

## PLANT-PARASITIC NEMATODES ASSOCIATED WITH GRAPEVINE IN SANA'A AND SADAH GOVERNORATES OF YEMEN

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### ABSTRACT

A survey of plant parasitic nematodes associated with vineyards was undertaken in Sana'a and Sadah governorates, the two major grapevine-producing areas in Yemen. A total of 139 soil samples were collected and plant parasitic nematodes were extracted by a combination of sieving and Baerman-pan technique. Identification revealed presence of twenty four genera i.e., *Antarctenichus*, *Aphelenchoides*, *Aphelenchus*, *Basiria*, *Criconemoides*, *Ditylenchus*, *Dolichodorus*, *Gracilacus*, *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Pratylenchus*, *Rotylenchulus*, *Rotylenchus*, *Scutellonema*, *Telotylenchus*, *Tetylenchus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchus*, *Xiphinema* and *Zygotylenchus*. All nematode genera except *Aphelenchoides* on Asemi, *Aphelenchus* on Asemi and Raziki, *Helicotylenchus* on Black, *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Pratylenchus*, *Tylenchorhynchus* and *Xiphinema* in Bani-Hushaish are reported for the first time on grape in Yemen. The most predominant plant nematode genera on grape cultivars in all locations were *Tylenchus*, *Xiphinema*, *Helicotylenchus*, *Tylenchorhynchus*, *Rotylenchulus* and *Pratylenchus*, while *Paratylenchus* and *Meloidogyne* had high frequency occurrence in Sana'a and Sadah governorates, respectively. In Sana'a governorate *Paratylenchus* and *Xiphinema* exhibited the highest population densities of 646 and 405 nematode/250gm soil with frequency occurrence attaining 54% and 67% respectively. In Sadah governorate *Xiphinema* and *Meloidogyne* had relatively high population densities of 502 and 429 nematode/250 gm soils with 25% and 50% frequency occurrence, respectively.

**Keywords:** Survey, Nematode genera, Grape cultivars, Yemen

### INTRODUCTION

Grape (*Vitis vinifera*) is the most important fruit crop grown in Yemen especially in Sana'a and Sadah governorates. In Yemen, grape planted areas attain over 12920 hectares with yield production of about 125811 meter tons in 2007 and more than 82% of grape vine production is produced in Sana'a and Sadah governorates (72% and 10%, respectively; Anonymous, 2008). Plant parasitic nematodes are a serious threat to vineyards worldwide. In addition to direct damage caused by their feeding, some nematodes transmit virus diseases of grapevines (Neihaus, and Sikora, 1977). A large number of plant- parasitic nematodes associated with grape-vine cultivation have been reported from various grape vine producing areas of the world (Kanyagia, 1988; Coiro *et al.*, 1991 & 1992; Vadivelu *et al.*, 1992, Khan *et al.*, 1993; El-Maleh and Edongali 1995; Belair, *et al.*, 2001; Wang-Shouhua *et al.*, 2001; Manachini and Landi, 2003; Hoschitz, 2004 and Magunacelaya *et al.*, 2004). The distribution of parasitic nematodes in Yemen's vineyards have not been fully investigated and there is little published information about plant-parasitic

nematode genera involved (Oteifa, 1975 and Sikora, 1982 & 1986). Most of which only revealed the status of root-knot nematodes, *Meloidogyne spp.* on some economic crops in Yemen. El-Zoumair (1998) recorded in his list of plant diseases in the Republic of Yemen the presence of *Longidorus*, *Paratylenchus*, *Tylenchorhynchus* and *Xiphinema* on grapevine in Sana'a governorate (Bani-Hushaish). Moreover, El-Sherif, (2002) reported the nematode genera, *Aphelenchoides*, *Aphlenchus*, *Helicotylenchus*, *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Pratylenchus* and *Xiphinema* in association with grapevine in Sana'a governorate. The objective of this survey was to determine the current distribution and population density of plant-parasitic nematode in major grapevine production areas in Yemen (Sana'a and Sadah governorates). This will help in identifying locations appropriate for further research on nematode management program(s).

## MATERIALS AND METHODS

An extensive survey was carried out to detect the most prevailing nematodes in Sana'a and Sadah governorates of Yemen. Major grape vine production areas were chosen as sampling locations. A total of 112 samples were taken from Sana'a (Bani-Hushaish, Bani Al-Hareth and Hamdan regions) and 27 samples from Sadah (Al-Magash, Rownat Al-Homidan and Yarsim regions). Grape cultivars in all regions are presented in table (1). Soil samples were made up of 2-4 subsamples taken from roots rhizosphere of growing trees to a depth of 15-30cm with a garden spaced at random locations in the field. Samples (soil and root) from each field were placed in polyethylene bags and protected from sun. The collected samples were properly labeled and taken to Plant Protection Laboratory of the Faculty of Agricultural Sana'a University for analysis and identification of plant parasitic nematodes. Soil from each sample was thoroughly mixed and nematodes were extracted from 250gm soil samples with a combination of sieving and Baerman-pan technique (Goodey, 1975). The extracted plant-parasitic nematodes were identified to generic level using (Mai & Lyon, 1975 and Siddiqi, 2000). Population density (PD) and frequency occurrence (FO) of the extracted nematode genera were calculated and documented.

