Occurrence of Plant-parasitic Nematodes in the rhizophere of some mustard in Hlegu Township, Yangon Region

Aye Aye Thant[1], Myo Sabei Khaing[2]

Abstract

Occurrence of plant-parasitic nematodes from some mustard growing field of the Nyaung Na Pin village of Hlegu Township, Yangon Region *was*observed during the period from 2018, December to 2019, August. A total of ten genera belong to eight families of two orders were recorded. Among them, eight genera in *B. alba*, ten genera in *B. juncea* and nine genera in *B. rapa* var. *parachinensis* were found. Among the observed genera, *Helicotylenchus*, was found to be the predominant on the soil samples of *B.alba*, *B.juncea* and *B.rapa* var. *parachinensis*. Moreover, *Helicotylenchus*, *Aphelenchus* and *Meloidogyne* were found with highest number of 15950, 12000 and 10400, respectively. *Tylenchorhynchus*, *Pratylenchus* and *Criconemoides* was found to be the lowest in numbers of 350, 350 and 100, respectively. The data from seasonal variation recent study the highest season are wet season and lowest season are dry season. In all mustards, *B. juncea* revealed the highest relative abundance of plant-parasitic nematodes from soil (46%), followed by *B.rapa* var. *parachinensis* (30%) and *B.alba* (24%).

Keywords : occurrence, Plant-parasitic nematodes, morphological characters, some mustard

[1] Lecturer, Department of Zoology, Dagon University
[2] Demonstrator, Department of Zoology, Military Institute of Nursing and Paramedical Sciences

Introduction

Vegetables play an important role in human nutrition. Most are low in fat and calories but are bulky and filling. They supply dietary fiber and are important sources of essential vitamins, minerals, and trace elements (Terry and Leon 2011).

Brassica or *Cruciferous* vegetables are the most important genus of the Brassicaceae family and consist of thirty-seven different species. *Brassica* vegetables contain low fat, high vitamin, mineral and fibre as well as various phytochemicals (Cartea, *et al*. 2011). Nowadays, consumers are demanding products that are rich in nutrients for optimal health benefits. In this respect, the popularity of *Brassica* products is increasing because of their nutritional value, anticancer, antioxidant and anti-inflammatory properties (Gupta, 2011; Tan, *et al*., 2010).

Oriental mustard is used primarily for the production of table mustards, spices, and on oilseed crop. Oriental mustard is produced worldwide, but it is grown primarily in Canada, China, India, Australia, United States, and various parts of Europe (Kimber and McGregor 1995). In general, they are easy to grow for home consumption as well as for commercial purposes, and their nutritional value is good. In Myanmar, mustards grow throughout the year at cold regions and are grown more in winter season at all places.

The success of cropping system requires an understanding of different soil factors, including population densities of microorganisms, those causing plant diseases. Among the soil pathogens which can nullify the beneficial effects of cropping systems are nematodes. These are microscopic, unsegmented round worms that thrive abundantly in the soil causing severe constraints in agricultural production

(Oteifa, 1997). Most of them feed on bacteria and fungi. A few cause diseases of man and animals. Several hundred species are injurious to plants (Castillo, 1977).

In general, nematodes have slender, cylindrical, non-segmented bodies tapering towards the head and tail, but females of some of the plant-parasitic species assume varying forms, such as pear, lemon or kidney shapes. They are called plant-parasitic because of the nutrients they get from plants and have a needle-like structure called stylet, which is used to pierce plant cells to get food. The economic consequences of crop loss due to nematode-borne disease are many and varied. These involve reduction in quality and quantity of crop yield (Handoo, 1998).

Nematodes are the most numerous multicellular animals on earth. Plant-parasitic nematodes, which feed and reproduce on living plants and are capable of active migration in the rhizosphere, on aerial plant parts and inside the plants. Plant-parasitic nematodes cause significant economic loses to a wide variety of crops (Kimpinski and Sturz, 2003).

