014 from rhizosphere of each plant at a depth of 30 cm for vegetable and field crops besides weed plants. For fruit and ornamental trees, samples were taken at a depth 40-60cm. under the canopy of the tree. Each sample was kept in polyethylene bags and sent directly to the laboratory for nematode extraction. Some villages in three administrative counties (Beer El-Abd, El-Sheikh Zowaiid and Rafah) in North Sinai governorate and some villages belonging to Sahl El-Teina in the east of Suez Canal were selected for this study.

Extraction of nematodes from soil:

Nematodes in soil were extracted in an aliquot of 250g soil by sieving and decanting method (Byrd *et al*., 1996). The extracted nematodes were counted in Hawksly slide and identified under light microscope.

Corresponding Author: Korayem A.M., Plant Pathology Department, Nematology Laboratory, National Research Centre, Dokki, Post Code 12622, Cairo, Egypt.

Extraction of nematodes from roots:

Roots of plants were gently washed by tap water to avoid adhering soil. Then, roots were cut into small pieces and an aliquot of 5 g roots were extracted by incubation method according to Young (1954).

Nematode identification:

The surveyed nematodes were identified to generic level according to Golden, (1971) and Mai and Lyon (1975). Species of root knot nematode were identified depending morphological characteristic of female Perennial pattern according to Eisnback *et al*. (1981).

Nematode estimation:

Population density (PO) (Mean no. of a given genus) and frequency of occurrence% (PD) (No. of samples containing a given genus/no. of whole samples collected X100) were calculated for each nematode genus or species.

Results:

Data presented in Tables 1 and 2 recorded population density and frequency of occurrence of 14 genera of plant parasitic nematodes associated with different plants in some villages of Sahl El- Teina in the east of Suez canal it was observed that population density and frequency varied according to locality and host plant type as follows: The highest population of *Ditylenchus* (154) was found on nubk trees with frequency of occurrence of 27% in Gelbana village. Root knot and stunt nematodes were more predominant in village of El-Shaheid Mostafa El- Hawi with the percentage frequency of occurrence of 31.4% for each. While the highest population density of *Rotylenchulus reniformis* (500 individuals) was found on olive at the same village. As for the distribution of nematodes in villages no.4 and no.1750, stunt nematode was more predominant with the percentage frequency of 37.1 and 91.7%, respectively. While dagger nematode, *Xiphinema* sp. recorded the highest population density (983 individuals) on alfalfa plants at village no.4. *Meloidogyne* sp. recorded the highest population (3000 individuals) on eggplant at village 1750. In general, stunt nematode was the most predominant at the four villages of El-Teina plain with an average of 40.1% followed by root knot nematode (23.9%).

As for distribution of nematodes in villages of Beer El- Abd, ten genera were found in association with different plants (Tables 3 and 4). It was observed that root knot nematode had the highest population density on olive roots (651 individuals) at Shohadaa village and (436 individuals) on fig trees at Rommana village (Table3). Also, root knot nematode had the highest percentages frequency of occurrence (33.3,41.7 and 71.4%) at Shohadaa, Ahrar and Rommana villages, respectively with general average of 36.6% followed by ring nematode (*Criconemides* sp.) with the percentage occurrence of 16.7% (Table 4).

As for distribution of nematodes in El-Sheikh Zowaiid, six nematode genera were found in association with the surveyed plants (Table 5 and 7). It was noticed that the highest population density of stubby nematode (57 individuals) was found on okra plants in Kharroba village (Table 5). Root knot nematode had the highest percentage occurrence (33.3%) as illustrated in Table (7).

On the other hand, four nematodes were found in association with plants in Rafah (Table 6 and7). Stunt nematode had its highest population density (120 individuals) on peach in El-hussanyat village (Table 6) with the highest percentage occurrence (66.6%) followed by that of ring nematode (34%) as illustrated in Table (7). Also, from data in Table (7), it is noticed that *Meloidogyne* sp. was more predominant in samples collected from Sahl El-Teina, Beer El-Abd and El-Sheikh Zowaiid with the percentages frequency of 27.6, 48.1 and 33.3%, respectively. Whereas, stunt nematode, *Tylenchorhynchus* sp. was the most predominant in Rafah county with the percentage occurrence of 66.6%.

