

PLANT-PARASITIC NEMATODES OF CROPS IN DHOFAR GOVERNORATE SULTANATE OF OMAN

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ABSTRACT

Mani, A., M. S. Al-Hinai, and Z. A. Handoo. 1998. Plant-parasitic nematodes of crops in Dhofar Governorate, Sultanate of Oman. *Nematropica* 28:61-70.

A survey was carried out in August, 1995 in five wilayats of Dhofar Governorate in the Sultanate of Oman. A total of 125 soil samples collected from 12 vegetable, 11 tree fruit and eight field crops were examined, and 17 genera of plant-parasitic nematodes were recorded, of which 8 genera and 11 species are reported for the first time in the region. The economically important nematode genera found were *Helicotylenchus*, *Hoplolaimus*, *Meloidogyne*, *Pratylenchus*, *Radopholus*, *Rotylenchulus*, *Tylenchorhynchus* and *Tylenchulus*. *Helicotylenchus multicinctus*, *Meloidogyne incognita*, *M. javanica*, *Pratylenchus jordanensis*, and *Rotylenchulus reniformis* were the most frequently observed and widely distributed nematode species on several vegetable and tree fruit crops, whereas *Radopholus similis* was often recorded on banana. The other nematode genera recorded were *Aphelenchoides*, *Boleodorus*, *Criconemella*, *Hemicriconemoides*, *Hemicycliophora*, *Longidorus*, *Paratylenchus*, *Psilenchus* and *Xiphinema*.

Key words: banana, Dhofar Governorate, *Helicotylenchus multicinctus*, *Meloidogyne* spp., Oman, *Pratylenchus jordanensis*, *Radopholus similis*, *Rotylenchulus reniformis*, survey.

RESUMEN

Mani, A., M. S. Al-Hinai y Z. A. Handoo. 1998. Nematodos fitoparásitos de cultivos en la Gobernación de Dhofar, Sultanato de Omán. *Nematropica*. 28:61-70.

En agosto de 1995 se realizó un estudio en cinco distritos de la Gobernación de Dhofar en el Sultanato de Omán. Se recolectaron un total de 125 muestras de suelo procedentes de 12 cultivos hortícolas, 11 árboles frutales y 8 cultivos de campo. Diecisiete géneros de nematodos fitoparásitos fueron detectados, de los cuales 8 géneros y 11 especies son citados por primera vez en la región. Los géneros de nematodos económicamente importantes encontrados son *Helicotylenchus*, *Hoplolaimus*, *Meloidogyne*, *Pratylenchus*, *Radopholus*, *Rotylenchulus*, *Tylenchorhynchus* y *Tylenchulus*. Las especies observadas con mayor frecuencia y con una distribución más amplia en varios cultivos hortícolas y árboles frutales fueron *Helicotylenchus multicinctus*, *Meloidogyne incognita*, *M. javanica*, *Pratylenchus jordanensis* y *Rotylenchulus reniformis*. También se detectó con frecuencia a *Radopholus similis* en banano. Otros géneros de nematodos detectados fueron *Aphelenchoides*, *Boleodorus*, *Criconemella*, *Hemicriconemoides*, *Hemicycliophora*, *Longidorus*, *Paratylenchus*, *Psilenchus* y *Xiphinema*.

Palabras claves: banano, Dhofar Governorate, estudio, *Helicotylenchus multicinctus*, *Meloidogyne* spp., Omán, *Pratylenchus jordanensis*, *Radopholus similis*, *Rotylenchulus reniformis*.

