Nematode Species Attacking Crops in Thailand with Measurements of Second-Stage Juveniles of *Meloidogyne* spp.

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Abstract

Twenty nine species in 14 genera of plant-parasitic nematodes were collected and identified from mainly upland fields and orchards in Thailand from 1987 to 1990. *Pratylenchus* sp. was detected in this study and described as a new species, *P. subranjani* in 1990 and following six species were recorded for the first time in this country : *Echphyadophora quadralata*, *Helicotylenchus certus*, *Pratylenchus pratensiobrinus*, *Tylenchorhynchus maqbooli*, *T. leviterminalis* and *T. obregonus*. For the identification of *Meloidogyne* spp. in Thailand, measurements of the second-stage juveniles of four species were performed.

Additional key words : plant parasitic nematodes, field crops, fruit trees

Introduction

In Thailand plant-parasitic nematodes have been studied in the past 35 years by Thai and/or foreign nematologists. Chantanao[5] published the pioneer work on Thai nematodes in 1962, and recorded *Aphelenchoides ritzemabosi*, *Ditylenchus angustus*, *Meloidogyne exigua* and also several genera of nematodes including *Helicotylenchus*, *Pratylenchus*, *Rotylenchus* and *Xiphinema*. Hashioka[10] reported the occurrence of severe damage of rice by the rice stem nematode, *Ditylenchus angustus*, in 1963. In the same year Timm[25] reported 30 species of nematodes, of

which 18 were isolated from crop fields. Taylor[26] detected *Meloidogyne graminicola* and six species of *Hirschmanniella* from rice roots in 1969. Sher[22] identified 52 species in 21 genera of nematodes including *Heterodera* oryzae, *Tylenchulus semipenetrans*, etc. Chunram[7] compiled a list of plant-parasitic nematodes and their host plants in Thailand hitherto known. Boonduang and Pliansinchai[2] reported several species of *Meloidogyne*, as a part of the "International Meloidogyne Project", and Cliff and Hirschmann[8] described a new species of *Meloidogyne*, *M. microcephala*, found in this project in Thailand. Nematologists in the Department of Agriculture, Thailand, published a series of taxonomic papers related to Thai nematodes as follows: Criconematidae[3, 17], *Tylenchorhynchus*[4], Pratylenchidae[19], Hoplolaimidae[21], and nematodes of black pepper[18], sugarcane[20] and mulberry[12]. Toida, the first author of this paper, has also carried out studies on plant-parasitic nematodes in Thailand since 1987, and published several papers with his collaborators[6, 13, 14, 15, 16, 26].

Although many species of plant-parasitic nematodes have been recorded in Thailand so far, the important nematode pests for agriculture were not specified except for *D. angustus* on rice. In this paper we present not only a list of plant parasitic nematodes detected chiefly from field crops, vegetables and fruit trees, but also the results of our investigations to determine whether crop damage by the nematodes was economically tolerable in some cases. Furthermore we present the juvenile dimensions of four *Meloidogyne* species for accurate identification of the nematodes found in Thailand.

Materials and Methods

1. Collection and detection of nematodes

Three hundred samples (5-10 g crop roots and 200-500 g soil around them for each) were collected from fields in the northern, northeastern, southern and central parts of Thailand from 1987 to 1990. Nematodes were separated from soil samples by sieving and centrifugal flotation method. Nematodes in roots were stained with acid fuchsin in lactophenol.

2. Fixation and observation of nematodes

Nematodes from soil were treated by gentle heating (60°C), and fixed with TAF fixative. Fixed nematodes were mounted in lactophenol on glass slides after gentle heating process. Mounted nematodes were observed under a light microscope with differential interference system for identification.

3. Measurements of *Meloidogyne* juveniles

The second-stage juveniles of four species of *Meloidogyne* were investigated, i.e. *M. graminicola*, *M. hapla*, *M. incognita* and *M. javanica*. Juveniles were obtained from egg masses on upland rice or tomato, treated by gentle heating, fixed with TAF fixative, mounted in the same fixative, and observed under a light microscope for the measurements.

