

Ecological Studies on Plant Parasitic Nematodes Associated with Certain Fruit Trees in North Sinai Governorate

Eid, S. A. H.*, M. E. Mahrous***, M. N. El-Basiony**, A. A. El-Sebaei*

* Environment Protection Dept., Environ. Agric. Sci. Collage, Suez Canal Univ., El-Arish, Egypt.

** Plant Production & Its Protection Dept., Environ. Agric. Sci. Collage, Suez Canal Univ. El-Arish, Egypt.

*** Plant Protection Dept., Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

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Abstract : Eight genera of plant parasitic nematodes were found in association with peach trees grown in nine localities of North Sinai Governorate. These genera were *Criconemoides*, *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Tylenchorhynchus* and *Xiphinema*. The most frequently genera in the total collected samples were *Meloidogyne* spp., *Longidorus* spp., *Helicotylenchus* spp. and *Tylenchorhynchus* spp. Their percentages of frequency occurrence were 65.29, 63.52, 52.35 and 42.94% respectively. While the highest values of population density were detected the genera *Helicotylenchus*, *Meloidogyne*, *Tylenchorhynchus* and *Hoplolaimus*. Their population density per 250 gm soil were 95, 84, 78 and 46 nematodes, respectively. The genera *Helicotylenchus*, *Meloidogyne* and *Tylenchorhynchus* were found with high prominence values. On the other hand, ten genera of stylet bearing nematodes were detected in the rhizosphere of olive trees grown in five localities at three counties in North Sinai Governorate. These genera were *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Meloidogyne*, *Rotylenchulus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchulus*, *Tylenchus* and *Xiphinema*. The most frequently genera in the total collected samples were *Meloidogyne*, *Tylenchorhynchus*, *Rotylenchulus* and *Trichodorus*. Their percentages of frequency occurrence were 82, 60, 58 and 52% respectively. Regarding population density of the identified genera, it was found that *Meloidogyne* spp. occupied the first rank (247 juveniles per 250 gm soil) followed descendingly by *Helicotylenchus* (144), *Tylenchorhynchus* (131) and *Rotylenchulus* (117). The highest numbers of *Meloidogyne* were detected in Wadi Al-Arish (Al-Arish county) and Al-Kharouba (El-Sheikh Zewied county), while the lowest numbers were found in Al-Zawaraa (El-Sheikh Zewied county) and Al-Husseinat (Rafah county). Also nine genera of nematodes were found in association with citrus trees grown in Sahel El-Bahr and Canada localities (Rafah county). These genera were *Criconemoides*, *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchulus*, *Tylenchus* and *Xiphinema*. The most frequently genera in the total collected samples were *Tylenchulus*, *Tylenchorhynchus*, *Tylenchus*, *Helicotylenchus* and *Hoplolaimus*. Their percentages of frequency occurrence were 72.12, 70.19, 64.43, 59.62 and 60.58% respectively. Regarding population density of the identified genera, it was found that, *Tylenchulus semipenetrans* gained the highest value (437 individuals per 250 gm soil). This nematode can be considered as the dangerous pest attacking citrus orchards in North Sinai Governorate.

Keywords: Citrus; olive; peach; plant; parasitic; nematodes; plant Nematology; Nematology

INTRODUCTION

Peach, olive and citrus are the most important economically growing fruit crops in North Sinai Governorate, Egypt. According to statistical annual reports of the ministry of Agriculture in North Sinai Governorate, the total cultivated areas of the above mentioned crops in 2003 were 59048, 13393 and 1880 Feddan, respectively. The majority of these orchards were concentrated in Rafah, Al-Arish and El-Sheikh Zewied counties representing 98.4, 66.9 and 94.6% of the total grown areas of peach, olive and citrus in North Sinai, respectively. On the other hand, plant parasitic nematodes are the most serious problems of perennial trees. Since, in annual crops the problem can be solved in the next season by using resistant cultivars or rotation of non-host crops. Accordingly, this study was designed to throw light on frequency occurrence, population density and prominence value of plant parasitic nematodes associated with peach, olive and citrus orchards in North Sinai Governorate.

MATERIALS AND METHODS

Sampling procedures : A total of 374 soil and root samples were randomly collected from the rhizosphere

of peach *Prunus persica* L. (170 samples), olive *Olea europaea* L. (100 samples), and *Citrus* spp. (104 samples). Sampling sites were selected to represent the major growing areas of each fruit crop in different localities of North Sinai Governorate.

