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Plant-Parasitic Nematodes Associated with Certain Fruit Trees and Vegetable Crops in the North Eastern Egypt

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ABSTRACT

This survey was conducted in four locations of Ismailia governorate in the north eastern part of Egypt during the 2020-2022 seasons to investigate occurrence, population density and distribution of plant-parasitic nematodes associated with various crops. A total of 440 soil samples, were collected from infested fruit trees viz. grape (*Vitis vinifera* L.), guava (*Psidium guajava* L.), olive (*Olea europaea* L) and pomegranate (*Punica granatum* L.) and vegetable crops viz. green bean (*Phaseolus vulgaris* L.), pea (*Pisum sativum* L.), strawberry (*Fragaria ananassa*) and tomato (*Solanum lycopersicum* L.). Ten plant parasitic nematodes genera have been identified. The root- knot nematodes, *Meloidogyne* had the highest mean density over any nematode taxa in the tested samples. The highest density values of *Meloidogyne* were recorded on olive, grape and guava trees that amounted to 800, 640 and 200 juveniles/250 g soil. respectively. However, the maximum densities for *Tylenchorhynchus* were 160, 180, 120, and 120 juveniles /250 g soil for grape, guava, olive, and pomegranate, respectively. The maximum density values for *Helicotylenchus* were 180, 120 and 40 juveniles /250 g soil for guava, olive and pomegranate, respectively. Other genera were found at low density i.e. *Criconemoides*, *Trichodorus*, *Xiphinema*, *Longidorus*, and *Pratylenchus*. The root knot nematodes have been nearly found in all vegetable crops. The maximum densities for *Meloidogyne* were 600, 200, 240 and 720 juveniles /250 g soil for green bean, pea, strawberry and tomato, respectively. Generally obtained data indicated that plant-parasitic nematodes are considered as a serious threat to such plant species under variable agronomic and climatic conditions that need to further developed and implemented of control measures.

Keywords: Survey; plant-parasitic nematodes; fruits; vegetables; north eastern; Egypt.

INTRODUCTION

Plant-parasitic nematodes are widely regarded as one of the most serious biotic dangers to crops globally. Nematodes, either alone or in conjunction with other soil microbes, harmed nearly every component of the plant, including roots, stems, leaves, fruits, and seeds. Nematode infection can lead to secondary infection with fungal and bacterial pathogens and even transmission of plant-infecting viruses that negatively affect the yield quantity (Tileubayeva et al., 2021). The most typical indications of nematode infection are reduced root development, symptoms that resemble symptoms of mineral deficiencies, and perpetual plant mortality. Stunted growth, decreased yield, and leaf chlorosis is some of the indirect and relatively minor indications of nematode infection in terrestrial plants (Tileubayeva et al., 2021). Plant-parasitic nematodes cause an annual loss of 12.3% of 40 major crops on a global scale. Annually, losses are higher in developing countries (14.6%) than in developed countries which recorded (8.8%). Economic crop yield losses due to plant parasitic nematodes in key crops have been

estimated at US$173 billion (Kumar et al., 2020). Vegetable crops are usually among the most susceptible to nematodes. The decline in vegetable yield can sometimes reach about 29% in susceptible genotypes (Sabeh et al., 2019). Due to the intensive cultivation of vegetable crops, there is a greater likelihood of an increase in the population of nematodes, as well as minor pests that will become large pests. There are several vegetable-associated nematode species, that's causing significant yield losses, while others, cause minor injury (Anupriya et al., 2019). Most harmful plant-parasitic nematodes are the root-knot nematodes, *Meloidogyne* spp., which are generally responsible for vegetable crop losses worldwide (Almohithef et al., 2018). The destruction of such nematodes is one of the most important limiting factors in fruit tress production. Fruit trees which are inherently perennial, harbor and encourage nematode population build-up, resulting in reduced yields and poor fruit quality such as citrus, banana, grapevine, pineapple, olive, pomegranate and papaya (Bahadur, 2021). Parasitic nematode infections are not often noticed by farmers and are sometimes mistaken for water or nutrient deficits. In comparison to foliar diseases and insect pests, plant parasitic nematodes have fewer monitoring systems and practical management strategies. Moreover, scientific evidence related to nematode problems in agriculture is still limited and lacking.

