PLANT-PARASITIC NEMATODES ASSOCIATED WITH TOBACCO (*NICOTIANA TABACUM* L.) IN THE PINAR DEL RÍO PROVINCE OF CUBA

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ABSTRACT

Pérez, M., and E. Fernández. 1998. Plant-parasitic nematodes associated with tobacco (*Nicotiana tabacum*) in the Pinar del Río province of Cuba. Nematropica 28:187-193.

Six hundred and fourteen fields representing 26% of the tobacco crop in the Pinar del Río province of northwest Cuba were sampled to determine the presence and incidence of plant-parasitic nematodes. Nine genera including *Meloidogyne, Rotylenchulus, Pratylenchus, Helicotylenchus, Ditylenchus, Tylenchorhynchus, Criconemoides, Trichodorus,* and *Aphelenchoides* were identified from soil or root samples. *Meloidogyne* spp. and *Rotylenchulus* spp. were found in highest frequencies and numbers. On average, *Meloidogyne* spp. and *Rotylenchulus* spp. were found in 76% and 64%, respectively, of the fields within any of eight production zones in the province. *Meloidogyne* spp. were detected most frequently in the August C. Sandino production zone (99%) and least frequently in the Pilotos zone (47%). Greatest frequency of *Rotylenchulus* spp. was in tobacco fields in San Luis (91%) and lowest in those of Pilotos (37%). Average population density of *Rotylenchulus* spp. on tobacco roots in any production zone was 35.6% of that of *Meloidogyne* spp., but in the San Luis production zone both genera were detected with high frequency and at high population densities. *Meloidogyne* spp. was detected in 96% of fields planted to tobacco cv. Virginia 315, but all cultivars grown were susceptible to infection by species of *Meloidogyne.* Results of the survey indicate that, as for tobacco industries worldwide, *Meloidogyne* spp. are the plant parasitic nematodes of most economic concern to tobacco growers in Cuba.

Key words: Aphelenchoides, Cuba, *Ditylenchus, Helicotylenchus, Meloidogyne,* nematodes, *Nicotiana tabacum, Pratylenchus, Rotylenchulus,* survey, tobacco, *Trichodorus, Tylenchorhynchus, Xiphinema.*

RESUMEN

Pérez, M. y E. Fernández. 1998. Nematodos parasitadores de plantas asociados al tabaco (*Nicotiana tabacum* L.) en la provincia de Pinar del Río, Cuba. Nematrópica 28:187-193.

Seiscientos catorce campos, los que representan el 26% del tabaco cultivado en la occidental provincia de Pinar del Río, fueron muestreados para determinar la presencia e incidencia de nematodos parasitadores de plantas. Nueve géneros incluyendo *Meloidogyne, Rotylenchulus, Pratylenchus, Helicotylenchus, Ditylenchus, Tylenchorhynchus, Criconemoides, Trichodorus,* y *Aphelenchoides* fueron identificados en las muestras de raíz o suelo. *Meloidogyne* spp. y *Rotylenchulus* spp. fueron encontrados en las mayores frecuencias y números. Como promedio, un 76 y 64% de *Meloidogyne* spp. y *Rotylenchulus* spp. respectivamente, fueron encontrados en cualquiera de los campos dentro de las ocho zonas de producción en la provincia. *Meloidogyne* spp. se detectó con más frecuencia (99%) en la zona de producción Augusto C. Sandino y menos frecuentemente (47%) en la zona de Pilotos. La mayor frecuencia de *Rotylenchulus* spp. se encontró en el tabaco de San Luis (91%) y la menor en Piloto (37%). El promedio de densidad poblacional de *Rotylenchulus* spp. en las raíces del tabaco en cualquier zona de producción fue 35.6% del promedio de *Meloidogyne* spp., sin embargo en la zona de producción de San Luis ambos géneros fueron detectados a altas frecuencias y densidades poblacionales. *Meloidogyne* spp. se detectó en 96% de los campos plantados con tabaco de la variedad Virginia 315, pero todos los cultivos fueron susceptibles a la infección por especies de *Meloidogyne.* Los resultados del muestreo indican que, como la industria del tabaco a nivel mundial, *Meloidogyne* spp. es el parásito de plantas de más importancia económica para los cultivadores del tabaco en Cuba.

Palabras claves: *Aphelenchoides*, Cuba, *Ditylenchus*, *Helicotylenchus*, *Meloidogyne*, muestreo, nematodos, *Nicotiana tabacum*, *Pratylenchus*, *Rotylenchulus*, tabaco, *Trichodorus*, *Tylenchorhynchus*, *Xiphinema*.

