

Survey of Plant-Parasitic Nematode Genera Associated with Potato Plants at Dakahlia Governorate, Egypt

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Abstract

A survey was conducted to determine the types, frequency and population of plant parasitic nematode genera associated with the soils and roots from the rhizosphere of potato cultivars i.e. Spunta, Cilany, Cara and Shamcy, during the growing season of 2016. Three hundred composite soil samples were randomly collected where a modified Baermann technique for plant parasitic nematode extraction was applied. Potato crop grown within four counties belong to Dakahlia governorate i.e. Manzala, Gamalia, meet salsyel and Kordy revealed the presence of ten nematode genera i.e. *Criconeimoides*, *Helicotylenchus*, *Heterodera*, *longidorus*, *Meloidogyne*, *Pratylenchus*, *Rotylenchulus*, *Tylenchoryhnchus*, *Xiphinema* and *Tylenchus* that were found to be the most prevalent nematode genera in the surveyed counties. The two soil types, sandy loam and loamy soils have the highest number of nematode genera (10) with total occurrence of 126 and 166 times, respectively. *Meloidogyne* (J2s) was considered as the widely distributed pest of the potato crop as it was associated with four potato cultivars within all survey regions.

Keywords: Cultivars; Nematode; Parasitic; Soil type; Survey

Introduction

Potato (*Solanum tuberosum* L.) is one of the foremost common and necessary food crops. It contains a wealth of health edges that embrace their ability to boost digestion, scale back steroid alcohol levels, boost heart health, shield from polyps, impede cancer, manage polygenic disease, strengthen the system, scale back signs of aging, guard the skin, increase circulation, scale back vital sign, maintain fluid balance and decrease sleep disorder.

The world's potato production is about 365,365,367 tons in 2012 [1]. Egypt potato production was 3,643,217 tons with more than 637,434 tons exported at a charge of US\$250,654 million in 2010 (FAO, <http://www.fao.org>). Phytonematode caused considerable injure and losses to different agricultural crops all over the world [2]. A significant number of these species causes infectious diseases of potato, vector potato viruses or make potato plants more susceptible to diseases caused by pathogens. From this point, nematological survey is needed in providing information on the prospect and degree of crop losses due to nematode infection. Survey studies of such pest play an important role in update economic thresholds for economic crops such as potato infection. Pest survey is a vital element of plant quarantine, that afford early detection of pest attack, so that their further spread is limited, and timely measures may use for their suppression. The generated data about the status of plant parasitic nematode genera associated with potato crop in Dakahlia governorate, Egypt has not accessible or updated in the literature. Therefore, the present survey was carried-out to determine the plant parasitic nematode genera associated with four important areas of potato cultivars at Dakahlia governorate.

Materials and Methods

Three hundred complex soil samples were obtained from potato plants within rhizosphere zone, for the period of the growing season of 2016. The soil samples represented four counties belonging to Dakahlia governorate namely Manzala, Gamalia, Meet-Salsyel and Kordy. The obtained soil samples represented four potato cultivars; i.e. Spunta, Cilany, Cara and Shamcy. Samples were obtained by digging the soil to a distance downward of about 15 cm-30 cm from the rhizosphere of the potato plants in a systematic, zigzag-sampling pattern of each field.

Soil samples of about one kg each were positioned in plastic bags and sent directly to the laboratory of nematology at Agricultural Zoology Dept, Fac. of Agric., Mansoura Univ. and reserved in the refrigerator at 4°C awaiting extraction of nematodes. Soil sample textures related with the rhizosphere of potato plants that recognized from four counties at Dakahlia governorate were branded and recorded in Table 1. Nematode extraction from soil samples was done by sieving and modified Baermann method [3]. Identification of nematode genera in frequent aliquots (1 ml/each) in each soil sample was depended on the morphological characters of the nematode forms according to Mai and Lyon [4]. The Hawksely counting slide was used for determining the number of each nematode genus and recorded.

Results and Discussion

All the three hundred complex soil samples were collected from the rhizosphere of potato plants, through the growing season of 2016 (Tables 2-4). Data in Table 2 showed that ten nematode genera belonging to eight families were detected from the rhizosphere of potato plantations at the examined localities. These nematode genera were *Criconeimella* (Criconeimatidae), *Hemicriconeimoides* (Criconeimatidae),

Counties	Sand	Silt	Clay	Textures	No. of soil samples
Gamalia	32	13	55	Sandy loam	70
Kordy	26	15	59	Sandy clay loam	80
Manzala	19	33	48	loamy	80
Meet-Salsyel	21	29	50	loamy	70

Table 1: Mechanical analysis of soil collected from four counties of Dakahlia governorate.