Therefore, the current study aimed to determine the frequency and occurrence of plant-parasitic nematodes associated with vegetable crops and fruit trees in Ismailia governorate to identify the predominant nematode genera and species under such conditions.

MATERIALS AND METHODS

Samples Collection

A nematological survey was conducted at four different locations in Ismailia governorate, located at the north eastern of Egypt, viz. Abu Suwer, Ismailia, Kasaseen and Tell El Kebir-during 31 August 2020 to 31 July 2022 seasons on four species of fruit trees (grape, guava, olive and pomegranate) as well as four species of vegetable crops (green bean, pea, strawberry and tomato) were surveyed as shown in Fig.(1) and Table (1).

Figure 1: Map of Ismailia governorate from which four locations were surveyed

Table 1: A list of the examined host plants in Ismailia governorate.

Type of host plant	Common name	Scientific name	Family name
Fruit trees	Grape	*Vitis vinifera* L.	Vitaceae
	Guava	*Psidium guajava* L.	Myrtaceae
	Olive	*Olea europaea* L.	Oleaceae
	Pomegranate	*Punica granatum* L.	Lythraceae
Vegetable crops	Green Bean	*Phaseolus vulgaris* L.	Leguminosae
	Pea	*Pisum sativum* L.	Fabaceae
	Strawberry	*Fragaria ananassa* Duchesne	Rosaceae
	Tomato	*Solanum lycopersicum* L.	Solanaceae

A total of 440 soil and root samples were collected from the rhizosphere of such plants up to 15 cm from the base of the plants and at a depth of 15 cm in vegetable crops. For fruit trees, samples were taken 20-50 cm from the base of the plants and to a depth of 25-30 cm, according to the plant species and its age. A conventional soil probe (2.5 cm diameter, 30 cm depth) was used for collecting soil samples. Root and soil samples were placed in plastic bags, labelled and recorded. Nematodes were extracted from a composite 250 g soil sample using Cobb's wet-sieving and centrifugal sucrose flotation techniques (Ayoub, 1980). Nematodes were fixed in a 2% hot formaldehyde solution, assigned to genus, and counted through a binocular stereomicroscope. Specimens were fixed in 5% formaldehyde solution, processed to anhydrous glycerol (Seinhorst, 1959) and examined under a compound microscope for species identification. Population Density (P.D.) and Frequency of Occurrence % (F.O. %) were calculated as follows: Population Density (P.D.) = Total numbers of individuals of each genus per 250g soil/ Number of samples containing this genus. Frequency of Occurrence % (F.O. %) = Number of samples containing a certain genus/ total number of collecting samples x 100.

Nematode Identification

Root samples were thoroughly washed using tap water, then *Meloidogyne* females were isolated from the galled root tissue and then identified depending on the perennial patterns of adult females. Roots with lesions were chopped into small pieces and placed in water for 36-48 hours. Host plant species were chosen because they were either abundant, economically important, showed some disease symptoms (poor growth, yellowing, etc.), or had not been previously comprehensive examined for nematode infestation. The identification of nematodes was based on adult and juveniles morphology (Sher, 1966; Dasgupta et al., 1969; Golden, 1971; Esser, 1973; Tarjan, 1973; Brezeski, 1974; Mai and Lyon, 1975; Raski, 1975; Taylor and Sasser, 1978; Germani and Baldwin, 1985; Handoo and Golden; 1989; Handoo, 2000).

RESULTS

Plant-parasitic nematodes genera associated with certain fruit trees

Obtained results revealed that ten of plant-parasitic nematodes genera were associated with different fruit trees within surveyed localities of Ismailia governorate. Data presented in Tables (2 & 3) showed the population density (P.D.) and frequency of

occurrence percentage (F.O.%) of plant parasitic nematodes genera (*Criconemoides, Helicotyleuchus, Longidorus, Meloidogyne, Pratylenchus, Rotylenchulus, Trichodorus, Tylenchorhynchus, Tylenchulus* and *Xiphinema*). Root-knot nematode, *Meloidogyne* was the most prevalent genus in grape and guava assays as stated in 94.5and 61.6% of all studied soil samples, respectively (Table 2). The second most common genus was the stunt nematode, *Tylenchorhynchus*, which was found in 10.25 and 37.5% of grape and guava trees soil samples, respectively.

