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REGULAR ARTICLE

Detection of plant parasitic nematodes in the soil of crop field in Meiktila area, Myanmar

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Abstract

The occurrence of soil nematodes from groundnut and chilli crop fields were investigated during the period from November 2013 to February 2014. From the collected soil samples, 13 genera belonging to seven families of three orders under two classes were recorded. Among the observed genera, *Meloidogyene,* was found to be the predominant on the soil samples of both groundnut and chilli crop fields. Moreover, *Meloidogyene, Heterodera* and *Helicotylenchus* were found with prominent values of 138, 92 and 85, respectively and occurred in 16%, 11% and 10% of all soil samples, respectively. *Paratrichodorus* was found to be the lowest in numbers 27 (3%). The data from recent study indicated that the soil samples of groundnut crop field showed higher incidence of nematodes (57%) than that of chilli crop field (43%).

Key words: Soil nematodes, morphological characters, occurrence, crop fields, Meiktila

Introduction

There is a large scale diversity in soil nematodes and are one of the most numerous soil animals. In any case, because of their little size and complex extraction from soils, they are generally seldom studied. Most taxonomic efforts have been tended to towards significant plant parasites (Huang and Cares, 2006). Usually nematodes can be found in water-filled pore spaces in the upper soil layers due to high percentage of organic sources (Lavelle and Spain, 2001).

Nematodes are ofter considered as bioindicators which indicating the quality of soil health (Wang and McSorley, 2005). They show variations in their reactions to various pollutants. Application of nematode faunal composition analysis shows the soil food-web, nutrient status and soil fertility, acidity, and the effects of soil contaminants (Bongers and Ferris, 1999). Nematodes feed on bacteria, fungi, protozoans and even other nematodes thereby cycling the nutrients and elements and sometimes attack insects, and help to control insect pests (Hay, 2013). Still some other group dwell on plants as parasites, thereby destroying agricultural crops (McSorley and Frederick, 2000).

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According to the previous authors, nematodes threaten agricultural crops throughout the world, particularly in tropical and sub-tropical regions. Several hundred species of plant parasitic nematodes are known to feed on living plants causing a variety of plants diseases worldwide. In Myanmar, Sann Yi (1976) has been conducted the infestation of plant parasitic nematodes on okra, eggplants, cabbage, chilli and yard long bean at Agricultural Research Institute area, Gyogon, Yangon.

The study on plant parasitic nematodes in the soil has not been carried out in Meiktila environs previously. The aim of this study was to determine the species occurrence of plant parasitic nematodes in the soil of groundnut and chilli crop fields near Meiktila Township.

Materials and methods

Study area

The present study was carried out in some crop fields in Mondaing village of Meiktila Township, Mandalay Region. Meiktila Township is situated between the Latitudes of 20°50′44″ and 20° 55′ North and Longitudes of 95°49′44″ and 95°N 54′ 21″ East. Groundnut and chilli cultivated fields in Mondaing village were chosen as study sites and examination of collected soil and root samples to assay nematodes were conducted at Zoology Department of Meiktila University. The study period was from November 2013 to Feb 2014.

Collection of soil samples

For collection of soil samples, firstly removed upper soil layer for nematode assay because nematodes cannot survive in upper 2-4 inches (5-10 cm) of soil due to extreme environmental conditions (hot and cold). Then three soil samples on weekly basis from each cultivated field altogether ten times were taken using a shovel and placed in separate bags. Then the collected soil samples were carried to Zoology Department for investigation the nematodes.

Preparation for nematode extraction from soil samples

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

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

Collected soil samples from each cultivated field thoroughly mixed into one composite sample. The composite soil sample was passed through a coarse sieve (mesh openings of 10 mm or ¼ inch) to remove any lumps, stones, roots, etc. Any stones or hard lumps of soil were discarded. Then the soil was also passed onto the fine sieve to get smaller soil particles. The sifted soil mixed well to obtain a uniform distribution of nematodes. In the present study, the 50 ml volume of soil was used for nematode extraction by using Whitehead tray method based on Whitehead and Hemming (1965).

