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Plant-parasitic Nematodes Associated with Groundnut in North Vietnam

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Abstract. Distribution of plant-parasitic nematodes in coastal, midland hilly, and riverbed delta in Nghe An province in North Vietnam was appraised in April 1993. Thirty-one nematode species within 21 genera were identified associated with groundnut in 25 villages in five districts. *Macroposthonia ornata*, *Tylenchorhynchus annulatus*, and *Pratylenchus* species were the most frequently associated nematodes. *M. ornata* was considered most important because of its incidence in 93% of the surveyed region; it was predominant in 32% of the locations. Swelling of the apical parts of groundnut roots was common and *M. ornata* was suspected of being linked with 'apical gall' symptoms. *T. annulatus* was present in 80% of the samples but its population density was normally low (less than 0.5 nematodes per cm^3 soil). *Pratylenchus brachyurus* and *P. zeae* varied in their distribution; *P. brachyurus* was widespread in sandy coastal soils while *P. zeae* populations preferred loamy soils in the midland hilly region. Cysts of *Heterodera* species were found in soil samples in 43% of locations, but groundnut roots were free from cysts. *Meloidogyne graminicola, M. javanica, and Meloidogyne* sp. were found in 77% of locations surveyed. Populations of these species were suspected to affect the rice production. Incidentally, 21 of the species identified are being reported for the first time in association with groundnut in Vietnam, and 8 of them have not previously been reported in association with groundnut in any country.

Keywords: Groundnut, *Heterodera* spp., *Macroposthonia ornata, Meloidogyne* spp., Nematode distribution, North Vietnam, *Pratylenchus brachyurus, Pratylenchus zeae*.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an extensively grown grain legume in the tropical and subtropical regions of the world. It is an important crop in Vietnam where it is grown on over 217,000 ha with yields ranging between 800 and 1,000 Kg per ha. In North Vietnam, cultivation of groundnut is chiefly concentrated in the Nghe An province. Yields of groundnut, a component crop of traditional cropping systems with rice and sweet potato, are relatively low in farmers' fields because of the low rate of adoption of improved varieties, and the prevalence of insect pests and fungal diseases. Little is known about the distribution and abundance of plant parasitic nematodes in the groundnut producing regions in North Vietnam (Krall, 1985). Therefore, the major groundnut producing regions in Nghe An province were surveyed to identify the species of plant parasitic nematodes associated with groundnut and to assess their potential importance. This report is also aimed to assist in development of Geographic Information Systems for research into the biotic constraints of groundnut, and possibly of other crops, of the traditional cropping systems in North Vietnam.

MATERIALS AND METHODS

Thirty major groundnut producing locations in 25 villages within five districts of Nghe An province were randomly surveyed for occurrence of plant parasitic nematodes. The survey locations were representatives of coastal, midland hilly, and riverbed delta agroecological regions. Soils in the coastal region were sandy while in the other two regions they were predominantly sandy loam. Groundnut were sown in February in rows 30 to 45 cm apart and plants were about 60 to 75 days old at the time of survey. The individual fields were the primary unit of the survey. Composite soil samples were collected with the help of a 25-cm long soil sampler from each field, down to a depth of 15-20 cm. Each sample consisted of 6-10 soil cores. Root samples were also collected along with the soil. The nematodes were extracted from 250 cm^3 soil samples by suspending them in water, passing them through nested sieves (850, 180 and 38-μm-pore), and placing the residue from the 38-μm-pore sieve on a modified Baermann funnel (Cobb, 1918; Schindler, 1961). Residue collected on a 180-μm-pore sieve was examined for nematode cysts under a stereoscopic binocular microscope. Roots (2-5 g) were gently

chopped on the sieve to release any *Heterodera* cysts, or the females of reniform (*Rotylenchulus*) and root-knot (*Meloidogyne*) nematodes. The nematode populations were estimated in 250 cm^3 soil and densities of each species were provisionally divided into three groups of low (1-125 nematodes), moderate (126-250 nematodes), and high (>250 nematodes). The nematodes in suspensions were killed and fixed in 2% hot formalin and identified to generic and wherever possible, to species levels. *Meloidogyne* spp. were identified largely on the basis of soil populations, and when females were recovered from roots, perineal pattern morphology was also considered as an adjunct to second-stage morphology and morphometrics. The predominant nematode population in each sample was distinguished.