Samples of peach were collected from nine localities in El-Sheikh Zewied and Rafah counties. These localities were Al-Zawaraa, Al-Zaheer, El-Sheikh Zewied El-Balad, Al-Mouqataa and Al-Shalaq (El-Sheikh Zewied county) and Sheebana, Al-Masoura, AlWafaq and Al-Matala (Rafah county). On the other hand, olive samples were obtained from five localities in Al-Arish, El-Sheikh Zewied and Rafah counties. These localities were Wadi Al-Arish (Al-Arish county), Al-Kharouba, Al-Zawaraa and Al-Jura (El-Sheikh Zewied county) and Al-Husseinat (Rafah county). However, samples of citrus were collected from Sahel Al-Bahar and Canada localities (Rafah county) which were cultivated with Valencia orange, *Citrus sinensis* and Clementine, *Citrus reticulata*, respectively.

Samples were obtained by digging the soil to a depth of about 15-30 cm in the rhizosphere of growing trees. Each sample was made up of several subsamples which were mixed together to form composite sample of about 1 kg. records were made at time of sampling as

locality, tree age, cultivar, soil type and general condition of the trees. All samples were kept in polyethylene bags to prevent drying and sent directly to laboratory for nematode extraction.

Nematode extraction:

Each soil sample was carefully mixed and an aliquot sample of 250 gm was processed for nematode extraction according to the method described by Goodey (1963). The samples were soaked in tap water for 10 minutes. About 5 Litres of water were added to the soil in a plastic pan and the mixture was agitated by hand. After few seconds the suspension was poured into 65-mesh sieve, while the passing suspension was collected into another clean plastic pan.

Materials caught on the 65-mesh sieve were discarded, while the collected suspension was poured into a 380-mesh sieve. The materials remained on that fine sieve were washed by a gentle stream of tap water into 100 ml beaker. The remainder of the soil sample was sieved again as mentioned before. The resulting suspension containing nematodes was transferred on a special soft tissue paper fitted on a plastic screen support. This plastic screen was placed in a deep plate containing water to a level merely touch the base of the plastic support. After 48 hours, water in the plate containing nematodes were transferred to 100 ml beaker. After 10 minutes all nematodes were settled in the bottom of the beaker and suspension was decanted to about 20 ml.

Counting and identification of nematodes:

Replicated aliquots, each of 1 ml were pipetted into Hawksely counting slide and nematodes were examined by the aid of a research microscope under 100x magnification.

Nematode identification to generic level was based on morphology of adult and juvenile forms according to May & Lyon (1975), Siddiqi (1986). For each genus, population density per 250 gm soil, percentage of frequency occurrence and prominence value were calculated according to Norton (1978) as follows:

$$\text{Population density (PD)} = \frac{\text{Total number of individuals of a genus}}{\text{Number of samples containing this genus}}$$

$$\text{Frequency occurrence (FO)} = \frac{\text{Number of samples containing a genus}}{\text{Number of collected samples}}$$

$$\text{Prominence value (PV)} = \text{Population density} \sqrt{\text{Frequency occurrence}}$$

Identification of *Meloidogyne* species:

To study the distribution of *Meloidogyne* species on peach and olive at the surveyed counties, galled roots were collected from different localities and adult females were isolated from roots. Species of *Meloidogyne* were identified on the basis of perineal pattern system of mature females according to Whitehead (1968), Esser *et al.* (1976) and Eisenback *et al.* (1981). Perineal patterns were prepared by teasing selected galled roots in plastic petri dish with tap water to remove adult females. The cuticle of each female was ruptured near the neck and the body tissues were pushed out. The cuticle was placed in a drop of 45% lactic acid on small plastic petri-dish. After several hours the

posterior end was cut by using a sharp razor blade and trimmed down to the area showing pattern. The perineal patterns were cleaned in another drop of 45% lactic acid and transferred to a drop of glycerin in a clean microscopic slide. Slides were gently covered with a clean cover slip and sealed with finger nail polish. Preparations were examined microscopically by using oil immersion lens (Taylor and Netcher, 1974).