Table 2: Population density (P.D.) and frequency of occurrence (F.O.%) of nematode genera associated with grape and guava fruit trees in studied locations of Ismailia governorate**.**

Host plant	Location	Nematode genera	P.D.	F.O. (%)
Grape	Abu Suwer	*Helicotyleuchus*	80	8
		Meloidogyne	580	86
		Rotylenchulus	40	5
		Trichodorus	20	2
		Tylenchorhynchus	100	10
		Xiphinema	60	12
	Ismailia	*Helicotyleuchus*	40	6
		Longidorus	40	3
		Meloidogyne	640	100
		Rotylenchulus	60	4
		Tylenchorhynchus	120	12
		Xiphinema	120	14
	Kasaseen	*Meloidogyne*	600	100
		Pratylenchus	20	2
		Rotylenchulus	80	10
		Tylenchorhynchus	160	10
		Tylenchulus	80	4
		Xiphinema	60	5
	Tell El Kebir	*Helicotyleuchus*	60	7
		Longidorus	40	4
		Meloidogyne	520	92
		Rotylenchulus	80	4
		Tylenchorhynchus	60	9
		Xiphinema	100	10
Guava	Abu Suwer	*Meloidogyne*	200	55
		Xiphinema	40	5
		Tylenchorhynchus	180	50
		Helicotyleuchus	180	24
	Ismailia	*Meloidogyne*	120	60
		Tylenchorhynchus	140	50
	Kasaseen	*Helicotyleuchus*	140	20
		Pratylenchus	20	3
		Tylenchorhynchus	180	25
	Tell El Kebir	*Helicotyleuchus*	160	19
		Meloidogyne	200	70
		Trichodorus	40	2
		Tylenchorhynchus	120	25

Population Density (P.D.) = Total numbers of individuals of each genus per 250g soil/ Number of samples containing this genus. Frequency of Occurrence % (F.O. %) = Number of samples containing a certain genus/ total number of collecting samples X 100.

Other frequently detected genera were *Rotylenchulus* and *Xiphinema* both occurred between 5.75 and 10.25% of the grape samples. While the commonly recorded-spiral

nematode, *Helicotylenchus* was present in 21% of guava in all soil samples (Table 2). In the current survey, *Meloidogyne incognita*, *Rotylenchulus reniformis* and *Tylenchulus semipenetrans* were identified. During the current survey of olive and pomegranate orchards, frequency of occurrence of nematode genera in collecting soil samples, revealed that *Meloidogyne* was the most common genus which occurring in 91.5 and 35.5% of all studied soil samples, respectively (Table 3). The second most common genus was *Tylenchorhynchus*, which was revealed in 13.3% of all studied pomegranate soil samples. Consistent with the mean population densities of nematode genera found in soil samples from different surveyed fruit trees, *Meloidogyne* achieved the highest mean densities of any nematode taxa recording 800, 640 and 200 juveniles/250 g soil on olive, vine and guava trees, respectively (Tables 2 & 3) and Fig. (2).

Table 3: Population density (P.D.) and frequency of occurrence (F.O.%) of nematode genera associated with olive and pomegranate fruit trees in studied locations of Ismailia governorate.

Host plant	Location	Nematode genera	P.D.	F.O. (%)
Olive	Abu Suwer	*Criconemoides*	80	10
		Longidorus	40	2
		Meloidogyne	680	96
	Ismailia	*Helicotyleuchus*	80	14
		Meloidogyne	600	90
		Trichodorus	20	2
	Kasaseen	*Helicotyleuchus*	120	16
		Meloidogyne	800	88
		Tylenchorhynchus	120	8
		Xiphinema	20	3
	Tell El Kebir	*Meloidogyne*	720	92
		Tylenchorhynchus	120	15
Pomegranate	Abu Suwer	*Meloidogyne*	200	45
		Tylenchorhynchus	120	17
	Ismailia	*Meloidogyne*	140	42
		Tylenchorhynchus	80	5
	Kasaseen	*Helicotyleuchus*	40	2
		Longidorus	60	4
		Meloidogyne	240	40
	Tell El Kebir	*Meloidogyne*	100	15
		Tylenchorhynchus	120	18

Population Density (P.D.) = Total numbers of individuals of each genus per 250g soil/ Number of samples containing this genus. Frequency of Occurrence % (F.O. %) = Number of samples containing a certain genus/ total number of collecting samples X 100.