The economic impact of plant-parasitic nematodes on a variety of crops is estimated to range between 5 and 15% and in some cases it may be the main limitation factor in the production of specific crops (Stirling, 2014). The primary concern of this study, therefore, is to record as many soil nematodes as possible within the allotted time and to identify which nematodes are present on the association of nematode parasites with mustard in Myanmar. These objectives are-

- to identify the plant-parasitic nematodes on some mustards
- to examine the seasonal variation of plant-parasitic nematodes on some mustards and
- to analyze the composition and relative abundance of plant-parasitic nematodes on some mustards.

Materials And Methods

Study site and period

The present study was conducted on the some mustard (*Brassica alba*, *Brassica juncea*, *Brassica rapa* var. *parachinensis*) growing field of the Nyaung Na Pin village of Hlegu Township, Yangon Region. Collected samples were studied at Microbiology Department Laboratory, Military Institute of Nursing and Paramedical Sciences (MINP) from Mingalardon Township, Yangon Region. The study period lasted from December 2018 to August 2019.

Collection of soil and plant samples

Before planting or sowing, soil samples were taken with garden trowel and digging fork from four corners and one center at a depth of 18cm from each plot. Three weeks after planting, the root zone soil along with plant was removed by trowel from 0-20cm depth and collected in plastic bag (15cm x 35cm). Five plants including soil samples were weekly taken in a zigzag pattern from each plot. The samples were mixed in one bag and then one sample was taken from each respective plots, then attached with a complete label containing date of sampling, locality, crop name.

Extraction of nematodes

Each soil sample was thoroughly mixed and 100ml of composite soil was drawn for extraction of nematodes from soil and root samples were followed by using of Whitehead tray method (Whitehead and Hemming, 1965). The representative soil sample was evenly spread on a muslin cloth which was in a plastic basket (16 x 20 cm). The basket was placed in a plastic tray (19 x 26 cm). About 300 ml of water was carefully added down the inside edge of the tray until the soil looked wet. To obtain a clean extract, it is important not to move the tray once the water has been added. The tray was kept in a room temperature for 24h. The basket is then slowly and carefully removed. The suspension from the tray was collected in a 500ml glass beaker (PYREX) then allowed to settle for 4 h or more. The supernatant water was poured off to leave the nematode in 50ml of water. The root samples were separated from soil and carefully washed under tap water to remove adhering soil particles and then towel dried. 10 gm of mustard roots were taken which were cut in small pieces (2mm) and were put in the Sieve of Petri-dish with moist of water over the plant material. The Petri-dish was kept in a room temperature for 24h. The sieve is then slowly and carefully removed. The extracted nematodes were counted under the dissecting microscope.

Counting of plant-parasitic nematodes population

Extracting fixed volume of nematodes suspension was taken for determination of the nematode population of soil samples. This suspension was agitated by blowing through it for about 15 seconds using a pipette. Immediately, 1ml of suspension was taken into a counting dish with a graduated 1ml pipette. The population of each genus contained in each 1ml suspension was then counted by using a counter for three times under the dissecting microscope. Average population of the nematodes was calculated.

Identification of nematodes

All specimens were identified to the genus level according to Siddiqi, (2000) and Hunt *et al.,* (2005) under a compound microscope based on their outstanding taxonomic characters such as body shape, cuticle, head, stylet, oesophagus, ovary, vulvaposition, tail shape, bursa and spicules.

Data analyzing

Species composition and relative abundance of plant-parasitic nematodes were calculated following after Bisht *et al*., (2004).

$$\text{Species composition} = \frac{\text{No. of individuals of a species}}{\text{Total number of all the species}} \times 100$$

$$\text{Relative abundance} = \frac{\text{No. of individuals of a species}}{\text{Total number of all the species}}$$

RESULTS

A total of ten genera of plant-parasitic nematodes under eight families of two orders were recorded in the present study. Among them, eight genera in *B. alba*, ten genera in *B. juncea* and nine genera in *B. rapa* were found (Table 1 and Plate 1-5).