Firstly, a gauze cloth (22 x 16 cm) was prepared in the plastic basket (12 x 12 cm). The basket with a gauze cloth was placed in a plastic tray (22 x 22 cm). The 50 ml of soil sample was evenly spread on a gauze cloth. Then about 300 ml of water was carefully added down the inside the edge of the plastic tray until the soil looked wet but not immersed. The extraction was left at room temperature for 24 hours after which the extraction filter (gauze cloth) was carefully removed and water (nematode suspension) poured off into a beaker for allowing to settle for 5 minutes or more. After settling, 2 ml of suspension was taken for nematode assay by using compound microscope.

Identification of plant parasitic nematodes

Plant parasitic nematodes were identified to the genus level according to Tarjan et al. (1977), Hunt et al. (2005), Mekete et al. (2012). Identification were conducted under a compound microscope based on their taxonomic characters such as body shape, head, presence or absence and shape of a stylet, the shape and overlap of the pharyngeal glands with the intestine, oesophagus, ovary, valva position, tail shape, bursa and spicules. Morphological structures of these specimens were then recorded by digital micro-photographs.

Data analyzing

Species composition and relative abundance of plant parasitic nematodes were calculated followed after Bisht et al. (2004).

Results

Systematic position of recorded nematodes

A total of 13 genera belonging to seven families of the three orders under two classes of Phylum Nematoda were recorded (Table 1, Fig.1). Recorded nematodes were identified according to Tarjan et al. (1977), Hunt et al. (2005), Mekete et al. (2012).

Morphological description on recorded specimens

Table 1. Recorded nematodes in collected soil samples.

Phylum	Class	Order	Family	Genus	Common name
Nematoda	Secernentea	Tylenchida	Tylenchulidae	*Tylenchulus*	Citrus root nematode
				Pratylenchus	Lesion nematode
				Rotylenchulus	Reniform nematode
			Hoplolaimidae	*Helicotylenchus.*	Spiral nematode
				Hoplolaimus	Lance nematode
			Pratylenchidae	*Radopholus*	Burrowing nematode
				Nacobbus	False root-knot nematode
			Belonolaimidae	*Tylenchorhynchus*	Stunt nematode
			Heteroderidae	*Meloidogyne*	Root-knot nematode
				Heterodera.	Cyst nematode
	Adenophorea	Dorylaimida	Longidoridae	*Xiphinema*	Dagger nematode
		Triplonchida	Trichodoridae	*Trichodorus*	Stubby root nematode
				Paratrichodorus	Stubby root nematode

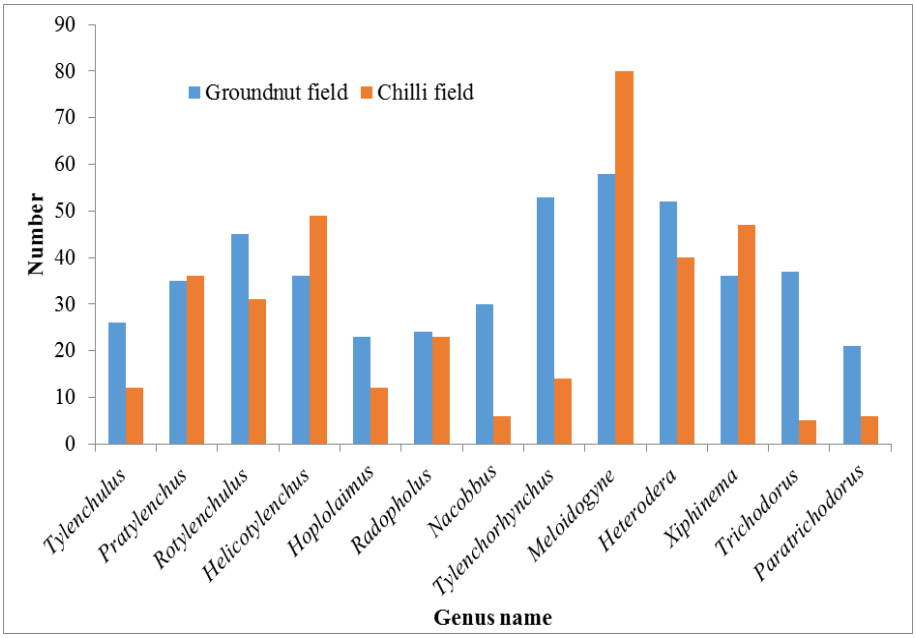

Fig. 1. Number of nematodes in soil samples from groundnut and chilli fields.