INTRODUCTION

The Pinar del Río province located in northwest Cuba is the major tobacco production region of the country with approximately 60% of the hectarage. The province is divided into eight production zones which grow a wide variety of tobacco (*Nicotiana tabacum* L.) types including flue-cured, burley, fire-cured, dark-cured and cigar wrapper tobacco. Plant-parasitic nematodes are major limiting factors to yield and quality of tobacco in Cuba and worldwide (Garcia, 1979; Shepard and Barker, 1990). Nematode parasites directly affect tobacco yield and quality, but in addition, facilitate entry by other pathogens such as fungi and bacteria resulting in additional losses (Good, 1968; Lucas, 1975). Worldwide, more than 50 species of nematodes have been associated with tobacco production (Roman, 1978). Of these, the most economically important genera for crops generally are *Ditylenchus*, *Globodera*, *Longidorus*, *Meloidogyne*, *Pratylenchus*, *Tylenchorhynchus*, and *Xiphinema*. However, species in the genus *Meloidogyne* (*M. incognita*, *M. javanica*, *M. arenaria*, and *M. hapla*) are the most economically damaging to tobacco (Dunn and Rich, 1997; Johnson, 1989; Khan, 1990; Scognamiglio, 1998).

Little published information is available on the distribution and incidence of plant-parasitic nematodes in tobacco in Cuba, or the resulting economic losses. A preliminary survey in the Pinar del Río province detected 15 genera of plant-parasitic nematodes associated with tobacco (Garcia, 1979). However, the survey was comprised of relatively few sample sites, and tobacco varieties used by growers have changed significantly in the past 2 decades. Therefore, the objective of this study was to provide more comprehensive information on the incidence, population density, and distribution and of plant-parasitic nematodes in tobacco in the Pinar del Río province of Cuba and to estimate their relative economic importance in this crop.

MATERIALS AND METHODS

A nematode survey was conducted annually between 1991 and 1994 in Pinar del Río province (Fig. 1). During this time, samples were collected from 192 ha (26% of the tobacco hectarage) divided among 614 fields (Table 1). Sample fields were chosen among eight zones within the province, and represent 16-68% of the tobacco hectarage within any zone. The majority of samples were collected 70-80 days after transplanting tobacco plants, although some samples (<5.0%) were collected as early as 40 days after transplanting. Ten soil and root samples were taken diagonally across each individual field or across each hectare in fields larger than 1 ha. Each sample consisted of an entire plant root system and surrounding soil. Soil samples from each field were combined, mixed, and two subsamples of 50 cm^3 soil were processed by the centrifugation-flotation method (Caveness and Jensen, 1955). Root samples were similarly combined, cut into small segments, mixed, and two subsamples of 20 g each of were macerated and then processed by the same method. Nematodes were counted under a stereoscopic microscope and identified to genus.

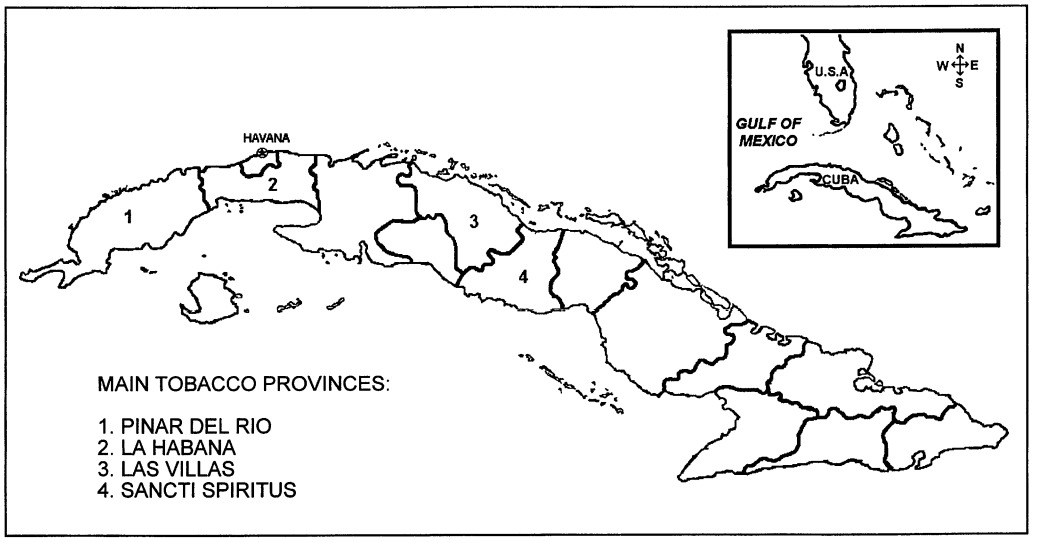

Fig. 1. Map of Cuba showing major tobacco-producing provinces.