Table 1. Recorded plant-parasitic nematodes in study site

No.	Phylum	Class	Order	Family	Genus	Common Name
1.	Nematoda	Secernentea	Tylenchida	Tylenchidae	Tylenchus	Citrus root nematode
2.					*Discotylenchus*	-
3.				Hoplolaimidae	*Rotylenchulus*	Reniform nematode
4.					*Helicotylenchus*	Spiral nematode
5.				Dolichodoridae	*Trophurus*	-
6.				Meloidogynidae	*Meloidogyne*	Root-knot nematode
7.				Belonolaimidae	*Tylenchorhynchus*	Stunt nematode
8.				Pratylenchidae	*Pratylenchus*	Lesion nematode
9.				Criconematidae	*Criconemoides*	Ring nematode
10.			Aphelenchida	Aphelenchoidae	*Aphelenchus*	Mycophagous nematode

- *Tylenchus* (male)
- B. *Tylenchus* (female head)
- C. *Tylenchus* (female tail)

- *Discotylenchus* (female)
- E. *Discotylenchus* (male head)
- F. *Discotylenchus* (male tail)
- G. *Discotylenchus* (juvenile)

Plate 1. Recorded Plant-Parasitic nematode in family Tylenchidae

- *Rotylenchulus* (female)
- B. *Rotylenchulus* (male head)
- C. *Rotylenchulus* (male tail)
- D. *Helicotylenchus* (female)

Plate 2. Recorded Plant-Parasitic nematode in family Hoplolaimidae

- *Trophurus* (female head) B. *Trophurus* (female tail) A. *Meloidogyne* (juvenile head) B. *Meloidogyne* (juvenile tail)

Plate 3. Recorded Plant-Parasitic nematode in family Dolichodoridae and Meloidogynidae

- *Tylenchorhynchus* (female) A. *Pratylenchus* (female) A. *Criconemoides* (female head) B. *Criconemoides* (female tail)

Plate 4. Recorded Plant-Parasitic nematode in family Belonolaimidae, Pratylenchidae and Criconematidae

- *Criconemoides* (juvenile) A. *Aphelenchus* (female head) B. *Aphelenchus* (female tail) C. *Aphelenchus* (juvenile)

Plate 5. Recorded Plant-Parasitic nematode in family Criconematidae and Aphelenchoidae

Seasonal variation of plant-parasitic nematodes on some mustards

Population size of genera associated with varying seasons was analyzed based on the abundance of that genera.

Plant-parasitic nematodes population in the rhizosphere of white mustard

A total of eight genera of plant-parasitic nematodes were observed during dry and wet season. Six genera of plant-parasitic nematodes were found in cold season.

In dry season, *Meloidogyne* was the most common with the number of (1700 individual), followed by *Helicotylenchus* (1650) and the least common was *Pratylenchus* (50). In wet season, *Helicotylenchus* (2850 individual) was most common and the least common was *Pratylenchus* (50) respectively. During the cold season, *Aphelenchus* was the most common with the number of (1250 individual) and the least common was *Discotylenchus* (350) respectively (Fig. 1).

Plant-parasitic nematodes population in the rhizosphere of mustard green

A total of ten genera of plant-parasitic nematodes were recorded during the study period. Among them, nine genera in wet season and eight genera of plant-parasitic nematodes were found in both dry and cold season.

In dry season, *Meloidogyne* was the most common with the number of (1450 individual) and the least common was *Tylenchorhynchus* (50). The most common number of *Helicotylenchus* (4250 individual) was recorded, followed by *Aphelenchus* (2400), *Discotylenchus* (1600), *Meloidogyne* (1250) and the least common was *Criconemoides* (100) in wet season. During the cold season, *Helicotylenchus* was the most common with the number of (1000 individual) and the least common was *Tylenchorhynchus* (50) and *Pratylenchus* (50) (Fig. 2).