For all surveyed villages, stunt nematode was the first in its average percentage frequency of occurrence of 29.1% followed by that of root knot nematode (27.3%), stubby nematode (13.9%) and lesion nematode (12.5%) as illustrated in Table (7).

Table (8) illustrates different species of genus *Meloidogyne* associated with some plant hosts depending on morphological characteristics of perennial pattern of adult females. The most predominant species was *M. incognita* in the most samples followed by *M. javanica* in samples of broad bean and tomato only.

Table 1: Population densities of phytoparasitic nematodes and associated host plants in Sahl El- Teina , North Sinai.

Village names	Host plant	Nematode genera and species	Population density in 250 g soil&5g roots
Gelbana	Pomegranate: (*Punica granatum* L.)	*Rotylenchulus reniformis*	21

//	Olives: (*Olea europaea* L.)	*Ditylenchus sp. Meloidogyne* sp.	12 123
//	Rape seed: (*Brassica napus* L.)	*Ditylenchus* sp.	16
//	Ficus : (*Ficus nitida* L.)	*Ditylenchus* sp.	18
//	Mango: (*Mangifera indica* L.)	*Xiphinema* sp.	22
//	Wheat : (*Triticum sativum* L.)	*Ditylenchus* sp.	18
//	Date palm (*phoenix dactylifera* L.)	*Criconemoides* sp. *Ditylenchus* sp.	13 22
//	Nubk: (*Rhamnus* sp.)	*Ditylenchus* sp.	154
El- Shaheid Mostafa El-Hawi	Carrot: (*Daucus carotu* L.)	*Tylenchorhynchus* sp.	28
//	Guava: (*Psidium guajava* L.)	*Hemicriconcmoides* sp.	61
		Melodidogyne sp.	68
		Rotylinchulus reniformis	12
		Tylenchorhynchus sp.	64
		Tylenchus sp.	12
//	Olives : (*Olea europaea* L.)		
		Meloidogyne sp.	182
		Rotylenchulus reniformis	500
		Tylenchorhynchus sp.	38
		Tylenchus sp.	19
//	Common bramble: (*Convolvulus arvensis* L.)		
		Meloidogyne sp.	72
		Rotylenchulus reniformis	82
		Tylenchorhynchus sp.	240
		Tylenchus sp.	12
//	Broad bean : (*Vicia faba* L.)	*Heterodera* sp.	40
		Meloidogyne sp.	27
		Rotylenchulus reniformis	13
		Tylenchorhynchus sp.	21
		Tylenchus sp.	14
//	Wheat : (*Triticum sativum* L.)		
		Ditylenchus sp.	45
		Tylenchus sp.	6
//	Citrus: (*Citrus sinensis* L.)		
		Rotylenchulus reniformis	15
		Tylenchulus semipenetrans	396
no.1750	Eggplant : (*Solanum melongena* L.)	*Meloidogyne* sp.	3000
		Tylenchorhynchus sp.	422
//	Egyptian clover: *Trifolium alexandrinum* L..)	*Heterodera* sp.	73
		Tylenchorhynchus sp.	227
		Tylenchus sp.	85
//	Onion: (*Allium cepa* L.)	*Pratylenchus* sp.	15
		Tylenchorhynchus sp.	15
		Tylenchus sp.	29
//	Potato: (*Solanum tuberosum* L.)		
		Tylenchorhynchus sp.	27
//	Sugarbect: (*Beta vulgaris* L.)		
		Ditylenchus sp.	35
		Heterodera sp.	16
		Meloidogyne sp.	10
		Tylencorhynchus sp.	80
		Tylenchus sp.	16
//	Olives: (*Olea europaea* L.)		
		Meloidogyne sp.	18
		Rotylenchulus reniformis	1500
		Tylenchorhynchus sp.	51
		Tylenchus sp.	49
//	Samma: (*Lolium* sp.)		
		Tylenchorhynchus sp.	30
//	Black nightshade: (*Solanum nigrum* L.)	*Meloidogyne* sp.	200
		Tylenchorhynchus sp.	50
		Tylenchus sp.	20
No.1750 .	Broad bean: (*Vicia faba L.*)	*Heterodera sp.*	39
		Meloidogyne sp.	42
//		*Criconema* sp.	7