The maximum densities for *Tylenchorhynchus* were 160, 180, 120, and 120 nematodes/250 g soil for grape, guava, olive, and pomegranate, respectively. The maximum densities for *Helicotylenchus* were 180, 120, and 40 nematodes/250 g soil for guava, olive, and pomegranate, respectively. Other genera found at low density were *Criconemoides, Trichodorus, Xiphinema, Longidorus*, and *Pratylenchus*.

Plant-parasitic nematodes genera associated with vegetable crops

Obtained data in Tables (4&5) revealed the presence of seven plant parasitic nematodes genera associated with various studied vegetable crops in tested localities of Ismailia governorate. Population density (P.D.) and frequency of occurrence (F.O.%) of *Criconemoides, Helicotyleuchus, Meloidogyne, Rotylenchulus, Trichodorus,*

Tylenchorhynchus and *Xiphinema* were recorded. *Meloidogyne* species representing *M. incognita*, *M. javanica* and *M. arenaria* were found associated with 84, 12 and 4% of surveyed vegetable crops, respectively. Nematode genera frequency in soil samples collected from green bean, pea, strawberry and tomato vegetable crops revealed that *Meloidogyne* was the most common genus with values 89.0, 69.0, 59.0 and 93.0% of total soil samples of such crops, respectively.

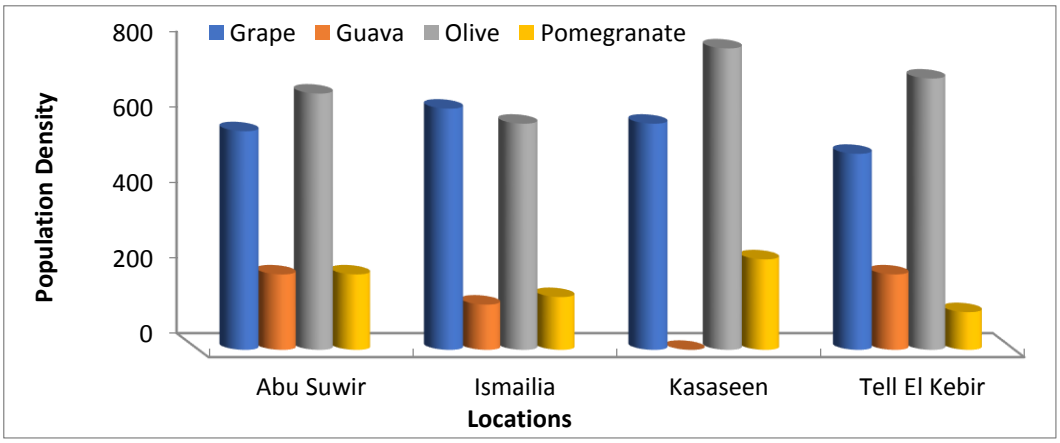

Figure 2: Population densities of *Meloidogyne* in fruit trees grown in four locations of Ismailia governorate.

Table 4: Population density (P.D.) and frequency of occurrence (F.O.%) of nematode genera associated with green bean and pea vegetable crops in the studied locations of Ismailia governorate.

