Plant-Parasitic Nematodes Associated with Garlic in Yemen

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Abstract

A survey was undertaken to determine the frequency and abundance of plant-parasitic nematodes associated with garlic (Allium sativum L.) in major garlic production governorates in Yemen. Twenty nematode genera were found in association with garlic in Sana’a, Ibb and Hadramout governorates of which Antarctenchus, Aphelenchoides, Aphelenchus, Basiria, Boleodorus, Ditylenchus, Helicotylenchus, Heterodera, Hoplolaimus, Meloidogyne, Microposthonia, Nothanguina, Pratylenchus, Rotylenchulus, Rotylenchus, Scutellonema, Tylenchus, Tylenchorhynchus, Tylenchus and Zygotylenchus. All nematode genera except Aphelenchus, Helicotylenchus, Meloidogyne and Tylenchorhynchus have been reported for the first time on garlic in Yemen. The most prevalent plant nematode genera associated with garlic cultivars in all surveyed districts were Aphelenchus, Ditylenchus, Pratylenchus, Tylenchorhynchus and Tylenchus. The largest number of nematode genera was recorded in Sana’a governorate (19 genera) compared to Ibb (14 genera) and Hadramout (12 genera). Antarctenchus, Hoplolaimus, Microposthonia, Nothanguina, Scutellonema and Zygotylenchus genera were only found in Sana’a governorate, while Heterodera was recorded only in Ibb governorate. The most serious pests on garlic, stem and bulb nematode (Ditylenchus) exhibited the highest average population density of 4214 nematodes/250gm soil with frequency of occurrence 49%. Therefore, effects of nematode damage on growth, vigor and yield of garlic need further investigation.

Key words: Survey, Associated nematode genera, Garlic, Yemen.

Introduction

Garlic (Allium sativum L.) is one the most important vegetable crops in Yemen. Sana’a, Ibb and Hadramout governorates are the main garlic growing areas. The total cultivated area attained over 933 hectares with a yield production of about 4332 meter tons in 2012, and more than 79% of garlic production was produced in Sana’a, Ibb and. Hadramout governorates (43%, 18.5% and 17.5%, respectively; Agricultural Statistics, 2013). A considered number of plant-parasitic nematode genera in association with garlic cultivation have been isolated from various garlic producing areas all over the world (Sundaram et al., 1990; Silva, and Carneiro, 1992; Doucet, 1999; Aballay and Eriksson, 2006; Patel, 2007, Yu et al., 2012 and Qiao et al., 2013). Relatively, few reports have been published about plant parasitic nematodes in Yemen. Most of which only revealed the status
of root-knot nematodes, *Meloidogyne* spp. on some economic crops including garlic in Yemen (Oteifa, 1975, Sikora, 1982 &1986 and Ibrahim, 1987). El-Zoumaire (1998) recorded in his list of plant diseases in the Republic of Yemen the presence of some plant parasitic nematode genera associated with some economic crops. Moreover, only the report of plant parasitic nematodes distribution on some plant crops in Yemen (Sana’a area) was published by El-Sherif, (2002) who recovered members of *Aphelenchoides, Ditylenchus, Helicotylenchus, Meloidogyne, Paratylenchus, Trichodorus, Tylenchorhynchus* and *Xiphinema* from garlic soil.

The stem and bulb nematode (*Ditylenchus dipsaci*) has been reported as a serious pest on garlic in many regions of the world especially in the colder and temperate regions causing necrosis or rotting of bulbs, swelling and distortion of aerial plant parts, leaf stunting, thickening, looping and yellowing and death of young plants (Netscher and Sikora, 1990; Potter and Olthof, 1993; Johnson Roberts, 1995 and Tenente, 1996).

In Yemen the stem and bulb nematode causes extensive deterioration to garlic production and can cause complete failure of the host plants (Awadh et al., 2008). Moreover, the European and Mediterranean Plant Protection Organization (EPPO) has placed *D. dipsaci* as No. 174 on the A2 list of phytosanitary categorization, which is distributed locally in EPPO countries, and it is regulated as a quarantine pest (EPPO, 1997).

Information of plant parasitic nematodes associated with garlic and the damage or severity caused in field plants is a meager problem in Yemen. Therefore, the present study was conducted to identify nematode genera and determine their current distribution and population density, especially in the major garlic production areas (Sana’a, Ibb and Hadramout governorates).

