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Nematode Faunas and Their Population Dynamics in Mulberry Fields Infected by Root Rot in Thailand

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Abstract
Nematode faunas in more than 30 mulberry fields in Thailand were investigated to identify nematodes causing damages to mulberry. *Criconemella* spp., *Helicotylenchus dihystera, Hoplolaimus seinhorsti, Rotylenchulus reniformis and Tylenchorhynchus* spp. were found to be major nematodes parasitic to mulberry. *Ecphyadophora quadralata* was found in Thailand for the first time in mulberry fields infected by root rot. Seasonal prevalence of occurrence of five species was examined in the infected fields with root rot at the Nakhon Ratchashima Sericulture Research Center, taking into account their possible relationships with the occurrence of t he root rot. The fact that the peaks of density of *H. seinhorsti* and *E. quadralata* coincide with the occurrence of mulberry root rot suggests that these two nematodes be one of the causes of this symptom.

Discipline: Plant disease
Additional key words: Ecphyadophora, Hoplolaimus, mulberry root rot

Introduction

There have been a few reports on information pertaining to the nematodes detected from mulberry fields in Thailand[5–7]. Keereewan and Leeprasert[6] presented a report which contained data on classification and distribution of the plant parasitic nematodes collected in mulberry fields as well as on ecology of *Hoplolaimus seinhorsti* on the mulberry plants. Keereewan et al.[7] studied relationships between the population density of *Ecphyadophora quadralata* and the occurrence of mulberry root rot. Although some other studies relating to root rot disease of mulberry were undertaken by plant pathologists[1–4, 8] and by agronomists[10–13] as well, any detailed analysis on nematological aspects of the symptom had not been made until Keereewan et al. reported first the role of *Ecphyadophora quadralata* in the occurrence of root rot in Thailand. This paper presents results of the investigations on nematode faunas in mulberry fields with and without root rot. It also includes data which indicate a relationship of the seasonal prevalence of some species of nematodes with the occurrence of root rot disease in mulberry fields in Nakhon Ratchasima, Thailand.

Materials and method

1) Nematode fauna in mulberry fields in Thailand

Soil samples collected from more than 30 mulberry fields in Thailand were subjected to separation of nematodes by a centrifugal flotation and sieving method. The nematode specimens fixed by TAF were taxonomically analyzed under a light microscope for identification, and number of nematodes and their frequencies in detection were recorded. Nematode faunas in mulberry fields with and without root rot disease were also examined to compare their difference.

The present paper is prepared on the basis of the results obtained from the cooperative study on nematode in mulberry fields undertaken by Tropical Agriculture Research Center, Japan and Department of Agriculture, Thailand.

2) Seasonal prevalence of the nematodes in mulberry fields

Soil samples collected in a mulberry field were examined on the density of the following four predominant nematode species: *Helicotylenchus dihystera, Hoplolaimus seinhorsti, Criconemella* sp. and *Rotylenchulus reniformis.* The samplings were made at the Nakhon Ratchasima Sericulture Research Center during the period May 1987 to February 1989.

3) Correlation between nematodes and mulberry root rot disease

Hoplolaimus seinhorsti and *Ecphyadophora quadralata* were collected every month for a one-year period from the soils surrounding roots of mulberry trees with and without root rot symptoms at the Nakhon Ratchasima Sericulture Research Center. Records on seasonal changes of the population density of those nematode species were taken for comparison regarding the occurrence of root rot in mulberry plants.

Results and discussion

1) Nematode fauna in mulberry fields

Major species of nematodes detected in mulberry fields in Thailand are shown in Table 1. *Rotylenchulus reniformis, Helicotylenchus* spp. (most of them were likely to be *H. dihystera*), *Criconemella* spp., *Tylenchorhynchus* spp. and *Hoplolaimus seinhorsti* were found frequently, but their role causing damages to mulberry plants was not clearly identified. Both of *H. seinhorsti* and *R. reniformis* were regarded as the most important nematodes parasitic to mulberry in Thailand. Keereewan and Leeprasert[6] listed 12 genera of plant parasitic nematodes on mulberry with some detailed information on each of them. The nematode species they recorded are mostly identical to those observed in the authors' investigation except for the records on *Longidorus* and *Paratylenchus.* Among those species *Ecphyadophora quadralata* and *Hoplolaimus seinhorsti* sampled in the mulberry fields infected by root rot showed higher densities and frequencies of detection than those in the healthy field compared with the cases of other nematodes.