Results and Discussion

1. Identification of nematode species parasitizing crops

In this investigation, 14 genera of nematodes parasitic to crops were detected and 29 species of these were identified at the species level (Table 1). The detected genera were as follows: *Aphelenchoides* (leaf and stem nematodes), *Criconemella* (ring nematodes) (Plate 1), *Ecphyadophora*, *Helicotylenchus* (spiral nematodes), *Hirschmanniella* (rice root nematodes), *Hoplolaimus* (lance nematodes), *Longidorus* (needle nematodes), *Meloidogyne* (root-knot nematodes), *Pratylenchus* (root-lesion nematodes), *Radophorus* (burrowing nematodes), *Rotylenchulus*, *Trichodorus* (stubby root nematodes) (Plate 6), *Tylenchorhynchus* (stunt nematodes) and *Xiphinema* (dagger nematodes).

Pratylenchus sp. from maize in Phraphutthabat was described as a new species, *P. subranjani*, by Mizukubo et al.[16] Following six species were

recorded for the first time in Thailand : *Ecphyadophora quadralata* from mulberry[26], *Helicotylenchus certus* from maize[14], *P. pratensiobrinus* from citronella grass[26], *Tylenchorhynchus leviterminalis*[15] from queen crape-myrtle, *T. maqbooli* from papaya[15] and *T. obregonus* from cotton[26]. *E. quadralata*, a long and slender nematode, was detected in soil surrounding mulberry roots which were severely infected with root rot in Nakhon Ratchasima. Correlation between the presence of the nematode and the incidence of root rot of mulberry was analyzed, but no significant relations were revealed[13]. In the genus *Meloidogyne*, the most harmful nematode, 4 species including *M. graminicola* (rice root-knot nematode), *M. hapla* (northern root-knot nematode), *M. incognita* (southern root-knot nematode) and *M. javanica* (Javanese root-knot nematode) (Plate 4) were found in this investigation. Formerly known species of this genus in Thailand, *M. arenaria*[2, 7], *M. exigua*[5], *M. microcephala*[8] and *M. naasi*[23] were not detected. They were considered to be rare species with a small population and/or a limited distribution in this country because there have been no records of detection since the first records of them except for *M. arenaria*[2]. It was generally recognized that the genus *Hirschmaniella* was

Table 1. Species of plant-parasitic nematodes detected in Thailand.

Species	One of host crops	Localities
Aphelenchoides spp.	Kenaf (*Hibiscus cannabinus*)	Roi Et
Criconemella spp.	Barley (*Hordeum vulgare*)	Chiang Mai
*Ecphyadophora quadralata**	Mulberry (*Morus alba*)	Nakhon Ratchasima
Helicotylenchus abunaamai	Papaya (*Carica papaya*)	Nakhon Ratchasima
H. cavenessi	Clove tree (*Eugenia caryophyllata*)	Bangkok
*H. certus**	Maize (*Zea mays*)	Phraphutthabat
H. crenacauda	Mangosteen (*Garcinia mangostana*)	Bangkok
H. dihystera	Eggplant (*Solanum melongana*)	Chiang Rai
H. indicus	Areca-nut palm (*Areca catechu*)	Bangkok
Hirschmaniella mucronata	Blackgram (*Phaseolus mungo*)	Pak Chong
Hoplolaimus seinhorsti	Maize (*Zea mays*)	Lopburi
Longidorus spp.	Mandarin (*Citrus reticulata*)	Pathum Thani
Meloidogyne graminicola	Rice (*Oryza sativa*)	Chiang Mai
M. hapla	Potato (*Solanum tuberosum*)	Chiang Mai
M. incognita	Bitter cucumber (*Momordica charantia*)	Petchaboon
M. javanica	Mungbean (*Phaseolus aureus*)	Bangkok
Pratylenchus brachyurus	Soybean (*Glycine max*)	Chiang Mai
P. coffeae	Pummelo (*Citrus grandis*)	Thonburi
*P. pratensiobrinus**	Citronella grass (*Cymbopogon nardus*)	Bangkok
*P. subranjani***	Maize (*Zea mays*)	Lopburi
P. sudanensis	Yellow narra (*Pterocarpus indicus*)	Bangkok
P. zeae	Peanut (*Arachis hypogaea*)	Lampang
Radophorus similis	Banana (*Musa sapientum*)	Rayong
Rotylenchulus reniformis	Chilli (*Capsicum minimum*)	Narathiwat
Trichodorus spp.	Tobacco (*Nicotiana tabacum*)	Chiang Rai
Tylenchorhynchus annulatus	Clove tree (*Eugenia caryophyllata*)	Bangkok
T. capitatus	Papaya (*Carica papaya*)	Nakhon Ratchasima
T. divittatus	Mulberry (*Morus alba*)	Bangkok
T. elegans	Maize (*Zea mays*)	Chiang Mai
*T. leviterminalis**	Queen crape-myrtle (*Lagerstroemia speciosa*)	Bangkok
T. maqbooli *	Papaya (*Carica papaya*)	Nakhon Ratchasima
T. obregonus *	Cotton (*Gossypium* sp.)	Lopburi
Xiphinema americanum s.l.	Mulberry (*Morus alba*)	Chiang Mai

