

SURVEY OF PLANT PARASITIC NEMATODE GENERA ASSOCIATED WITH SOME PLANT CROPS IN SANA'A AREA, YEMEN ARAB REPUBLIC.*

El-Sherif , A.G.

Department of Agricultural Zoology, Faculty of Agric., Mansoura Univ., Mansoura, Egypt.

ABSTRACT

A survey of plant parasitic nematodes associated with the rhizosphere of fruit orchards of grape cvs. Asmei, Razqui and Black; plum, apple, peach and pear, vegetable crops i.e. potato, cucumber and garlic; ornamental plant, gladiolus plus one garlic bulb was carried out. Twenty soil samples plus one sample of garlic bulb were collected from five localities: Karada, El-Force, Bani-mater, El-Klees and Azban Farm. Description of climatic conditions of the studied area of Sana'a district, the capital of Yemen was included. Twelve nematode genera were recorded. Based on their frequency of occurrence, these genera can be arranged in descending order as follows: *Pratylenchus*, *Ditylenchus*, *Longidorus*, *Tylenchorhynchus*, *Meloidogyne* (Larvae), *Xiphinema*, *Helicotylenchus*, *Trichodorus*, *Criconemoides*; *Paratylenchus*; *Aphelenchus* and *Aphelenchoides*.

Grape cv. Asemi and Plum appeared to encounter the highest number of nematode genera (9 gen. each), followed by garlic plant (8 gen.), apple (7 gen.) potato (7 gen.), barely (7 gen.), grape cv. Black and Razqui (4 gen. each), peach (4 gen.), pear (4 gen.), cucumber (3 gen.) and gladiolus (2 gen.). Relations between frequency of occurrence of nematode genera, soil type and plant species are discussed.

Keywords: Survey, Soil fauna, Nematode genera, Plant species, fruits orchards, vegetables, ornamental, field crops.

INTRODUCTION

The annual agricultural statistics book for the year 1995 in Yemen Arab Republic revealed that the cultivated area in hectares and the agricultural productions in tons for the studies area i.e. Sana'a district, the capital of Yemen A.R. was 21338, 7848 and 195934 for fruits, vegetables and cereals, with average productions 132961, 159777 and 1998990, respectively.

As for the surveyed plant crops, the cultivated area for potatoes, grapes, plum, peach apple, barely and garlic was 2709, 16997, 3330, 404, 38, 29535 and 2787 ha. with average productions 121210, 6360, 2267, 310, 2966 and 30047 tons, respectively.

It is clear that Sana'a district is characterized by its rich plant life associated with varied soil fauna. Our knowledge of plant parasitic nematodes is far from complete, especially those associated with the plant crops. Few reports of plant parasitic nematodes in Yemen A.R. were published. Most of these reports reveal only the status of root-knot nematodes, *Meloidogyne* spp. in Yemen (Sikora, 1982a and Ibrahim, 1987). Sikora (1982b) said that *Meloidogyne* spp. occurred in 29.5% and 21.2% of samples from Yemen in

* This work was undertaken in 1997 during my sabbatical leave as a visiting Professor to Plant Protection Dept., Fac. of Agric., Sana'a Univ., Yemen A.R.

1977 and 1978, respectively. He also pointed out that of the 110 fields sampled in Yemen, 33 contained *Meloidogyne* spp. *M. incognita* being predominant (60% of samples), Major crop plants attacked by *Meloidogyne* spp. Moreover, Ibrahim (1987) also summarized the status of *Meloidogyne* spp. in countries of region VII of the International *Meloidogyne* project including Cyprus, Egypt, Greece, Iran, Iraq, Italy, Jordan, Portugal, Sudan, Turkey and Yemen and concluded that *Meloidogyne* spp. are the most important nematode pathogens on many agricultural crops in most countries of the Middle East and Mediterranean Region.

The present work deals with the survey of plant parasitic nematode genera associated with some plant crops cultivated in the area of Sana'a district, the capital of Yemen Arab Republic.

