Survey of Plant-Parasitic Nematodes and Phytopathogenic Fungi Associated with Citrus Trees in Egypt

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ABSTRACT

Twenty-one plant-parasitic nematode genera were found associated with citrus trees in the five surveyed governorates. The citrus nematode, *T. semipenetrans*, was the most prevalent occurring at 99 % in the tested samples with an average number of 5539 juvenile / 250 cc soil. The present study recorded 13 plant parasitic nematode genera associated with citrus roots, e.g., *Aphelenchoides*, *Aphelenchus*, *Criconemella*, *Discocriconemella*, *Ditylenchus*, *Hemicriconemoides*, *Hemicycliophora*, *Heterodera*, *Irantylenchus*, *Paratylenchus*, *Pratylenchus*, *Tylenchus* and *Xiphinema*. Soil samples from El-Behera governorate comprised the largest number of nematode genera (17). The sandy clay loamy, sandy clay, silty clay loamy and sandy soil textures supported the largest number of nematode genera, whereas clay and loamy sandy soil textures were recorded to contain the number of nematode genera.

The most favorable scion-rootstock matching for nematode infection was that of clementine mandarin-sour orange in which occurrence percentage was 2.2%, giving a density of 6401 citrus nematode juvenile (CNJ)/250 cc soil, followed by navel orange (75.2%) and 6224 CNJ/250 cc soil.

The highest number of nematode genera (17) was recorded in navel orange in El Behera, followed by Kafer El-Sheikh (12), then El-Menoufyia (10). In addition five nematode genera were recorded in sour orange, while in common mandarin, five genera were found in El-Behera and three in each of Kafer El-Sheikh and El-Menoufyia. Amonge the fungi found to be associated with rhizosphere of citrus tree roots, *Fusarium solani* was the most prevalent (86.4%), whereas *Phytophthora citrophthora* was the least (8.2%).

INTRODUCTION

Plant-parasitic nematodes are considered among the most important pests of citrus trees and responsible for their reduction in yield (Hassan, 1985). Most of the commercial nurseries in Egypt were heavily infested with the citrus nematode *Tylenchulus semipenetrans* Cobb. It is well known that citrus nematode is the most serious nematode attacking citrus rootstocks causes slow decline of citrus trees (Cohan, 1972). The citrus nematode *T. semipenetrans*, was recorded to be the most prevalent, followed by *Helicotylenchus* and *Pratylenchus*, whereas *Rotylenchulus* and *Longidorus* were less common (Ibrahim, 1990; Ibrahim and El-Sharkawy, 2001; Oteifa, 1965; Oteifa *et al.*, 1997: Ahmed, 1974; Mahros *et al.*, 1985 and Sweelam and Abo-Taka, 1989). The nematode feeds on citrus roots causing reduction

in growth rate of young trees, tree debilitation, lower fruit yield and reduction in fruit quality. When infested trees are removed from the soil grove, infective stages remain in the soil for several years and may infect replant trees (Tarjan, 1964; O'Bannon and Tarjan, 1973). The association of nematodes and fungi may increase the damage to citrus trees (Duncan *et al.*, 1995). The objectives of this study aimed to: i) make nematode and fungi surveys in five Egyptian governorates; ii) study the effect of soil textures on nematode genera associated with each texture; iii) study the role of scion types in nematode population on citrus trees.

MATERIALS AND METHODS

Nematode and Fungi Samples Collection:

A total of 669 rhizophere soil and root samples were collected throughout 1996-1999 from citrus orchards grown in five governorates at the northern region of Egypt. The surveyed governorates and respective samples were as follows: Alexandria, 29; El-Behira, 540; El-Fayoum, 15; Kafr El-Shiekh, 65; and El-Menoufyia 20 samples. Composite soil samples of 1 kg each were collected from the rhizosphere of the surveyed trees at a depth of 5-20 cm. Samples were sealed in a labeled plastic bags, kept out of the sun to prevent drying and transported to the nematode laboratory for extraction and identification.

For fungal isolation, a total of 110 rhizoshere soil, root and trunk samples were collected from citrus plantations at three Egyptian governorates. The fungal surveyed governorates and respective samples were as follows: Alexandria, 10; El-Behira, 90 and Kafr El-Sheikh, 10 samples.