* : Recorded for the first time in Thailand.
** : Described as a new species in 1990.

pathogenic to rice in the tropics and 4 species of this genus had been recorded in *Thailand*[19]. However, only one species, *H. mucronata*, was found in blackgram fields probably because we conducted the survey in upland areas whereas most species of the genus are distributed in paddy fields or in marshlands. Though *Hoplolaimus* spp. were also common plant-parasitic nematodes in the tropical and the subtropical regions, 2 species of the genus merely had been reported from Thailand[21]. *H. seinhorsti* (Plate 3) was detected mostly from orchards at a high frequency as well as *Helicotylenchus* spp. *Xiphinema americanum* sensu lato was the only one species of this genus to be detected from mulberry fields in Nakhon Ratchasima, while the genera *Ditylenchus*[1, 20], *Heterodera*[7] and *Scutellonema*[7, 20, 21] which were more or less injurious to crops could not be detected. The following nematodes known in Thailand, which seemed to be slightly harmful to crops, were not observed in this investigation : *Aglenchus costatus*[1], *Boleodorus thylactus*[18], many species of *Criconemella*[1, 2, 3, 7, 12, 18, 20, 24, 25], *Discocriconemella limitanea*[7, 17, 18], *Hemicriconemoides* spp.[7, 17, 20], *Hemicycliophora tesselata*[3], *Lobocriconema rara*[3, 20], *Longidorus citri*[1] and *L. elongatus*[20].

Although more than 100 species of plant-parasitic nematodes have been recorded in Thailand so far (Tables 1, 2), important nematode pests to the crops consist of about 25 species in 12

Table 2. Species of plant-parasitic nematodes which had been recorded in Thailand

Species	Species	Species
Aglenchus costatus	*H. litchi*	*P. vulnus*
Aphelenchoides besseyi	*H. mangiferae*	*P. zeae*
A. ritzemabosi	*H. strictathecatus*	*Radophorus similis*
Atylenchus decalineatus	*Hemicycliophora tesselata**	*Rotylenchulus reniformis*
Boleodorus thylactus	*Heterodera oryzae*	*Scutellonema brachyurum*
Criconemella curvata	*Hirschmaniella bispina**	*S. clathricaudatum*
C. denoudeni	*H. mucronata*	*S. siamense*
C. humilis	*H. oryzae*	*Tylenchorhynchus acutus*
C. onoensis	*H. thornei*	*T. bifasciatus*
C. ornata	*Hoplolaimus indicus*	*T. brassicae*
C. rustica	*H. seinhorsti*	*T. castatus*
C. spherocephala	*Lobocriconema rara**	*T. crassicaudatus*
Discocriconemella limitanea	*Longidorus citri*	*T. curvus*
Ditylenchus angustus	*L. elongatus*	*T. dactylurus*
D. triformis	*Meloidogyne arenaria*	*T. delhiensis*
Helicotylenchus abunaamai	*M. exigua*	*T. divitatus*
H. cavenessi	*M. graminicola*	*T. duvius*
H. crenacauda	*M. incognita*	*T. elegans*
H. densibulatus	*M. javanica*	*T. latus*
H. digitatus	*M. microcephala**	*T. lineatus*
H. digonicus	*M. naasi*	*T. maqbooli*
H. dihystera	*Paralongidorus sacchari*	*T. martini*
H. egyptiensis	*Paratylenchus christiei*	*T. minutus*
H. erythrinae	*P. minutus*	*T. nudus*
H. exallus	*Pratylenchus alleni*	*T. semipenetrans*
H. indicus	*P. brachyurus*	*T. thailandicus**
*H. microcephalus**	*P. breviobesus**	*T. triglyphus*
H. microdorus	*P. coffeae*	*Tylenchulus semipenetrans*
H. multicinctus	*P. delattrei*	*Trichotylenchus bifasciatus*
H. pseudorobustus	*P. minyus*	*T. thailandicus**
H. retusus	*P. neglectus*	*Xiphinema americanum*
H. rotundicauda	*P. nongkhaiensis**	*X. australiae*
H. varicaudatus	*P. sudanensis*	*X. insigne*
Hemicriconemoides birchfieldi	*P. thailandicus**	*X. orthotenum*
H. cocophillus	*P. thornei*	*X. radicicola*