Climate of Sana'a district

With respect to its climate, spring is the rainy season in the studied area. Rainfall is characterized by its irregularities and variability, both in space and time. Mean annual rainfall is 116948 mm (of 18 years). This is associated with the sharp rise of 2183 m above sea level and average relative humidity 49.8% daily. The soil is relatively deep and fine textured, the ground surface is covered by boulders and rocks of different sizes. The wadis are the richest of all the studied area (Year book, 1995).

MATERIALS AND METHODS

The present work was carried out during the period from May to June 1997. Twenty soil samples (1 kg each) were collected from the rhizosphere of different plant species i.e. fruit orchards of grape *Vitis vinifera* cv. Asmei, Razqui and Black, plum, *Prunus domestica*, apple, *Malus* sp., peach, *Prunus persica* and pear, *Pyrus communis*; vegetable crops, i.e. potato, *Solanum tuberosum*, cucumber, *Cucurbita* sp. and garlic, *Allium sativum*; ornamental plants, i.e. gladiolus, *Gladiolus hybrida*; and field crop, barely, *Hordeum vulgare* in five localities in Sana'a district the capital of Republic of Yemen: Karada, El-Forice, Bani-Mater, El-Klees and Azban farm.

The separation of nematodes from soil was accomplished by a modification of Christie and Perry's method (1951). Direct sieving through 60 and 325 mesh screens was employed. Resulting suspension was cleared by means of the Baermann-pan technique for separating active nematodes from soil particles. In addition to one sample of garlic bulb which was cut into pieces, incubated in jar filled with tap water 24, 48 and 72 hrs and collected for nematode extraction through 325 mesh screen for counting (Goodey, 1957). Identification of nematode genera in repeated aliquots (1 ml each) followed the key of Mai and Lyon (1960) as well as Goodey (1963). The hawksey counting slide under x 100 magnification was used for determining each nematode genus.

RESULTS AND DISCUSSION

All the twenty soil samples plus one sample of garlic bulb collected from five localities of Sana'a district contained plant nematodes (Tables 1, 2 and 3). Data showed that the true plant parasitic nematode genera, *Pratylenchus*, *Ditylenchus*, and *Longidorus* seemed to be the major pests as they occurred at rates of 12, 11 and 9 times with percentage of 57.1%, 52.3% and 42.3%, respectively (Table 1). Nematodes of genera, *Tylenchorhynchus*, *Xiphinema*, *Meloidogyne* (Larvae) and *Helicotylenchus* showed moderate distribution as they occurred at rates of 8, 7, 7 and 6 times with percentage levels of 38.0%, 33.3%, 33.3% and 28.5%, respectively. While *Trichodorus*, *Criconemoides* and *Paratylenchus* showed the lowest values of distribution as they occurred at rates of 4, 2 and 2 with percentages levels of 19.0%, 9.5% and 9.5%, respectively.

Table 1: Prevalence of plant parasitic nematodes in the different localities of Sana'a area, Republic of Yemen.

| Nematode genera | Localities | | | | | | Frequency occurrence % | No. of infested localities |
|-----------------------------------|----------------|------------------|-------------------|------------------|--------------------|--------------|------------------------|----------------------------|
| | Karada (n = 3) | El-Force (n = 2) | Bani-Mater (n=10) | El-Klees (n = 3) | Azban Farm (n = 3) | Total (n=21) | | |
| True Plant Parasites: | | | | | | | | |
| <i>Criconemoides</i> | 0 | 0 | 1 | 1 | 0 | 2 | 9.5 | 2 |
| <i>Ditylenchus</i> | 0 | 0 | 9 | 2 | 0 | 11 | 52.3 | 2 |
| <i>Helicotylenchus</i> | 0 | 1 | 3 | 2 | 0 | 6 | 28.5 | 3 |
| <i>Longidorus</i> | 3 | 2 | 2 | 1 | 1 | 9 | 42.3 | 5 |
| <i>Meloidogyne</i> (Larvae) | 0 | 2 | 2 | 1 | 3 | 7 | 33.3 | 4 |
| <i>Paratylenchus</i> | 1 | 0 | 0 | 1 | 0 | 2 | 9.5 | 2 |
| <i>Pratylenchus</i> | 0 | 1 | 9 | 2 | 0 | 12 | 57.1 | 3 |
| <i>Trichodorus</i> | 0 | 0 | 3 | 1 | 0 | 4 | 19.0 | 2 |
| <i>Tylenchorhynchus</i> | 0 | 0 | 7 | 1 | 0 | 8 | 38.0 | 2 |
| <i>Xiphinema</i> | 2 | 1 | 2 | 2 | - | 7 | 33.3 | 4 |
| Suspected Plant Parasites: | | | | | | | | |
| <i>Aphelenchoides</i> | 2 | 0 | 0 | 0 | 0 | 2 | 9.5 | 1 |
| <i>Aphelenchus</i> | 3 | 0 | 6 | 1 | 2 | 12 | 57.1 | 4 |
| Nematode genera/locality | 5 | 5 | 10 | 11 | 3 | | | |