RESULTS AND DISCUSSION

The obtained results which recorded in Table (1) revealed that eight genera of plant parasitic nematodes were found in association with peach trees. These genera were *Criconemoides*, *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Tylenchorhynchus* and *Xiphinema*. The most frequently genera in the total collected samples were the root-knot nematodes *Meloidogyne* spp., the needle nematodes *Longidorus* spp., the spiral nematodes *Helicotylenchus* spp. and the stunt nematodes *Tylenchorhynchus* spp. Their percentages of frequency occurrence were 65.29, 63.52, 52.35 and 42.94%, respectively.

Concerning population density of the identified genera in the total collected samples, it was found that the highest values were detected with the genera *Helicotylenchus*, *Meloidogyne*, *Tylenchorhynchus* and *Hoplolaimus*. Their population density per 250 gm soil were 94.91, 84.19, 78 and 45.73% respectively. The identified genera varied in their frequency of occurrence and population density from one locality to another. For instances, members of *Meloidogyne* spp. were more distributed in Al-zaheer, El-Sheikh Zewied El-Balad and Al-Matala recording the same value of percent frequency of occurrence (75%), while the lowest value (41.66%) was detected in Al-Mouqataa village. Whereas, the highest population density were detected in Al-Wafaq and Al-Zawaraa localities with values of 104.28 and 96.25 second stage juveniles per 250gm soil respectively, compared to lowest numbers found in Sheebana and Al-Masoura localities with values of 70.58 and 70.76 respectively. The relationship of both parameters i.e., frequency of occurrence and population density was calculated as prominence value according to Norton (1978), it could be concluded that the genera *Helicotylenchus*, *Meloidogyne* and *Tylenchorhynchus* were found with a relatively high prominence value.

These results are in harmony with those mentioned by Melton *et al.*, 1985; Ding *et al.* 1995; Sultan *et al.*, 1997 and Park *et al.*, 1999.

Data in Table (2) indicated that ten genera of stilet bearing nematodes were detected in the rhizosphere of olive trees. These genera were *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Meloidogyne*, *Rotylenchulus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchulus* and *Xiphinema*. The most frequently genera in the total collected samples were *Meloidogyne*, *Tylenchorhynchus*, *Rotylenchulus* and *Trichodorus*. Their percentages of frequency occurrence were 82, 60, 58 and 52% respectively. Regarding population density of the identified genera in the total collected samples, it is evident that *Meloidogyne* spp. occupied the first rank (247.04 infective juveniles per 250 gm soil), followed

Table (1) : Percentage frequency of occurrence (%FO), population density (PD) and prominence value (PV) of plant parasitic nematodes associated with peach trees in North Sinai Governorate.

Nematode genera	El-Sheikh Zewied county					Rafah county				Total Collected Samples n = 170
	Al-Zawaraa n = 26	Al-Zaheer n = 20	El-Sheikh Zewied n = 12	Al-Shalaq n = 10	Al-Mouqataa n = 12	Sheebana n = 30	Al-Masoura n = 20	Al-Wafaq n = 20	Al-Matala n = 20	
<i>Criconemoides</i>										
% FO	23.07	25	8.33	10	33.33	10	10	10	15	15.88
PD	20.83	25.2	19.99	19.98	19.25	20.67	39.5	23.5	19.33	23.14
PV	10.05	12.6	5.77	6.32	11.11	6.54	12.49	7.43	7.49	9.22
<i>Helicotylenchus</i>										
% FO	53.84	50	41.66	60	58.33	46.66	50	45	70	52.35
PD	94.28	82.8	77.2	73.33	97.14	77.14	88.5	106.66	157.14	94.91
PV	69.17	58.55	49.83	56.80	74.19	52.69	62.58	71.55	131.47	68.67
<i>Hoplolaimus</i>										
% FO	30.76	25	25	40	33.33	20	15	30	45	28.23
PD	32.5	37.2	39.33	34.5	34.75	56.66	46.66	63.33	66.66	45.73
PV	18.02	18.6	19.67	21.82	20.06	25.34	18.07	34.68	44.71	24.30
<i>Longidorus</i>										
% FO	65.38	75	66.66	50	66.66	60	55	55	75	63.52
PD	24.70	28.33	24.38	28.8	25.88	25.55	27.27	34.54	48.2	29.74
PV	19.97	24.53	19.91	20.36	21.13	19.79	20.22	25.61	41.74	23.70
<i>Meloidogyne*</i>										
% FO	61.53	75	75	70	41.66	56.66	65	70	75	65.29
PD	96.25	86.66	71.11	82.85	88.6	70.58	70.76	104.28	86.66	84.19
PV	75.50	75.05	61.58	69.31	57.19	53.13	57.05	87.24	75.05	68.03
<i>Paratylenchus</i>										
% FO	23.07	10	8.33	0	16.66	13.33	20	0	20	13.53
PD	19.83	21.5	59.97	0	21.5	20.75	24.25	0	25.75	21.51
PV	9.52	6.80	17.31	0	8.78	7.58	10.84	0	11.52	7.91
<i>Tylenchorhynchus</i>										
% FO	57.69	40	25	40	16.66	53.33	50	20	55	42.94
PD	56.33	64.88	82.33	65.75	98.5	77.5	86.3	84.25	89.09	78.33
PV	42.78	41.03	41.17	41.58	40.20	56.59	61.02	37.68	66.07	51.33
<i>Xiphinema</i>										
% FO	23.07	15	16.66	20	16.66	16.66	10	0	0	12.94
PD	23.33	26.66	22.50	22.5	22.5	28.4	21.5	0	0	18.60
PV	11.20	10.32	9.18	10.06	9.18	11.59	6.80	0	0	6.69