* : Nematodes described as new species in Thailand.

genera as follows : *Aphelenchoides besseyi*, *A. ritzemabosi*, *Criconemella* spp., *Ditylenchus angustus*, *Helicotylenchus dihystera* (Plate 2), *H. indicus*, *Hirschmaniella mucronata*, *H. oryzae*, *Hoplolaimus seinhorsti*, *Meloidogyne arenaria*, *M. graminicolla*, *M. hapla*, *M. incognita*, *M. javanica*, *Pratylenchus coffeae*, *P. neglectus*, *P. thornei*, *P. vulnus*, *P. zeae*, *Radophorus similis*, *Rotylenchulus reniformis* (Plate 5), *Tylenchorhynchus martini*, *T. nudus*, *Tylenchulus semipenetrans*, *Xiphinema americanum* sensu lato, *X. radicicola*, etc. Of these nematodes, *Criconemella* spp., *Helicotylenchus* spp., *Hirschmaniella* spp., *H. seinhorsti*, *M. incognita*, *M. javanica*, *P. coffeae*, *R. reniformis*, *Tylenchorhynchus* spp. and *Xiphinema* spp. were detected, at a higher frequency, from fruit trees and various kinds of field crops including vegetables, mungbean, soybean, maize, kenaf, etc. in Thailand. Nematodes belonging to genera *Helicotylenchus, Hoplolaimus, Tylenchorhynchus* and *Xiphinema* were detected mainly from fruit and flowering trees and found to parasitize roots, but crop injury to these woody plants was unclear. Furthermore yellowing of paddy leaves probably due to *Hirschmaniella* spp. and root lesions of vegetables, banana, pummelo and tobacco caused by *Pratylenchus* spp. were also observed in the northern part of this country. However, crop damage was not very serious.

Typical instances of severe crop damage caused by the nematodes in Thailand were as follows : yellowing of rice caused by *Meloidogyne graminicola* in the Central Plain of and Northeast Thailand, rugged surface and lesion of potato tubers by *Meloidogyne hapla* in the North, dwarfing of banana plants and yield reduction by *Radophorus similis* in the South, etiolation of cotton and some vegetables by *Rotylenchulus reniformis* in the Northeast, withering of mungbean, tobacco and some other vegetables by *M. javanica* and withering of soybean, black pepper, kenaf, cassava, tomato, carrot, bitter cucumber and several other vegetables by *M. incognita* in the North and the Northeast of this country. Thus several species of nematodes such as *M. graminicola*, *M. hapla*, *M. incognita*, *M. javanica*, *Radophorus similis* and *Rotylenchulus reniformis* were found to be major pests damaging economically impotant crops in Thailand at present. Further accurate assessment of the crop damage caused by other major nematodes including genera *Aphelenchoides*, *Ditylenchus*, *Helicotylenchus*, *Hirschmaniella*, *Hoplolaimus*, *Pratylenchus*, *Tylenchorhynchus*, *Xiphinema*, etc. is required as well as the identification of unknown species of the pest nematodes in Thailand.