INTRODUCTION

Dhofar Governorate (commonly called Salalah) is situated in the southern part of the Sultanate of Oman at a latitude

of N 17°2' and longitude of E 54°5'. The climate is generally moderate throughout the year with a mean monthly temperature of 22.8 to 29°C and relative humidity of 58 to 90%. The annual rainfall of about 112

mm is distributed throughout the year (Anonymous, 1992). The Governorate has a cultivated area of about 2 827 ha, which is 6.9% of the total area under cultivation in the country. The approximate areas under agronomic utilization are the following: perennial grasses 30%, banana 28%, coconut 15%, vegetable crops 13%, papaya 3%, other tree fruit and field crops 4%, and fallow 7% (Anonymous, 1992). Because there is only limited area available for cultivation of annual crops to meet the needs of local markets, vegetables are cultivated in rotation for most of the year. Under these conditions, plant-parasitic nematodes have become one of the constraints in crop production. Waller and Bridge (1978) reported the presence of *Meloidogyne* spp. on vegetable crops and *Helicotylenchus multicinctus* (Cobb, 1893) Golden, 1956 and *Radopholus similis* (Cobb, 1893) Thorne, 1949 on banana, and Mani and Al Hinai (1996a) recorded the widespread occurrence of *M. incognita* (Kofoid and White, 1919) Chitwood, 1949 and *M. javanica* (Treub, 1885) Chitwood, 1949 on many crops and weeds in this region. Nev-

ertheless, the nematode fauna infesting this agricultural area is not well known. Therefore, a survey was organized to more fully characterize the plant-parasitic nematodes associated with crops grown in the region and to establish their contribution and pest status.

MATERIALS AND METHODS

The survey was carried out in August 1995, two months after the onset of the cropping season, in all five wilayats (divisions) of Dhofar Governorate: Awqad, Salalah, Hafa & Qarad, Dahariz, and Taqah (Fig. 1). Ten farms were randomly selected in each wilayat. Additionally, Razat farm and research farms situated in Salalah plain and at Qairoon Hairtti on Jabal Akhdar mountain were also surveyed. In total, 125 soil and root samples were collected from 12 vegetable, 11 tree fruit and eight field crops (Table 1).

Different kinds of farms were sampled among the 51 private and two research farms visited in the five wilayats. Most were small to medium size farms and only a few

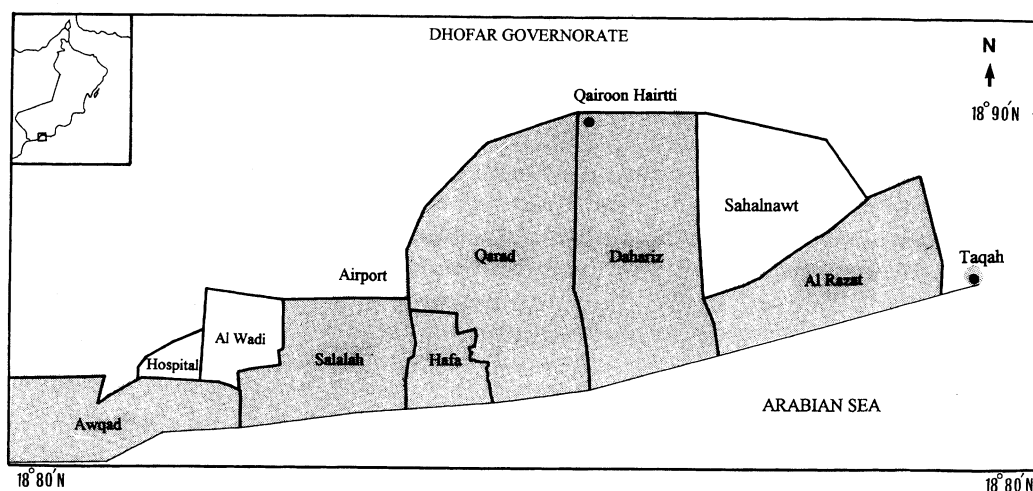


Fig. 1. Map of Dhofar Governorate in the Sultanate of Oman showing the administrative divisions (wilayats) in which samples were taken.