Nematode Extraction:

Plant-parasitic nematodes associated with the soil samples were extracted within 24 hrs after sample collection. Soil samples were thoroughly mixed and a volume of 250 cc soil was used to extract plant-parasitic nematodes using sieving & Barmann plate and Centrifugal-Floatation techniques (Ayoub, 1980). The plant-parasitic nematodes in the suspension were collected by backwashing the retained materials on a 325 mesh sieve into 250-ml beaker using tap water.

Identification of the extracted plant-parasitic nematodes in each soil sample was based on the morphological characters of the adult and larval forms according to the description of Goody (1963), Mai and Lyon (1975) and the Commonwealth International Parasitology Description (CIPD) (1972-1985). The plant-parasitic nematode genera, which presented in the suspension, were counted using Peter's 1-ml eelworm count ng slide under a compound microscope.

Isolation and Identification of fungi isolated:

Fungi present in the rhizoshere soil, root and trunk samples of citrus trees were isolated according to Johanson *et al.* (1960). The purification and identification of fungi were carried out according to Lilly and Barnett (1951), Barnett and Hunter (1972) and Nelson *et al.,* (1983).

RESULTS AND DISCUSSION

A: Survey of citrus nematode on citrus trees in Egypt.

Data presented in Table (1) indicated that, twenty-one plant-parasitic nematode genera were found associated with citrus trees in the five surveyed governorates. The citrus nematode, *T. semipenetrans*, was the most prevalent occurring at 99 % of the tested samples with an average number of 5539 juvenile / 250 cc soil. The present study recorded 13 plant parasitic nematode genera associated with citrus roots in Egypt, e.g., *Aphelenchoides*, *Aphelenchus*, *Criconemella*, *Discocriconemella*, *Ditylenchus*, *Hemicriconemoides*, *Hemicycliophora*, *Heterodera*, *Irantylenchus*, *Paratylenchus*, *Pratylenchus*, *Tylenchus* and *Xiphinema*. Obtained results also indicated the presence of 17 nematode genera in El-Behera,11 in El-Menofyia,10 in El-Fayoum and 9 in Alexandria governorates. The citrus nematode was the most prevalent in all surveyed governorates occurring in 100 % of the tested samples except in those collected from El-Menoufyia governorate (65 %). Similar results were obtained in Egypt by several authors, Doss *et al.* (1967) reported that *T. semipenetrans* occurred in 60 % of the collected samples of Behera, Gharbia, Sharkia, Giza, Kaliobia and Fayoum governorates, while Tahrir and Menoufyia samples showed 38-44% FQ. Occurrence of *Pratylenchus* sp. ranged from 4.8 to 46.6 % in Kaliobia and Giza, respectively, and 19.2% in the other governorates. Ahmed (1974) found that *T. semipenetrans* had 94% of occurrence in Fayoum, Giza, Menoufyia, Behera and Kaliobia governorates. In El-Sharkia governorate, Osman and Hendy (1989) showed the presence of *T. semipenetrans* associated with citrus trees roots.

B: Survey of fungi on citrus trees in Egypt

Data in Table (2) showed that the presence of 4 fungi associated with soil and roots of citrus plants in the surveyed governorates. *Fusarium solani* was the most prevalent followed by *Diplodia* sp. and *Rhizoctonia solani* then *Phytophthora citrophthora*. These results are in agreement with those of LeRoux *et al.* 1998; Matheron *et al.,* 1998; Peever *et al.* 1999; Widmer *et al.,* 1999; Gautam *et al.*, 1999; and Walker and Morey, 1999. They reported

the presence of *Fusariun solani*, *F. oxysporium*, *Phytophthora citrophthora*, *P. parasitica*, and *P. nicotianae* infecting citrus orchards, especially those infested with citrus nematode. Moreover, Peever *et al.* (1999) isolated several pathogenic isolates of *Alternaria alternata* from rough lemon roots in Florida. Moreover, Walker and Morey (1999) isolated *Pythium ultinum* more frequently from orange roots.