Plant-parasitic nematodes population in the rhizosphere of yu choy

A total of nine genera of plant-parasitic nematodes were found in this study. Among them, seven genera in dry season and eight genera of plant-parasitic nematodes were found in both wet and cold season.

In dry season, *Meloidogyne* was the most common with the number of (1250 individual), followed by *Discotylenchus* (1150), *Helicotylenchus* (1050) and the least common was *Trophurus* (150). The most common number of *Helicotylenchus* (3100 individual) was found, followed by *Aphelenchus* (2050) and the least common was *Pratylenchus* (50) in wet season. During the cold season, *Meloidogyne* was the most common with the number of (1800 individual), followed by *Aphelenchus* (1550) and the least common was *Tylenchorhynchus* (100) (Fig. 3).

Prevalence of plant-parasitic nematodes from soil of some mustard

From the 61800 individual uncounted, 20000 individual (in white mustard), 21200 individual (in mustard green) and 20600 individual (in yu choy) were recorded from soil samples, respectively. The prevalence of most genera encountered were *Helicotylenchus*, *Aphelenchus*, *Meloidogyne* with 5150, 4150, 3400 in white mustard, *Helicotylenchus*, *Aphelenchus*, *Discotylenchus*, *Meloidogyne* with 6100, 3800, 3200, 3100 in mustard greenand, *Helicotylenchus*, *Aphelenchus*, *Meloidogyne*, *Discotylenchus* with 4700, 4050, 3900, 3150 in yu choy, respectively (Fig. 4)

Relative abundance of plant-parasitic nematodes from some mustard

In all mustards, mustard green revealed the highest relative abundance of plant-parasitic nematodes from soil (46%), followed by yu choy (30%) and white mustard (24%). Among them genera *Helicotylenchus* was highest (25.8%) followed by *Aphelenchus* (19.41%), *Meloidogyne* (16.82%), lowest frequency of the genera

Tylenchorhynchus (0.56%), *Pratylenchus* (0.56%) and *Criconemoides* (0.16%) (Table 2).

Table 2. Species composition and relative abundance of plant-parasitic nematodes from soil of some mustard

Sr. no	Genus Name	white mustard	(%)	mustard green	(%)	yu choy	(%)	Total	(%) Species composition	Relative abundance
1.	*Tylenchus*	2200	11	2300	11	2350	11	6850	11.08	0.11
2.	*Discotylenchus*	2300	11	3200	15	3150	15	8650	13.99	0.13
3.	*Rotylenchulus*	2100	10	1300	6	1650	8	5050	8.17	0.08
4.	*Helicotylenchus*	5150	26	6100	29	4700	23	15950	25.8	0.25
5.	*Trophurus*	600	3	1000	5	500	2	2100	3.39	0.33
6.	*Meloidogyne*	3400	17	3100	15	3900	19	10400	16.82	0.16
7.	*Tylenchorhynchus*	-	-	250	1	100	1	350	0.56	0.005
8.	*Practylenchus*	100	1	50	0	200	1	350	0.56	0.005
9.	*Criconemoides*	-	-	100	0	-	-	100	0.16	0.001
10.	*Aphelenchus*	4150	21	3800	18	4050	20	12000	19.41	0.19
	Total	20000		21200		20600		61800		
	(%)	24%		46%		30%				

Fig. 1. Seasonal variation of plant-parasitic parasitic nematodes in white mustard

Fig. 2. Seasonal variation of plant-nematodes in mustard green

Fig. 3. Seasonal variationof plant-parasitic nematodes in yu choy

Fig. 4. Prevalence of plant-parasitic nematodes from soil of some mustard

DISCUSSION

A total of ten genera of plant-parasitic nematodes belonging to eight families under two orders were recorded in this study. Among them, *Tylenchus, Discotylenchus, Rotylenchulus, Helicotylenchus, Trophurus, Meloidogyne, Pratylenchus, Tylenchorhynchus, Criconemoides* and *Aphelenchus* were found in the rhizosphere of some mustard plants. Low number of root nematode populations and no cause root symptoms were found. In a test with *Brassica* spp., root nematode populations were low in the root samples and did not cause root symptoms. All other nematodes were found only in soil samples (Mennan and Handoo, 2006). The finding of the present study agree with above authors.