2. Measurement of second-stage juveniles of *Meloidogyne* species for identification

Measurements of the second-stage juveniles of 4 species of *Meloidogyne* are listed in Table 3. Length of body and tail of *M. hapla* juvenile from Chiang Mai was shorter than that of other species. Tail length of *M. graminicola* juvenile was greatest among the 4 species. *M. hapla* juvenile could be distinguished from other species by the shorter body and tail and larger c-value. *M. graminicola* juvenile differed from others in the presence of a longer body, tail and hyaline part of tail length, and a smaller c-value. Difference in measurements of the juveniles between *M. incognita* and *M. javanica* was not distinct. The correlation between the length of the body and tail in each species is shown in Fig. 1, 2, 3 and 4. Correlation coefficient in each species was significant. Bivariate plots of stylet length and stylet cone length in 4 species are exhibited in Fig. 5 which shows that *M. hapla* was significantly different from the 3 other species and *M. incognita* also differed from others whereas *M. javanica* resembled *M. graminicola*.

It is concluded that morphological studies of the second-stage juveniles are also useful for the identification of *Meloidogyne* species based on morphological characters as a supplement to the observation of female perineal patterns, as pointed out by Eisenback & Hirschmann[9] and Jepson[11].

References

1) Boonduang, A. & Pliansinchai, U. (1980). Identification of plant parasitic nematodes of

Table 3. Measurements of the 2nd-stage juveniles in four species of *Meloidogyne* in Thailand.

	Meloidogyne species			
	M. incognita	*M. graminicola*	*M. hapla*	*M. javanica*
n	50	50	50	50
Location	Nontha Buri	Chiang Mai	Chiang Mai	Chiang Mai
Host plant	Eggplant	Rice	Potato	Tobacco
Body length (um)	413±21.8	475±28.7	345±18.7	458±12.1
Width (um)	14.7±1.5	14.6±1.4	14.1±0.7	15.5±1.2
Stylet (um)	15.2±0.8	14.4±0.7	13.4±0.8	15.4±0.7
DEGO	2.1±0.3	2.0±0.1	3.1±0.2	3.0±0.1
Excretory pore (%)	20.3±1.0	16.0±0.9	20.2±1.1	18.6±0.6
Tail length (um)	51.4±3.7	68.1±4.0	36.8±3.2	52.0±3.9
c value	8.1±0.5	7.0±0.5	9.5±0.7	8.9±0.7
Hyaline tail length (um)	12.9±1.2	19.1±2.0	12.8±1.1	15.4±2.0
Position of hemizonid	above ex. pore	above ex. pore	above ex. pore	above ex.pore

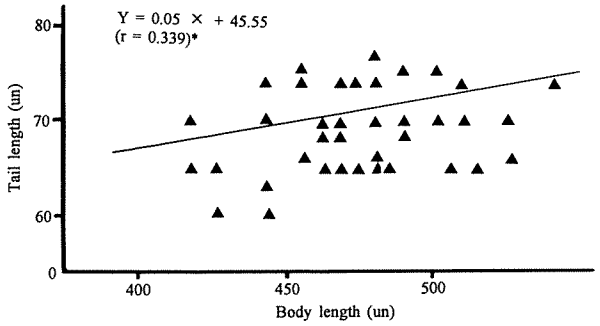

Fig. 1 Correlation between body length and tail length of 2nd-stage juveniles of *Meloidogyne graminicola* on rice in Chiang Mai.

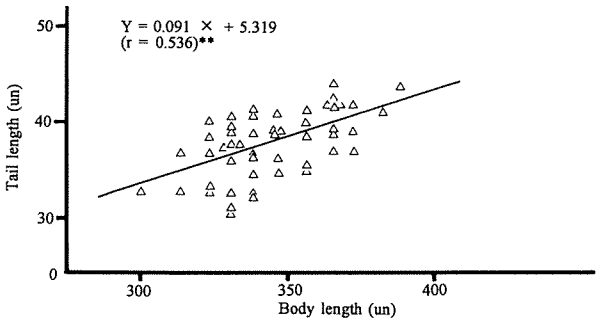

Fig. 2 Correlation between body length and tail length of 2nd-stage juveniles of *Meloidogyne hapla* on potato in Chiang Mai.