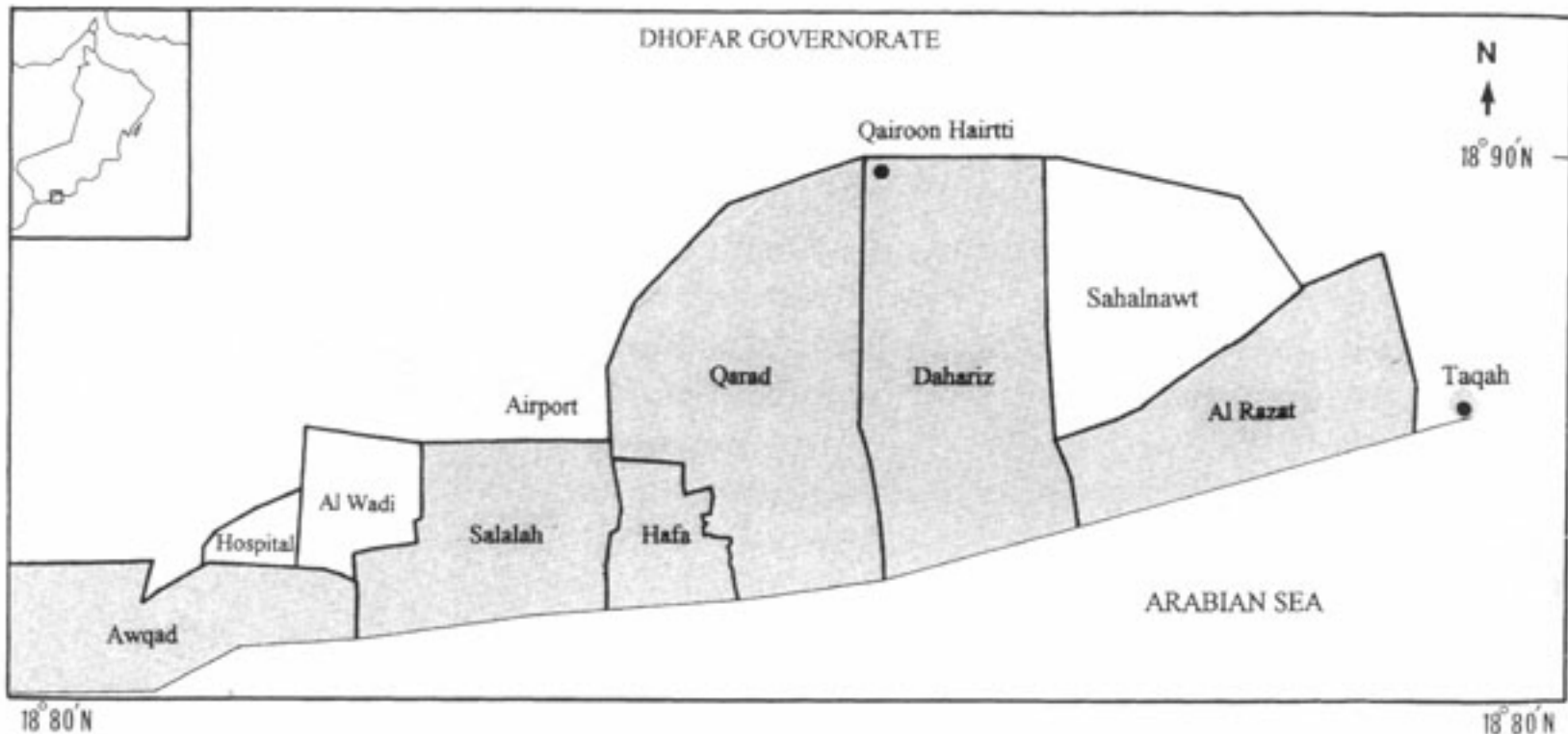


Fig. 1. Map of Dhofar Governorate in the Sultanate of Oman showing the administrative divisions (wilayats) in which samples were taken.

were large commercial farms. Mixed cropping was usually practiced and a wide range of crops was grown under the traditional farming system. Soils were mostly sandy loam, and wells were the major sources of irrigation. The water table started at 2.5-3.5 m from ground level in most of the farms and the quality of water was moderate; pH ranged from 6.9-7.4 and electrical conductivity ranged from 1740-3950 $\mu\text{mhos/cm}$.

