RESEARCH NOTE

A SURVEY OF PHYTOPARASITIC NEMATODES ON SOME PLANT CROPS IN NORTHERN EGYPT

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ABSTRACT

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A nematode survey was conducted in Alexandria and El-Behera Governorates in northern Egypt during the 2019-2022 cropping seasons to study the occurrence, population density, host association and distribution of phytoparasitic nematodes associated with seven crops. A total of 604 soil and root samples containing mixed population of 21 genera and 25 species of phytoparasitic nematodes were analyzed. Root-knot nematodes (*Meloidogyne incognita* and *M. javanica*) with 36-62% frequency of occurrence, respectively, were the most frequently encountered nematodes. The citrus nematode (*Tylenchulus semipenetrans*) had 94% frequency of occurrence on citrus trees, while the golden potato cyst nematode (*Globodera rostochiensis*) had a high (54%) frequency of occurrence on potato in El-Behera governorate. The genera *Criconema* spp., *Hemicriconemoides* spp., *Longidorus* spp., *Merlinius* spp., *Mesocriconema* spp., *Paratylenchus* spp., *Psilenchus* spp., and *Rotylenchus* spp. were less common, with a low (8-12%) frequency of occurrence.

Key words: Northern Egypt, occurrence, phytoparasitic nematodes, survey, citrus

RESUMEN

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Se realizó un estudio de nematodos en Alexandria y El-Behera, en el norte de Egipto durante las estaciones de producción entre el 2019 a 2022 para estudiar la ocurrencia, la densidad poblacional, la asociación de hospederos y la distribución de nematodos fitoparásitos asociados con siete cultivos. Se analizaron un total de 604 muestras de suelo y raíces que contenían poblaciones mixtas de 21 géneros y 25 especies de nematodos fitoparásitos. Los nematodos agalladores (*Meloidogyne incognita* y *M. javanica*), con una frecuencia de ocurrencia del 36 y 62%, respectivamente, fueron los nematodos más frecuentemente encontrados. El nemátodo del cítrico (*Tylenchulus semipenetrans*) tuvo una frecuencia de ocurrencia del 94% en los árboles de cítricos que se muestrearon, mientras que el nematodo dorado de la papa (*Globodera rostochiensis*) tuvo una alta frecuencia de ocurrencia (54%) en papa en El-Behera. Los géneros Criconema spp., *Hemicriconemoides* spp., *Longidorus* spp., *Merlinius* spp., *Mesocriconema* spp., *Paratylenchus* spp., *Psilenchus* spp., y *Rotylenchus* spp. fueron los menos comunes, con niveles bajos (frecuencia de ocurrencia

entre 8-12%).

Palabras clave: Cultivos, norte de Egipto, ocurrencia, nematodos fitoparásitos, studio

Information concerning the occurrence and distribution of phytoparasitic nematodes in Egypt is very important since many nematodes, such as citrus (*Tylenchulus semipenetrans*), cyst (*Globodera* spp., *Heterodera* spp.), dagger (*Xiphinema* spp.), lance (*Hoplolaimus* spp.), lesion (*Pratylenchus* spp.), root-knot (*Meloidogyne* spp.), reniform (*Rotylenchulus reniformis*), ring (*Mesocriconema* spp.), spiral (*Helicotylenchus* spp.) and stunt (*Tylenchorhynchus* spp.) may occur at high densities and cause economic damage to many crop plants (Oteifa, 1962; Tarjan, 1964; Oteifa and Tarjan, 1965; Ibrahim, 1990; Ismail and Eissa, 1993; Lamberti *et al*., 1996; Oteifa *et al*., 1997; Ibrahim *et al*., 2000, 2010; Ibrahim and Handoo, 2007; Adam *et al*., 2013; Handoo *et al*., 2015). The present nematode survey was carried out in Alexandria and El-Behera governorates in north Egypt, which has a Mediterranean climate with rainy cool winters and dry hot summers that favors and encourages the cultivation of several economically important agricultural crops. The leading agricultural crops in this region are wheat, corn, rice, clover, potato, tomato, sugar beet, guava, banana, orange, grape, and date palm. Certain important crops from this region, like potatoes and oranges, are underperforming, with low yields and poor development due to high infestations with phytoparasitic nematodes.

Recent studies in Egypt have shown the presence of about 60 genera and 170 species of phytoparasitic nematodes associated with many cultivated plants, grasses, and weeds (Ibrahim *et al*., 2010, 2023; Adam *et al*., 2013; Ibrahim and Handoo, 2016). The objective of this study was to identify phytoparasitic nematodes associated with certain crops in northern Egypt and provide additional information on the occurrence and distribution of genera and species of phytoparasitic nematodes that have the potential to significantly impact agricultural production in Egypt.

