Meloidogyne mayaguensis a new plant nematode species, poses threat for vegetable production in Florida.

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Abstract

Seven species of root-knot nematodes were identified from 465 soil and root samples collected in Florida agriculture. The plant nematodes were identified primarily by isozyme analysis (EST and MDH), however morphology and mitochondrial DNA analyses were used when needed. The species identified were *Meloidogyne arenaria, M. graminicola, M. graminis, M. hapla, M. incognita, M. javanica,* and *M. mayaguensis*. Several species remain unidentified. *M. mayaguensis* occurred sympatrically with *M. arenaria, M. incognita,* and *M. javanica*. *M. mayaguensis* was found in roots of basil (*Ocimum* sp.), bell pepper *Capsicum annuum* var. *annuum,* egg plant (*Solanum melogena*), guava (*Psidium guajava*), and tomato (*Lycopersicon esculentum*). Several ornamental plants found as hosts included ajuga, (*Ajuga reptans*), angel trumpet (*Brugmansia* 'Sunray'), cape honeysuckle (*Tecomaria capensis*), crimson bottlebrusth (*Callistemon citrinus*), glorybower (*Clerodendrum ugandense*), glory bush (*Tibouchina* 'Compacta' and *Tibouchina elegans*), lantana (*Lantana* sp.), and wax myrtle (*Myrica cerifera*). Also, two wild-plant species, American black nightshade (*Solanum americanum*) and wild poinsettia (*Poinsettia cyathophora*), were found heavily infected with *M. mayaguensis*. In differential host tests this nematode shows the same reaction as that of *M. incognita* race 4. *Pasteuria penetrans,* a bacterial parasite of *Meloidogyne* spp., was not found infecting *M. graminicola* or *M. mayaguensis*.

Introduction

Root knot nematodes (RKN) are widely distributed, have a broad-host range, and cause substantial reduction of crop yield and quality. More than 80 nominal species have been described (Karssen, 2002). *M. mayaguensis* is now considered as one of the most important RKN species because of its ability of overcome the resistance of important crop plants, such as Mi-1 carrying tomato genotypes (Fargette, 1987), pepper, and some agronomic crops (Fargette et al., 1987) that confers resistance to *M. javanica, M. arenaria,* and *M. incognita*. This nematode was originally described from a population collected from egg plant (*Solanum melongena*) in Puerto Rico. In 2001 it was reported for the first time in the continental USA in Florida (Brito et al., 2003). It also has been found in Brazil (Carneiro et al., 2001), Cuba (Decker and Rodriguez-Fuentes, 1989); France (Blok et al., 2002), Guadalupe and Martinique, (Carneiro et al., 2000), Malawi, and Tobago-Trinidad (Trudgill et al., 2000), South Africa (Willers, 1997), and West Africa (Burkina Faso, Ivory Coast, and Senegal) (Fargette et al., 1994; Duponnois et al., 1995; Trudgill et al., 2000).

Biological control of RKN is a promising method of management, especially by the bacterial endospore-forming parasite *Pasteuria penetrans* (Chen and Dickson, 1998). The bacterium has been reported infecting several species of RKN in most parts of the world (Chen and Dickson, 1998; Trudgill et al., 2000), thus we were interested in determining its occurrence on *M. mayaguensis* and other *Meloidogyne* spp. in Florida.

Objective

Our objectives were to identify *Meloidogyne* spp. on ornamentals, herbs, fruits and vegetables crops; determine their distribution in Florida; elucidate host preferences for *M. mayaguensis*, and determine the occurrence of *P. penetrans* on this plant nematode and other *Meloidogyne* spp.

Materials and Methods

A total of 465 soil and root samples (295 root and 170 soil) were collected from agronomic and vegetable crops, fruit trees, herbs, ornamentals, and wild plants in 26 Florida counties. Ornamental nurseries and vegetable production areas were sampled more intensively and the number of samples was increased in areas where *M. mayaguensis* was previously detected. Root-knot nematodes were identified primarily by esterase and malate dehydrogenase phenotypes (Esbenshade and Triantaphyllou, 1985). Perineal patterns, morphometrics (Jepson, 1987), and mitochondrial DNA (Powers and Harris, 1993) analyses were used when needed. At least 26 young, egg-laying females per population were used for isozyme analyses. Corresponding egg masses were used to build up isolates. For samples where only a few roots were slightly infected, the number of females used for isozymes analyses were reduced (8 to 13 females per gel). Two individual *M. javanica* females per gel were used as standards. Ten to twenty females were observed to determine the percentage infected by *P. penetrans* and the developmental stages of the bacterium present (Serracin et al., 1997). Nematodes were extracted from soil collected at each site using a centrifugal-flotation method (Jenkins, 1964), the number of endospore-encumbered second-stage juveniles (J2) per 100 cm^3 of soil, and the number of endospores attached per J2 were quantified (Chen et al., 1997).