## RESULT AND DISCUSSION

Approximately 95% of the collected samples were positive for nematode prevalence. Mean abundance of nematodes ranged from 25-976 individuals/ 250gm soil (Table, 1). Data reveal presence of twenty-four genera of plant-parasitic nematodes extracted from soil samples of Sana'a (Bani-Hushaish, Bani Al-Hareth and Hamdan regions) and Sadah (Al-Magash, Rownat Al-Homidan and Yarsim regions) governorates.

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The genera are *Antarctenichus*, *Aphelenchoides*, *Aphelenchus*, *Basiria*, *Criconemoides*, *Ditylenchus*, *Dolichodorus*, *Gracilacus*, *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Pratylenchus*, *Rotylenchulus*, *Rotylenchus*, *Scutellonema*, *Telotylenchus*, *Tetylenchus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchus*, *Xiphinema* and *Zygotylenchus*. The most predominant plant nematode genera in all locations were *Tylenchus*, *Xiphinema*, *Paratylenchus*, *Pratylenchus*, *Rotylenchulus*, *Helicotylenchus* and *Tylenchorhynchus*. Members of *Meloidogyne* were observed in all locations except on grape cultivar Raziki in Bani Al-Hareth and Hamdan regions. *Ditylenchus* and *Dolichodorus* were only found in Bani Al-Hareth with 20% FO and population densities of 130 and 120 nematodes/250 gm soils, respectively. While *Trichodorus* and *Zygotylenchus* were relatively found in low population densities only in Yarsim and Bani-Hushaish, respectively.

In Sana'a governorate (Bani-Hushaish), all genera were detected except *Ditylenchus*, *Dolichodorus* and *Trichodorus*. Fifteen genera were found on all grape cultivar (Asemi, Black and Raziki), while *Antarctenichus*, *Tetylenchus* or *Criconemoides* were only found on two grape cultivars, i.e., Asemi and Black or Raziki and Black, respectively. *Hoplolaimus*, *Longidorus* or *Zygotylenchus* were found with low frequency occurrence and population density only on one grape cultivar, either Asemi or Black, respectively. *Xiphinema* was the most frequently occurring genus (76%) with an average of population density of 478 nematodes/250 gm soils. Then, it was followed by *Tylenchus* and *Paratylenchus* with 67% and 62% FO and population densities of 330 and 698 nematodes/250 gm soils, respectively. The genera *Aphelenchus*, *Basiria*, *Helicotylenchus*, *Rotylenchulus*, and *Tylenchorhynchus* occurred by 22-29% FO and populated by 167-249 nematodes/250gm soil. On the other hand, the rest genera occurred, however, less with low frequencies 1-8% FO and mostly with low population densities ( 25-240)

In Bani Al-Hareth, Sana'a governorate, fifteen genera were identified from soil samples. *Tylenchus* were found with 100% FO and a population density of 398 nematodes/250 gm soils, followed by *Helicotylenchus*, *Rotylenchulus* and *Tylenchorhynchus* with 60% FO and population densities of 155, 177 and 308 nematodes/250 gm soils, respectively. The genera *Antarctenichus*, *Criconemoides*, *Pratylenchus*, *Scutellonema* and *Xiphinema* occurred with 40% FO and abundances of nematodes ranged from 115-210 nematodes/250 gm soils. Other genera associated with grapevines appeared in limited distribution (20%) with densities ranging from 120- 600 nematodes/250 gm soils. Population densities of *Paratylenchus* were the highest among the other nematodes genera averaging 600 individuals/250 gm soils.

In Hamdan, Sana'a governorate, twelve genera were identified from soil samples. *Antarctenichus* and *Meloidogyne* were recorded at low densities (50 and 96 nematodes/250 gm soils) only on black grape cultivar with 13 and 50%FO, respectively. Population densities were, relatively, high on grape cultivar Raziki than Black. Population density of *Paratylenchus* was the highest among the other nematode genera as it was 655 nematodes/250 gm

soils on grape cultivar Raziki with 40% FO, followed by *Rotylenchulus* recording 420 nematodes/250 gm soils with 60% FO. In general members of *Tylenchus* had the highest percent of occurrence in soil (69%) with population density averaging 355 nematodes/250 gm soils. Then, members of *Aphelenchus* attained 54% FO with a population average of 119 nematodes/250 gm soils, while those of *Paratylenchus*, *Tylenchorhynchus* or *Xiphinema* had 46% FO with population densities of 449, 278 and 158 nematodes/250 gm soils, respectively. Other genera, including *Hoplolaimus*, *Basiria*, *Pratylenchus*, *Helicotylenchus* and *Rotylenchulus* were found in a range of 15-39% FO with population densities of 70-394 nematodes/250 gm soils.