C: Effect of soil texture on citrus nematode population

Data shown in Table (3) clearly indicated that the sandy clay soil had the highest values of frequency of occurrence of citrus nematode, (35 %) followed by sandy clay loamy (calcareous) soil (31.8 %), than sandy soil (21.4 %). On the other hand, clay, loamy sandy and silty clay loamy soils had the least FO values (3.9, 2.3 and 6.0 %) among all the collected samples. In relation to soil texture, average numbers of CNJ/250 cc soil samples were also determined (Table 3). It was found that in most cases, PD values in sandy soils were higher than those of clay soils.

Data presented in Table (4) indicated that in El-Behera governorate, the citrus nematode, *T. semipenetrans*, was occurred at 100 % FO in the different soil textures with an average PD values of 6425 CNJ/250 cc soil. In the clay soil, the genera *Aphelenchus*, *Tylenchorhynchus* and *Xiphinema* were occurred at 5.6 % with average PD values of 50, 50 and 70 nematodes/250 cc soil, respectively. In the loamy sandy soil, the genera *Criconemella* and *Rotylenchulus* were occurred at 20 % and 6.7% with average PD values of 73 and 55 nematodes/250 cc soil, respectively. In the sandy soil, the genera *Rotylenchulus*, *Tylenchorhynchus, Tylenchus* and *Xiphinema* were occurred 12.1, 10.6, 10.6, 10.6 and 9.2 % with average PD values of 469, 155, 122 and 61 nematodes/ 250 cc soil, respectively. On the other hand, the genera *Aphelenchoides, Hemicycliophora*, and *Hoplolaimus* had the least FO values (0.9, 1.4 and 0.5%) with an average PD values of 163, 57 and 85 nematodes/250 cc soil, respectively.

In Kafr El-Sheikh governorate (Table 5), data indicated that the citrus nematode was the most prevalent and occurred at 100% in the different soil textures with average PD values of 2561, 237 and 1983 CNJ/250 cc soil in the clay, sandy clay and silty clay loamy soils, respectively. In the clay soil, the genera *Helicotylenchus, Hemicriconemoides, Meloidogyne, Pratylenchus* and *Rotylenchulus* were occurred at 12.5–62.5% and had an average PD values of 108-428 nematodes/250cc soil. In the sandy clay soil, the genera *Helicotylenchus, Rotylenchulus* and *Tylenchorhynchus* were occurred at 17.6, 5.9 and 11.8% with average PD values of 58, 120 and 63 nematodes/250 cc soil. In the silty clay loamy, the genera *Helicotylenchus* and *Rotylenchulus* were occurred at 12.5 and 62.5 % of

the tested samples and had average PD values of 210 and 252 nematodes/250 cc soil, respectively.

These results came in contrast to that previously reported in China by Yin and Li (1982). They showed that the highest population of citrus nematode was in clay soil, high in sand, and lowest in coarse sand. On the other hand, Al-Yahya *et al.,* (1988) showed that reproduction of citrus nematode was greatest in sandy soil, intermediate in sandy loamy or loamy sand, and lowest in clay soil. . Hernandez *et al.* (1993) revealed that the largest populations of the nematode occurred in loamy soil. Al-Qasem and Abu-Gharbieh (1995) found that nematode numbers were high in sandy loam soil.

D: Effect of scions on citrus nematode population

Data obtained in Table (6) clearly indicated that navel orange scion was the most common in the five surveyed governorates with FO values of 75.2% and the roots of its rootstock had an average number of 6224 CNJ/250 cc soil followed by valencia orange (*C. sinensis,* Osbeck) scion having 9.9% with an average number of 3931 CNJ/250 cc soil. On the other hand, balady orange (*C. sinensis*, Osbeck), clementine mandarin (*C. tangarina*), common mandarin (*C. reticulata,* Blanco) eureka lemon (*C. limon*, Bur) and sour orange scions were found less common. Navel orange had the highest FO values in soil samples collected from all gavernorates tested. The least FO values were recoded in Balady orange, Clementine mandarin, Eukea lemon, Sweet orange and Valencia orange for all five gavernorates tested. In El- Menoufiya soil samples, Clementine and Common mandarins, were presented with 10 and 20% FO and an average number 2185 CNJ/ 250 cc soil.