Results and Discussion

The major species identified were *M. incognita* (29%), *M. mayaguensis* (20%), *M. javanica* (17%), and *M. arenaria* (14%). Other species identified were *M. graminicola* (1%), *M. graminis* (1%), *M. hapla* (0.4%), and unidentified *Meloidogyne* spp. (25%). Mixed populations were found in 16% of the samples. Only 9% of the samples were negative for *Meloidogyne* spp., but sites with potential infestations of RKN were targeted in the survey. *M. mayaguensis* was found in 10 Florida counties infecting vegetable crops, herbs, one fruit tree, two species of wild plants, and ornamental plants belonging to several botanical families (Tables 1,2). *M. graminicola* was found infecting purple nutsedge (*Cyperus rotundus*) in one site in Dade Co. *M. hapla* was found infecting strawberry in Hillsborough Co. In some of the sites *M. mayaguensis* occurred sympatrically with *M. arenaria*, *M. incognita*, and *M. javanica*. Similar results were

reported on coffee in Cuba (Rodriguez et al., 1995) and tomato in Senegal (Duponnois et al., 1995). This is the first report of *M. mayaguensis* infecting certain ornamentals, herbs, and three new species of wild plants. These results show that *M. mayaguensis* is wide spread in Florida and it has a wide host range. No *M. mayaguensis* was found infected by *P. penetrans*. The percentage of spore encumbered J2 and *P. penetrans* infected females of *Meloidogyne* spp. was relatively low. *P. penetrans* infected *Meloidogyne* spp. females were found in only 7% of the samples analyzed, whereas only 10% of the J2 extracted from the soil were encumbered with *P. penetrans*.

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Table 1. County, plant species, and isoenzyme phenotypes of *Meloidogyne mayaguensis* found in root samples collected from selected plants in Florida.

County	Plant species	No. of samples	Isoenzyme phenotypes		% *Pasteuria penetrans*[c]
			Est	Mdh	
Alachua	*Capsicum annuum*	2[d]	VS1-S1	N1a	0
Dade, Gilchrist	*Lycopersicon esculentum*	7[d,g]	VS1-S1	N1a	0
Hendry, Martin St. Lucie	*Solanum melogena*	2[e]	VS1-S1	N1a	0
Martin, St. Lucie	*Ocimum* sp.	5[f]	VS1-S1	N1a	0
Dade,	*Psidium guajava*	3[g]	VS1-S1	N1a	0
St. Lucie	Mixed roots (*Annona* sp., *Pouteria sapota*, *Euphorbia longana*, *Chrysophyllum cainito*, and *Psidium guajava*)	1	VS1-S1	NIa	0
Dade,	*Fatoua villosa*	1	VS1-S1	N1a	0
Nassau	*Poinsettia cyathophora*	1	VS1-S1	N1a	0
	Solanum americanun	2[g]	VS1-S1	N1a	0

[d,e,f,g]Mixed populations, Mm and Mi, Mm and Mj, Mm and Ma; and Mm and *Meloidogyne* spp., respectively.

Table.2. County, plant species, and isoenzyme phenotypes of *Meloidogyne mayaguensis* found in root samples collected from ornamental plants in Florida.

County	Plant species	No. of samples	Isoenzyme phenotypes	
			Est	Mdh
Alachua, Dade, Nassau, Orange, Palm Beach	*Ajuga reptans*	l	VS1-S1	N1a
	Brugmansia sp.	3	VS1-S1	N1a
	Brugmansia x 'Sunray'	3	VS1-S1	N1a
	Calistemoon viminalis	1	VS1-S1	NIa
	Calistemoon sp.	1	VS1-S1	NIa
	Clerodendrum ugandense	2[a]	VS1-S1	N1a
	Lantana sp.	1	VS1-S1	N1a
	Myrica cerifera	7[b]	VS1-S1	N1a
	Solandra maxima	1	VS1-S1	N1a
	Tecomaria capensis	1	VS1-S1	N1a
	Tibouchina x *compacta*	1	VS1-S1	N1a
	Tibouchina x *elegans*	1	VS1-S1	N1a
Broward	Mixed roots (*Hibiscus* sp. and an unknown wild plant)	1[a]	VS1-S1	N1a
Palm Beach	Mixed roots (*Thunbergia* spp., *Tithonia* spp., *Tibouchina* spp., *Torenia* spp., and *Trachelospermum* spp.)	1	VS1-S1	N1a

[a,b]Mixed population, Mm and Ma; and Mm and *Meloidogyne* sp., respectively.