2) Seasonal prevalence of nematode density in a mulberry field

Seasonal changes in the two periods, 1987 to 1988 and 1988 to 1989, of population density of *Helicotylenchus dihystera, Hoplolaimus seinhorsti, Rotylenchulus reniformis* and *Criconemella* sp. in a mulberry field infected by root rot disease, are shown in Figs. 1 and 2, respectively.

As indicated in those figures, there are some differences of the seasonal prevalence pattern in soils among the nematode species and also among the two periods.

During the period 1987 to 1988 (Fig. 1), *H. dihystera* showed its first peak of density in May and the second one in September; *H. seinhorsti* had a moderate peak only in July; *R. reniformis* presented the first peak in December and the second one in March; and *Criconemella* sp. showed the highest

Table 1. Nematode species detected in mulberry fields with and without root rot and density and frequency of detection

Nematode species	Healthy field		Root rot infected field		B/A
	No. of nematodes per 200 g soils	Frequency of detection of nematodes (A)	No. of nematodes per 200 g soils	Frequency of detection of nematodes (B)	
Criconemella spp.	269.0	53.3	214.3	56.7	1.1
Ecphyadophora quadralata	36.7	3.3	56.0	13.3	4.0
Helicotylenchus spp.	22.1	63.3	16.3	70.0	1.1
Hoplolaimus seinhorsti	31.9	40.0	94.5	60.0	1.5
Meloidogyne sp.	4.8	6.7	14.9	3.3	0.5
Pratylenchus sp.	1.8	3.3	14.6	6.7	2.0
Rotylenchulus reniformis	517.6	70.0	508.7	73.3	1.1
Tylenchorhynchus spp.	15.0	46.7	10.9	53.3	1.1
Xiphinema sp.	2.6	3.3	0	0	0

Each value is a mean of 30 replications.

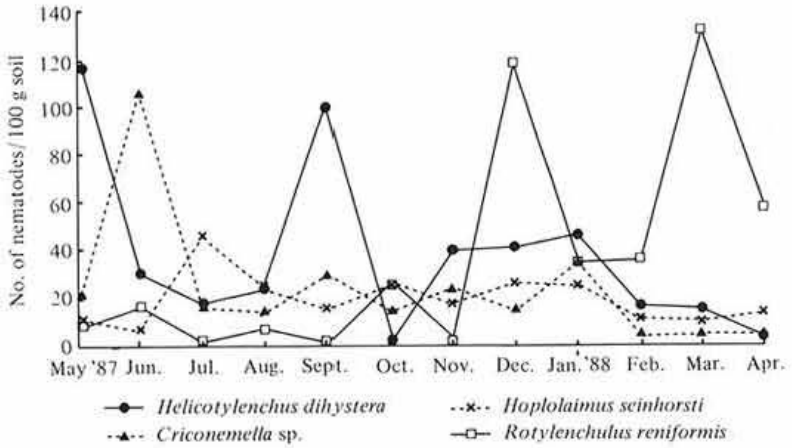

Fig. 1. Seasonal occurrence of nematodes during the period 1987 to 1988 in a mulberry field infected with root rot
Data were obtained at the Nakhon Ratchasima Sericulture Research Center (NRSRC), Thailand.