Data shown in Tables 7, 8, and 9 indicate the FO values of plant parasitic genera and their average numbers of CNJ per 250cc soil samples collected from El-Behera, Kafer El-Sheikh and El- Menoufiya gavernorates in relation to scion type grafted on Sour orange rootstock. It was obviously noticed that the scion type had its significant role in nematode pathogenicity to citrus trees. Eight scions, represented different citrus scions, grafted on sour orange rootstock, were evaluated to their frequency in citrus cultivation as well as to susceptibility to nematode infection. The most favorable scion-rootstock matching for nematode infection was that of clementine mandarin-sour orange with FO values of 2.2 % and a density of 6401 CNJ/250 cc soil, followed by navel orange with 75.2% occurrence and 6224 CNJ/250 cc soil, Valencia orange with 9.9% occurrence and 3931 CNJ/250 cc soil, Egyptian lime with 5.2% occurrence and 3682 CNJ/250 cc soil and common mandarin 2.5% and 1904 CNJ/250 cc soil. Sour orange-sour

orange occurring at 1.1% gave 1196 CNJ. On the other hand, scions, i.e., sweet orange (2.8 % FO), eureka lemon (0.5 % FO) and, balady orange (0.5% FO) showed different degrees of nematode infection depression, giving 1086, 920 and 343 CNJ/250 cc soil, respectively. Moreover, studied scions affected community composition of nematode genera associated with each combination. The navel orange scion supported the largest number of nematode genera (17 in El Behera, 12 in Kafer El-Sheikh and 10 in El-Menoufyia) followed by Valencia orange (7), Egyptian lime (6 in El Behera, 6 in Kafer El-Sheikh and 5 in El-Menoufyia) while sour orange (5) and common mandarin (5 genera in El Behera, 3 in Kafer El-Sheikh and 3 in El-Menoufyia). On the other hand, the scions permitted lesser number associated with, were clementine mandarin (3), sweet orange (3), balady orange (3 in El-Behera and 4 in Kafer El-Sheikh) and eureka lemon (2) genera.

The 6 nematode genera *Aphelenchus*, *Hemicycliophora*, *Heterodera*, *Hoplolaimus*, *Irantylenchus* and *Meloidogyne* were detected only in soil samples collected from navel orange grafted on sour orange. The genus, *Aphelenchoides* was observed in samples collected from soil of both common mandarin and navel orange scions. The genus, *Hemicriconemoides* occurred in samples collected from soil of navel orange and Valencia orange scions while *Trichodorus* was found only in samples collected from Egyptian lime and navel orange scions soils. Our results could be considered new record of these pathogenistic phenomena, and might be explained by an expected compound(s) formed within scion shoots and translocated downwards to tree roots affecting their susceptibility to nematode parasitism and/or modifying rhizosphere environment. Such suggestions need further investigations.

Table (1): Frequency of plant-parasitic nematode genera and their average numbers per 250 cc soil samplescollected from five Egyptian governorates

Nematode genera	Governorate										%Occurrence	Mean
	Alexandria (29)[a]		El-Behera (540)		El-Fayoum (15)		El-Menoufyia (20)		Kafr El-Sheikh (65)			
	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD		
Aphelenchoides	-	-	1.3	91	6.7	110	5	55	1.5	60	1.5	86
Aphelenchus	-	-	1.1	66	20	68	35	78	-	-	2.4	71
Criconemella	31	135	10.2	285	20	150	10	48	1.5	150	10.5	251
Discocriconemella	-	-	-	-	-	-	-	-	3.1	115	0.3	115
Ditylenchus	-	-	3.7	174	-	-	-	-	1.5	65	3.1	169
Helicotylenchus	24.1	96	22.2	305	60	185	5	60	13.9	115	22.1	271
Hemicriconemoides	9.6	53	1.7	222	13.3	130	5	36	4.6	222	2.5	180
Hemicycliophora	-	-	1.1	77	-	-	-	-	-	-	0.9	77
Heterodera	-	-	0.2	125	-	-	10	43	-	-	0.5	70
Hoplolaimus	-	-	0.4	85	-	-	-	-	-	-	0.3	85
Irantylenchus	-	-	1.1	111	-	-	-	-	-	-	0.9	111
Meloidogyne	-	-	0.9	130	-	-	-	-	9.2	366	1.6	259
Paratylenchus	6.9	1060	-	-	-	-	10	353	-	-	0.6	707
Pratylenchoides	-	-	-	-	-	-	-	-	3.1	108	0.3	108
Pratylenchus	-	-	-	-	-	-	30	56	1.5	80	1.1	59
Rotylenchulus	44.8	144	20.4	574	40	258	10	176	29.2	199	22.4	501
Trichodorus	3.4	230	2.8	66	13.3	78	-	-	-	-	2.7	76
Tylenchorhynchus	10.3	953	6.1	148	20	132	30	159	3.1	63	7.0	196
Tylenchulus	100	402	100	6425	100	393	65	175	100	159	99.0	5539
Tylenchus	3.4	120	8.7	152	46.7	2	-	0	6.2	7	8.8	139
Xiphinema	-	-	3.0	60	-	79	-	-	-	91	2.4	60
						-		-		-		