**Materials and Methods**

An extensive survey was carried out in the major garlic production areas in Yemen. A total of 134, 56, and 62 samples were collected from Sana’a (Al Haymah, Bani Matar, Bilad Al Rus and Hamdan districts), Ibb (Al Nadirah, Al Saddah and Ba’dan districts) and Hadramout (Al Qatn, Sayun and Tarim districts) governorates, respectively. Soil samples were taken from roots rhizosphere of growing plants to a depth of 10-15cm with a garden spade at random locations in the field. Soil samples 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 Agriculture, Sana’a University for analysis and identification of the recovered plant parasitic nematodes. Soil from each sample was thoroughly mixed and nematodes were extracted from a 250gm soil sample with a combination of sieving and Baerman-pan technique (Goodey, 1957). The extracted nematodes were counted using a Hawkesly counting slide and identified to generic level based on morphological characters of the adults and juveniles forms according to Mai and
Lyon, (1975) and Siddiqi, (2000). Population density (PD) and frequency of occurrence (FO) of the extracted nematode genera were calculated and documented.

Results and Discussion

Approximately 95% of the collected samples were positive for nematode prevailing. Average abundance of nematodes ranged from 47-4214 individuals/250gm soil (Table, 1). Data reveal presence of twenty nematode genera associated with the rhizosphere of garlic plants in Sana'a (Al Haymah, Bani Matar, Bilad Ar Rus and Hamdan districts), Ibb (Al Nadirah, Al Saddah and Ba'dan districts) and Hadramout (Al Qatn, Sayun and Tarim districts) governorates. The genera are Antarctenchus, Aphelenchoidea, Aphelenchus, Basiria, Boleodorus, Ditylenchus, Helicotylenchus, Heterodera, Hoploaimus, Meloidogyne, Microposthonia, Nothanguina, Pratylenchus, Rotylenchulus, Rotylenchus Scutellonema, Tylenchus, Tylenchorhynchus, Tylenchus, and Zygotylenchus. The largest number of nematode genera was recorded in Sana'a governorate (19) compared to Ibb (14) and Hadramout (12). Evidently genera, of Aphelenchus, Ditylenchus, Pratylenchus, Tetylenchus and Tylenchorhynchus were recovered from samples of all surveyed districts. Members of the stem and bulb nematode (Ditylenchus) were observed in all the surveyed districts with average frequency occurrence ranging between 14-49% and population densities 62-4214 nematodes/250 gm soil.

Antarctenchus, Hoploaimus and Microposthonia were only found in Sana’a governorate, Bani Matar district with low FO and population densities of 235, 72 and 305 nematodes/250 gm soil, respectively, while Nothanguina was only found in Hamdan with low occurrence 4% and population density of 78 nematodes/250 gm soil. Scutellonema and Zygotylenchus were detected only in Sana’a governorate except Bilad Al Rus district. On the other hand, Heterodera was only recorded in Al Nadirah district Ibb governorate with 24% FO and population density of 154 nematodes/250 gm soil, while Rotylenchus was found in Bani Matar and Al Nadirah districts with low FO and population densities.

In Sana’a governorate, it was evident that Bani Matar district sustained the largest number of nematode genera (18) compared to Hamdan (14), Al Haymah (10) and Bilad Al Rus (9). Seven genera, Aphelenchus, Basiria, Ditylenchus, Helicotylenchus, Pratylenchus, Tylenchorhynchus and Tylenchus were found in all surveyed districts in Sana’a governorate. The Highest density of Helicotylenchus was found in samples of Al Haymah district with 1377 nematodes/250 gm soil. In Hamdan district, Ditylenchus exhibited the highest percent of occurrence (67%) and the highest population density of 8745 nematodes/250 gm soil.

In Ibb governorate, Al Nadirah, Al Saddah and Ba’dan districts, fourteen genera were identified from soil samples in all surveyed districts except, Heterodera, Rotylenchus and Tetylenchus which were only found in Al Nadirah.
Table (1): Density and frequency of occurrence of nematode genera in major garlic production governorates in Yemen.