Table 2. Species composition and relative abundance of nematodes in all soil samples.

Sr. No.	Genus Name	Groundnut field (%)	Chilli field (%)	Total	Species composition	Relative abundance
1.	*Tylenchulus*	26 (5)	12 (3)	38	4.54	0.05
2.	*Pratylenchus*	35 (7)	36 (10)	71	8.48	0.08
3.	*Rotylenchulus*	45 (9)	31 (9)	76	9.08	0.09
4.	*Helicotylenchus*	36 (8)	49 (14)	85	10.16	0.10
5.	*Hoplolaimus*	23 (5)	12 (3)	35	4.18	0.04
6.	*Radopholus*	24 (5)	23 (6)	47	5.62	0.06
7.	*Nacobbus*	30 (6)	6 (2)	36	4.30	0.04
8.	*Tylenchorhynchus*	53 (11)	14 (4)	67	8.00	0.08
9.	*Meloidogyne*	58 (12)	80 (22)	138	16.49	0.16
10.	*Heterodera*	52 (11)	40 (11)	92	10.99	0.11
11.	*Xiphinema*	36 (8)	47 (13)	83	9.92	0.10
12.	*Trichodorus*	37 (8)	5 (1)	42	5.02	0.05
13.	*Paratrichodorus*	21 (4)	6 (2)	27	3.23	0.03
		476 (57%)	361 (43%)	837		

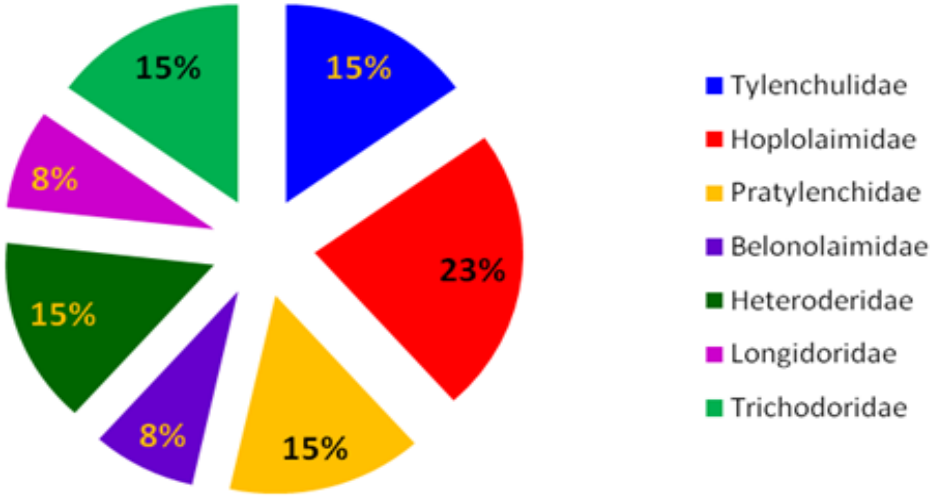

Fig. 2 Number of recoded nematode species in different families.

Discussion

In the present investigation, *Tylenchulus, Pratylenchus., Rotylenchulus., Helicotylenchus, Hoplolaimus, Radopholus, Nacobbus, Tylenchorhynchus, Meloidogyene, Heterodera* under the class Secernentea, and *Xiphinema, Trichodorus* and *Paratrichodorus* under the class Adenophorea were observed.

DNA or isozyme analysis is required to identify nematodes to the species level (Lambert and Bekal, 2002). In the present study, the identification of recorded specimen was also conducted only to the genus level.

Males do not penetrate roots (Evans et al., 1993). In recent study, females were found to be attached to the plant root hairs and males were free living in the soil. *Tylenchulus* were low numbers in yard long bean and chilli in the study conducted by Aye Aye Thant (2009) and the data were similar to that of present study.

Aye Aye Thant (2009) found high numbers of *Pratylenchus* in okra, yard long bean, and low numbers in chilli. In the recent study, the genus *Pratylenchus* found about 8% in all soil samples. So, the data from recent findings were slightly differed from that of Aye Aye Thant. *Rotylenchulus* occurred in low number. But in the present study, the higher number of *Rotylenchulus* found to be equally infested in both groundnut and chilli fields.