a = Number of samples collected from each governorate.

FQ=Frequency of occurrence %, [(number of positive samples / a) × 100].

PD=Population density, mean number of nematode present /250 cc soil in each governorate.

Table (2): Frequency of occurrence of fungi associated with the rhizosphere of citrus tree roots and soil samples, which collected from three Egyptian governorates

Fungi genera	Governorate			% Occurrence
	Alexandria (10)[a]	El-Behera (90)	Kafr El-Sheik (10)	
Diplodia sp.	-	14, 15.6	-	12.7
Fusarium solani	10[b],100[c]	75, 83.3	10, 100	86.4
Phytophthora citrophthora	-	9, 10	-	8.2
Rhizoctonia solani	-	12, 13.3	-	10.9

a= Number of samples collected from each of the governorate. b= Number of positive samples.
c= Frequency of occurrence % = (b/a) × 100. % Occurrence = (Σb) / (Σa) × 100.

Table (3): Frequency of soil texture and their average numbers of citrus nematode, *T. semipenetrans*, per 250 cc soil samples collected from five governorates

Soil texture	*Governorates*										%Occurrence	Mean
	Alexandria (29)[a]		El-Behera (540)		El-Fayoum (15)		El-Menoufyia (20)		Kafr El-Sheikh (65)			
	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD		
Clay soil (26)	-	-	3.3	98	-	-	-	-	12.3	2561	4.0	1155
Loamy sandy soil(15)	-	-	2.8	1257	-	-	-	-	-	-	2.3	1257
Sandy soil(141)	-	-	26.1	1734	-	-	-	-	-	-	21.4	1734
Sandy clay soil(234)	100	402	28.3	932	100	3932	100	1750	26.2	237	34.0	1166
Sandy clay loamy soil(213)	-	-	39.4	11249	-	-	-	-	-	-	32.3	11249
Silty clay loamy soil(40)	-	-	-	-	-	-	-	-	61..5	1983	6.1	1983

a= Number of samples collected from each of the governorate.
FQ=Frequency of occurrence % = (Number of positive samples / a) × 100
PD=population density= Mean number of citrus nematode present in the positive samples in each governorate.

Table (4): Frequency of plant-parasitic nematode genera and their average numbers per 250 cc soil samples, Which collected from El-Behera governorate in relation to the soil texture.