RESULTS AND DISCUSSION

Seven genera of plant-parasitic nematodes and 2 genera (*Ditylenchus* and *Aphelenchoides*) that contain species of both free-living and plant parasitic nematodes were found associated with tobacco (Table 2). Most of the genera were present in the each of the eight tobacco zones of the Pinar del Río province. *Meloidogyne* spp. and *Rotylenchulus* spp. were detected most frequently; 47-99% of samples in different zones contained *Meloidogyne* spp. and 37-91% contained *Rotylenchulus* spp. *Meloidogyne* spp. was found most often in fields in the August C. Sandino (99%), San Luis (85%), and Briones Montoto (84%) zones and least often in those of the Pilotas zone (47%). *Rotylenchulus* spp. were detected most frequently in fields in the zones of San Luis (91%) and San Juan (86%), and least frequently in those of the Pilotos (37%), Consolacíon del Sur (43%), and Santa Maria (47%) zones.

On average, the highest numbers of nematodes recovered were *Meloidogyne* spp., followed in descending order by *Rotylenchulus* spp., *Pratylenchus* spp., *Criconemoides* spp., and *Helicotylenchus* spp. (Table 3). Population densities of *Meloidogyne* spp. were highest (>200 nematodes / 20 g roots) in the San Juan, San Louis, Briones Montoto, and Augusto C. Sandino zones, and lowest (<50 nematodes/20 g roots) in Pilotos and Consolacíon del Sur zones (Table 3). Only in the San Luis zone did *Rotylenchulus* spp. attained average population densities comparable to those of *Meloidogyne* spp. Numbers of nematodes in the genera *Tylenchorhynchus*, *Trichodorus*, and *Aphelenchoides* were generally low.

Symptoms observed in *Meloidogyne*-infected tobacco included typical root-galling, plant stunting, and chlorosis which varied with the level of infestation among fields (data not shown). Few foliar or root symptoms were associated with *Rotylenchulus* spp., but some plant stunting was evident in highly infested fields. Similarly, foliar symptoms were not apparent in fields containing *Pratylenchus* spp., but roots were necrotic when high numbers were present. Also, high infestation levels

Table 1. Tobacco zones, hectares and number of fields sampled for presence of plant-parasitic nematodes in the Pinar del Río province of Cuba.

Zones	Production area (ha)	Hectares sampled	Total fields	Fields sampled
San Juan	100.0	22.5	630	113
San Luis	97.9	22.1	462	86
Pinar del Río	69.0	20.4	296	58
Pilotos	69.2	30.0	467	87
Briones Montoto	47.3	32.4	167	54
Santa María	95.5	33.9	163	44
Consolacíon del Sur	95.2	28.7	446	78
Augusto D. Sandino	153.0	25.0	410	94
Total	727.1	192.1	3041	614

of *Meloidogyne* spp. or *Pratylenchus* spp. were associated with the root-rotting fungi *Phytophthora nicotianae* var. *nicotianae* and *Sclerotium rolfsii*. No obvious foliar or root symptoms were observed due to presence of other nematode genera.

Tobacco type and cultivars were identified and associated with the presence of *Meloidogyne* spp. which were found in 96% and 94% of fields planted to cvs. Virginia 315 and Speight G28, respectively (Table 4). However, this genus was widely prevalent in all tobacco types/cultivars, never being found associated with less than 78% of the samples from a particular cultivar. Cultivars of flue-cured tobacco were more affected by *Meloidogyne* spp. than the varieties of fire-cured tobacco. This can be par-

Table 2. Frequency (%) of appearance of nematode genera in 614 fields in 8 tobacco production zones in the Pinar del Río province of Cuba.

Nematode genus	SJ[a]	SL	PR	P	BM	SM	CS	ASC
Meloidogyne	67.5	84.9	74.1	47.2	84.3	79.6	70.1	98.9
Rotylenchulus	86.0	90.7	82.8	37.3	62.7	46.9	43.0	67.0
Pratylenchus	17.6	9.3	48.3	5.6	17.6	10.2	8.4	7.4
Helicotylenchus	35.1	8.1	20.7	8.1	15.7	2.0	16.8	11.7
Ditylenchus	1.8	4.7	8.6	5.6	0.0	2.0	1.9	4.3
Tylenchorhynchus	19.3	1.7	17.2	7.5	15.7	6.1	6.5	11.7
Criconemoides	50.0	31.0	29.3	6.8	21.6	38.8	22.4	71.3
Trichodorus	9.6	37.5	6.9	1.9	15.7	4.1	0.0	19.1
Aphelenchoides	29.8	19.8	31.0	6.2	3.9	6.1	2.8	4.3

[a]Abbreviations for zones: SJ = San Juan, PR = Pinar del Río, BM = Briones Montoto, CS = Consolacíon del Sur, P = Pilotos, SL = San Luis, SM = Santa María, ACS = Augusto C. Sandino.