According to O'Bannon, and Inserra (1989), most of *Helicotylenchus* inserted their stylets into root epidermis to feed. From the examination of recent study, they were also found to be inserted into root hairs. Wallingford (2007) reported that major host of *Helicotylenchus* was chill and minor hosts were eggplant and yard long bean. In the present investigation, there were high numbers of *Helicotylenchus* in the rhizosphere of chilli.

In the study of soil nematodes by Sann Yi (1976), *Thylenchulus, Hoplolaimus, Pratylenchus* and *Meloidogyne* in Myaung Mya, *Helicotylenchus* in Meiktila were found in okra. There was no record for the genus *Radopholus* in the analyzing by Sann Yi. Higher numbers of *Radopholus* (6%) found in the present study.

Netscher and Sikora (1990) stated that the plant parasitic nematodes found from chilli were *Rotylenchulus, Nacobbus, Trichodorus,* and *Paratrichodorus*. During the study period, the genus *Nacobbus* were found more numbers in the soil samples of groundnut field than that of chilli field.

Aye Aye Thant (2009) pointed that there were high numbers of *Tylenchorhynchus* in eggplant, okra, yard long bean and chill. This observation probably differed from those in the recent work. But the numbers of *Tylenchorhynchus* were greater in the soil of groundnut than in the soil of chilli.

Eisenback and Hirschmann (1991) mentioned that root-knot nematodes, are important group of obligate parasites of various plant. In recent study, both adult's males and females were observed from nearly all soil samples and root tissues of plants.

Wallingford (2007) also reported that major host of *Meloidogyne* were chilli, eggplant, okra and yard long bean. In present study, high numbers of *Meloidogyne* were found to be infested in the soil of chilli. Therefore, the result of this study was similar to those reported by Wallingford (2007).

Wallingford (2007) pointed that the minor hosts of *Xiphinema* were chilli, okra, eggplant and yard long bean. Sann Yi (1976) recorded that the numbers of *Xiphinema* were significantly higher in eggplant than those in chilli and yard long bean. The present result was not consistent with the finding of Sann Yi but the same as the Wallingford (2007).

In the assay of nematodes conducted by Aye Aye Thant (2009), there were high numbers of *Trichodorus* and *Paratrichodorus* in eggplant and cabbage. This study did not agree with Aye Aye Thant (2009).

In the study conducted by Anwar and McKenry (2012), *Meloidogyne incognita* were detected to be the most abundant plant parasitic nematodes in the examination of 325 root and soil samples. This data had consistency with the recent findings.

According to the recent findings, the numbers of nematode from the soil samples in the groundnut fields was found to be higher (57%) than that of chilli fields (43%). The tap roots of groundnut having numerous root hairs with galls and pods of groundnut underneath of the soil may more preferred by soil dwelling nematodes for their nourishment than soil of chilli crop fields. Moreover, more space of soil particles with slits from groundnut fields may allow for easily movement of the nematodes than a large percentage of clay types of soil from chilli crop fields. So, the incidence and severity of nematodes on groundnut may be related to soil texture.

Furthermore, Pankaj et al. (2006) conducted field experiments and they pointed out ploughing decreased nematode population densities significantly. The figures from recent investigation, community structure were zero or small after ploughing. So, the findings had consistency with Pankaj et al. (2006).

According to the previous literatures, all recorded nematodes in the recent study can also be categorized into three feeding types. Ectoparasites were *Rotylenchulus, Hellicotylenchus, Nacobbus* and *Trichodorus, Paratrichodorus;* sedendary endoparasites were *Tylenchorhynchus, Meloidogyne, Heterodera*; and migratory endoparasites were *Tylenchulus, Pratylenchus, Hoplolaimus* and *Radopholus*.

The present study may provide important information to extension specialists and plant scientists to consider that nematodes are major damaging pests of crops and start searching plant parasitic nematode managements.

There is need for concerted effort to control the pest nematodes on plantation area without damaging the beneficial soil organisms including nematodes.

Authors' contributions

Authors contributed equally to the overall design of the study as well as field work, treatment of data and manuscript preparation and approved the final version of the manuscript for publication.