Nematode genera	Soil texture										%Occurrence	Mean
	Clay (18)*		Loamy sandy (15)		Sandy clay loamy (213)		Sandy clay (153)		Sandy (141)			
	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD		
Aphelenchoides	-	-	-	-	2.1	53	1.3	75	0.9	163	1.3	91
Aphelenchus	5.6	50	-	-	3.5	69	-	-	-	-	1.1	66
Criconemella	-	-	20	73	-	-	12.4	195	18.5	357	10.2	285
Ditylenchus	-	-	-	-	3.5	185	2.0	111	5.2	192	3.7	174
Helicotylenchus	-	-	-	-	5.0	62	17.0	165	40.8	366	22.2	305
Hemicriconemoides	-	-	-	-	-	-	3.3	262	1.9	174	1.7	222
Hemicycliophora	-	-	-	-	-	-	2.0	97	1.4	57	1.1	77
Heterodera	-	-	-	-	-	-	0.7	125	-	-	0.2	125
Hoplolaimus	-	-	-	-	-	-	0.7	85	0.5	85	0.4	85
Irantylenchus	-	-	-	-	-	-	-	-	2.8	111	1.1	111
Meloidogyne	-	-	-	-	-	-	0.7	50	1.9	150	0.9	130
Rotylenchulus	-	-	6.7	55	12.1	469	34.6	513	18.3	830	20.4	614
Trichodorus	-	-	-	-	0.7	95	-	-	6.6	64	2.8	66
Tylenchorhynchus	5.6	50	-	-	10.6	155	5.9	146	3.8	148	6.1	148
Tylenchulus	100	930	100	1957	100	2169	100	1931	100	13249	100	6425
Tylenchus	-	-	-	-	10.6	122	6.5	89	11.3	197	9.1	152
Xiphinema	5.6	70	-	-	9.2	61	1.3	45	-	-	3.0	60

a= Number of samples collected from each of the soil texture.
FQ=Frequency of occurrence % = (Number of positive samples / a) × 100
PD=population density= Mean number of citrus nematode present in the positive samples in each governorate.

Table (5): Frequency of plant-parasitic nematode genera and their average numbers per 250 cc soil samples collected from Kafr El-Sheikh governorate in relation to soil texture

Nematode genera	*Soil type*						%Occurrence	Mean
	Clay (8)[a]		Sandy clay (17)		Silty clay loamy (40)			
	FQ	PD	FQ	PD	FQ	PD		
Aphelenchoides	-	-	-	-	2.5	60	1.5	60
Criconemella	-	-	-	-	2.5	150	1.5	150
Discocriconemella	-	-	-	-	5.0	115	3.1	115
Ditylenchus	-	-	-	-	2.5	65	1.5	65
Helicotylenchus	12.5	210	17.6	58	12.5	130	13.9	115
Hemicriconemoides	12.5	130	-	-	5.0	268	4.6	222
Meloidogyne	62.5	428	-	-	2.5	55	9.2	366
Pratylenchoides	25.0	108	-	-	-	-	3.1	108
Paratylenchus	-	-	-	-	2.5	80	1.5	80
Rotylenchulus	62.5	252	5.9	120	32.5	184	29.2	199
Tylenchorhynchus	-	-	11.8	63	-	-	3.1	63
Tylenchulus	100	2561	100	237	100	1983	100	1597
Tylenchus	-	-	-	-	10	91	6.2	91

a= Number of samples collected from each of the soil texture.
FQ=Frequency of occurrence % = (Number of positive samples / a) x 100
PD=population density= Mean number of citrus nematode present in the positive samples in each governorate.

Table (6): Frequency of scions on rootstock and average numbers of citrus nematode per 250 cc soil samples collected from five governorates

Scion type	Governorates										% Occurrence	Mean
	Alexandria (29)[a]		El-Behera (540)		El-Fayoum (15)		El-Menoufyia (20)		Kafr El-Sheikh (65)			
	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD		
Balady orange	-	-	-	-	-	-	-	-	4.6	343	0.5	343
Clementine mandarin	-	-	2.8	6401	-	-	-	-	-	-	2.2	6401
Common mandarin	-	-	1.3	2747	-	-	10	0.0	12.3	1642	2.5	1904
Egyptian lime	-	-	5	3930	-	-	20	0.0	6.2	2185	5.2	3682
Eurkea lemon	-	-	0.6	920	-	-	-	-	-	-	0.5	920
Navel orange	96.6	402	73.51.	7448	100	3932	65	1750	76.9	1618	75.2	6224
Sour orange	3.4	125	1	1374	-	-	-	-	-	-	1.1	1196
Sweet orange	-	-	3.5	1086	-	-	-	-	-	-	2.8	1086
Valencia orange	-	-	12.2	3931	-	-	-	-	-	-	9.9	3931

a= Number of samples collected from each governorate.
FQ=Frequency of occurrence % = (Number of positive samples / a) × 100
PD=population density= Mean number of citrus nematode present in the positive samples in each governorate.