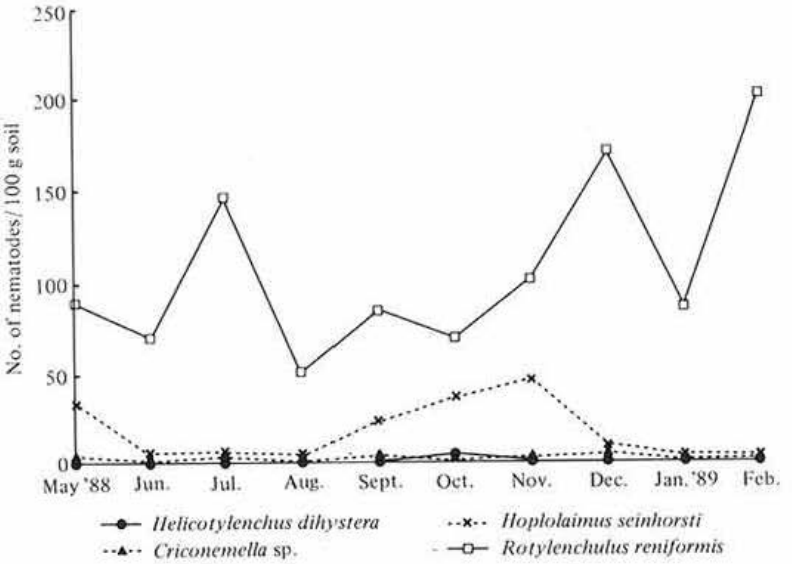

Fig. 2. Seasonal occurrence of nematodes during the period 1988 to 1989 in a mulberry field infected with root rot
Data were obtained at NRSRC, Thailand.

peak in June and the second peak in January. The prevalence patterns of the nematodes in the following year were somewhat different from those in the preceding year, as shown in Fig. 2. Densities of *H. dihystera* and *Criconemella* sp. were low throughout the year; *R. reniformis* showed its peaks in July, December and February in the following year; and *H. seinhorsti* had its first peak in May and the second one in November.

Keereewan and Leepresert[5] reported a seasonal occurrence of *H. seinhorsti* in a mulberry field. In their investigations, the nematode presented its peak of population density in March, which was immediately before the rainy season. This pattern of occurrences was different from the cases in the authors' observation. The prevalence of occurrence namatodes

in soils may vary from year to year, since their densities are greatly influenced by presence of the host plants, soil temperature and moisture. As far as the other two species, i.e., *R. reniformis* and *H. seinhorsti*, were concerned, their seasonal changes were rather consistent through the above two periods, as shown in comparison between Figs. 1 and 2.

3) Correlation between nematodes and mulberry root rot

Results of the experiment are shown in Figs. 3, 4 and 5. The frequencies of detection of *Ecphyadophora quadralata* showed the peaks of density in the months of February, April, June and December and a lower level from July to November. The frequency of detection of mulberry root rot increased from March, reaching the highest level in April and May, being followed by a gradual declining from June to July. After the month of July, the frequencies of the root rot were continuously low (Fig. 3). Although the density of *E. quadralata* is likely to be associated with the occurrence of root rot in the period January to November, the correlation between the nematode density and the root rot does not hold good in December. This discrepancy renders a rather low correlation between them (Fig. 4). In identifying the cause of that discrepancy, further investigations on environmental parameters in December were required. Population density and frequency of detections of the two species of nematodes as mentioned above were compared regarding the differences between the fields with and without mulberry root rot. Table 2 indicates that there are significant differences of the density and frequency of detection in *H. seinhorsti* between the fields with and without root rot, whereas no difference exists in *E. quadralata*.

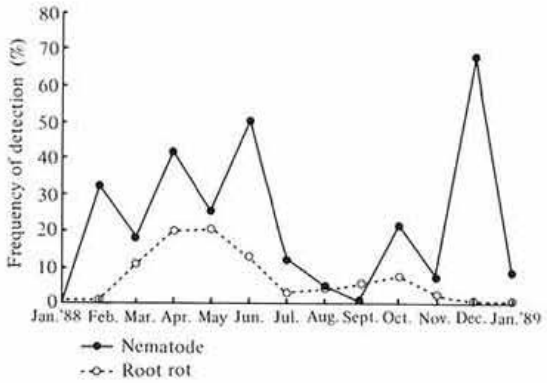

Fig. 3. Seasonal changes of detection of *Ecphyadophora quadralata* and mulberry root rot
Data were obtained at NRSRC, Thailand.