Sampling: Crops showing poor growth or symptoms of nematode damage as well as apparently healthy plants were sampled. Soil and root samples were collected from the rhizosphere with a garden trowel and/or an auger to depths of 20-25 cm (Mani *et al.*, 1998). Root galling was scored on a 0-5 scale (Taylor and Sasser, 1978). The samples were stored and processed in the laboratory within a week after collection.

Extraction and Processing: Each soil sample was mixed thoroughly and a 250 cm^3 subsample was processed following Cobb's gravitational sieving technique in combination with a modified Baermann funnel method. Nematodes in roots were extracted by incubating pieces of roots or macerated root suspensions in a modified Baermann funnel containing water with 0.5% hydrogen peroxide and the nematodes from alfalfa roots were extracted by blending. Nematodes extracted on Baermann funnels were collected on a 38 μ sieve after 48 hours. The suspended nematodes were fixed in 2% hot formaldehyde, identified and counted in a counting dish under a stereo binocular microscope. Specimens of each genus were fixed in 5% formaldehyde, processed to anhydrous glycerine by the modified Seinhorst method (Seinhorst, 1959) and mounted on Cobb slides with double cover slips. The nematodes were examined with a compound microscope and identified using recent taxonomic keys (Handoo and Golden, 1989, 1992; Hunt,

1993; Nickle, 1991, Siddiqi, 1986). *Meloidogyne* spp. were identified based on perineal patterns of adult females as well as the characters of second-stage juveniles (J_2) (Jepson, 1987). Soil and water samples collected from the farms were analyzed for pH and electrical conductivity.

RESULTS

Nematodes identified from Dhofar Governorate: Seventeen genera of plant-parasitic nematodes were recorded from 125 soil and root samples collected from 31 major crops (Table 1). Twenty-two species belonging to 11 genera were identified. Thirteen other species were identified only to genus level. *Tylenchorhynchus* (66% of samples) was the most frequently encountered genus followed by *Helicotylenchus* (54%), *Meloidogyne* (54%), *Rotylenchulus* (42%), and *Pratylenchus* (38%). In addition, *Hemicriconemoides* (11%), *Longidorus* (11%), *Criconemella* (10%), *Radopholus* (10%), and *Xiphinema* (10%) were also frequently recorded. The genera *Psilenchus* (6%), *Aphelenchoides* (4%), *Hoplolaimus* (2%), *Paratylenchus* (2%), *Tylenchulus* (2%), *Boleodorus* (1%), and *Hemicyclophora* (1%) were recorded less frequently. Five nematode genera—*Aphelenchoides*, *Boleodorus*, *Criconemella*, *Psilenchus*, *Paratylenchus*—and 11 species—*Criconemella sphaerocephala* (Taylor) Luc and Raski, *Hoplolaimus columbus* Sher, *Pratylenchus jordanensis* Hashim, *Pratylenchus scribneri* Steiner, *Pratylenchus zaeae* Graham, *Tylenchorhynchus annulatus* (Cassidy) Golden, *Tylenchorhynchus clarus* Allen, *Tylenchorhynchus coffeae* Siddiqi and Basir, *Tylenchorhynchus nudus* Allen, *Tylenchorhynchus striatus* Allen, and *Xiphinema guirani* Luc and Williams are reported for the first time in the region. Following are the associations of plant-parasitic nematodes with the various crops in Dhofar Governorate.

Table 1. Plant-parasitic nematodes associated with crops in Dhofar Governorate, Sultanate of Oman.