The suspected plant parasitic nematode genera, *Aphelenchoides* and *Aphelenchus* proved to be of major importance as they occurred at rates of almost equal to that of the true plant nematodes recorded.

Various localities of the surveyed area within Sana'a district showed differences in the frequency occurrence of plant nematode genera (Table 1). These frequency occurrences of nematode genera were 11, 10, 5, 5 and 3 for the following studied localities: El-Klees, Bani-Mater, El-Force, Karada and Azban, respectively. Apparently, El-Klees locality appeared to yield the highest number of nematode genera recorded, despite its few number of soil samples investigated. This may be attributed to its rich plantation. It is

obvious that *Longidorus* was the only dominant nematode genus recovered from the five localities studied, then *Meloidogyne* (Larvae), *Xiphinema* and *Aphelenchus* which were also recovered from four localities, *Helicotylenchus* and *Pratylenchus* were present in the soil of three localities, whereas, *Criconemoides*, *Ditylenchus*, *Trichodorus* and *Tylenchorhynchus* were only detected from the soil of two localities, namely, Bani-Mater and El-Klees. On the other hand, *Aphelenchoides* was the only nematode genus restricted to one locality viz, Karada (Table 1).

Concerning the ten soil samples collected from the rhizosphere of surveyed fruit orchards viz. grape cv. Asemi, Razqui, and black, pear, apple, plum and peach, data showed that the true plant parasitic nematode genera, *Longidorus*, *Pratylenchus*, *Ditylenchus*, *Meloidogyne* (Larvae) and *Xiphinema* appeared to be the principle pests as they occurred at rates of 5, 5, 4, 4 and 4 times with percentage of 50.0%, 50.0%, 40.0%, 40.0% and 40.0% respectively (Table 2). Nematode of genera, *Helicotylenchus*, *Paratylenchus*, *Tylenchorhynchus*, *Criconemoides* and *Trichodorus* showed moderate distribution as they occurred at rates of 3, 2, 2, 1 and 1 times with percentage levels of 30.0%, 20.0%, 20.0%, 10.0% and 10.0%, respectively.

The suspected plant parasitic nematode genera, *Aphelenchus* and *Aphelenchoides* showed almost an equal level of frequency occurrence as the true plant nematode genera recorded (Table 2). It is obvious that plum and grape cv. Asemi orchards appeared to encounter the highest number of plant nematode genera, while apple orchard ranked the second in the number of genera recorded. Grape cv. Razqui and Black, and peach orchards ranked next to them in their number of nematode genera.

The highest densities of nematode individuals per 250 gm soil of the rhizosphere of apple orchard averaged 410, 150 and 150; 120, and 120; 80, and 80 individuals for *Pratylenchus*, *Ditylenchus* and *Xiphinema*; *Meloidogyne* (Larvae) and *Tylenchorhynchus*; *Longidorus* and *Aphelenchus*, respectively (Table 2). While in the case of plum orchard, *Ditylenchus* spp. (300) presented the highest density of nematode individuals per 250 gm of soil the rhizosphere, followed by *Pratylenchus* (180), *Longidorus*, *Tylenchorhynchus*, and *Xiphinema* (150 each) then the genus, *Aphelenchus* (120), whereas *Criconemoides*, *Meloidogyne* (Larvae) and *Paratylenchus* which has 30 individuals each. Moreover, the highest densities of nematode individuals/250 gm soil of grape orchard cv. Asmi averaged 405, 300, 300, 240 and 160 individuals for *Aphelenchoides*, spp., *Longidorus* and *Xiphinema*, spp.; *Paratylenchus* spp. and *Aphelenchus* spp., respectively (Table 2).