In the present study, *Tylenchus, Discotylenchus, Helicotylenchus, Trophurus, Aphelenchus,* and *Criconemoides* were found in the rhizosphere of some mustard plants. Endo (1975) described that nematode genera identified during his study included *Aphelenchus, Helicotylenchus* and *Xiphinema.* These are ectoparasites of epidermal root tissues and have not been documented as dangerous pests of

vegetables. According to Anwar and McKenry (2010); Anwar and Akhtar (1992); Barker *et al.,* (1998), the occurrence of ectoparasitic nematodes genera has frequently been found in commercially grown vegetable crops. So, the finding of present study were generally similar with those of above authors.

Madamba and Sevilla (1988) reported that both root-knot and reniform nematodes were the most prevalent among the nematodes associated with vegetable crops and they occurred in excessive numbers. Celery, egg-plant and mustard were also good hosts for the root-knot nematode. In the present study, *Meloidogyne* was more prevalent and *Rotylenchulus* was slightly prevalent among the nematodes associated with all mustards. Test variety of mustard and environmental conditions in this observation probably differed from those in Madamba and Sevilla (1988).

Naing Naing Oo (2009) observed that the population assessment on soil nematodes of mustard green. Throughout the experimental period, *Tylenchus, Rotylenchulus, Helicotylenchus, Aphelenchus, Tylenchorhynchus, Meloidogyne* were abundantly found. In present study, *Helicotylenchus*, *Aphelenchus*, *Discotylenchus* and *Meloidogyne* were abundantly found in mustard green. The reason might be different field situation.

The present observation, total number of plant-parasitic nematodes from soil of all mustards was the highest in wet season on all mustards, the lowest in cold season on white mustard and mustard green but dry season on yu choy. One of the important aspects revealed by Hassan *et al.,* (2009), seasonal nematode population in soil of mustard reached its peak in June-July and declined gradually from July to August and December to March. The data is in conformity with the finding of Hassan *et al.,* (2009) except yu choy. Test variety of mustard and environmental conditions probably differed from those in Hassan *et al.,* (2009).

Castillo (1977) mentioned that the crop species and varieties determine the kind of plant-parasitic nematodes and their population densities in the soil. In resistant varieties and unsuitable plant species, there is little or no nematodes reproduction, consequently, the population density falls. Conversely, high reproduction rates occur in susceptible varieties and suitable plant species, consequently, the population density rises. In general, *B. juncea* might be the suitable host and *B.alba*, and *B. rapa* might be unsuitable host for the plant-parasitic nematodes. In this study, eight genera in *B. alba,* ten genera in *B. juncea* and nine genera in *B. rapa* were recorded. The highest composition of genera *Helicotylenchus* (25.8%), followed by *Aphelenchus* (19.41%), *Meloidogyne* (16.82%), and lowest composition in genera *Tylenchorhynchus* (0.56%) and *Pratylenchus* (0.56%), followed by *Criconemoides* (0.16%) were examined.

Conclusion

The mustard plants are 9 weeks old. The numbers of other parasitic nematodes are higher than that of root nematode populations. Although mustards having root-knob nematode *Meloidogyne* and lesion nematode *Pratylenchus,* no cause root symptoms were found. At current situation, there is no problem of plant-parasitic nematode. Therefore, it is no need to control the plant-parasitic nematode.

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