HOST STATUS OF ACRICULTURALLY IMPORTANT PLANT FAMILES TO THE ROOT-KNOT NEMATODE *MELODOGYNE MAYAGUENSIS* IN CUBA

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ABSTRACT

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Meloidogyne mayaguensis is a major pest of coffee in Cuba and has been reported parasitising plants from several families in Africa. Three populations of *M. mayaguensis*, one indigenous to Cuba, the type population from Puerto Rico and one from the Ivory Coast were studied. They were identified by biochemical tests and morphology. The main objective of this study was to determine the relative host status of thirty-two agriculturally important crops, including coffee, are susceptible to the root-knot nematode, *M. mayaguensis*. The results obtained from plants grown under controlled greenhouse conditions at 25°C in pots for 12 weeks indicated that all of the solanaceous plants tested were susceptible, including one variety of tomato containing the Mi gene; about a third of the plants evaluated were non-hosts. Information from this initial test will enable additional field studies to be undertaken to give a true assessment of host status.

Key words: Meloidogyne mayaguensis, Solanaceae, host status.

RESUMEN

Meloidogyne mayaguensis es una importante plaga del cafeto en Cuba y ha sido informada afectando otras plantas en Africa. Tres poblaciones de *M. mayaguensis* fueron evaluadas, una originaria de Cuba, la población tipo de Puerto Rico y otra preveniente de Costa de Marfil. Las poblaciones fueron identificadas empleando métodos de taxonomía clásica y bioquímicos, antes de que la evaluación de hospedantes se efectuara. El principal objetivo del este trabajo fue determiner la condición de hospedantes o no a *M. mayaguensis*, de trenta y una plantas de cultivo, incluyendo el cafeto. Los resultados obtenidos de las plantas creciendo en macetas, bajo condiciones controladas en invernaderos a 25°C durantes 12 semanas fueron los siguientes: 100% de las solanaceas evaluadas resultaron susceptibles, incluyendo un cultivar de tomate contentivo del gen Mi; la tercera parte del total de plantas evaluadas fueron no hospedantes. Utilizando la información de esta prueba piloto, profundizaremos en experimentos de campo que serán ejecutados para determinar el comportamiento de los hospedantes en esas condiciones. La información potencial podra ser empleada para encontrar cultivos trampa o posibles no hospedantes como el cacahuete que podra crecer en las áreas donde cultivos susceptibles crecen.

INTRODUCTION

Meloidogyne mayaguensis Rammah and Hirshmann, 1988 was initially detected in 1981 on coffee (*Coffea arabica* L.) crops growing in the eastern region of Cuba. At the time it was simply recorded as *Meloidogyne* sp., as many other species of root-knot nematode are present in Cuba. It has since been subjected to morphological and molecular studies. (Rodriguez, 2000). The population (P8) of *M. mayaguensis* indige-

nous to Cuba, was subjected to scanning electron microscope studies and morphological and morphometric comparisons with other *M. mayaguensis* populations (L13, the type population from Puerto Rico, and L3 from the Ivory Coast, supplied by Dr. Mirelle Fargette and Dr. M. Phillips), and characterized by isoelectric focusing, chromosome number, isozyme esterase and PCR-RFLPs (Rodriguez, 2000). *Meloidogyne mayaguensis* is also known to cause crop losses on a variety of other botanical families in Africa. Plant species appear to vary greatly in susceptibility to this species of *Meloidogyne*, as observed by Netscher and Sikora (1990). In Cuba, this species was only known to attack coffee and some weeds but, in view of the information from Africa and the yield losses already experienced by Cuban coffee growers, an evaluation of the host status of this nematode and its capacity to develop on other crops commonly grown in Cuba was a necessity.

Here we report results of a greenhouse trial to reveal the relative host status of 32 agriculturally important plant species.