Nematode genus and species	Crop Association'	% incidence
<i>Aphelenchoides</i> sp.	1,16,21,29,30	4
<i>Boleodorus</i> sp.	7	1
<i>Criconemella sphaerocephala</i>	7,12,13,25	4
<i>Criconemella</i> spp.	1,2,7,12,13,16,22	7
<i>Helicotylenchus dihystra</i>	7	1
<i>H. indicus</i>	1,7,17,19,25	5
<i>H. multincinctus</i>	2,3,7,8,14,20,21,31	31
<i>Helicotylenchus</i> spp.	2,6,7,12,16,17,20,21,24,25,28	18
<i>Hemicriconemoides mangiferae</i>	7,11,17,22	10
<i>Hemicriconemoides</i> sp.	17,21	2
<i>Hemicycliophora</i> sp.	2	1
<i>Hoplolaimus columbus</i>	28	1
<i>Hoplolaimus</i> sp.	25	2
<i>Longidorus</i> sp.	1,3,7,8,9,11,14,15,17,22,25,28	11
<i>Meloidogyne incognita</i>	2,3,4,12,14,15,19,20,21,22,26,31	30
<i>M. javanica</i>	2,5,10,12,19,20,23,31	18
<i>Meloidogyne</i> spp.	1,2,7,17,20,21	7
<i>Paratylenchus</i> sp.	1,17,28	2
<i>Pratylenchus jordanensis</i>	1,2,4,6,10,17,19,23,25,29	15
<i>P. scribneri</i>	1,4,7,10,11,22,25,28	11
<i>P. zeae</i>	30	1
<i>Pratylenchus</i> spp.	1,2,9,10,15,25,27	10
<i>Psilenchus</i> sp.	2,7,12,20,25	6
<i>Radopholus similis</i>	2,3	10
<i>Rotylenchulus reniformis</i>	1,2,3,4,7,10,11,12,14,15,16,17,19,20,21,22,23,25,27,28,31	42
<i>Tylenchorhynchus annulatus</i>	7	1
<i>T. clarus</i>	25	1
<i>T. coffeae</i>	2,7,8	14
<i>T. goffarti</i>	1,7,10,12,14,19,21,30,31	9
<i>T. nudus</i>	2	2
<i>T. striatus</i>	21	1
<i>Tylenchorhynchus</i> spp.	1,2,6,7,11,12,13,17,20,21,25,27,28,30,31	38
<i>Tylenchulus semipenetrans</i>	18,29	2
<i>Xiphinema americanum</i>	15,17,22	4
<i>Xiphinema guirani</i>	17	2

Table 1. (Continued) Plant-parasitic nematodes associated with crops in Dhofar Governorate, Sultanate of Oman.

Nematode genus and species	Crop Association ¹	% incidence
<i>Xiphinema</i> spp.	7,17,19,21,25	4

¹1: Alfalfa, *Medicago sativa* L.; 2: banana, *Musa paradisiaca* L.; 3: betelvine, *Piper betle* L.; 4: bittergourd, *Momordica charantia* L.; 5: bottlegourd, *Lagenaria vulgaris* Ser.; 6: cauliflower, *Brassica oleracea* L. var. *botrytis*; 7: coconut, *Cocos nucifera* L.; 8: coffee, *Coffea arabica* L.; 9: corn, *Zea mays* L.; 10: cucumber, *Cucumis sativus* L.; 11: custard apple, *Annona reticulata* L.; 12: eggplant, *Solanum melongena* L.; 13: elephant grass, *Pennisetum purpureum* K. Schum.; 14: fig, *Ficus carica* L.; 15: grapevine, *Vitis vinifera* L.; 16: guava, *Psidium guajava* L.; 17: lime, *Citrus aurantifolia* (Christm.) Swingle; 18: mandarin, *Citrus reticulata* Blanco; 19: okra, *Abelmoschus esculentus* (L.) Moench.; 20: papaya, *Carica papaya* L.; 21: pepper, *Capsicum annuum* L.; 22: pomegranate, *Punica granatum* L.; 23: pumpkin, *Cucurbita maxima* Duch.; 24: radish, *Raphanus sativus* L.; 25: rhodes grass, *Chloris gayana* Kunth.; 26: spinach, *Spinacea oleracea* L.; 27: squash, *Cucurbita pepo* L.; 28: sugarcane, *Saccharum officinarum* L.; 29: sweet orange, *Citrus sinensis* (L.) Osbeck; 30: sweet potato, *Ipomoea batatas* (L.) Lam.; 31: tomato, *Lycopersicon esculentum* Mill.