	Wheat: (*Triticum sativum L.*)	*Heterodera* sp.	13
		Longidorus sp.	10
		Tylenchorhynchus sp.	11
//	Mango (*Mangifera indica L.*):	*Xiphimea* sp.	16
		Ditylenchus sp.	19
		Tylenchus sp.	3 0
		Xiphinema sp.	153
No. 4	Tomato: (*Lycopersicum esculentum* L.)	*Hoplolaimus* sp.	11
		Meloidogyne sp.	400
		Tylenchorhynchus sp.	170
		Tylenchus sp.	17
		Xiphinema sp.	359
//	Alfalfa : (*Medicago sativa* L.)	*Hoplolaimus* sp.	22
		Tylenchorhynchus sp.	53
		Xiphinema sp.	983
//	Wheat: (*T. sativum* L.)	*Tylenchorhynchus* sp.	372
		Xiphinema sp.	10

Table 2: Frequency of occurrence of plant parasitic nematodes associated with plants grown in Sahl El- Teina Region, north Sinai.

Nematode genera	% nematode frequency of occurrence in the surveyed villages.				
	1	2	3	4	Average
Criconema sp.	-	-	2.8	-	0.7
Criconemoides sp.	2.7	-	-	-	0.7
Ditylenchus sp.	27.0	-	8.6	-	8.9
Hemicriconemoides sp.	-	8.6	-	-	2.2
Heterodera sp.	-	-	11.4	-	2.9
Hoplolaimus sp.	-	-	-	16.7	4.2
Longidorus sp.	-	-	2.8	-	0.7
Meloidogyne sp.	10.8	31.4	20.0	33.3	23.9
Pratylenchus sp.	-	-	2.9	-	0.70
Rotylenchulus sp.	2.7	28.6	8.5	-	10.0
Tylenchorhynchus sp.	-	31.4	37.1	91.7	40.1
Tylenchulus sp.	-	14.3	-	-	3.6
Tylenchus sp.	-	11.4	25.7	8.3	11.4
Xiphinema sp.	2.7	-	11.4	66.7	3.5

1-Gelbana village, 2-El-Shaheid Mostafa El-Hawi village, 3-village no.1750 and4- village no.4.

Table 3: Population densities of phytoparasitic nematodes and associated host plants in Beer- El- Abd district, North Sinai.

Name of village	Host plant	Nematode genera and Species	Average of Population density/250g soil&5g roots
El- Shohadaa	Eggplant: (*Solanum melongena* L.)	*Meloidogyne* sp.	39
//	Guava: (*Psidiun guajava* L.)	*Helicotylenchus* sp. *Rotylenchulus reniformis*	180 26
//	Olives: (*Olea europaea* L.)	*Meloidogyne* sp.	651
//	Date palm: (*Phoenix dactylifera* L.)	*Hoplolaimus* sp. *Tylenchus* sp.	20 17
El- Ahrar	Mulberry : (*Morus* sp.)	*Ditylenchus* sp. *Meloidogyne* sp.	19 34
//	Prickly pear : (*Ficus* sp.)	*Paratylenchus* sp.	34
		Rotylenchulus reniformis	17
		Hoplolaimus sp. *Longidorus* sp.	18 18
		Meloidogyne sp.	25
		Tylenchus sp.	121
Balousa	Olives: (*Olea europaea* L.)	*Criconemoides* sp.	121
Rommna	Figs: (*Ficus carica* L.)	*Hoplolaimus* sp. *Meloidogyne* sp.	26 436
//	Guava: (*Psidium guajava* L.)	*Ditylenchus* sp. *Meloidogyne* sp.	27 310
		Paratylenchus sp.	135
		Tylenchus sp.	68
//	Olives: (*Olea europaea* L.)	*Meloidogyne* sp. *Tylenchorhynchus* sp.	80 13
//	Tomato: (*Lycopersicum esculentum L.*)	*Meloidogyne* sp.	192
//	Grapes: (*Vitis vinifera* L.)	*Meloidogyne* sp. *Pratylenchus* sp.	70 8
//		*Rotylenchulus reniformis*	8