Host plant	Location	Nematode genera	P.D.	F.O. (%)
Green bean	Abu Suwer	*Meloidogyne*	420	89
		Rotylenchulus	60	12
		Tylenchorhynchus	120	24
	Ismailia	*Meloidogyne*	400	85
		Rotylenchulus	80	11
		Xiphinema	20	2
	Kasaseen	*Criconemoides*	60	5
		Meloidogyne	500	90
		Tylenchorhynchus	200	20
	Tell El Kebir	*Criconemoides*	60	3
		Meloidogyne	600	92
		Tylenchorhynchus	100	8
Pea	Abu Suwer	*Meloidogyne*	120	72
		Rotylenchulus	40	3
	Ismailia	*Meloidogyne*	200	80
		Tylenchorhynchus	120	55
	Kasaseen	*Helicotyleuchus*	20	1
		Meloidogyne	100	65
		Xiphinema	20	2
	Tell El Kebir	*Meloidogyne*	120	60
		Tylenchorhynchus	80	45
		Xiphinema	20	2

Population Density (P.D.) = Total numbers of individuals of each genus per 250g soil/ Number of samples containing this genus. Frequency of Occurrence % (F.O. %) = Number of samples containing a certain genus/ total number of collecting samples X 100.

Table 5: Population density and frequency of occurrence of nematode genera associated with tomato and strawberry vegetable plants in the studied locations of Ismailia governorate.

Host plant	Location	Nematode genera	P.D.	F.O. (%)
Strawberry	Abu Suwer	*Criconemoides*	40	3
		Meloidogyne	220	87
		Pratylenchus	40	3
		Xiphinema	20	2
	Ismailia	*Longidorus*	40	4
		Meloidogyne	200	60
		Tylenchorhynchus	100	14
	Kasaseen	*Meloidogyne*	240	14
		Xiphinema	60	5
	Tell El Kebir	*Meloidogyne*	180	75
		Tylenchorhynchus	60	12
Tomato	Abu Suwer	*Longidorus*	60	4
		Meloidogyne	620	90
		Tylenchorhynchus	100	11
		Xiphinema	20	2
	Ismailia	*Meloidogyne*	720	100
		Tylenchorhynchus	160	14
	Kasaseen	*Helicotyleuchus*	40	3
		Meloidogyne	660	100
		Trichodorus	20	2
	Tell El Kebir	*Criconemoides*	60	3
		Meloidogyne	580	85
		Pratylenchus	20	2

Population Density (P.D.) = Total numbers of individuals of each genus per 250g soil/ Number of samples containing this genus. Frequency of Occurrence % (F.O. %) = Number of samples containing a certain genus/ total number of collecting samples X 100

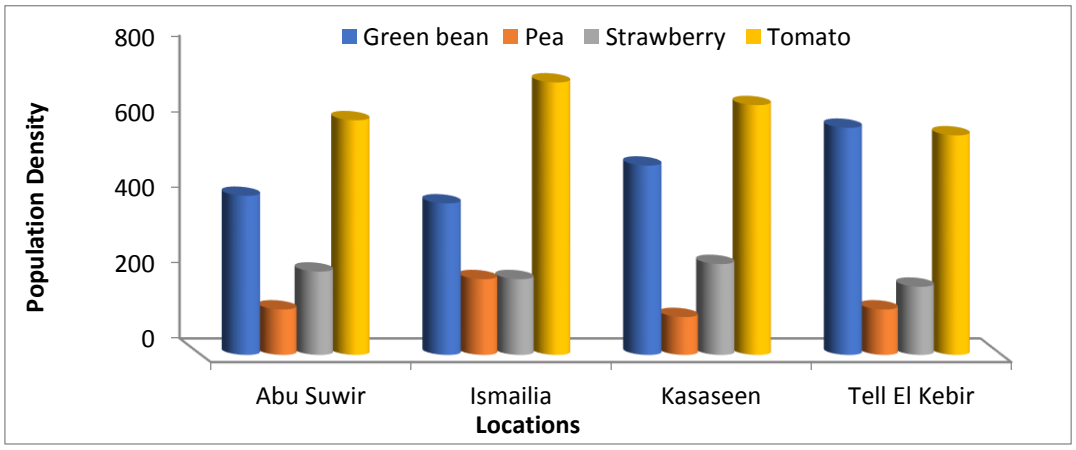

Figure 3: Population densities of *Meloidogyne* in vegetable crops grown in four locations of Ismailia governorate

Nematode genera frequency in soil samples collected from green bean, pea, strawberry and tomato vegetable crops revealed that *Meloidogyne* was the most common genus with values 89.0, 69.0, 59.0 and 93.0% of total soil samples of such crops, respectively. Other frequently recorded genera were *Rotylenchulus* and *Tylenchorhynchus* and, both of which occurred between 11.5 and 17.3% of the green bean cultivated soil samples. Root-knot nematodes have been found in the root and soil of all studied vegetable crops.