Vegetables: Vegetable crops are grown for most of the year (June to March), as the weather conditions are favorable. Root-knot nematodes were widespread and important pests of these crops, causing severe root galling, with gall indices of 4-5 (Taylor and Sasser, 1978). *Meloidogyne incognita* was the most common and damaging nematode species recorded on bittergourd, eggplant, okra, hot pepper, spinach and tomato. Seedlings of eggplant, lettuce, pepper and tomato were also often found infected by this nematode in nurseries. *Meloidogyne javanica* was observed on bittergourd, cucumber, eggplant, okra, pumpkin and tomato. These nematodes were present in high population densities both in nurseries and in fields (Table 2). The cropping pattern (rotation of nematode-susceptible vegetable crops), soil type, and climate were apparently favorable for the survival and multiplication of root-knot nematodes throughout the year. Severe infection by root-knot nematodes on vegetable crops caused stunting, chlorosis, and death of plants, resulting in patchy growth. The occurrence of *Meloidogyne* spp. on 11 weed hosts (Table 3) suggested the need for

controlling weeds to prevent the carry-over of nematode inoculum from one season to another. Interestingly, the J₂ of *M. incognita* collected from the rhizosphere of bittergourd at Dahariz were covered with spores of *Pasteuria* sp. (> 50 spores per juvenile). This is the first record of *Pasteuria* in Oman. High population levels of *Rotylenchulus reniformis* Linford and Oliveira and *P. jordanensis* were also recorded in association with many vegetable crops.

Banana and plantain (*Musa* spp.): Bananas (often cv. Dwarf Cavendish) were grown in almost all farms. Samples from different banana cultivars were collected in both small and large commercial plantations. *Helicotylenchus multicinctus*, *M. incognita*, *M. javanica*, *R. similis*, and *R. reniformis* were the most common nematode species recorded in many farms. *Helicotylenchus multicinctus* was the dominant species observed in 85% of the samples from banana with a mean population density of 556 nematodes per 250 cm³ soil. High populations of 1100-1400 nematodes per 250 cm³ soil sample were recorded in Salalah, Hafa & Qarad, and Taqah, a moderate population of 700 nematodes occurred in Awqad, and a low population of 182 in Dahariz. Population densities

Table 2. Population density and geographic distribution of the most important plant-parasitic nematodes of crops recorded in Dhofar Governorate, Sultanate of Oman.

Nematode species	Nematode population in 250 cm ³ soil		Roots ^y	Geographic Distribution ^x
	Min.-max.	Mean		
<i>Helicotylenchus multincinctus</i>	20-2060	556	368	A, D, HQ, RF, S, T
<i>Helicotylenchus spp.</i>	30-360	125	180	A, D, HQ, RF, S, T
<i>Meloidogyne incognita</i>	60-2000	678	243	A, D, HQ, RF, S, T
<i>Meloidogyne javanica</i>	100-5280	1193	394	A, D, HQ, S, T
<i>Hemicriconemoides mangiferae</i>	40-520	100	—	A, D, HQ, S, T
<i>Pratylenchus jordanensis</i>	20-500	116	—	A, D, HQ, RF, S
<i>Pratylenchus scribneri</i>	20-500	113	—	A, D, HQ, RF, S, T
<i>Pratylenchus zaeae</i>	40	40	—	HQ
<i>Radopholus similis</i>	40-200	177	200	A, D, HQ, RF, S, T
<i>Rotylenchulus reniformis</i>	100-2800	900	—	A, D, HQ, RF, S, T
<i>Tylenchulus semipenetrans</i>	400-1580	900	—	QH

^yPopulation density in 20g banana roots.