In Sadah governorate (Al-Magash, Rawnat Al-Homidan and Yarsim) thirteen genera were identified from soil samples of Black grape cultivar in all regions except, *Paratylenchus* and *Telotylenchus* which were only found in Al-Magash and Rawnat Al-Homidan, respectively, while *Aphelenchus* and *Trichodorus* were only found in Yarsim region. Population densities of *Paratylenchus* and *Xiphinema* were the most highest, although *Tylenchus* and *Helicotylenchus* occurred with greater frequencies. Population densities of *Helicotylenchus* and *Xiphinema* were higher in Al-Ma Zygotylenchus gash and Yarsim than in Rawnat Al-Homidan. Highest densities of *Meloidogyne* were found in samples of Al-Magash region with an average of 300 nematodes/250 gm soils. *Tylenchus* was widely distributed in all regions with an average of 71% FO, and highly populated in Yarsim region (224 nematodes/250 gm soils). *Helicotylenchus* was the second prevalent genera with 50% FO and average population density of 429 nematodes/250 gm soils. *Meloidogyne*, *Pratylenchus*, *Tylenchorhynchus*, *Rotylenchulus* and *Xiphinema* genera exhibited 25-38% FO with average population density ranging between 153-502 nematodes/250 gm soils. On the other hand, *Aphelenchoides*, *Aphelenchus*, *Paratylenchus*, *Scutellonema*, *Telotylenchus*, *Trichodorus* and *Xiphinema* genera were less common with 4-17% FO and average population density ranging between 66-502 nematodes/250 gm soils.

Obviously, the nematode genera did occur more frequently in localities of Sana'a governorate especially in Bani-Hushaish than that of Sadah governorate.

Evidently all nematode genera except *Aphelenchoides*, *Aphelenchus*, *Helicotylenchus*, *Meloidogyne*, *Pratylenchus*, *Longidorus*, *Paratylenchus*, *Tylenchorhynchus* and *Xiphinema* are reported for the first time on grape in Yemen.

Therefore, impact of nematode damage on growth, vigor and yield of grapevines need further investigation.

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### النيماتودا نباتية التطفل المصاحبة لأشجار العنب في محافظتي صنعاء وصعدة اليمنية

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تم حصر اجناس النيماتودا نباتية التطفل المصاحبة لأشجار العنب في محافظتي صنعاء وصعدة وهما المنطقتان الرئيسيتان لإنتاج العنب في اليمن حيث جمعت ١٣٩ عينة تربة واستخلصت النيماتودا منها بطريقة المصافي واطباق بيرمان حيث تم تعريف ٢٤ جنس نيماتودي من تربة العنب وهي *Antarctenchus*, *Aphelenchoides*, *Aphelenchus*, *Basiria*, *Criconemoides*, *Ditylenchus*, *Dolichodorus*, *Gracilacus*, *Helicotylenchus*, *Hoplolaimus*, *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Pratylenchus*, *Rotylenchulus*, *Rotylenchus*, *Scutellonema*, *Telotylenchus*, *Tetylenchus*, *Trichodorus*, *Xiphinema*, *Zygotylenchus* و *Tylenchus*, *Tylenchorhynchus*, كل الاجناس تم تعريفها لأول مرة على العنب في اليمن ما عدا الاجناس *Aphelenchoides* على العاصمي و *Aphelenchus* على صنفي العاصمي والرازقي و *Helicotylenchus* على الصنف الأسود اضافة الى اجناس *Longidorus*, *Meloidogyne*, *Paratylenchus*, *Pratylenchus*, *Tylenchorhynchus* و *Xiphinema* في بني حشيش.

كانت الاجناس *Tylenchus*, *Xiphinema*, *Helicotylenchus*, *Tylenchorhynchus*, *Pratylenchus* و *Rotylenchulus* اكثر انتشارا في كل المناطق بينما كان الجنس *Paratylenchus* و *Meloidogyne* اكثر انتشارا في كل من محافظتي صنعاء وصعدة على التوالي.

في محافظة صنعاء اظهر الجنسين *Paratylenchus* و *Xiphinema* كثافة عددية عالية (٦٤٦ , ٤٠٥ نيماتودا/٢٥٠جم تربة) وبمعدل تواجد تكراري ٥٤, ٦٧% على التوالي, بينما سجل الجنسين *Meloidogyne* و *Xiphinema* اعلى كثافة عددية لهما في محافظة صنعاء (٤٢٩, ٥٥٠ نيماتودا/٢٥٠جم تربة) وبمعدل تواجد تكراري بلغ ٢٥, ٥٠% على التوالي.