MATERIALS AND METHODS

A pure population of *M. mayaguensis* P8 was reproduced from single egg masses from coffee plants, from Santiago de Cuba province. Multiplication was in pots containing 1000 cm^3 of sterilized compost, sown with tomato (*Lycopersicon esculentum* M. cv. Campbell 28), eggplant (*Solanum melongena* L. cv. Blackbell) or (*Impatiens balsamina* L. busy lizzie), to obtain inoculum for screening.

Thirty-one plant varieties, belonging to thirteen families, were evaluated. To produce seedlings for the evaluation, seeds were sown in standard seed trays containing sterilized substrate.

When the seedlings were 10 cm high, they were transplanted into black plastic bags containing a similar sterile substrate in quantities of, 250 cm^3 for herbaceous plants and 1000 cm^3 for fruit plants and paradise trees. A week after transplanting, each seedling was inoculated with 1500 eggs and second stage juveniles (J2) of *M. mayaguensis* P8. The inoculum was prepared using the NaOCl-blender extraction method (Hussey and Barker, 1973). It was then divided into aliquots of 3mls./per plant each containing 1500 eggs and juveniles injected into the substrate using a 5ml. syringe at four equal points surrounding the plant roots.

Three individual plants (replicates) of each species were grown in the glasshouse at a constant temperature of 25°C and watered daily. The root systems were examined 60 days after inoculation for the annual plants and 120 days after inoculation for perennial hosts. The plants were taken from their pots, the roots washed carefully, the root-galling index (IG) determined, and the reproduction index (RI) calculated according to the methodology of Taylor and Sasser (1978). The criteria defined by Zhang and Schmitt (1994) were used to determine the host status of the plant.

Data analysis

The various measures of host status of the plant species tested were compared using analysis of variance (ANOVA) and Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Meloidogyne mayaguensis P8 reproduced (RI >1) on 18 (58%) of the 31 cultivars of plants evaluated from six botanical families (Table 1). All plants screened from the Solanaceae were good hosts. The tomato cv. Guadajira was the best host with the highest RI ($P < 0.05$), although this was not significantly different from pepper *Capsi-*

Table 1. Host efficiency of different plants to *Meloidogyne mayaguensis.*

Family	Common name	Scientific name	Cultivar	IG	RI
Solanaceae	Pepper	*Capsicum annuum* L.	California Wonder	3.0	19.8
	Eggplant	*Solanum melongena* L.	F1-100	4.3	13.2
	Potato	*Solanum tuberosum* L.	Désirée	3.0	1.3
	Tobacco	*Nicotiana tabacum* L.	Virginia	2.7	2.5
			Nat*. H- 92	3.7	2.8
			Criollo	3.0	2.3
			NC 95	3.7	4.7
	Tomato	*Lycopersicon esculentum* L.	Guadajira	5.0	21.0
			Nat[c]. I-17	5.0	5.9
			Campbell -28	5.0	13.6
Fabaceae	Horsebean	*Canavalia ensiformis* (L.) DC.	—	4.0	1.7
	Soybean	*Glycine max* L.	Forrest	3.0	0. 7
	Common Bean	*Phaseolus vulgaris* L.	Icapijao	1.3	1.3
	Peanut	*Arachys hypogaea* L.	Cascajal rojo	0	0
Anonaceae	Anona	*Anona squamosa* L.	—	0	0
	Chirimoya	*Anona cherimolia* M.	—	0	0
Myrtaceae	Guava	*Psidium guajaba* L.	Cotorrera	5.0	12.4
Rutaceae	Sour orange	*Citrus aurantium* L.	—	0	0
	Grapefruit	*Citrus paradisi* Macf.	March	0	0
Meliaceae	Paradise	*Melia azederach* L.	—	0	0
Umbelliferae	Parsley	*Petroselinum crispum* (Mill.) Airy - Shaw	Plain	4.0	3.1
	Celery	*Apium graveolens* L.	Utah	5.0	3.8
Cruciferae	Cabbage	*Brassica oleracea* L.	Premium	4.0	0.9
	Broccoli	*B. oleracea* var. *botrytis* L.		3.3	0.4
Cucurbitaceae	Pumpkin	*Cucurbita* sp. Duch.	Nat[c]. I-F	2.7	1.5
			Nat[c]. I-M	2.7	1.3
Chenopodiaceae	Sugarbeet	*Beta vulgaris* var. *cicla* L.	Canton	4.0	0.9
	Beetroot	*Beta vulgaris* L.	Detroit	4.7	12.4
Lamiaceae	Thyme	*Thymus vulgaris* L.	—	0	0
Asteraceae	Lettuce	*Lactuca sativa* L.	BSS	3.7	0.3
Liliaceae	Garlic	*Allium sativum* L.	Criollo	0	0