* Larval forms .

n = Number of collected samples .

Table (2) : Percentage frequency of occurrence (%FO), population density (PD) and prominence value (PV) of plant parasitic nematodes associated with olive trees in North Sinai Governorate.

Nematode genera	Al-Arish county			El-Sheikh Zewied county									Rafah county			Total collected samples		
	Wadi Al-Arish n= 50			Al-Kharouba n=10			Al-Zawaraa n=10			Al-Jura n=10			Al-Husseinat n = 20			n = 100		
	% FO	PD	PV	% FO	PD	PV	% FO	PD	PV	% FO	PD	PV	% FO	PD	PV	% FO	PD	PV
<i>Helicotylenchus</i>	48	273.17	189.26	20	61.5	27.50	40	75.75	47.91	30	160.67	88.00	65	150.77	121.55	46	144.37	97.92
<i>Hoplolaimus</i>	40	48.4	30.61	10	40	12.65	30	27.67	15.16	40	45.75	28.93	30	39.83	21.82	34	40.33	23.52
<i>Longidorus</i>	26	55.38	28.24	20	41.5	18.56	20	21.5	9.62	0	0	0	50	81.2	57.42	27	39.92	20.74
<i>Meloidogyne</i> *	74	340.11	292.57	90	257.78	244.55	80	192.5	172.18	90	231.11	219.25	95	213.68	208.27	82	247.04	223.70
<i>Rotylenchulus</i> *	60	328.2	254.22	50	31.6	22.34	70	42.86	35.86	30	86.67	47.47	65	93.85	75.66	58	116.64	88.83
<i>Trichodorus</i>	52	43.08	31.07	60	66.67	51.64	40	81.25	51.39	70	65.71	54.98	45	62.22	41.74	52	63.79	45.99
<i>Tylenchorhynchus</i>	60	232.80	180.33	40	56.25	35.58	60	77.50	60.03	50	124.8	88.25	75	162.67	140.88	60	130.80	101.32
<i>Tylenchulus</i> *	36	220.39	132.23	70	34.29	28.69	50	52.8	37.34	60	90.17	69.85	45	99.78	66.93	45	99.49	66.74
<i>Tylenchus</i>	36	75.22	45.13	50	62	43.84	50	44.6	31.54	70	88.57	74.10	80	86.25	77.14	51	71.33	50.94
<i>Xiphinema</i>	26	33.85	17.26	20	32.5	14.53	30	26.67	14.61	20	21.5	9.62	50	50.4	35.64	30	32.98	18.06

* Larval forms .

n = Number of collected samples .

by *Helicotylenchus* (144.37), *Tylenchorhynchus* (130.80) and *Rotylenchulus* (116.64).