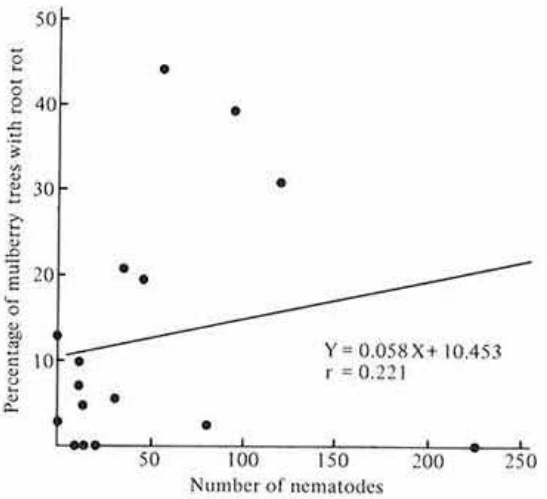

Fig. 4. Correlation between number of *Ecphyadophora quadralata* and percentage of mulberry trees infected with root rot
Data were obtained at NRSRC, Thailand.

Table 2. Number and frequency of detection of *Hoplolaimus seinhorsti* and *Ecphyadophora quadralata* in a mulberry field with and without root rot in Nakhon Ratchasima

Nematodes and root rot	No. of nematodes per 200 g soils		Frequency of detection of nematodes	
	Mulberry infected with root rot	Healthy mulberry	Mulberry infected with root rot	Healthy mulberry
H. seinhorsti	411.9*	205.0	63.8*	42.3
E. quadralata	228.5	135.3	56.1	38.6

Each value is a mean of 24 replications.
* Significantly different at 95% level in *t*-test.

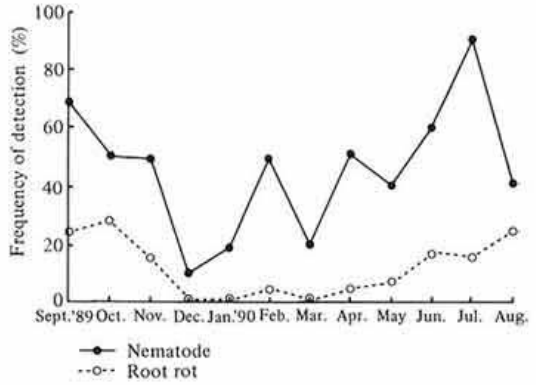

Fig. 5. Seasonal changes of frequency of detection of *Hoplolaimus seinhorsti* and mulberry root rot
Data were obtained at NRSRC, Thailand.

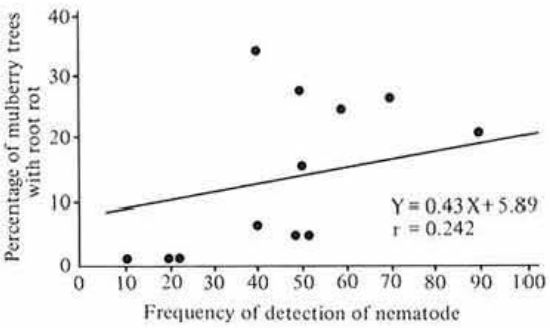

Fig. 6. Correlation between the frequency of detection of *Hoplolaimus seinhorsti* and the percentage of occurrence of mulberry root rot
Data were obtained at NRSRC, Thailand.

Seasonal changes in frequency of detection of *Hoplolaimus seinhorsti* and mulberry root rot in the field at Nakhon Ratchasima are shown in Fig. 5. *H. seinhorsti* generally indicated its high densities in September of the preceding year, February, April and July. Frequency of detection of root rot showed the pattern almost similar to *H. seinhorsti,* suggesting that the density of the nematode be related to occurrence of mulberry root rot. However, the correlation was again rather low because the low incidence of the root rot took place in spite of high nematode density in winter season (Fig. 6).

The fact that *H. seinhorsti* belongs to the group of nematode having a large size of spear and mechanically injures mulberry plants might be worth noticing.

Yagita and Komuro[9] discovered that *Longidorus martini* was a vector of mulberry ring spot virus in Japan. *Xiphinema* spp. and *Trichodorus* spp. have also been known as vectors of virus causing a plant disease. All of these nematodes have large spears, with which pathogen is transmitted to crops. *H. seinhorsti* has never been recorded so far as a vector of any pathogen. However, it may be necessary to take into consideration the implication of the mechanical injuries caused by the spears in analyzing the occurrence of root rot accompanied by the presence of this nematode.

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