Table (7): Occurrence of plant-parasitic nematode genera and their average numbers of CNJ per 250 cc soil samples collected from El-Behera governorate in relation to scion type grafted on sour orange rootstock.

Nematode genera	Scion type																% Occurrence	Mean
	Clemintine mandarin (15)[a]		Commor Mandarin (7)		Egyptian mandarin (27)		Eurkea lemon (3)		Navel orange (397)		Sour orange (6)		Sweet orange (19)		Valencia orange (66)			
	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD	FQ	PD		
Aphelenchoides	-	-	14.3	40	-	-	-	-	1.5	109	-	-	-	-	-	-	1.3	91
Aphelenchus	-	-	-	-	-	-	-	-	1.5	66	-	-	-	-	-	-	1.1	66
Criconemella	-	-	-	-	-	-	-	-	12.3	310	-	-	21.1	73	3	90	10.2	285
Ditylenchus	-	-	14.3	130	-	50	-	-	4.3	184	16.7	63	-	-	1.5	160	3.7	174
Helicotylenchus	26.7b	83c	-	-	7.4		-	-	26.5	326	16.7	125	-	-	12.1	226	22.2	305
Hemicriconemoides	-	-	-	-	-	-	-	-	1.8	196	-	-	-	-	3	315	1.7	222
Hemicycliophora	-	-	-	-	-	-	-	-	1.5	77	-	-	-	-	-	-	1.1	77
Heterodera	-	-	-	-	-	-	-	-	0.3	125	-	-	-	-	-	-	0.2	125
Hoplolaimus	-	-	-	-	-	-	-	-	0.5	85	-	-	-	-	-	-	0.4	85
Irantylenchus	-	-	-	-	-	-	-	-	1.5	111	-	-	-	-	-	-	1.1	111
Meloidogyne	-	-	-	-	-	-	-	-	1.3	130	-	-	-	-	-	-	0.9	130
Rotylenchulus	-	-	28.6	375	-	95	33.3	165	25.9	632	16.7	650	5.3	55	30.3	388	20.4	614
Trichodorus	-	-	-	-	3.7	-	-	-	3.5	64	-	-	-	-	-	-	2.8	66
Tylenchorhynchus	20	75	-	-	3.7	95	-	-	7.1	158	16.7	125	-	-	-	-	6.1	148
Tylenchulus	100	6401	100	2747	100	393	100	950	100	7448	100	137	100	1086	100	3931	100	642
Tylenchus	-	-	-	-	3.7	2	-	-	11.8	156	-	4	-	-	1.5	90	9.1	5
Xiphinema	-	-	14.3	34	25.9	45	-	-	2	52	-	-	-	-	-	-	3.0	152
						72												60

a= Number of samples collected from each governorate.

FQ=Frequency of occurrence % = (Number of positive samples / a) × 100

PD=population density= Mean number of citrus nematode present in the positive samples in each governorate.

Table (8): Frequency of plant-parasitic nematode genera and their average numbers of CNJ per 250 cc soil samples collected from Kafr El-Sheikh governorate in relation to scion type grafted on sour orange rootstock

Nematode genera	*Scion type*								%Occurrence	Mean
	Balady orange (3)[a]		Common Mandarin (8)		Egyptian Lime (4)		Navel orange (50)			
	FQ	PD	FQ	PD	FQ	PD	FQ	PD		
Aphelenchoides	-	-	-	-	-	-	2	60	1.5	60
Criconemella	-	-	-	-	-	-	2	150	1.5	150
Discocriconemella	-	-	-	-	-	-	4	115	3.1	115
Ditylenchus	-	-	-	-	-	-	2	65	1.5	65
Helicotylenchus	-	-	-		25	210	16	103	13.9	115
Hemicriconemoides	-	-	-	-	25	130	4	268	4.6	222
Meloidogyne Pratylenchoides	-	-	25	273	75	532	2	55	9.2	366
Pratylenchus	-	-	-	-	50	108	-	-	3.1	108
Rotylenchulus	-	-	-	-	-	-	2	80	1.5	80
Tylenchorhynchus	33.3	120	37.5	252	50	253	26	184	29.2	199
Tylenchulus	33.3	60	-	-	-	-	2	65	3.1	63
Tylenchus	100	343	100	1642	100	2185	100	1618	100	1597
	33.3	95	-	-	-	-	6	90	6.2	91

a= Number of samples collected from each scion type.