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Nematode genera	Occurrence of nematode genera per 250 g soil within each county of potato cultivars								Total 300	% F.O
	Gamalia n=70	% F.O	Kordy n=80	% F.O	Manz ala n=80	% F.O	Meet salsiel n=70	% F.O		
<i>Criconebella</i>	0	0	1 (13)	1.3	0	0	1 (7)	1.4	2	0.7
<i>Hemicriconeboides</i>	0	0	1 (16)	1.3	1 (45)	1.3	1 (16)	1.4	3	1.0
<i>Heterodera</i>	0	0	3 (46)	3.8	2 (16)	2.5	1 (20)	1.4	6	2.0
<i>Longidorus</i>	13 (50)	18.6	5 (24)	6.3	19 (51.2)	23.8	2 (24)	2.9	39	13.0
<i>Meloidogyne</i>	40 (32.8)	57.1	65 (66)	81.3	37 (56.1)	46.3	35 (44)	50.0	177	59.0
<i>Pratylenchus</i>	33 (99)	47.1	26 (23.1)	32.5	20 (49.7)	25.0	18 (11.1)	25.7	79	26.3
<i>Rotylenchulus</i>	7 (17)	10.0	2 (24.5)	2.5	0	0	4 (18.5)	5.7	13	4.3
<i>Tylenchorynchus</i>	0	0	1 (22)	1.3	0	0	3 (12)	4.3	4	1.3
<i>Xiphinema</i>	11 (16)	15.7	20 (23.7)	25.0	3 (46.1)	3.8	12 (21)	17.1	46	15.3
<i>Tylenchus</i>	6 (21)	8.6	2 (16.5)	2.5	7 (44.1)	8.8	0	0	15	5.0
Total occurrence	110	--	126	---	89	----	77	--	--	--
Nematode genera/county	6	--	10	---	7	-----	9	--	--	--

*n=number of soil samples.

Number before parentheses represented number of samples containing a genus

Number between parentheses represented the average of nematode population density per 250 g. soil.

% F.O (Frequency of occurrence) = (Number of samples containing a genus/number of collected samples) × 100

Table 2: Frequency occurrence and population density of nematode genera linked with potato plantations within four counties at Dakahlia governorate.

Nematode genera	Occurrence and population density of nematode per 250 g. soil in three peanut cultivars.						
	Spunta n=164	Cilany n=50	Cara n=60	Shamcyia n=26	Total n=300	% Frequency occurrence	No. of infested cultivars
<i>Criconebella</i>	0	1 (13)	0	1 (7)	2.0	0.7	2
<i>Hemicriconeboides</i>	0	0	1 (45)	2 (32)	3.0	1.0	2
<i>Heterodera</i>	0	3 (46)	3 (36)	0	6.0	2.0	2
<i>Longidorus</i>	10 (33)	8 (41)	19 (51.2)	2 (24)	39.0	13.0	4
<i>Meloidogyne</i>	55 (30)	60 (70)	28 (58.3)	44 (30)	177.0	59.0	3
<i>Pratylenchus</i>	35 (89)	26 (33.1)	18 (49.7)	18 (11.1)	79.0	26.3	4
<i>Rotylenchulus</i>	5 (15)	4 (26.5)	0	4 (18.5)	13.0	4.3	3
<i>Tylenchorynchus</i>	0	1 (22)	1 (6)	2 (6)	4.0	1.3	3
<i>Xiphinema</i>	5 (12)	20 (27.7)	9 (46.1)	12 (21)	46.0	1.5	4
<i>Tylenchus</i>	3 (12)	4 (26.5)	5 (34.1)	3 (9.0)	15.0	5.0	4
Total occurrence	113	127	84	88	---	----	---
Nematode genera per cultivars	6	9	8	9	---	----	---

*n=Number of soil samples.

Number before parentheses represented number of samples containing a genus

Number between parentheses represented the average of nematode population density per 250 g. soil.

% F.O (Frequency of occurrence) = (Number of samples containing a genus / number of collected samples) × 100

Table 3: Frequency occurrence and population density of nematode genera associated with four potato cultivars grown in four counties of Dakahlia governorate.