From 2019-2022, 604 samples were collected from a variety of cultivated plants from different localities in Alexandria and El-Behera governorates in northern Egypt (Fig. 1). From Alexandria governorate, 86 soil samples were collected from the ornamental shrub lantana (*Lantana camara* L.) and 84 samples from tomato (*Lycopersicon esculentum* Mill.). From El-Behera governorate, 92, 84, 56, 86, and 116 soil samples were collected from citrus (*Citrus aurantium* L.), guava (*Psidium guajava* L.), potato (*Solanum tuberosum* L.), spinach (*Spinacia oleracea* L.), and sugar beet (*Beta vulgaris* L.), respectively. Soil and root samples were collected from the rhizosphere region of the surveyed host plants at a depth of 15-40 cm below the soil surface. Soil samples were collected using a standard (2.5 cm diam., 30 cm depth) soil probe. The soil types in Alexandria are sandy clay and in El-Behera are silt, clay, sand, or calcareous soil. Root samples were washed free of soil and examined for cyst and root-knot nematode infections. Root-knot nematodes were isolated from galled roots and identified by examination of perineal patterns of adult females as well as the characters of the second-stage juveniles (Taylor and Sasser, 1987; Hunt and Handoo, 2009). Cysts and females of cyst nematodes were extracted from sugar beet soil and root samples and identified by morphological characteristics (Mulvey and Golden, 1983; Golden, 1986). Nematodes from a composite sample of 250 cm^3 soil were extracted using Cobb's wet-sieving and centrifugal sugar flotation techniques (Ayoub, 1980; Ibrahim *et al*., 2000). Nematodes were fixed in 3% formaldehyde solution then identified to genus and counted using a binocular stereomicroscope (Goodey, 1963; Mai and Lyon, 1975). Some nematode specimens were processed in 5% formaldehyde solution followed by anhydrous glycerin (Seinhorst, 1959) and examined under a compound microscope for species identification by morphological analysis using taxonomic keys (Sher, 1966; Golden, 1986; Handoo and Golden, 1989; Raski, 1991; Handoo, 2000; Handoo *et al*., 2007; Geraert, 2008; Hunt and Handoo, 2009). Frequency of occurrence (FO = [number of positive samples/numbers of total samples] x 100) and population densities (PD) were determined for the identified nematodes in composite samples and recorded (Table 1). Some nematode samples were fixed in 2% formaldehyde solution and sent to the Mycology and Nematology Genetic Diversity & Biology Laboratory, USDA (MNGDBL) in Beltsville, Maryland, USA for

Figure 1. Map of Egypt governorates. Soil samples were collected from Alexandria and El-Behra governorates.

species identification using compound microscopes.

The FO and PD of phytoparasitic nematode genera and species found in the rhizosphere soil samples collected from the surveyed crop plants in Alexandria and El-Behera governorates in northern Egypt are shown in Table 1. A total of 21 genera and 25 species of phytoparasitic nematodes were detected in the soil samples of the surveyed plants. Root-knot nematodes (*Meloidogyne incognita* and *M. javanica*) were the most frequent nematodes encountered with 32-62% FO and PD of 284-366 nematodes/250 cm^3 soil. They were found in all soil samples of the surveyed plants except those collected from citrus trees. *Helicotylenchus* spp., *Pratylenchus* spp., *Tylenchorhynchus* spp. and *Tylenchus* spp. were common and observed in soil samples from all surveyed plants with 10 - 42% FO and 72 - 260 nematodes/250 cm^3 soil. *Criconema* spp., *Hemicriconemoides* spp., *Longidorus* spp., *Merlinius* spp., *Paratylenchus* spp. and *Rotylenchus* spp. were less common with 8-12% FO.

In soil samples from the Alexandria governorate, 12 nematode genera were identified associated with lantana and tomato (Table 1). *Meloidogyne incognita* and *M. javanica* were the most frequently found nematodes in these crops with 36-62% FO and PD of 284-366 nematodes/250 cm^3 soil. *Aphelenchoides* spp., *Merlinius* spp. and *Rotylenchulus reniformis* were observed on lantana while *Criconema* spp., *Hoplolaimus* spp. and *Trichodorus* spp. occurred on tomato with 12-18% FO and PD 54-184 nematodes/250 cm^3 soil. A previous nematode survey in Alexandria governorate showed the occurrence of 21 genera and 27 species of phytoparasitic nematodes associated with certain ornamental plants, weeds, and grasses (Ibrahim *et al*., 2000).

Nematodes in 21 genera were extracted from

Table 1. Genera and species of phytoparasitic nematodes and their frequency of occurrence% (FO) and average nematode population density (PD) on the associated host plants in Alexandria and El-Behra governorates.