The maximum densities for *Meloidogyne* were 600, 200, 240 and 720 nematodes/ 250 g soil for green bean, pea, strawberry and tomato, respectively (Fig.3). *Tylenchorhynchus* was found in all soil samples, the maximum densities were 200, 120, 100, and 160 individuals/250g soil for green bean, pea, strawberry and tomato, respectively.

DISCUSSION

Agricultural practices under mixed-crop systems are resulted in increased biodiversity and activity of soil organisms that may affect plant-parasitic nematodes (Freckman, 1988; Griffiths et al., 1994). Plant parasitic nematodes genera commonly found in the governorate of Ismailia were stated to be *Meloidogyne, Tylenchorhynchus, Rolylenchulus, Helicotylenchus* and *Pratylenchus*, which were found mainly under Egyptian agriculture having same climatic and environmental factors, such as sandy soil (Ibrahim et al., 2000). *Meloidogyne*, was the most abundant genus of pathogenic nematodes as it is common in most Egyptian soils (Abou El-Naga et al., 1985; Korayem et al., 2011). Differences in the distribution of nematodes are not clearly known (Norton, 1978), our study concludes that the samples collected from these areas revealed the distribution of pathogenic nematodes under the same environmental conditions prevailing there and the host cultivated plant may be partly responsible for these distribution and population differences of some nematode species.

Results showed that among plant-parasitic nematodes infecting grapes, the root-knot nematode, *Meloidogyne* spp., was more common in 94.5% of all studied soil samples, followed by *Xiphinema* and *Tylenchorhynchus*. Mohamed et al. (2017) found similar results in the governorates of Giza, Qualiabia and Behaira. Data also showed that the highest plant-parasitic nematodes associated with guava and olive fruit trees were the root-knot nematode, *Meloidogyne* which was detected in 61.6 and 91.5% of all studued soil samples, respectively, followed by the stunt nematode, *Tylenchorhynchus* spp., and the spiral nematode, *Helicotyleuchus* sp. These results are confirmed by Ibrahim and Handoo (2016) in Alexandria governorate.

Root-knot nematode, *Meloidogyne* was a widespread genus in pomegranate fruit trees soil samples collected from four localities in Ismailia governorate. These results agreed with those obtained by Korayem et al. (2014) under North Sinai conditions. In the meantime, results show that root knot nematodes, *Meloidogyne* spp., are widespread in the studied areas in green beans, tomatoes and peas vegetable crops. These results are consistent with Ibrahim and Mokbel (2009) in respect to Alexandria and El-Behera governorates. *Meloidogyne* spp., are a global threat to crop production, causing about 5% crop loss worldwide, which may vary from crop to crop and from country to country (Taylor and Sasser, 1978; Sasser, 1980). The level of damage depends on the nematode population density, the prevailing environmental conditions as well as the type of host plant (Korayem et al., 2014). Despite the occurrence, *Meloidogyne* was associated with over 85% of all surveyed vegetable crops and particularly dense in surveyed samples, specially tomatoes (Adam et al., 2013). Tomato grown in greenhouses was a preferred as a host plant to *M. incognita*, which could reach mean densities of up to 800,640 juveniles/250 g of soil in olives and grapes. While it is 720 juveniles/250g of tomato potting soil (Adam et al., 2013).). Under conventional vegetable production system, *Meloidogyne* has reportedly recorded population densities of 233 juveniles/100 g soil (Haroon and Osman, 2003; Bakr et al., 2011).

The current survey results showed that RKNs are widespread in the studied vegetable growing areas of Ismailia governorate, while the incidence varied between different locations. Such difference may be related to soil type (Starr et al., 1993; Anwar

et al., 2007). Typically, arable areas with soils with a higher proportion of sand had higher populations of *M. incognita* compared to fields with low sand content (Robbins et al., 1989; Wrather et al., 1992; Lawrence et al., 1997; Ogbuji, 2004). This may also be a result of a different circumstances, including variations in plants and their developmental stages, specific agricultural techniques that support natural control, or the application of compost and some biological control agents. This might also be attributed to variations in temperature, as well as, soil moisture.