It is obvious that species of *Meloidogyne* occurred in a relatively high percentage of frequency occurrence. The minimum value (74%) was detected in Wadi Al-Arish, (Al-Arish county), while the maximum value (95%) was found in Al-Husseinat (Rafah county). On the other hand, the highest numbers of this genus were determined in Wadi Al-Arish (Al-Arish county) and Al-Kharouba (El-Sheikh Zewied county) 340.11 and 257.78 juveniles per 250 gm soil, respectively while the lowest numbers were found in Al-Zawaraa (El-Sheikh Zewied county) and Al-Husseinat (Rafah county) 192.5 and 213.68 juveniles per 250 gm soil, respectively.

The obtained results are in harmony with those reported by many authors (Lamberti & Vovlas, 1993 and Nico *et al.*, 2002). On the other hand, Osman & Hendy, 1989; Mahrous, 1991; Ghoneim *et al.*, 1996; Kassab & Abd-El-Kader, 1996 and Abd-El-Moneim, 2001 came to the same conclusion.

Nine genera of stylet bearing nematodes were identified in the rhizosphere of citrus trees. These genera were *Criconemoides*, *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchulus*, *Tylenchus* and *Xiphinema* as presented in Table (3). With

respect to nematode distribution in the total collected samples, it is clear that the genera *Tylenchulus*, *Tylenchorhynchus*, *Helicotylenchus* and *Hoplolaimus* were most frequently occurred. They appeared in 72.12%, 70.19%, 64.43% and 60.58% of the total collected samples. Regarding population density of the identified genera, it is obvious that the citrus nematode *Tylenchulus semipenetrans* gained the highest value of population density (436.83 individuals per 250 gm soil) followed descendingly by *Tylenchus* (145.18), *Helicotylenchus* (136.94) and *Tylenchorhynchus* (132.51). It is obvious that percent frequency of occurrence of all identified genera were higher on Valencia as compared to those on Clementine. For instances, percent frequency of occurrence for *Tylenchulus*, *Tylenchorhynchus* and *Helicotylenchus* on Valencia were 76.92%, 76.92% and 69.23% respectively, while the parallel values on Clementine were 67.31%, 63.46% and 59.62% respectively. On the other hand values of population density for *Tylenchulus*, *Tylenchorhynchus*, *Hoplolaimus* and *Xiphinema* were higher on Valencia as compared to those on Clementine. The obtained results agree to certain extent with those reported by (Lopez & Azofeifa, 1985; Dareker *et al.*, 1990; Ferguson *et al.*, 1996 and Crozzoli *et al.*, 1998).

Table (3): Percentage frequency of occurrence (%FO), population density (PD) and prominence value (PV) of plant parasitic nematodes associated with citrus trees in North Sinai Governorate.

Nematode genera	Valencia orange n = 52			Clementine orange n = 52			Total collected samples n = 104		
	%FO	PD	PV	%FO	PD	PV	%FO	PD	PV
<i>Criconemoides</i>	42.31	55.91	36.37	34.62	66.67	39.23	38.47	61.29	38.01
<i>Helicotylenchus</i>	69.23	131.94	109.78	59.62	141.94	109.60	64.43	136.94	109.92
<i>Hoplolaimus</i>	67.31	77.14	63.29	53.85	70.71	51.89	60.58	73.93	57.54
<i>Longidorus</i>	48.08	64.8	44.93	40.38	71.43	45.39	44.23	68.12	45.30
<i>Trichodorus</i>	55.77	75.07	56.06	40.38	104.76	66.57	48.08	89.92	62.35
<i>Tylenchorhynchus</i>	76.92	153.2	134.36	63.46	111.82	89.08	70.19	132.51	111.02
<i>Tylenchulus</i> *	76.92	445.88	391.05	67.31	427.78	350.96	72.12	436.83	370.97
<i>Tylenchus</i>	67.31	130.17	106.79	51.92	160.19	115.43	59.62	145.18	112.10
<i>Xiphinema</i>	44.23	69.57	46.27	38.46	66.2	41.05	41.35	67.89	43.66

* Larval forms.

n = Number of collected samples.