	Alexandria				El-Behra									
	Lantana (86)[x]		Tomato (84)		Citrus (92)		Guava (84)		Potato (56)		Spinach (86)		Sugar Beet (116)	
Nematode species	FO[y]	PD[z]	FO	PD	FO	PD	FO	PD	FO	PD	FO	PD	FO	PD
Aphelenchoides spp.	14	154	-	-	8	11	20	136	16	86	-	-	16	148
Criconema spp.	-	-	12	140	12	132	-	-	-	-	10	148	-	-
Ditylenchus spp.	-	-	-	-	-	-	10	184	24	64	8	122	10	94
Globodera rostochiensis	-	-	-	-	-	-	-	-	54	382	-	-	-	-
Helicotylenchus spp.	42	160	22	120	40	192	20	160	28	84	42	260	40	174
Hemicriconemoides spp	-	-	-	-	-	-	-	-	-	-	-	-	10	74
Heterodera schachtii	-	-	-	-	-	-	-	-	-	-	20	274	48	264
Heterodera trifolii	-	-	-	-	-	-	-	-	-	-	14	182	-	-
Hoplolaimus spp.	-	-	18	160	16	158	20	182	-	-	14	194	16	72
Longidorus spp.	-	-	-	-	10	84	-	-	-	-	-	-	-	-
Meloidogyne incognita	54	320	62	366	-	-	52	282	24	328	64	364	62	344
Meloidogyne javanica	36	248	62	320	-	-	40	274	-	-	54	286	54	294
Merlinius spp.	12	132	-	-	-	-	-	-	-	-	-	-	-	-
Mesocriconema spp.	-	-	-	-	-	-	-	-	-	-	10	132	8	86
Paratylenchus spp.	-	-	-	-	-	-	-	-	-	-	-	-	10	74
Pratylencus spp.	36	120	32	136	20	142	24	164	16	48	40	184	36	96
Psilenchus spp.	-	-	-	-	-	-	-	-	12	46	8	170	10	68
Rotylenchulus reniformis	16	184	-	-	-	-	-	-	-	-	8	154	14	96
Rotylenchus spp.	-	-	-	-	10	74	-	-	-	-	8	110	-	-
Trichodorus spp.	-	-	18	96	-	-	16	140	-	-	8	184	-	-
Tylenchorhynchus spp.	16	84	22	112	18	124	16	74	20	262	32	164	20	128
Tylenchulus semipenetrans	-	-	-	-	94	5,640	-	-	-	-	-	-	-	-
Tylenchus spp.	14	96	10	114	16	74	10	72	20	140	12	220	16	124
Xiphinema spp.	12	74	12	66	14	112	8	74	-	-	10	84	-	-
Xiphinema rivesi	-	-	-	-	36	342	-	-	-	-	-	-	-	-

[x]Total numbers of soil samples.
[y]FO = Number of positive samples/total number of collected soil samples 100.
[z]PD = Numbers of nematodes per 250 cm3 soil.

from soil samples collected from the El-Behera governorate (Table 1). *Helicotylenchus* spp., *Hoplolaimus* spp., *Pratylenchus* spp., *Tylenchorhynchus* spp. and *Tylenchus* spp. were found on all surveyed host plants. *Meloidogyne incognita* and *M. javanica* were found in all surveyed plants except citrus with 40-64% FO and PO of 282-364 nematodes/250 cm^3 soil.

In the El-Behera governorate, *Heterodera schachtii*, was found on spinach and sugar beet with 20-48% FO and PD of 264-274 nematodes/250 cm^3 soil while *H. trifolii* was observed on spinach with 14% FO and an average PD of 182 nematodes/250 cm^3 soil. *Globodera rostochiensis*, was identified on potato with 54% FO and an average PD of 382 nematodes/250 cm^3 of soil. This cyst nematode was widespread in El-Nitron Valley and El-Nobaria region, southwest of El Behera governorate. *Tylenchulus semipenetrans* was very common in all citrus trees surveyed with high (94%) FO and an average PD of 5,646 nematodes/250 cm^3 soil. Recently the pathogenicity and control of this nematode on citrus and other fruit trees were studied by Ibrahim *et al*. (2022). *Xiphinema* spp. was identified on citrus, guava, and spinach with 8-14% FO and PD of 66-112 nematodes/250 cm^3 soil while *X. rivesi* was found on citrus trees in El-Nobaria region with 36% FO and an average PD of 342 nematodes/250 cm^3 soil. In a previous nematode survey in El-Behera governorates (Ibrahim *et al*., 2000), 14 nematode genera were recorded on ornamental palm trees, grasses, and weeds. The present results are supportive of previous studies (Handoo *et al*., 2015; Ibrahim *et al*., 2017, 2023) regarding the occurrence of *X. rivesi* on citrus and *G. rostochiensis* on potato in El-Behera governorate, Egypt.

The results of this survey provide insight concerning important phytoparasitic nematode genera and species associated with certain important crops grown in northern Egypt. Surveyed plant crops were selected either because their economic importance or because they showed stunted growth symptoms with leaf yellowing on citrus, potato and sugar beet that were infested with *T. semipenetrans*, *G. rostochiensis* and *H. schachtii*. In conclusion, this survey establishes a foundation for assessing the extent and intensity of these phytoparasitic nematode-related challenges, thus aiding in the formulation of effective mitigation strategies for sustainable plant health.

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