Regarding the ten soil samples collected from the rhizosphere of potato, cucumber, garlic, gladiolus, and barely plants and one sample of garlic bulb (crown), the extraction process of these samples revealed the presence of ten plant nematode genera (Table 3). Data showed that the rhizosphere of garlic plant appeared to encounter the highest number of plant nematode genera (8), while barely plant ranked the second in the number of nematode genera (7), followed by potato (7), then cucumber (3), whereas, gladiolus plant (2) showed the lowest number of nematode genera (Table 3).

من الأصل

2

The highest densities of nematode individual per 250 gm soil averaged 4000 and 373 in the garlic bulb (crown) as well as its rhizosphere of soil sample for *Ditylenchus* spp., while average of 500, 360, 290, 200 and 150 individuals were observed for *Aphelenchus* spp. in the rhizosphere of potato, gladiolus, barely, cucumber and garlic plants, respectively. Furthermore, average of 440, 250 and 250 individuals were observed for *Pratylenchus* spp. in the rhizosphere of garlic, potato and barely, respectively. It is worth to note that the nematode genera i.e. *Paratylenchus* and *Aphelenchoides* were not recovered from any of the soil samples of either vegetable or ornamental or field crops surveyed in the present work (Table 3).

With regard to soil types, the occurrence of plant nematode genera revealed that among the true plant parasitic nematode, *Pratylenchus*, *Longidorus*, *Ditylenchus*, *Meloidogyne* (Larvae), *Helicotylenchus* and *Tylenchorhynchus* were abundant in their distribution in the soil types studied as they occurred at rates of 11, 10, 8, 8, 7 and 7 times with percentage of 52.3%, 47.6%, 38.0%, 38.0%, 33.3% and 33.3%, respectively (Table 4). The nematode genus, *Xiphinema* showed moderate distribution as it occurred at a rate of 6 times with a percentage level of 28.5%. The recovered nematode genera which proved to be of minor occurrence included, *Criconemoides*, *Trichodorus*, *Paratylenchus* and *Aphelenchoides*. It is obvious that *Aphelenchus*, *Longidorus* and *Meloidogyne* (Larvae) were commonly found in the four soil types studied, while *Helicotylenchus*, *Pratylenchus*, *Trichodorus* and *Xiphinema* were only recovered from three soil types. *Criconemoides*, *Ditylenchus*, *Paratylenchus* and *Tylenchorhynchus* were detected from two soil types, whereas, *Aphelenchoides* was only restricted to one soil type viz. clayey loam (Table 4).

Table 4: Relative infestation of soil types by plant parasitic nematode genera associated with various plant crops.