[b]R I reproduction index.
[a]I G: Root galling index.
Nat.[c]: Cuban National Varieties.

cum annuum L. cv. California Wonder. These were better hosts then the tomato cv. Campbell-28, and were therefore used as the standard susceptible control.

The term virulent is applied to populations of *Meloidogyne* that reproduce significantly in a host that prevents or suppresses the reproduction of non-virulent populations (Roberts, 1995). Thus, the Cuban population of *M. mayaguensis* P8 is likely to be virulent as it was capable of high rates of reproduction in the tomato cv. Guadajira, which is resistant to *M. incognita* and *M. arenaria* from Spain (Fernández-Muñoz *et al.*, 1999).

Populations of *M. mayaguensis* from the Ivory Coast and Burkina Faso have been shown capable of reproducing on the tomato cv. Rossol, which also has resistance to *Meloidogyne* spp. (Blok *et al.*, 1997). The Cuban population of *M. mayaguensis* P8 is capable of infesting and reproducing in cultivars of tomato that contain the Mi gene, corroborating the findings of Fargette *et al.* (1994). The high virulence of this species makes the evaluation of any new varieties of Solanaceae in Cuba imperative. Results for eggplant for *M. mayaguensis* is comparable with that for other species of root-knot nematodes, supporting the conclusion by Johnson (1998) that almost all varieties of eggplant are susceptible to *Meloidogyne* spp. The guava plant is also a good host of Cuban population *M. mayaguensis* P8, Willers (1997) found this crop to be severely affected in South Africa by this nematode.

In the Fabaceae, common and horse bean were both hosts for *M. mayaguensis*. The common bean is widely used as a food source in Cuba, while the horse bean *Canavalia ensiformisis* (L.) DC. is used as a cover crop or green manure. The horse bean is also used as an alternative crop for rotation in soils infested with *Rotylenchulus reniformis* (Rodriguez-Kabana *et al.*, 1997) and *Heterodera glycines* (Diogo *et al.*, 1999). It has shown variable reactions to the presence of *M. javanica*, *M. arenaria* and *M. incognita* (Rodriguez-Kabana *et al.*, 1992; Marban-Mendoza *et al.*, 1997; Saavedra and Vargas-Ayala, 1999). In view of this study it would be unwise to grow horse bean where infestations of *M. mayaguensis* are known to exist. Therefore, it is unsuitable for rotation or intercropping in areas where coffee crops are grown or as a green manure in soils where *M. mayaguensis* is present.

Soybean (cv. Forrest) displayed an index of root-galling of 3 (11-30 galls/roots) and was a poor host (RI < 1) for the Cuban *M. mayaguensis* P8 (Table 1). This is in contrast to *M. mayaguensis* L3 from Africa, which reproduced well on this cultivar thought to have moderate resistance to *Meloidogyne* spp. (Fargette *et al.*, 1996).

The representatives of Umbelliferae and Cucurbitaceae proved to be excellent hosts able to maintain populations of this nematode in the soil, and it would be wise also to avoid growing these in areas already known to be infested with *M. mayaguensis*.