RESULTS AND DISCUSSION

Thirty-one species of plant-parasitic nematodes within 21 genera were found in association with groundnut in 25 villages in the major groundnut producing region of North Vietnam (Table 1). *Aphelenchus avenae*, *Macroposthonia ornata*, *Tylenchorhynchus annulatus*, and *Pratylenchus* species were consistently present in >80% locations. *Macroposthonia ornata* was present in 93% of the surveyed region, in 54% locations it was the main nematode population, and in 32% locations its density was high (>250 nematodes per 250 cm^3 soil). This species is a proven pest of groundnut in the United States of America, and it is also reported on groundnut from Burkina Faso, Egypt, the Gambia, and India (Minton and Baujard, 1991). Heavy infestation of this nematode causes 'peanut yellows' disease (Machmer, 1953; Barker *et al.*, 1982). Similar symptoms were recognized in the riverbed delta, and midland hilly agro-ecological regions. Roots and pegs were discolored with lesions. In addition, swellings on apical region of the root were observed in locations where the nematode population was high. An association of *M. ornata* with the 'apical gall' symptom was hypothesized. Another species of the ring nematode, *M. onoensis*, is an important pest of rice and causes apical root-knots (Hollis and Keoboonrueng, 1984) on that crop.

The lesion nematodes (*Pratylenchus brachyurus* and *P. zeae*) were present in 80% area of the regions surveyed; in 30% of the locations they were the chief populations with high densities in 18% of samples. The two species varied in their distribution pattern; *P. brachyurus* was widespread in the coastal region, and *P. zeae* in the hilly region. *Pratylenchus zeae* has not been shown to reduce groundnut yields, however, its average frequency of occurrence was greater than that of *P. brachyurus* in the Nghe An province. Moderate lesions on roots, pegs, and young pods, typical of the lesion nematode infection, were seen at many locations. Low to moderate densities of *Tylenchorhynchus annulatus* were noticed in 80% of the locations surveyed. Very limited information is available on the pathogenic potential of *T. annulatus* on groundnut, but its occurrence on groundnut has been reported from Burkina Faso in West Africa (Minton and Baujard, 1991). A related species, *T. brevilineatus*, is an important pest of groundnut in the coastal regions of Andhra Pradesh in India (Reddy *et al.*, 1988) where it significantly reduces groundnut yields.

Second-stage juveniles of *Meloidogyne* spp. were present in 77% of samples. Species of *Meloidogyne* (*M. graminicola, M. javanica, and Meloidogyne* sp.) found in this region differed in their distribution patterns. *Meloidogyne graminicola* was widely distributed in the coastal, midland hilly, and riverbed delta regions. *M. javanica* was prevalent in the coastal region, and *M. javanica* in the riverbed delta and midland hilly regions. An unidentified *Meloidogyne* sp. was occasionally found. Perineal patterns of the females of this species conformed to *M javanica*; but in isolated cases the perineal patterns were similar to those of *M. graminicola*. Identification of *M. graminicola* was on the basis of soil populations. Incidence of the root galls was 60% in the sandy soils of the coastal region in Nghai Loc and Nam Dan districts. Root galls were very small and were usually on the lateral roots which had swollen and curved tips. Rice plants growing in these fields and in the adjoining fields had moderate to severe infection of the root-knot nematode and root symptoms on the two crops were similar.

Rotylenchulus reniformis populations were found associated with groundnut in 65% of locations, specially in the riverbed delta region where the nematode density was high (>250 per 250 cm^3 soil) in 90% of samples. In the coastal region, the nematode density was generally low (<50 per 250 cm^3 soil). This nematode is not reported as an important parasite of groundnut; some *R. reniformis* populations do not even parasitize groundnut. Investigations on the pathogenicity of *R reniformis* populations on groundnut would help in understanding the pathogenic nature of Vietnamese populations.

Cysts of *Heterodera* species were found in soil samples in 43% of locations, but roots were free from cysts. The cyst number was greater (between 4 and 6) at Nghe Trung and Dien Hong locations than in other locations. One of the populations was identified as being close to *H. elachista*.