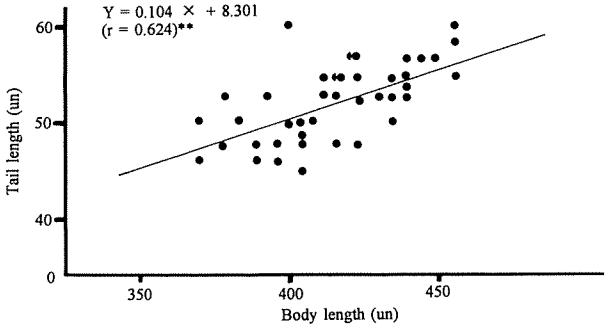

Fig. 3 Correlation between body length and tail length of 2nd-stage juveniles of *Meloidogyne incognita* on eggplant in Nontha Buri.

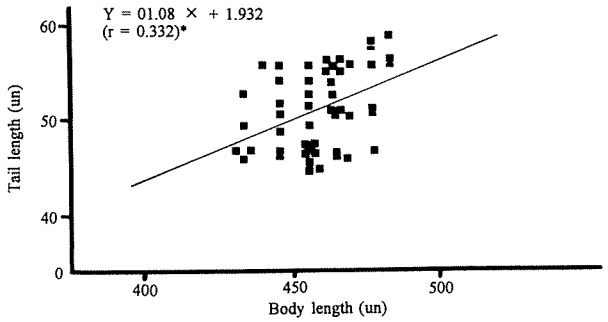

Fig. 4 Correlation between body length and tail length of 2nd-stage juveniles of *Meloidogyne javanica* on tabacco in Chiang Mai.

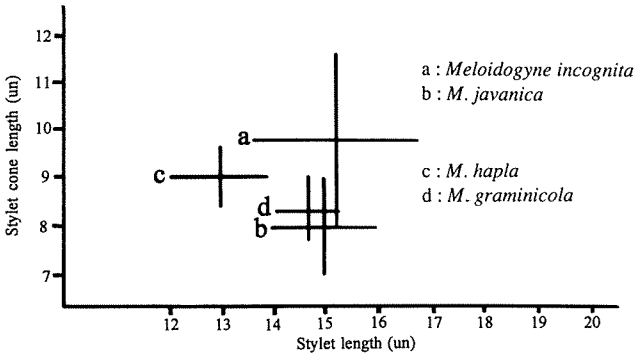

Fig. 5 Bivariate plot of stylet length and stylet cone length of 2nd-stage juveniles of 4 species of *Meloidogyne* in Thailand.

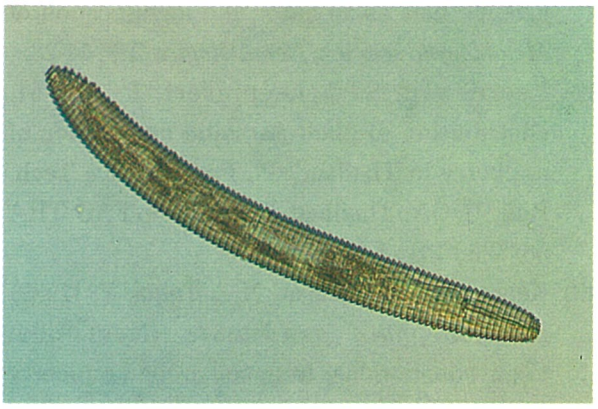

Plate 1. A female of *Criconemella* sp.

Plate 2. A female of *Helicotylenchus dihystera* attacking eggplant root.

Plate 3. *Hoplolaimus seinhorsti* invading maize root.

Plate 4. Females of *Meloidogyne javanica* parasitizing mungbean root.

Plate 5. Females of *Rotylenchulus reniformis* attacking chilli root.

Plate 6. A female of *Trichodorus* sp. invading tabacco root.

Thailand. A systematic study of plant parasitic nematodes of kenaf in Thailand. Nematol. Section Tech. Bull. (DOA, Thailand) **3** : 1-45.