Non-hosts made up 29% of the plants evaluated and included peanut, garlic, anona, *Anona cherimolia*, sour orange, paradise tree, grapefruit and thyme (Table 1). All had galling indices of 0, as compared to 5.0 for the most susceptible plants such as tomato, pepper and guava.

In Cuba, Fernández *et al.* (1998) studied populations of *M. incognita, M. javanica* and *M. arenaria* and found that garlic and peanut were resistant to infestation. The results of this preliminary study show that these plants are suitable alternative crops for infested areas, especially peanut, which has the potential to be used as an intercropping plant in young coffee plantations (Willson, 1999).

Several plants, including grapefruit, anona, chirimoya, sour orange and paradise tree, are non-hosts of *M. mayaguensis*

P8, and are commonly found in coffee growing areas used for fruit production. The paradise tree is useful for shade in nurseries and plantations. This plant, well known in India as Persian Lilac, has been shown to be an effective antagonist to nematodes, giving satisfactory control of *M. incognita* and *R. reniformis* (Alam *et al.*, 1990).

The results of this study, and previous work with *Coffea arabica* L., *C. canephora* Pierre, *Ricinus comunis* L., (Rodriguez, 2000), tobacco (Duponnois *et al.*, 1997b), vegetables (Fargette *et al.*, 1994), *Ziziyphus maritima* and species of acacias (Duponnois *et al.*, 1997a) show that all act as good hosts of *M. mayaguensis* including population P8, and provide evidence that this is a polyphagous species and able to overcome resistance to the Mi gene. It is essential to take all precautionary measures possible to limit the spread of *M. mayaguensis* from known areas of infestation to non-infested areas, particularly in tropical countries where this nematode is already prevalent. It will also be necessary to widen and enlarge a study both in greenhouse conditions and field studies and to include new potential hosts.

The information will then be used to identify potential trap crops, and possibly non-hosts such as peanut, which could be grown in areas where crops highly susceptible to this root-knot species are currently grown.

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LITERATURE CITED

ALAM, M. M., M. A.SIDDIQUI, and A. AHAMAD. 1990. Antagonistic Plants. Pp. 41-55 *in*, M. S. Jairajpuri, M. M. Alam, and I. Ahamad, eds. Nematode Bio-Control (Aspects and Prospects). CBS Publishers & Distributors PVT LTD, Delhi 110032, India.

BLOK,V. C., M. S. PHILLIPS, and M. FARGETTE. 1997. Comparison of sequences from ribosomal DNA Intergenic Region of *Meloidogyne mayaguensis* and other Major Tropical Root-Knot Nematodes. Journal of Nematology 29:16-22.

DIOGO, A. M., T. SEDIYAMA, R. D. LIMA, and C. S. SEDIYAMA. 1999. Penetration and reproduction of *Heterodera glycines*, race 3, in some plant species. Nematologia Brasileira 23:24 -33.

DUPONNOIS, R. T., K. TABULA, and P. CADET. 1997a. Étude des interactions entre trois espécés d´*Acacia* (*Faidherbia albida* Del., *Acacia seyal* Del., *A. holosericea* A.Cunn. ex G. Don) et *Meloidogyne mayaguensis* au Sénégal. Canadian Journal of Soil Science 77:359-365.

DUPONNOIS, R., T. MATEILLE, and A. BA. 1997b. Potential effects of sahelian nematophagous fungi against *Meloidogyne mayaguensis* on tobacco (*Nicotiana tabacum* L. var. Paraguay x Claro). Ann. du Tabac, Section 2, 29:61-70.

FARGETTE, M., K. G. DAVIES, M. P. ROBINSON, and D. L. TRUDGILL. 1994. Characterization of resistance breaking *Meloidogyne incognita* - like populations using lectins, monoclonal antibodies and spores of *Pasteuria penetrans*. Fundamental and Applied Nematology 17:537-542.