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PD= Population Density  FO= Frequency of  * New records

district, while *Boleodorus* and *Meloidogyne* were only found in Ba’dan and Al Saddah districts or Ba’dan and Al Nadirah districts, respectively. *Aphelenchus* and *Meloidogyne* genera exhibited the highest percent of occurrence and population densities in Al Nadirah district compared to different surveyed districts with 81% and 24% FO and population densities of 611 and 209 nematodes/250 gm soil, respectively. In Al Saddah district population densities of *Aphelenchoides, Tylenchorhynchus, Basiria, Tetylenchus* and *Boleodorus* were the highest among the other surveyed districts with 3203, 554, 525, 388 and 280 nematodes/250 gm soil, respectively, while *Tylenchorhynchus* and *Boleodorus* genera exhibited the highest percent of occurrence with 90% and 50% FO, respectively. The highest frequency occurrence of *Helicotylenchus* and *Basiria* were found in Ba’dan district among the other districts with 60% and 48%, respectively.

In Hadramout governorate Al Qatn, Sayun and Tarim districts twelve genera were identified from soil samples in all districts except, *Meloidogyne* and *Rotylenchulus* which were only found in Al Qatn and Tarim districts, respectively, while *Boleodorus, Helicotylenchus* and *Tetylenchus* were only found in Sayun district. On the other hand *Aphelenchoides* or *Basiria* were found in Sayun and Al Qatn or Sayun and Tarim districts, respectively.

With reference to Hadramout governorate, it was evident that most of detected genera occurred with low frequencies and population densities. *Tylenchorhynchus* was widely distributed especially in Sayun and Tarim with an average of 73% FO and with highest average population density of 263 nematodes/250 gm soil. The highest population density of *Pratylenchus* was found in Tarim district comparing to different surveyed districts in all governorates with 378 nematodes/250 gm soil and with a limited distribution (14%).

In this survey, nematode population densities and frequency occurrences differed from one district to another, which could be explained in terms of varying local soil and weather conditions, weed types, cropping, land history, and farming practices. The lower frequency and population density of root-knot nematode (*Meloidogyne*) in this survey compared to *Ditylenchus* could be due to low temperature at the time of sampling, or to the soil types which are loamy, or clay loam being unfavorable to this nematode and may be due to differences of garlic varieties.

Members of *Criconemoides* (ring), *Longidorus* (needle), *Paratylenchus* (pin), *Trichodorus* (stubby root) and *Xiphinema* (dagger) which were occurred on garlic in Sana’a governorate (*El-Sherif, 2002*) were not found in the present survey. On the other hand, fifteen nematode genera: *Antarctenchus, Aphelenchoides, Basiria, Boleodorus, Heterodera, Hoplolaimus, Microposthonia, Nothanguina, Pratylenchus, Rotylenchulus, Rotylenchus Scutellonema, Tetylenchus, Tylenchus*, and *Zygotylenchus* were recorded for the first time on garlic in Yemen.
References


الملخص العربي

النematoda نباتية التثقل المصاحبة لمبيد النوم في اليمن

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تم إجراء حصر لتحديد نسبة التواجد والكثافة العددية للنematoda نباتية التثقل المصاحبة لمحصول النوم في المحافظات الرئيسية لإنتاج النوم في اليمن، سجل تواجد عشرون جنس نematodi مصاحب لمحصول النوم في محافظات صنعاء وآب وحضرموت وهي Antarctenchus, Aphelenchoides, Aphelenchus, Basiria, Boleodorus, Ditylenchus, Helicotylenchus, Heterodera, Hoplolaimus, Meloidogyne, Microposthonia, Nothanguina, Pratylenchus, Rotylenchulus, Rotylenchus Scutellonema, Tetleylenchus, Tylenchorhynchus, Tylenchus, وZygoylenchus. كل الأجناس سجلت لأول مرة على النوم في اليمن عدا الأجناس Aphelenchus, Helicotylenchus, Meloidogyne Ditylenchus, Aphelechus, Tylenchorhynchus, وكانت الأجناس Tylenchus, وPratylenchus, Tylenchorhynchus أكثر انتشارًا على محصول النوم في كل المديريات التي تم بها الحصر. صاحب مضخ찰 النوم أكثر عدد من الأجناس النematودية في محافظة صنعاء (19 جنس) بليها محافظة آب (14 جنس) ثم محافظة Hoplolaimus Antarctenchus, Zygoylenchus, Scutellonema Microposthonia, Nothanguina, في محافظة آب فقط بينما سجل جنس Heterodera نematoda السوق والأعمال الذي يعد أخطر جنس نematodi على النوم أعلى معدل كثافة عددية 4214 نematoda / 250 جم تربة وبمعدل تواجد تكاري 49%. لذا هناك حاجة لمزيد من البحث لدراسة تأثير النematoda على نمو وإنتاج محصول النوم.