^xA: Awqad; D: Dahariz; HQ: Hafa & Qarad; QH: Qairoon Hairtti; RF: Research Farm at Salalah; S: Salalah; T: Taqah.

of *H. multincinctus* in roots averaged 368 per 20 g roots and caused cortical necrosis. In general, because nematicide application was not a regular practice in the small private farms, high populations of various nematode species and a high degree of root damage were recorded. However, at Al Razat farm, a large commercial enterprise which regularly applied nematode control measures, the number of nematode species as well as their population levels were low, resulting in negligible root damage. *Radopholus similis* was observed in two farms in each of four wilayats and in one farm in Taqah. The mean population densities of *R. similis* in soil and roots and the severity of damage to roots and corms were higher in Dahariz (40-80% cortical root necrosis) than in the other wilayats. The nematode produced pink to brown lesions on roots and corms. Although *Meloidogyne spp.*, *R. reniformis*, and *T. coffeae*

occurred at high population levels in association with different banana cultivars, the economic significance of these nematodes on this crop remains largely unknown.

Citrus (Citrus spp.): Tylenchulus semipenetrans Cobb was not found on trees growing on the rootstock *C. aurantifolia* (Christm.) Swingle, which is known to have resistance to this nematode. However, this nematode species was commonly recorded on mandarin (*C. reticulata* Blanco), sweet orange (*C. sinensis* (L.) Osbeck.) and other citrus species, growing on other rootstocks in the research farm at Qairoon Hairtti. Among the nematode species recorded, *X. guirani* was found at a high population level (> 1000/250 cm³ soil) in a farm in Dahariz. *Pratylenchus coffeae*, which was reported previously on citrus in north Oman (Mani *et al.*, 1997) was not found in this survey.

Table 3. Weed hosts of *Meloidogyne* spp. recorded in Dhofar Governorate, Sultanate of Oman.

Scientific name of plant	Family	Nematode species ^a	Gall index ^b
<i>Achyranthes aspera</i> L.	Amaranthaceae	Mi	4
<i>Amaranthus graecizans</i> L.	Amaranthaceae	Mi	2.5
<i>Amaranthus viridis</i> L.	Amaranthaceae	Mi	1.5
<i>Boerhaavia diffusa</i> L.	Nyctaginaceae	Mj	3
<i>Chenopodium murale</i> L.	Chenopodiaceae	Mi, Mj	3
<i>Convolvulus arvensis</i> L.	Convolvulaceae	Mj	2
<i>Datura metel</i> L.	Solanaceae	Mi	2
<i>Euphorbia granulata</i> Forssk.	Euphorbiaceae	Mi, Mj	3
<i>Phyllanthus nodiflora</i> (L.) Greene	Verbanaceae	Mi, Mj	4
<i>Phyllanthus maderaspatensis</i> L.	Euphorbiaceae	Mi	3
<i>Portulaca oleracea</i> L.	Portulacaceae	Mi	4
<i>Vernonia cinerea</i> (L.) Lees	Compositae	Mi, Mj	5

Coconut (*Cocos nucifera* L.): Eleven genera of plant-parasitic nematodes were found associated with coconut: *R. reniformis*, *Hemicriconemoides mangiferae* Siddiqi, *H. multincinctus*, species of *Pratylenchus* and *Tylenchorhynchus* were commonly observed. Population levels of *H. multincinctus* and *R. reniformis* were usually high. Although *R. similis* was recorded on banana, it was not observed on coconut.

Papaya (*Carica papaya* L.): Of the five genera recorded on papaya, *Meloidogyne* spp. and *R. reniformis* were frequently present at high population levels. Infected plants showed chlorosis of old leaves. In all farms, papaya was severely affected by *M. incognita* and/or *M. javanica*, which caused severe root galling resulting in root rot. Seedlings in nurseries were also often infected by these nematode species. High population densities of *R. reniformis* (1500-1800 per 250 cm³ soil) were observed in three farms, one each in Salalah, Hafa & Qarad and Taqah.

Minor tree fruit crops: Custard apple (*Annona reticulata* L.), fig (*Ficus carica* L.), grapevine (*Vitis vinifera* L.), guava (*Psidium*

guajava L.) and pomegranate (*Punica granatum* L.) were usually attacked by either *M. incognita* or *R. reniformis* or both. High population densities of *M. incognita* were observed on fig (1200 per 250 cm³ soil) in Awqad, and on grapevine (2000 per 250 cm³ soil) in a research farm, and of *R. reniformis* on grapevine (2400 per 250 cm³ soil) in Salalah. Other nematode species occurred at low population levels.