References

Anwar, S.A., McKenry, M.V., (2012). Incidence and population density of plant-parasitic nematodes infecting vegetable crops and associated yield losses in Punjab, Pakistan. *Pakistan J. Zool. ,* vol. 44(2), 327-333.

Aye Aye Thant, (2009). Population status of soil nematodes in relation to cropping patterns. *PhD. Dissertation*. Department of Zoology, University of Yangon. Myanmar.

Bisht, M.S., Kukreti, M., Shantikhuson, (2004). Relative abundance and distribution of bird fauna of Garhwal Himalaya. *Ecology and Conservation* 10 (4): 451-460.

Bongers, T., & Ferris, H. (1999). Nematode community structure as a bioindicator in environmental monitoring. *Trends in Ecology & Evolution, 14*(6), 224-228.

Eisenback, J.D., Hirschmann, H.T., (1991). Root-knot nematodes: *Meloidogyne* species and races. In: Nickle, W.R., *Manual of Agricultural Nematology*. Marcel Dekker, Inc. New York, 191-274.

Evans, K., Trudgill, D.L., Webster, J.M., (1993). *Extraction, Identification and Control of Plant Parasitic Nematodes in Temperate Agriculture*. CAB International, UK.

Hay, F.S., 2013. Nematodes - the good, the bad and the ugly. *The American Phytopathological Society*.

Huang, S.P., Cares, J.E., (2006). Nematode communities in soils under different land-use systems in Brazilian Amazon and

savannah vegetation. In: Moreira, F.M.S., Siqueira J.O., Brussaard, L., (Ed.). *Soil biodiversity in Amazonian and other Brazilian ecosystems*. Wallingford: CAB International. 163-183.

Hunt, D.J., Luc, M., Manzanilla-Lopez, R.H., (2005). Identification, morphology and biology of plant parasitic nematodes. In: Luc, M., Sikora, R.A., Bridge, J. (eds) *Plant parasitic nematodes in subtropical and tropical agriculture*, 2nd Edition. CAB international, Wallingford, UK, pp. 11-52.

Lambert, K., Bekal, S., (2002). *Introduction to Plant-Parasitic Nematodes*. The Plant Health Instructor.

Lavelle, P., Spain, A.V., (2001). *Soil Ecology*. Kluwer Academic Publishers, Boston.

McSorley, R., Frederick, J.J., (2000). Short-term effects of cattle grazing on nematode communities in Florida pastures. *Nematropica,* 30: 211-221.

Mekete T., Dababat A., Sekora N., Akyazi F., Abebe E. (comps). (2012). Identification key for agriculturally important plant-parasitic nematodes Prepared for the International Nematode Diagnosis and Identification Course 2012 - A manual for nematology. Mexico, D.F.: CIMMYT

Netscher, C., Sikora, R.A., (1990). Nematode parasites of vegetable. In: Luc, M., Sikora, R.A., Bridge, J. (eds) *Plant parasitic nematodes in subtropical and tropical agriculture.* CAB International, Wallingford, UK. 237-283.

O'Bannon, J. H., Inserra, R. N., (1989). *Helicotylenchus* species as crop damaging parasitic nematodes. *Nematology Circular 165.* Florida, Department of Agriculture and Consumer Services.

Pankaj, Sharma, H.K., Gaur, H.S., Singh, A.K., (2006). Effect of zero tillage on the nematode fauna in a rice wheat cropping system. *Nematol. medit,* 34:175-178.

Sann Yi, 1976. The study of some plant parasitic nematodes found in different parts of Burma. *M.Sc. Thesis*. Rangoon Art and Science University, Myanmar.

Tarjan, A.C., Esser, R.P., Chang, S.L., (1977). Interactive Diagnostic Key to Plant Parasitic, Freeliving, and Predaceous Nematodes *Journal of Water Pollution,* Vol. 49: 2318-2337.

Wallingford., (2007). CAB International, Crop Protection, Compendium, 2007 Edition. UK.

Wang, K.H., McSorley, R., (2005). Effects of Soil Ecosystem Management on Nematode Pests, Nutrient Cycling, and Plant Health. Online. *AP net Features*. doi: 10.1094/APSnetFeatures/2005-0105

Whitehead, A.G., Hemming, J.R., (1965). A comparison of some quantitative methods of extracting small vermiform nematodes for soil. *Annals of Applied Biology,* 55: 25-38.