Table 3. Average density of nematode genera in soil and root samples of tobacco taken from 614 fields in 8 production zones in the Pinar del Río province of Cuba.

	SJ[y]		SL		PR		P		BM		SM		CS		ACS	
Genera	S[z]	R[z]	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Meloidogyne	11	246	1	284	8	122	2	36	80	248	40	82	16	43	95	297
Rotylenchulus	24	94	3	249	9	52	6	16	106	27	15	3	21	6	43	36
Pratylenchus	11	21	1	23	2	48	4	8	6	17	—	3	2	3	4	6
Helicotylenchus	28	11	8	6	8	4	1	2	4	1	—	—	4	1	2	—
Tylenchorhynchus	8	4	5	3	4	8	4	—	6	—	2	—	4	—	1	—
Ditylenchus	—	—	2	1	8	2	6	3	—	—	4	—	—	—	2	—
Criconemoides	36	18	1	8	2	2	1	—	10	3	7	—	24	2	134	3
Trichodorus	—	—	2	—	5	—	—	—	5	2	2	—	1	—	—	—
Aphelenchoides	2	—	1	6	9	6	—	—	—	—	2	—	4	6	—	—

[y]Abbreviations for zones: SJ = San Juan, PR = Pinar del Río, BM = Briones Montoto, CS = Consolacíon del Sur, P = Pilotos, SL = San Luis, SM = Santa Maria, and ACS = Augusto C. Sandino.

[z]S = Number of nematodes extracted by the centrifugation-flotation method from 50 cm^3 soil; R = Nematodes present in 20 g of representative roots from each field.

Table 4. Incidence of *Meloidogyne* by tobacco type and cultivar in 8 tobacco production zones of the Río del Pinar province of Cuba.

Zones	Cultivars													
	Criollo		C-30		Corojo		Speight G-28		Burley 37		Virginia 315		Cabaiguan	
	CM[z]	CI	CM	CI	CM	CI	CM	CI	CM	CI	CM	CI	CM	CI
San Juan	80	57	—	—	33	20	—	—	—	—	—	—	—	—
San Luis			16	13	70	60	—	—	—	—	—	—	—	—
Pinar del Río	47	38	5	0	6	5	—	—	—	—	—	—	—	—
Pilotos	62	53	—	—	—	—	—	—	2	2	—	—	23	21
Briones Montoto	—	—	—	—	—	—	—	—	48	42	6	4	—	—
Santa Maria	11	9	10	9	—	—	2	1	—	—	21	20	—	—
Consolacíon del Sur	39	—	29	26	—	—	—		10	10	—	—	—	—
Augusto C. Sandino	—	—	—	—	—	—	51	49	—	—	43	43	—	—
Total Fields	239	157	60	48	109	85	53	50	60	54	70	67	23	21
Total %	65.7		80.0		78.0		94.3		90.0		95.8		91.3	

[z]CM = Number fields sampled, CI = Number fields infested.

tially explained by soil type, since flue-cured tobacco is grown in more sandy soil types. Because Speight G28 is resistant to *Meloidogyne incognita* Race 1 and Race 3, it is suspected that *M. javanica* may have been associated with this variety.

Most reports indicate that root-knot nematodes (*Meloidogyne* spp.) are the most important nematode pest of tobacco worldwide (Martin, 1960; Johnson, 1989; Rich *et al.*, 1989; Khan, 1990). Data from this survey and other observations indicate that they are also the key nematode pests in Cuba. However, the high frequencies and numbers of *Rotylenchulus* spp. in this survey indicate a potential problem with this nematode. Other genera found in the survey such as *Pratylenchus* and *Ditylenchus* have caused problems in tobacco areas of some countries (Johnson, 1989; Shepard and Barker, 1990) but present survey data and field symptom expression were inconclusive for Cuba. Additional work is necessary to determine the species of *Meloidogyne*, *Rotylenchulus*, and *Pratylenchus* present in Cuban tobacco fields. These data would be helpful in the development of appropriate management practices including rotation systems for tobacco production and breeding programs to create resistant cultivars.

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