Slightly lower densities of *Rotylenchulus* were found in grapes and green beans with densities mean values of 50 and 70 nematodes/250 g soil, compared to 429 and 20 individuals/100 g soil (Adam et al., 2013) in El-Sharkia governorate. Virus-borne nematodes (*Longidorus* spp., *Trichodorus* spp. and *Xiphinema* spp.) were found at lower densities in the fruit and vegetable crops examined samples, whether vegetable or fruit samples. These nematodes are known to transmit some plant viruses that cause some viral diseases in crops in Europe (Brown et al., 2004), but their economic importance as vectors of plant viruses under Egyptian conditions requires further studies.

CONCLUSION

The results of the review study provide important information on genera and species of plant-parasitic nematodes correlated with different crops and trees grown in Egypt. Also, the possible potential nematode pests crop damage and economic impacts. This can help in the development of appropriate necessary different plans to control these nematode pests through environmentally friendly methods that result in an increase in economic agricultural productivity.

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الملخص العربى

النيماتودا المتطفلة المصاحبة لبعض اشجار الفاكهة ومحاصيل الخضر فى شمال شرق جمهورية مصر العربية

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**قسم الانتاج النباتى – كلية العلوم الزراعية البيئية – جامعة العريش

اجرى حصر فى ٤ مواقع مختلفة من محافظة الاسماعيلية – شمال شرق جمهورية مصر العربية وذلك خلال موسمى ٢٠٢١/٢٠٢٠ و ٢٠٢٢/٢٠٢١ لدراسة التواجد والكثافة العددية والتوزيع للنيماتودا المتطفلة على النبات والمصاحبة لبعض اشجارالفاكهة ومحاصيل الخضر . ولقد اشتمل الحصر على ٤٤٠ عينة تربة مأخوذة من المجال الجذرى لاربعة انواع من اشجار الفاكهة وهى العنب والجوافة والزيتون والرمان واربعة من محاصيل الخضر وهى الفاصوليا الخضراء والبسلة والفراولة والطماطم. وأظهرت النتائج ان هناك عشرة اجناس من النيماتودا المتطفلة على النبات حيث سجلت نيماتودا تعق

د الجذور كاعلى كثافة عددية مقارنة بالاجناس الاخرى .وبالنسبة لتوزيع تلك النيماتودا المتطفلة على النبات فى المحاصيل تحت الدراسة فقد اوضحت النتائج ان اعلى متوسطات الكثافة العددية كانت ٨٠٠ ، ٦٤٠، ٢٠٠ يرقة /٢٥٠ جرام تربة وذلك لنيماتودا تعقد الجذور على اشجار الزيتون ثم العنب ثم الجوافة على التوالى .بينما كانت سجلت متوسطات الكثافة العددية لنيماتودا الموالح **حيث سجلت** ١٦٠،١٨٠،١٢٠ و ٢٥٠/١٢٠ جرام تربة وذلك فى العنب والجوافة والزيتون والرمان على التوالى.هذا بالاضافة الى تواجد اجناس اخرى من النيماتودا المتطفلة على النبات ولكن بكثافة عددية منخفضة . كما اوضحت نتائج الدراسة تواجد نيماتودا تعقد الجذور فى محاصيل الخضر تحت الدراسة حيث سجلت الكثافة العددية لتلك النيماتودا ٧٢٠،٢٤٠،٢٠٠،٦٠٠ يرقة /٢٥٠ جرام تربة فى الفاصوليا الخضراء والبسلة والفراولة والطماطم على التوالى .وقد تبين من الدراسة ان نيماتودا تعقد الجذور تسبب تهديدا خطيرا للمحاصيل تحت الدراسة وذلك تحت الظرووف المزرعية والمناخية المختلفة ومن هنا يتضح اهمية استخدام الطرق المناسبة للتحكم فى تقليل ضرر تلك النيماتودا على المحاصيل المختلفة .