FARGETTE, M., M. PHILLIPS, V. C. BLOK, R. WAUGH, and D. TRUDGILL. 1996. An RFLP study of the relationships between species, populations and resistance-breaking lines of tropical species of *Meloidogyne*. Fundamental and Applied Nematology 19:193-200.

FERNANDEZ, E., M PEREZ., H. GANDARILLA, and R. CUADRA. 1998. Guía para disminuir infestaciones de *Meloidogyne* spp. mediante el empleo de cultivos no susceptibles. Boletín Técnico 4:1-18. (INISAV-Cuba)

FERNANDEZ-MUNZO, R., J. CABRERA, M. C. RODRIGUEZ, G. ESPARRAGO, J. A. GONZALEZ, M. BAGUENA, C. L. ENZINA, A. RODRIGUEZ, and J. CUARTERO. 1999. "Guadajira" and "Gevora": Open-pollinated, processing tomato cultivars resistant to Root knot Nematodes and Fusarium Wilt. HortScience 34 (2):356-357.

HUSSEY, R. S., and K. BARKER. 1973. A comparison of methods of collecting inocula of *Meloidogyne*

spp. including a new technique. Plant Disease Reporter 57:1025-1028.

JOHNSON, A. W. 1998. Vegetable Crops. Pp. 595-635 *in* K. Barker, G. Pederson, and G. Windham, eds. Plant and Nematode Interactions. Agronomy Monograph No 36. Madison, Wisconsin, USA.

MARBARN-MENDOZA, N., A. JAYAPRAKASH, H-B. JANSSON, R. DAMON JR, and B. M. ZUCKERMAN. 1987. Control of root-knot nematode on tomato by lectins. Journal of Nematology 19:331-335.

NETSCHER, C., and R. A. SIKORA. 1990. Nematodes parasites of vegetables. Pp. 237-283 *in* M. Luc, R. A. Sikora, and J. Bridge, eds. Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. CAB International. UK.

ROBERTS, P. A. 1995. Conceptual and practical aspects of variability in root-knot nematodes related to host plant resistance. Annual Review of Phytopathology 33:199-221.

RODRIGUEZ, M. G. 2000. Identificación y caracterización de *Meloidogyne mayaguensis* (Nemata: Meloidogynidae) en el cafeto en Cuba. PhD Thesis. Universidad Agraria de La Habana, Cuba. 100 pp.

RODRIGUEZ-KABANA, R., J. PINOCHET, D. G. ROBERTSON, C. F. WEAVER, and P. S. KING. 1992. Horsebean (*Canavalia ensiformis*) and crotalaria (*Crotalaria spectabilis*) for management of *Meloidogyne* spp. Nematropica 22:30-35.

RODRIGUEZ-KABANA, R., P. S. KING, and C. F. WEAVER. 1997. Host suitability of selected tropical legumes and others plants for the reniform nematode (*Rotylenchulus reniformis*). Nematropica 27:121.

SAAVEDRA, E. D., and R. VARGAS-AYALA. 1999. Prácticas de manejo sustentables sobre nematodos del platanero en Puerto Rico. Nematropica 29:133.

TAYLOR, A. L., and J. N. SASSER.1978. Biology, Identification, and Control of Root-Knot Nematodes (*Meloidogyne* species). Raleigh, North Carolina State Univ. Graphics, 111 pp.

WILLERS, P. 1997. Die aalwurmprobleem by koejawels en moontlike gebruik van kadusafos aalwurmdoder. (Guava Koejawel) ITSC Information Bulletin No. 293:10-11. (Sudáfrica).

WILLSON, K. C. 1999. Botany and Plant Improvement. Pp. 33-44 *in* Coffee, cocoa and tea. CAB International, Oxford, UK.

ZHANG, F., and D. P. SCHMITT. 1994. Host status of 32 plant species to *Meloidogyne konaensis*. Journal of Nematology 26:744-748

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