2) Boonduang, A. & Pliansinchai, U. (1986). Identification of plant parasitic nematodes of Thailand. A systematic study of root-knot nematodes (*Meloidogyne* spp.) in Thailand. Nematol. Section Tech. Bull. (DOA, Thailand) **6** : 1-17.
3) Boonduang, A. & Ratanaprapa, D. (1974). Identification of plant parasitic nematodes of Thailand. Systematic study of Criconematidae in Thailand with descriptions of three new species. Pl. Prot. Service Bull. (DOA, Thailand & FAO) **22** : 1-16.
4) Boonduang, A. & Ratanaprapa, D. (1977). Identification of plant parasitic nematodes of Thailand. A systematic study of *Tylenchorhynchus* in Thailand. Nematol. Section Tech. Bull. (DOA, Thailand) **1** : 1-27.
5) Chantanao, A. (1962). Nematodes of rice and some other plants in Thailand. Dept. Entomol. & Pl. Pathol., Kasesart Univ. Tech. Bull. **1** : 1-15 (in Thai with English summary).
6) Chinnasri, B, Tangchitsomkid, N. & Toida, Y. (1994). *Heterodera zeae* on maize in Thailand. *Jpn, J. Nematol.* **24** : 35-38.
7) Chunram, C, (1972). A list of plant parasitic nematodes in Thailand. Pl. Prot. Service Tech. Bull. (DOA, Thailand & UNDP 9/FAO THA 68/526) **1** : 1-44.
8) Cliff, M. G. & Hirschmann, H. (1984). *Meloidogyne microcephala* n. sp. (Meloidogynidae), a root-knot nematode from Thailand. *J. Nematol.* **16** : 183-193.
9) Eisenback, D. J. & Hirschmann, H. (1979). Morphological comparison of second-stage juveniles of several *Meloidogyne* species (root-knot nematodes) by scanning electron microscopy. Scanning Electron Micro scopy III : 223-229.
10) Hashioka, Y. (1963). The rice stem nematode, *Ditylenchus angustus*, in Thailand. FAO Pl. Prot. Bull. **11** : 97-102.
11) Jepson, S. B. (1983). The use of second-stage juvenile tails as an aid in the identification of *Meloidogyne* species. *Nematologica* **29** : 11-28.
12) Keereewan, S. & Leeprasert, P. (1975). Distribution of plant parasitic nematodes of mulberry in Thailand. Pl. Prot. Service Tech. Bull. (DOA, Thailand & UNDP 9/FAO THA 68/526) **28** : 1-18.
13) Keereewan, S. Puttirut, N & Toida, Y. (1989) *Ecphyadophora quadralata* (Nematoda: Ecphyadophoridae) from soil around mulberry in Thailand, with its ecology. *Thai Phytopathology* **9** : 39-45.
14) Mizukubo, T., Toida, Y. & Keereewan, S. (1992). A survey of the nematodes attacking crops in Thailand I, Genus *Helicotylenchus* STEINER, 1945. *Jpn. J. Nematol.* **22** : 26-36.
15) Mizukubo, T., Toida, Y. & Keereewan, S. (1993). A survey of the nematodes attacking crops in Thailand II, Genus *Tylenchorhynchus* COBB, 1913. *Jpn. J. Nematol.* **23** : 19-27.
16) Mizukubo, T., Toida, Y., Keereewan, S. & Yoshida, M. (1990). *Pratylenchus subranjani* n. sp. (Nematoda : Pratylenchidae) from maize in Thailand. *Appl. Ent. Zool.* **25** : 311-318.
17) Pholcharoen, S., Boonduang, A. & Taylor, A. L. (1972). Identification of plant parasitic nematodes of Thailand. I. Criconematidae. Pl. Prot, Service Tech. Bull. (DOA, Thailand & UNDP 9/ FAO THA 68/526) **2** : 1-8.
18) Pliansinchai, U. & Boonduang, A. (1978). Identification of plant parasitic nematodes of Thailand. A systematic study of the plant parasitic nematodes of black pepper in Thailand. Nematol. Section Tech. Bull. (DOA, Thailand & UNDP 9/FAO THA 68/526) **2** : 1-52.
19) Pliansinchai, U. & Boonduang, A. (1986). Identification of plant parasitic nematodes of Thailand. A systematic study of Pratylenchidae in Thailand. Nematol. Section Tech. Bull. (DOA, Thailand) **4** : 1-47.
20) Pliansinchai, U. & Boonduang, A. (1986). Identification of plant parasitic nematodes of sugarcane in Thailand. A systematic study of plant parasitic nematodes of sugarcane in

Thailand. Nematol. Section Tech. Bull. (DOA, Thailand) **5** : 1-75.