	Mango: (*Mangifera indica* L.)	*Hoplolaimus* sp. *Meloidogyne* sp.	25 23
		Tylenchus sp.	12
//	Date palm: (*Phoenix dactylifera* L.)	*Tylenchus* sp.	107
Rommana	Guava: (*Psidium guajava* L.)	*Ditylenchus* sp.	36
//	Pomegranate: (*Punica granatum* L.)	*Meloidogyne* sp.	20
//	Olives: (*Olea europaea* L.)	*Meloidogyne* sp.	134
//	Grapes: (*Vitis vinifera* L.)	*Meloidogyne* sp.	21
//	Black nightshade: (*Solanum nigrum* L.)	*Meloidogyne* sp.	41
//	Date palm: (*Phoenix dactylifera* L.)	*Meloidogyne* sp.	115
		Tylenchus sp.	108

Table 4: Frequency of occurrence of plant parasitic nematodes associated with plants grown in Beer- El- Abd County, North Sinai.

Nematode genera	% nematode frequency of occurrence in the surveyed villages.				
	1	2	3	4	Average
Criconemoides sp.	-	-	66.7	-	16.7
Ditylenchus sp.	-	12.5	-	-	3.1
Helicotylenchus sp.	25.0	-	-	-	6.3
Hoplolaimus sp.	8.3	4.2	-	14.3	6.7
Longidorus sp.	-	4.2	-	-	1.0
Paratylenchus sp.	-	8.3	-	14.2	5.6
Meloidogyne sp.	33.3	41.7	-	71.4	36.6
Rotylenchulus sp.	8.3	4.2	-	4.8	4.3
Tylenchorhynchus sp.	-	-	-	4.8	1.2
Tylenchus sp.	8.3	25.0	-	33.3	16.6

1 = El- Shohadaa village, 2 = Ahrar village, 3 =Balousa village, 4 = Rommana village.

Table 5: Population densities of phytoparasitic nematodes and associated host plants in El- Sheikh Zowaiid County, North Sinai.

Name of village	Host plant	Nematode genera and species	Average of population density/250g soil&5g roots
El- Kharroba	Okra : (*Hibiscus esculentus L.*)	*Meloidogyne* sp. *Trichodorus* sp.	56 27
//	Figs : (*Ficus carica* L.)	*Tylenchorhynchus* sp.	40
//	Apple: (*Malus sylvestris* L.)	-	-
//	Maize: (*Zea mays* L.)	*Trichodorus* sp.	42
//	Grapes : (*Vitis venifera* L.)	*Criconema* sp. *Helicotylenchus* sp.	40 40
//	Date palm: (*Phoenix dactylifera* L.)	*Tylenchorhynchus* sp.	40
		Meloidogyne sp. *Pratylenchus* sp.	42 14

Table 6: Population densities of phytoparasitic nematodes and associated host plants in Rafah County.

Name of village	Host plant	Nematode genera and species	Average of population density/250g soil
El- Hussaynat	Apple : (*Malus sylvestris* L.)	*Pratylenchus* sp.	23
//	Peach : (*Prunus persica* L.)	*Criconema* sp. *Tylenchorhynchus* sp.	40 120
//	Pear: (*Pyrus communis* L.)	*Aphelenchus sp.* *Trichodorus* sp.	40 40
		Tylenchorhynchus sp.	80

Table 7: Frequency of occurrence of plant parasitic nematodes associated with plants grown in North Sinai.

Nematode genera	% nematode frequency of occurrence in the surveyed Localities				
	Sahl El- Teina	Beer El- Abd	El- Sheikh Zowaiid	Rafah	Average
Criconema sp.	-	-	11.1	34.0	11.3
Criconemoides sp.	0.7	3.3	-	-	1.0
Ditylenchus sp.	9.7	5.0	-	-	3.7
Helicotylenchus sp.	-	5.0	11.1	-	4.0
Hemicriconemoides sp.	2.2	-	-	-	0.6
Heterodera sp.	4.5	-	-	-	1.1

Hoplolaimus sp.	1.5	8.3	-	-	2.5
Longidorus sp.	5.0	-	-	-	1.3
Meloidogyne sp.	27.6	48.1	33.3	-	27.3
Paratylenchus sp.	-	1.7	-	-	0.4
Pratylenchus sp.	0.74	5.0	11.1	33.0	12.5
Rotylenchulus sp.	12.7	5.0	-	-	4.4
Trichodorus sp.	-	-	22.2	33.3	13.9
Tylenchorhynchus sp.	26.1	1.7	22.2	66.6	29.1
Tylenchulus sp.	7.4	-	-	-	1.9
Tylenchus sp.	11.2	23.3	-	-	8.6
Xiphinema sp.	8.9	-	-	-	2.2
No. of samples	110	60	32	20	

Table 8: *Meloidogyne* species associated with some host plants collected from North Sinai.