| Nematode genera | Soil types and number of soil samples (n) | | | | Total (n=21) | Frequency occurrence % | No. of infest-ed soil types |
|-----------------------------------|---|-----------------|--------------------|---------------|--------------|------------------------|-----------------------------|
| | Clayey Loam (n = 5) | Clayey (n = 10) | Silty loam (n = 3) | Loamy (n = 3) | | | |
| True Plant Parasites: | | | | | | | |
| <i>Criconemoides</i> | 0 | 2 | 1 | 0 | 3 | 14.2 | 2 |
| <i>Ditylenchus</i> | 0 | 6 | 2 | 0 | 8 | 38.0 | 2 |
| <i>Helicotylenchus</i> | 1 | 4 | 2 | 0 | 7 | 33.3 | 3 |
| <i>Longidorus</i> | 5 | 2 | 1 | 2 | 10 | 47.6 | 4 |
| <i>Meloidogyne</i> (Larvae) | 2 | 2 | 1 | 3 | 8 | 38.0 | 4 |
| <i>Paratylenchus</i> | 1 | 0 | 1 | 0 | 2 | 14.2 | 2 |
| <i>Pratylenchus</i> | 1 | 8 | 2 | 0 | 11 | 52.3 | 3 |
| <i>Trichodorus</i> | 0 | 2 | 1 | 0 | 3 | 14.2 | 3 |
| <i>Tylenchorhynchus</i> | 0 | 6 | 1 | 0 | 7 | 33.3 | 2 |
| <i>Xiphinema</i> | 3 | 2 | 1 | 0 | 6 | 28.5 | 3 |
| Suspected Plant Parasites: | | | | | | | |
| <i>Aphelenchoides</i> | 2 | 0 | 0 | 0 | 2 | 9.5 | 1 |
| <i>Aphelenchus</i> | 3 | 6 | 1 | 2 | 12 | 57.1 | 4 |
| Total | 18 | 40 | 14 | 7 | | | |
| Nematode genera/locality | 8 | 10 | 11 | 3 | | | |

It is also evident from Table (4) that among the four soil types surveyed, the silty loam appeared to encounter the highest number of plant nematode genera. While the clayey soil ranked the second in the number of nematode genera recorded, followed by clayey loam soil, whereas loamy soil seemed to encounter the least number of plant nematode genera (Table 4). This is expected since plant parasitic nematodes are generally in favour of light soils (Steiner, 1950).

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حصر لأجناس النيماتودا المصاحبة لنباتات بعض المحاصيل بمنطقة صنعاء (اليمن)*.

أحمد جمال الشريف

قسم الحيوان الزراعي - كلية الزراعة - جامعة المنصورة - مصر.

تتميز منطقة صنعاء عاصمة جمهورية اليمن بكثرة وديانها ووفرة نباتاتها وتنوعها من بساتين الفاكهة والخضروات والزينة ومحاصيل الحقل ولم تتوفر تقارير كاملة على أى دراسة لأجناس النيماتودا المصاحبة لتلك النباتات محل الدراسة.

وتشتمل الدراسة الحالية على حصر لأجناس النيماتودا المصاحبة لخمسة بساتين فاكهة (العنب - الكمثرى - التفاح - البرقوق - الخوخ) ولأربعة محاصيل خضر (البطاطس - الخيار - الثوم) ولنباتات الزينة الجلاديسوك وكذلك الشعير من محاصيل الحقل ذلك من خمسة مواقع منتقاة تبين الوديان الزراعية فى منطقة صنعاء.

وتتضمن الدراسة أيضا وصفا مختصراً لمناخ المنطقة وأنواع تربها الزراعية، وقد تم تسجيل أثنى عشر جنساً من أجناس النيماتودا وهى حسب أهميتها بالنسبة لمعدل تواجدها: *Pratylenchus*, *Ditylenchus*, *Longidorus*, *Tylenchorhynchus*, *Meloidogyne* (Larvae), *Xiphinema*, *Helicotylenchus*, *Trichodorus*, *Criconemoides*, *Paratylenchus*; and *Aphelenchus* and *Aphelenchoides*.

أظهرت الدراسة أن نباتات صنف العنب (عاصمى) والبرقوق يصاحبهما أكبر عدد من أجناس النيماتودا (٩ أجناس) يليها نباتات الثوم فيصاحبها (٨ أجناس)، بينما نباتات التفاح والبطاطس وكذلك الشعير يصاحبها (٧ أجناس) فى حين كان عدد الأجناس لكل من العنب صنف أسود ورازقى والخرخ والكمثرى هو (٤ أجناس)، بينما أقلهم الخيار ثم الجلاديسولاس فيصاحبها (٣ ثم ٢ جنس). تمت مناقشة العلاقة بين معدلات وجود أجناس النيماتودا وعلاقة ذلك بنوع التربة ونوع النبات.

* تم إجراء هذا البحث أثناء تواجد الباحث فى زيارته كأستاذ زائر لقسم وقاية النبات - كلية الزراعة - جامعة صنعاء - اليمن عام ١٩٩٧م.