Table 1. Density and frequency occurrence of nematode populations in some vineyards in Yemen.

Nematode Genera	Sanaa																Sadah											
	Bani-Hushaish								Bani		Hamdan						Average		Rawonat Al-Homidan		Yarsim		Al-Magash		Average			
	Asemi		Raziki		Black		Mean		Raziki		Raziki		Black		Mean		Black		Black		Black		Black		Black			
	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%	P.D	F.O%
* <i>Antarctenches</i>	160	4	0	0	60	4	110	3	203	40	0	0	50	13	50	8	141	7	0	0	0	0	0	0	0	0	0	0
<i>Apehlenchoides</i>	430	8	380	7	330	8	380	8	0	0	0	0	0	0	0	0	380	5	158	22	62	13	120	14	124	17	0	
<i>Aphelenchus</i>	173	21	146	30	242	16	176	22	360	20	135	40	113	63	119	54	163	29	0	0	196	38	0	0	196	13	0	
* <i>Basiria</i>	302	25	76	22	113	20	167	22	130	20	280	20	255	25	263	23	187	22	0	0	0	0	0	0	0	0	0	
* <i>Criconemoides</i>	0	0	70	4	50	4	60	3	115	40	0	0	0	0	0	0	97	5	0	0	0	0	0	0	0	0	0	
* <i>Ditylenchus</i>	0	0	0	0	0	0	0	0	130	20	0	0	0	0	0	0	130	2	0	0	0	0	0	0	0	0	0	
* <i>Dolichodorus</i>	0	0	0	0	0	0	0	0	120	20	0	0	0	0	0	0	120	2	0	0	0	0	0	0	0	0	0	
* <i>Gracilichus</i>	150	4	110	4	90	4	117	4	0	0	0	0	0	0	0	0	117	3	0	0	0	0	0	0	0	0	0	
<i>elichotylenchus</i>	240	25	179	26	156	20	193	24	155	60	165	40	125	38	141	39	171	30	199	33	563	50	459	71	429	50	0	
* <i>Hoploaimus</i>	85	4	0	0	0	0	85	1	0	0	70	20	70	13	70	15	73	4	0	0	0	0	0	0	0	0	0	
<i>Longidorus</i>	80	4	0	0	0	0	80	1	260	20	0	0	0	0	0	0	200	3	0	0	0	0	0	0	0	0	0	
<i>Meloidogyne</i>	229	25	174	22	141	28	179	25	0	0	0	0	96	50	96	31	154	24	210	44	124	50	300	14	181	38	0	
<i>Paratylenchus</i>	672	67	680	63	750	56	698	62	600	20	655	40	346	50	449	46	646	54	0	0	0	0	976	14	976	4	0	
<i>Pratylenchus</i>	310	13	193	11	180	4	241	9	163	40	70	20	47	25	54	23	157	15	200	33	225	25	190	43	203	33	0	
* <i>Rotylenchus</i>	130	8	90	4	57	12	87	8	0	0	0	0	0	0	0	0	87	5	0	0	0	0	0	0	0	0	0	
* <i>Rotylenchulus</i>	219	29	359	26	180	32	249	29	177	60	420	60	355	25	394	39	276	34	143	22	140	13	161	57	153	29	0	
* <i>Scutellonema</i>	304	4	240	4	214	4	240	4	210	40	0	0	0	0	0	0	223	6	300	11	325	25	300	14	313	17	0	
* <i>Telotylenchus</i>	120	4	120	4	123	8	121	5	0	0	0	0	0	0	0	0	121	4	165	11	0	0	0	0	0	165	4	
* <i>Tetylenchus</i>	65	4	0	0	1213	8	830	4	0	0	0	0	0	0	0	0	830	3	0	0	0	0	0	0	0	0	0	
* <i>Trichodorus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	13	0	0	0	66	4	
<i>Tylenchorhynchus</i>	221	29	189	37	209	20	204	29	308	60	325	40	255	50	278	46	242	36	143	33	462	50	169	14	306	33	0	
* <i>Tylenchus</i>	359	88	299	56	320	60	330	67	398	100	357	60	354	75	355	69	344	71	190	56	224	88	131	71	187	71	0	
<i>Xiphinema</i>	659	83	322	70	443	76	478	76	185	40	195	40	140	50	158	46	405	67	170	11	560	50	600	14	502	25	0	
* <i>Zygotylenchus</i>	0	0	0	0	25	4	25	1	0	0	0	0	0	0	0	0	25	1	0	0	0	0	0	0	0	0	0	

PD= Population Density      FO%= Frequency occurrence      \* New record