Nematode genera	Soil type and number of samples (n)			Total n=300	Frequency occurrence %	No. of infested soil types
	Sandy clay loam n=80	Sandy loam n=70	Loamy n=150			
True plant parasites						
<i>Criconebella</i>	0	1 (13)	1 (7)	2	0.7	2
<i>Hemicriconeboides</i>	0	1 (16)	2 (61)	3	1.0	2
<i>Heterodera</i>	0	3 (46)	3 (36)	6	2.0	2
<i>Longidorus</i>	13 (50)	5 (24)	21 (75.2)	39	13.0	3
<i>Meloidogyne</i>	40 (32.8)	65 (66)	72 (100.1)	177	59.0	3
<i>Pratylenchus</i>	33 (99)	26 (23.1)	38 (60.8)	79	26.3	3
<i>Rotylenchulus</i>	7 (17)	2 (24.5)	4 (18.5)	13	4.3	3
<i>Tylenchorynchus</i>	0	1 (22)	3 (12)	4	1.3	2
<i>Xiphinema</i>	11 (16)	20 (23.7)	15 (67.1)	46	1.5	3
<i>Tylenchus</i>	6 (21)	2 (16.5)	7 (44.1)	15	5.0	3
Total	110	126	166	--	---	--
Nematode genera per soil type	6	10	10	---	--	--

*n=Number of soil samples.

Number before parentheses represented number of samples containing a genus

Number between parentheses represented the average of nematode population density per 250 g. soil.

% F.O (Frequency of occurrence) = (Number of samples containing a genus/number of collected samples) × 100

Table 4: Relative infestation of soil types by the various potato plantations associated with plant parasitic nematodes.

Heterodera (Heteroderidae), *Longidorus* (Longidoridae), *Meloidogyne* (Meloidogynidae), *Pratylenchus* (Pratylenchidae), *Rotylenchulus* (Hoplolaimidae), *Tylenchorynchus* (Tylenchorhynchidae), *Xiphinema* (Longidoridae), and *Tylenchus* (Tylenchidae). Soil samples obtained from Gamalia county exposed the attendance of six genera of the phytonematodes. These genera were indentified to be *Longidorus*, *Meloidogyne*, *Pratylenchus*, *Rotylenchulus*, *Xiphinema* and *Tylenchus*. Meanwhile, *Meloidogyne* and *Pratylenchus* genera alike to be the widespread nematode pests as they occurred at the rates of 40 and 33 times with percent incidence of 57.1% and 47.1%, correspondingly. Furthermore, the two nematode genera, *Longidorus* and *Xiphinema* showed modest distributions as they occurred at the rates of 13 and 11 times with percent occurrence of 18.6 and 15.7%, respectively. The genera, *Rotylenchulus* and *Tylenchus* were fewer widespread as they occurred at the rate of 7 and 6 times with percent occurrence of 10.0 and 8.6%, respectively. It was obvious that Kordy county accomplished ten of plant parasitic nematode genera (Table 2). In the meantime, *Meloidogyne*, *Pratylenchus* and *Xiphinema* genera seemed to be the most widespread nematode pests on potato as they occurred at the rates of 65, 26 and 20 times with percent incidence of 81.3%, 32.5% and 25.0%, respectively. The nematode genera *Criconebella*, *Hemicriconebellodes* and *Tylenchorynchus* were less frequent as they occurred at the rate of one time each with percent occurrence of 1.3% each, respectively. Soil samples collected from Manzala county showed the presence of seven of the plant parasites nematode genera. *Meloidogyne*, *Pratylenchus* and *Longidorus* genera seemed to be the mainly prevailing nematode pests on potato as they occurred at the rates of 37, 20 and 19 times with percent occurrence of 46.3%, 25.0% and 23.8%, respectively. Conversely, *Hemicriconebellodes* was less common genera as they occurred at the rate of one time with percent occurrence of 1.3%. Meet-Salseil county revealed the presence of 9 of the plant parasites nematode genera. *Meloidogyne* and *Pratylenchus* genera seemed to be the widespread nematode pests as they occurred at the rates of 35 and 18 times with percent occurrence of 50.0% and 25.7%, respectively. On the other hand, *Criconebella*, *Hemicriconebellodes* and *Heterodera* were less common genera as they occurred at the rate of one time each with percent occurrence of 1.4% everyone, respectively. In general, it was also clear that Kordy county encountered the main number of nematode genera (10) followed by Meet-Salseil (9). Amongst the ten phytonematode genera, *Meloidogyne* seemed to be the major pest as its occurred at rate of 177 times with percent occurrence of 59.0% while, the nematode genera, *Pratylenchus*, *Xiphinema* and *Longidorus* showed modest distribution as they occurred at rates of 79.0, 46 and 39.0 with percent occurrence of 26.3%, 15.3% and 13.0%, respectively. Meanwhile, *Criconebella*, *Hemicriconebellodes*, *Heterodera*, *Rotylenchulus*, *Tylenchorynchus*, and *Tylenchus* had the lowest values of distribution as they occurred at rate of 2, 3, 6, 13, 4 and 15 times with percent occurrence of 0.7%, 1.0%, 2.0%, 4.3%, 1.3% and 5.0% respectively.