Presence of many polyphagous plant parasitic nematodes in association with groundnut in North Vietnam deserves serious attention because some of the associated nematode species are proven pathogens of life sustaining crops (Sharma and McDonald, 1990). Incidentally, 21 nematode species are being reported for the first time in association with groundnut in Vietnam, and 8 nematode species are reported in association with groundnut (Table 1) for the first time. Results of this survey are expected to generate awareness among growers, plant protection workers, policy makers and politicians that dangerous species of plant parasitic nematodes are present in

Table 1. List of plant-parasitic nematodes associated with groundnut in Nghe An province in Vietnam

Location (nearest village)	Nematode species
	Nghi Loc district (coastal)
Nghe Trung	*Tylenchorhynchus annulatus* (Cassidy, 1930) Golden, 1971 + , *Pratylenchus brachyurus* (Godfrey, 1929) Schuurmans Stekhoven, 1941*, *Rotylenchulus reniformis* Linford *et* Oliver, 1940 + , *Macroposthonia ornata* (Raski, 1958) De Grisse *et* Loof, 1965 + , *Longidorus elongatus* (de Man, 1876) Thorne *et* swanger 1936 + + , *Divittus* sp + + , *Tylenchorhynchus* sp , *Heterodera* sp
Nghe Trung	*T annulatus*, *P brachyurus*, *R reniformis*, *M ornata**, *Paratrichodorus (Nanidorus) minor* (Colbran, 1956) Siddiqi,1974 + , *Xiphinema* sp , *Ditylenchus* sp + , *Malenchus* sp + + , *Divittus* sp , *Heterodera* sp
Nghe Thinh	*T annulatus*, *P brachyurus**, *M ornata*, *L elongatus*, *P minor*, *Meloidogyne graminicola* + + , *Divittus* sp
Nghe Thinh	*Ottolenchus* sp + + , *M ornata*, *R reniformis*, *Pratylenchus zeae**, *P minor*, *Paralongidorus citri* (Siddiqi, 1959) Siddiqi *et al* ,1963 + + , *Ditylenchus* sp , *Malenchus* sp
Nghi Khanhar	*T annulatus*, *P zeae*, *M ornata**, *M graminicola*, *Ottolenchus* sp , *Divittus* sp , *Aphelenchoides* sp + , *Aphelenchus avenae* + , *Heterodera* sp
Nghi Thach	*A avenae*, *Ditylenchus* sp , *Ottolenchus* sp , *T annulatus*, *P zeae** *M ornata*, *M graminicola*, *M javanica* + , *Heterodera* sp
Nghi An	*T annulatus*, *P brachyurus*, *P zeae*, *M ornata**, *L elongatus*, *M graminicola*, *A avenae*, *P minor*, *Divittus* sp , *Filenchus* sp + +
Dong Vinh	*P zeae*, *R reniformis*, *Divittus* sp , *M ornata**, *A avenae*, *Filenchus* sp , *Heterodera* sp
Hung Dung	*T annulatus* *R reniformis*, *P zeae*, *M ornata**, *Divittus* sp , *Meloidogyne graminicola*, *Heterodera* sp
Nghi Phong	*T annulatus*, *P zeae*, *A avenae*, *P brachyurus*, *M ornata**, *Ditylenchus* sp , *Aphelenchoides* sp , *M graminicola*, *Xiphinema elongatum* Schuurmns Stekhoven *et* Teunissen, 1938, *Divittus* sp
	Nghia Dan district (midland hilly)
Nghia Thuan	*Ditylenchus* sp , *P zeae*, *M ornata*, *T annulatus*, *R reniformis*, *Sakia* sp + + , *R reniformis**
Nghia Hung	*A avenae*, *Ditylenchus* sp , *Ottolenchus* sp , *T annulatus*, *P zeae**, *R reniformis*, *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961, *M ornata*, *Heterodera* sp,
Hong Phong	*A avenae*, *P zeae*, *P brachyurus*, *T annulatus*, *M ornata**, *M graminicola*, *M javanica*, *X elongatum*
Hong Phong	*A avenae*, *T annulatus*, *P zeae*, *M ornata**, *M graminicola*, *Aphelenchoides* sp , *Filenchus* sp
Nghia Thang	*Divittus* sp , *Ditylenchus* sp , *P zeae**, *M ornata*, *L elongatus*, *P minor*, *X elongatum*, *M graminicola*, *Meloidogyne* sp *Heterodera* sp
Dong Hieu	*Radopholus* sp + , *Ditylenchus* sp , *Divittus* sp , *R reniformis*, *Helicotylenchus indicus* Siddiqi, 1963 + + , *P zeae**, *M ornata*, *L elongatus*, *M graminicola*, *M javanica*
Tay Hieu	*Divittus* sp , *P zeae*, *R reniformis*, *M ornata**, *T annulatus*, *Helicotylenchus pseudorobustus* (Steiner, 1914) Golden, 1956 + , *H dihystera*, *Xiphinema insigne* Loos, 1949 + , *L elongatus*, *Paralongidorus citri*, *A avenae*, *P minor*, *X elongatum*, *M graminicola*, *Heterodera* sp