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دراسات بيئية على النيماتودا المتطفلة على النبات والتي تصيب أشجار الفاكهة في محافظة شمال سيناء

سامية عواد حسن عيد* - مصطفى النبوي محروس*** - محمد نجيب البسيوني** - على عبد الخالق السباعي*

* قسم حماية البيئة- كلية العلوم الزراعية البيئية- جامعة قناة السويس- العريش- مصر
** قسم الإنتاج النباتي ووقايته- كلية العلوم الزراعية البيئية- جامعة قناة السويس- العريش- مصر
*** قسم وقاية النبات- كلية الزراعة- جامعة الزقازيق- الزقازيق- مصر

تم حصر ثمانية أجناس من النيماتودا المتطفلة على النبات مرتبطة بأشجار الخوخ وهي النيماتودا الحلقيّة و النيماتودا الحلزونية و النيماتودا الرمحية و النيماتودا الإبرية و نيماتودا تعقد الجذور و النيماتودا الدبوسية و نيماتودا التقزم و النيماتودا الخنجرية. وكانت نيماتودا تعقد الجذور و النيماتودا الإبرية و النيماتودا الحلزونية و نيماتودا التقزم هي أكثر الأجناس تواجداً في العينات الكلية وبلغت نسب التواجد لها ٦٥,٢٩٪ ، ٦٣,٥٢٪ ، ٥٢,٣٥٪ ، ٤٢,٩٤٪ على التوالي. وقد اتضح أن أعلى قيم للكثافة العددية كانت مع النيماتودا الحلزونية و نيماتودا تعقد الجذور و نيماتودا التقزم و النيماتودا الرمحية حيث بلغت ٧٨ ، ٤٦ ، ٩٥ ، ٨٤ ، ٧٨ ، ٤٦ نيماتودا في ٢٥٠ جرام تربة على التوالي.

من ناحية أخرى تم حصر عشرة أجناس من النيماتودا في منطقة المجموع الجذري لأشجار الزيتون ، وهذه الأجناس هي النيماتودا الحلزونية و النيماتودا الرمحية و النيماتودا الإبرية و نيماتودا تعقد الجذور و النيماتودا الكلوية و نيماتودا تقصف الجذور و نيماتودا التقزم و نيماتودا الموالح و الجنس *Tylenchus* و النيماتودا الخنجرية. وكانت نيماتودا تعقد الجذور و نيماتودا التقزم و النيماتودا الكلوية و نيماتودا التقصف هي الأكثر شيوعاً في العينات التي تم جمعها حيث كانت النسب المئوية لتكرار تواجدها هي ٨٢٪ ، ٦٠٪ ، ٥٨٪ ، ٥٢٪ على التوالي. وبالنظر إلى الكثافة العددية للأجناس التي تم تعريفها فقد وجد أن نيماتودا تعقد الجذور قد جاءت في المرتبة الأولى (٢٤٧ يرقة لكل ٢٥٠ جرام تربة) تلتها تنازليا النيماتودا الحلزونية (١٤٤) ثم نيماتودا التقزم (١٣١) ثم النيماتودا الكلوية (١١٧) ، وقد سجل أعلى تعداد من نيماتودا تعقد الجذور في وادي العريش (مركز العريش) وقرية الخروبة (مركز الشيخ زويد) بينما وجدت أقل الأعداد في قرية الزوارعة (مركز الشيخ زويد) وقرية الحسينات (رفح).

أيضاً اتضح وجود تسعة أجناس من النيماتودا التي تتميز بوجود الرمح في أشجار الموالح في منطقتي ساحل البحر وكندا بمركز رفح، وهذه الأجناس هي : النيماتودا الحلقيّة و النيماتودا الحلزونية و النيماتودا الرمحية و النيماتودا الإبرية و نيماتودا تقصف الجذور و نيماتودا التقزم و نيماتودا الموالح و الجنس *Tylenchus* و النيماتودا الخنجرية. وبالنظر إلى توزيع النيماتودا في العدد الكلي للعينات اتضح أن نيماتودا الموالح و نيماتودا التقزم و الجنس *Tylenchus* و النيماتودا الحلزونية و النيماتودا الرمحية كانت الأكثر تكراراً حيث ظهرت في ٧٢,١٢٪ ، ٧٠,١٩٪ ، ٦٤,٤٣٪ ، ٥٩,٦٢٪ ، ٦٠,٥٨٪ من العدد الكلي للعينات على التوالي. وبالنظر إلى الكثافة العددية لهذه الأجناس فقد وجد أن نيماتودا الموالح حصلت على القيمة الأعلى (٤٣٧ فرد لكل ٢٥٠ جرام تربة). وعموماً يمكن القول أن هذه النيماتودا تعتبر آفة تهاجم بسنتين الموالح في محافظة شمال سيناء.