21) Ratanaprapa, D. & Boonduang, A. (1975). A second systematic study of Hoplolaimidae in Thailand. Pl. Prot. Service Tech. Bull. (DOA, Thailand & UNDP 9/FAO THA 68/526) **27** : 1-35.

22) Sher, S. A. (1968). Plant parasitic nematodes. Final report to the Government of Thailand, UNDP No. TA 2562 FAO, Rome : 53p.

23) Sontirat, S. (1981). Root-knot nematodes, *Meloidogyne* spp. in Thailand. Proc. of the third research planning conference on root-knot nematodes, *Meloidogyne* spp., Jakarta, Indonesia : 89-96.

24) Taylor, A. L. (1969). Nematode problems of rice. Tropical Nematology (Smart, G. C. and Perry V.G. edited), Center for Tropical Agriculture. Univ. Florida Press : 68-80.

25) Timm, R. W. (1965). A preliminary survey of the plant parasitic nematodes of Thailand and Philippines. South-East Asia Treaty Organization Secretariat-General : 71p.

26) Toida. Y., Keereewan, S., Sano, Z., Mizukubo, T., Iemwimangsa, M. & Chunram, C. (1990). Studies on prevention of crop damage caused by nematodes in Thailand. Final report to National Research Council of Thailand, TARC, Japan : 107p.(Unpublished)

タイ国における作物加害線虫の種類

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摘　要

タイ国の主に畑圃場と果樹園の植物寄生線虫の種類と作物の被害の程度を調べ，有害性の高い線虫を特定した。また，ネコブセンチュウ４種の２期幼虫の体長，尾長などを計測し，これらの値が種の同定上有用であるかどうかを検討した。その結果、以下の14属29種を同定した。それらはハセンチュウ（*Aphelenchoides spp.*），ワセンチュウ（*Criconemella spp.*），*Ecphyadophora quadralata*，ラセンセンチュウ（*Helicotylenchus abunaamai*，*H. cavenessi*，*H. certus*，*H. crenacauda*，*H. dihystera*，*H. indicus*），ネモグリセンチュウ（*Hirschmaniella mucronata*），ヤリセンチュウ（*Hoplolaimus seinhorsti*），ナガハリセンチュウ（*Longidorus sp.*），イネネコブセンチュウ（*Meloidogyne graminicola*），キタネコブセンチュウ（*M. hapla*），サツマイモネコブセンチュウ（*M. incognita*），ジャワネコブセンチュウ（*M. javanica*），ネグサレセンチュウ（*Pratylenchus brachyurus*，*P. coffeae*，*P. pratensiobrinus*，*P. subranjani*，P. sudanensis，*P. zeae*），ミカンネモグリセンチュウ（*Radophorus similis*），ニセフクロセンチュウ（*Rotylenchulus reniformis*），ユミハリセンチュウ（*Trichodorus spp.*），イシュクセンチュウ（*Tylenchorhynchus annulatus*，*T. capitus*，*T. divittatus*，*T. elegans*，*T. leviterminalis*，*T. maqbooli*，*T. obregonus*）およびオオハリセンチュウ（*Xiphinema americanum sensu lato*）であった。このうち，ネグサレセンチュウ１種が新種（*P. subranjani*）として記載されたほか，タイ国からの新記録種は*E. quadralata*，*H. certus*，*P. pratensiobrinus*，*T. maqbooli*，*T. leviterminalis*および*T. obregonus*であった。作物へ特に顕著な被害を及ぼす線虫は，*M. hapla*，*M. incognita*，*M. javanica*，*Radophorus similis*および*Rotylenchulus reniformis*と考えられた。*M. hapla*，*M. incognita*，*M. javanica*および*M. graminicola*の2期幼虫の尾長，体長と尾長の比および口針長と口針錐との比は種ごとに異なるものがあり，同定の補完資料として有用と思われた。

キーワード：植物寄生線虫，ネコブセンチュウ２期幼虫，畑作物，果樹