	Quynh Luu district (riverbed delta)
Quynh Chau	*P. brachyurus, P. zeae, R. reniformis, Ottolenchus* sp., *Radopholus* sp., *P. minor, M. ornata*, L. elongatus, Xiphinema* sp., *Ditylenchus* sp., *M. javanica.*
Dien Hong	*T. annulatus, P. citri, P. minor, M. ornata*, Divittus* sp., *M. javanica, Ditylenchus* sp., *Hirschmanniella* sp., *M. javanica, Heterodera* sp.
	Dien Chau district (midland hilly)
Dien Thinh	*T. annulatus*, P. brachyurus, A. avenae, M. ornata, Sakia* sp., *M. javanica, P. citri.*
	Nam Dan district (riverbed delta)
Xuanhou	*T. annulatus, P. citri, R. reniformis*, M. ornata, A. avenae, M. javanica, Heterodera* sp.
Nam Dan	*T. annulatus, R.reniformis, A. avenae, P. citri, M. ornata*, L. elongatus, Trichodorus* sp.+, *M.javanica, Ottolenchus* sp.
Hung Tien	*T. annulatus, L. elongatus, Trichodorus* sp, *Ditylenchus* sp., *Divittus* sp., *P. brachyurus, P. minor, M. ornata*, M. javanica.*
Nam Hung	*T. annulatus, P. brachyurus, M. ornata*, P. minor, Filenchus* sp., *A. avenae, Divittus* sp., *R. reniformis, Trichodorus* sp., *Heterodera* sp.
Nam Loc	*T. annulatus, P. brachyurus, M. ornata*, A. avenae, M. javanica, Trichodorus* sp., *R. reniformis, Filenchus* sp., *Heterodera* sp., *Helicotylenchus* sp.
Hong Long	*R. reniformis*, Ditylenchus* sp., *Helicotylenchus* sp., *A. avenae, Filenchus* sp., *P. brachyurus, Ottolenchus* sp., *M. ornata, Aphelenchoides* sp.
Nam Long	*T. annulatus, Aphelenchoides* sp., *Malenchus* sp., *A. avenae, Ditylenchus* sp., *Ottolenchus* sp., *R. reniformis, M. ornata, P. brachyurus*.*
Nam Long	*T. annulatus, A. avenae, P. minor, M. ornata, R. reniformis*, Aphelenchoides* sp.
Xuan Lam	*P. citri, T. annulatus*, Aphelenchoides* sp., *Heterodera* sp., *A. avenae, P. brachyurus, M. ornata, M. javanica.*
	Hung Nguyen district (riverbed delta)
Hung Linh	*T. annulatus*, Filenchus* sp., *Aphelenchoides* sp., *A. avenae, P. zeae, M. ornata, Meloidogyne* sp.

*Predominant nematode population; + First report on groundnut in Vietnam.
+ + First report on groundnut (Sharma and McDonald, 1990).

agricultural soils in North Vietnam and it seem logical that research on protection of crop yields from nematode pests should be expanded. Rice, sweet potato, and groundnut are the main crops of production systems in North Vietnam and the associated nematode species could be one of the important constraints to the productivity of traditional cropping systems. Widespread distribution of root-knot, and cyst nematode species in North Vietnam is being reported for the first time. These species, particularly *M. graminicola, M. javanica,* and *H. elachista*, are documented as causing serious problems on rice (Bridge *et al.*, 1990), and the rice crop in the surveyed region is presumably prone to significant damage by these species. Determining the importance of nematodes as production constraints on a regional basis is an on-going, gradual and long-term process. This survey indicates nematode species of possible economic importance in groundnut production and in rice-groundnut-sweet potato production systems in North Vietnam. Further work on host range and actual damage potential of these nematode species on groundnut, rice, and sweet potato is suggested.

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