FQ=Frequency of occurrence % = (Number of positive samples / a) × 100

PD=population density= Mean number of citrus nematode present in the positive samples in each governorate.

Table (9): Frequency of plant-parasitic nematode genera and their average numbers of CNJ per 250 cc soil samples collected from El- Menoufyia governorate in relation to scion type grafted on sour orange rootstock

Nematode genera	Scion type						% Occurrence	Mean
	Common mandarin (2)		Egyptian Lime (4)		Navel orange (14)			
	FQ	PD	FQ	PD	FQ	PD		
Aphelenchoides	-	-	-	-	7	55	5	55
Aphelenchus	50	45	25	80	35	84	35	77
Criconemella	-	-	-	-	14	48	10	48
Helicotylenchus	-	-	-	-	7	60	5	60
Hemicriconemoides	-	-	-	-	7	36	5	36
Heterodera	50	45	25	40	-	-	10	43
Paratylenchus	-	-	-	-	14	353	10	353
Pratylenchus	-	-	100	48	14	73	30	56
Rotylenchulus	-	-	25	315	7	36	10	176
Tylenchorhynchus	50	45	75	63	14	191	30	103
Tylenchulus	-	-	-	-	93	1750	65	1750

a= Number of samples collected from each scion type.
FQ=Frequency of occurrence % = (Number of positive samples / a) × 100
PD=population density= Mean number of citrus nematode present in the positive samples in each governorate.

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الملخص العربـــــى

حصر للنيماتودا المتطفلة والفطريات الممرضة المرتبطة بأشجار الموالح فى مصر

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أثبتت دراسات حصر الأجناس النيماتودية المصاحبة لجذور أشجار الموالح و التى أجريت فى خمس محافظات من الجمهورية وجود احدى و عشرون جنسا نيماتوديا كانت مصاحبة لجذور أشجار الموالح. و كانت أكثرالأجنـــاس وجـــودا هو جنس نيماتودا الموالح (تيلينكيولس سيميبينيترانس) بنسبة ٩٩% من مجموع العينات المختبرة بمتوسط ٥٣٦٥يرقة/٢٥٠جم تربة. كما أوضحت الدراسة وجود ثلاثة عشر جنساً نيماتودياً مصاحبة لجذور أشجار الموالح. كما أوضحت عينات التربة المختبرة من محافظة البحيرة وجود أعلى نسبة من الأجناس المتحصل عليها و هى ١٧ جنسا نيماتوديا.كما أثبتت دراسة علاقة الطعوم بالشدة المرضية للأجناس المختبرة أن الطعم كليمانتين ماندرين و المطعم على أصل نارنج كان أكثر الطعوم حساسية للاصابة بالنيماتودا حيث وجد بنسبة ٢,٢% من العينات المختبرة بكثافة١٤٠١يرقة/٢٥٠جم تربة يليه البرتقال بسره بنسبة ٧٥,٢% بكثافة ٦٢٢٤يرقة/٢٥٠جم تربة.و قد سجل استخدام الطعم برتقال بسرة أعلى نسبة من الأجناس النيماتودية وكان عددها ١٧ جنسا و ذلك فى محافظة البحيرة يليها محافظة كفر الشيخ ١٢ ثم المنوفية عشرة أجناس.

أوضحت دراسة علاقة قوام التربة بأعداد اليرقات النيماتودية المصاحبة لجذور أشجار الموالح إحتواء التربة اللومية الطينية الرملية و الطينية الرملية و اللومية الطينية السلتيةو الرملية على أعلى عدد من يرقات نيماتودا الموالح بينما إحتوت التربة الطينية و الرملية اللومية على أقل عددمن اليرقات النيماتودية.

كما أوضحت دراسة حصر الأجناس الفطرية المصاحبة لجذور أشجار الموالح أن فطر فيوزاريوم سولانى كان أكثر الفطريات شيوعا حيث وجد بنسبة ٨٦,٤% من العينات المختبرة .بينما كان فطر فيتوفثورا سيتروفثورا أقل الفطريات شيوعا.