Regarding the three hundred composite soil samples that were collected from the rhizosphere of surveyed potato crop, results in Table 3 indicated that the potato plant cvs. Spunta, Cilany, Cara and Shamcya encountered 6, 9, 8 and 9 of nematode genera, respectively. It noticed that *Criconebella*, *Hemicriconebellodes* and *Heterodera* were recorded on only two cultivars. On the other hand, *Longidorus*, *Pratylenchus*, *Xiphinema* and *Tylenchus* were recorded on the four tested potato cultivars. Data also revealed that the highest densities of nematode individuals per 250 g. soil averaged 177.0, 79.0 and 46.0 for the root-knot nematode, *Meloidogyne* spp., the lesion nematode, *Pratylenchus* spp., and the dagger nematode, *Xiphinema* spp., in the rhizosphere of surveyed potato cultivars. In conclusion, *Longidorus*, *Pratylenchus*,

Xiphinema and *Tylenchus* were the most prevailing nematode genera as they found in the rhizosphere of the four surveyed cultivars.

With regard to soil types i.e. sandy clay loam, sandy loam and loamy, the occurrence of plant nematode genera reveal that among the true plant parasitic nematodes, *longidorus*, *Meloidogyne*, *Pratylenchus*, *Rotylenchulus*, *Xiphinema* and *Tylenchus* were abundant in their distribution in the three soil types surveyed as they occurred at rates of 39, 177, 79, 13, 46 and 15 times with percent occurrence of 13.0%, 59.0%, 26.3%, 4.3%, 1.5% and 10.7%, respectively (Table 4). The nematode genera, *Criconebella*, *Hemicriconebellodes*, *Heterodera* and *Tylenchorynchus* showed minor values at the rates of 2, 3, 6 and 4 times with percentage occurrence of 0.7%, 1.0%, 2.0% and 1.3%, respectively. Moreover, it was also evident that the two soil types, sandy loam and loamy soils encountered the highest number of true nematode genera that assigned ten for each soil type with total occurrence of 126 and 166 times, respectively. The soil type, sandy clay loam encountered the lowest number of nematode genera (6) with total occurrence of 110 times as the nematode genera i.e. *Criconebella*, *Hemicriconebellodes*, *Heterodera* and *Tylenchorynchus* were absent in this soil type (Table 4).

Conclusion

The present study reported the presence of ten of plant parasitic nematodes genera belonging to 8 families, found associated with the rhizosphere of potato plantations at four counties, Manzala, Gamalia, Meet Salsyel and Kordy within Dakahlia governorate. Among the ten phytonematode genera, *Meloidogyne* and *Pratylenchus* genera seemed to be the prevailing nematode pests as they occurred at the rates of 40 and 33 times with percent occurrence of 57.1% and 47.1%, respectively. Moreover, the nematode genera, *Longidorus* and *Xiphinema* showed modest distributions as they occurred at the rates of 13 and 11 times with percent occurrence of 18.6% and 15.7%, respectively, whereas, the genera, *Rotylenchulus* and *Tylenchus* were less frequent as they occurred at the rate of 7 and 6 times with percent occurrence of 10.0% and 8.6%, respectively. The root-knot nematodes, *Meloidogyne* spp. were recovered from the rhizosphere of the three surveyed potato cultivars with highest population densities amounted to 177.0 individuals/ 250 g. soils. Furthermore, *Meloidogyne* spp. were detected in all tested soil types. This is predictable since plant parasitic nematodes are commonly favored light soils [5]. Results showed that the differences between population densities and the frequency of occurrence of the root-knot nematodes, *Meloidogyne* spp., existed in the examined locations. Plant parasitic nematodes population density are affected by different factors such as site, soil type, irrigation system, soil humidity, cultured crops and agricultural practices as assured by Anwar et al. [6], who revealed that the root-knot nematode species were the foremost nematode genera of vegetable crops such as tomato, okra, potatoes etc. Mousa [7] and Ibrahim et al. [8] stated that the uppermost distribution and infection of *Meloidogyne* spp., occurred in sandy soil particularly in the new reclaimed area and also relies on the soil temperature and type of crop. The diverse in the soil types may play a significant responsibility in altering the surveyed nematodes genera [9]. In general, the essence of this survey would facilitate in choosing planting systems in the elected locations and evade planting the susceptible hosts, as well as should use in design of nematode management programs.

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