Perennial grasses: Rhodes grass (*Chloris gayana* Kunth.) and elephant grass (*Pennisetum purpureum* K. Schum.) were the most common grasses grown in the region. Although *Criconemella* spp., *P. jordanensis*, *P. scribneri*, different species of *Helicotylenchus* and *Tylenchorhynchus* were often found associated with grasses, they were not considered as major limiting factors.

Alfalfa (*Medicago sativa* L.): Alfalfa is commonly grown in north Oman, but is rather uncommon in Dhofar Governorate. Among the 12 species of plant-parasitic nematodes identified, *P. jordanensis*, *P. scribneri*, *R. reniformis*, and *Tylenchorhynchus gofarti* Sturham were frequently encountered on this crop. A one-year-old alfalfa field

infected with high population levels of *P. jordanensis* and *P. scribneri* (500-600 per 250 cm³ soil) in Hafa & Qarad showed very poor, stunted and patchy growth. *Rotylenchulus reniformis* was observed at 1000 nematodes per 250 cm³ soil in Awqad.

Minor field crops: Betelvine (*Piper betle* L.), corn (*Zea mays* L.), sugarcane (*Saccharum officinarum*), sweet potato (*Ipomoea batatas* (L.) Lam. etc. were cultivated in some farms. Coffee was successfully grown in a research farm at Qairoon Hairtti. *Helicotylenchus multicinctus*, *M. incognita*, *P. scribneri*, *P. zae*, *R. similis* and *R. reniformis* were observed in low frequency on these crops.

DISCUSSION

The results of the survey not only provide an accurate identification of the most important nematode species associated with agricultural crops grown in Dhofar Governorate, but also reveal their frequency of occurrence, distribution, and preliminary observations of crop damage and economic importance. Among the plant-parasitic nematode species identified, *Meloidogyne* spp. on vegetable and other crops, *Pratylenchus* spp. on a range of crops, *R. similis* and *H. multicinctus* on banana and plantain, *R. reniformis* on banana, coconut, papaya and tomato and *T. semipenetrans* on citrus spp. at Qairoon Hairtti can be considered as economically important species, according to previous reports (Duncan and Cohn, 1990; Jatala, 1990; Waller and Bridge, 1978). Many of the species occurring in Dhofar Governorate were also reported from north Oman (Mani, 1993; Anonymous, 1993, 1995). It appears that *R. similis* was introduced into the country with infected banana plants. The nematode was recorded in Dhofar Governorate as early as 1974 (Waller and Bridge, 1978),

but was not detected in any of the regions in north Oman until 1994 (Mani, 1993; Anonymous, 1994). Recently, it was reported from Nizwa and Al Hamra wilayats where infected banana plants brought from Dhofar Governorate were planted (Mani and Al Hinai, 1996 b). These observations emphasize the importance of preventing the spread of plant-parasitic nematodes from south to north Oman via infected plants.

The root-lesion nematodes *P. jordanensis* and *P. scribneri* were the most common species infecting alfalfa, rhodes grass and vegetable crops. Although *P. jordanensis* was the most widely distributed nematode species and considered to be economically important on alfalfa (Mani and Al Hinai, 1997; Mani *et al.*, 1997), its importance on vegetable crops and grasses was not yet demonstrated. *Pratylenchus scribneri* was rather uncommon in north Oman. *Rotylenchulus reniformis* on a range of crops and *T. semipenetrans* on several *Citrus* spp. were often observed in other parts of Oman (Anonymous, 1994; Mani, 1993; Waller and Bridge, 1978). Their economic importance in other countries is well established (Duncan and Cohn, 1990; Jatala, 1991).

The results of this survey will help in planning future research as well as in developing effective nematode management and quarantine strategies suitable for the region. Also, they demonstrate the need to prevent the spread of *Tylenchulus semipenetrans* to new areas with infected nursery stock.

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