Host plant	*M. arenaria*	*M. incognita*	*M. javanica*
Olives :	-	+	-
Tomato:	-	+	+
Common bramble:	-	+	-
Black nightshade:	-	+	-
Broad bean	-	+	+

+: Present - : Not Present
*: The identification was based on the morphological characters of perennial pattern.

Discussion:

Microscopic examination of soil and root samples collected from different villages of North Sinai clarified the presence of 14 genera of plant parasitic nematodes. Some of which cause dangerous quantity and quality losses to various plants in Egypt (Ibrahim & El- Sharkawy, 2001). Root knot nematode (*Meloidogyne* sp.) represents one of the most pathogenic nematode, as it distributes in the most Egyptian soils (Abou El- Naga *et al*., 1985; Elgindi and Mousa, 1971; Oteifa *et al*., 1997; Ibrahim *et al*., 2000 and Korayem *et al*., 2011). The modern studies clarified that root knot nematode causes a large shortage in yield of vegetable and field crops and the amount of damage depends on nematode population density, predominant environmental conditions and type of host plant (Korayem, 2008; Youssef and Korayem, 2008; Korayem *et al.,* 2008; Korayem *et al.,* 2009; Korayem *et al.,* 2012 and Korayem and Bondok, 2013). Also, citrus nematode, *Tylenchulus semipenetrans* (and reniform nematode, *Rotylenchulus reniformis* are considered economically important nematodes causing damage to their host plants (Ibrahim, 2011 and Korayem and Hassabo, 2005). Cyst nematode (*Heterodera* sp.) was found in samples of Sahl El-Teina .This nematode is considered a pathogenic pest for many crops in Europe and other temperate regions (Webster, 1972). Although some researches in Egypt were carried out to study the relationship between this nematode with certain crops (Aboul- Eid and Ghroab, 1974, 1981), its economic importance and amount of damage are scientifically uncertain probably due to that predominant environmental conditions play an important role influencing its distribution and dissemination.

Virus-transmitted nematodes, (*Longidorus, Trichodorus* and *Xiphinema*) were found in the examined samples. These nematodes transmit some plant viruses causing some viral diseases to crops in Europe (Brown *et al.,* 2004) but their economic importance as vectors of plant viruses in Egypt needs more studies. Other plant parasitic nematodes were found in the examined samples. These were ring nematodes (*Criconema* sp., *Criconemoides* sp. and *Hemicriconemoides* sp.), stunt nematode (*Tylenchorhynchus* sp.) and lesion nematode (*Pratylenchus* sp.). These results agree with those obtained by Ashoub (2010) in North Sinai governorate. These nematodes feed on cell sap of infected plants causing damage to plants. Their economic importance and amount of damage have not received the necessary attention. Still, more studies are needed to determine the amount of damage caused by these nematodes, susceptible plants and suitable environmental conditions for nematode infection.

The stem and bulb nematode, *Ditylenchus* was found in the most samples. Some species belonging to this genus are known to cause dangerous diseases in Europe on potato and bulb plants and rice in south east of Asia. From its pathogenic species, *D. destructor* causes potato rot disease, *D. dipsaci* infects bulb plants and *D. angusts* infects rice stem (Ibrahim, 2010, Webster, 1972). No available scientific evidence on the existence of such species in Egypt perhaps may be due to the difference in environmental and biotic conditions or due to that the predominant species in Egypt is *D. myceliophora* which feeds on soil fungi.

In brief, the collected samples from villages of North Sinai governorate clarified the distribution of pathogenic nematodes under the predominant environmental conditions in North Sinai. This helps in putting and develop appropriate plans for management these nematode pests by eco-friendly methods resulting in economic production and agricultural safe byproducts. On the other hand, the present study clarifies nematode-free localities for agricultural extension and local government men for taking appropriate decision to prevent the arrival of the pathogenic nematodes to localities free of nematodes. Especially, cultivation in North Sinai

depends on rain and water wells free of nematodes, vice versa; Nile water helps to distribute nematodes from a place to another.

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