HOST STATUS OF SOME WEEDS TO *MELOIDOGYNE* SPP., *PRATYLENCHUS* SPP., *HELICOTYLENCHUS* SPP. AND *ROTYLENCHULUS RENIFORMIS* ASSOCIATED WITH VEGETABLES CULTIVATED IN POLYTUNNELS IN MARTINIQUE

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ABSTRACT

Quénéhervé, P., F. Drob, and P. Topart. 1995. Host status of some weeds to *Meloidogyne* spp., *Pratylenchus* spp., *Helicotylenchus* spp. and *Rotylenchulus reniformis* associated with vegetables cultivated in polytunnels in Martinique. Nematropica 25:149-157.

During a survey of the nematodes associated with weeds in vegetables growing in plastic polytunnels in Martinique, 33 weed species in 26 genera and 15 families were collected to extract nematodes from the roots. Results of this survey showed that weeds mainly belong to five families: the Asteraceae, Amaranthaceae, Poaceae, Euphorbiaceae, and the Portulacaceae and only four phytoparasitic nematode genera were consistently recovered. Four weed species were found to be nematode free. All the others were considered nematode reservoirs. The most frequently encountered nematodes were *Rotylenchulus reniformis*, followed by different species of *Meloidogyne*, *Helicotylenchus*, and *Pratylenchus*. When present, root infestation by *Meloidogyne* always outnumbered the other nematode species. It is noticeable that, during this survey, only three weed species exhibited typical symptoms of galls and deformed roots when infected by *Meloidogyne*.

Key words: *Helicotylenchus*, host status, integrated pest management, lesion nematode, *Meloidogyne*, Martinique, nematode, nematode control, nematode reservoir, polytunnel, *Pratylenchus*, reniform nematode, root-knot nematode, *Rotylenchulus reniformis*, spiral nematode, vegetables, weeds.

RESUMEN

Quénéhervé, P., F. Drob y P. Topart. 1995. Estado hospedero de algunas malas hierbas, en relación a *Meloidogyne* spp., *Pratylenchus* spp., *Helicotylenchus* spp. y *Rotylenchulus reniformis*, asociado con vegetales cultivados en sistemas multitunel en Martinique. Nematrópica 25:149-157.

Durante una inspección de los nemátodos asociados con malas hierbas, en vegetales cultivados en sistemas multitunel, fabricados de plástico; 33 especies de malas hierbas pertenecientes a 26 géneros y 15 familias fueron colectados, con el fin de extraer nematodos de las raíces. Los resultados de la inspección mostraron que las malas hierbas pertenecían a cinco familias: Asteraceae, Amaranthaceae, Poaceae, Euphorbiaceae, y Portulacaceae y solo cuatro géneros de nematodos fitoparasiticos se recuperaron. Solamente cuatro especies de malas hierbas no presentaron nematodos. Todas las otras, fueron consideradas como reservorios. Los nematodos más frecuentemente encontrados, fueron; *Rotylenchulus reniformis*, siguido de diferentes especies de *Meloidogyne*, *Helicotylenchus* y *Pratylenchus*. Cuando se encontró infección de las raíces por *Meloidogyne*, esta siempre excedió en número a las otras especies de nematodos. Se debe destacar que durante la inspección, solamente tres especies infectadas por *Meloidogyne*, manifestaron síntomas típicos de agallas y raíces desfiguradas.

Palabras clave: *Helicotylenchus*, estado del huésped, manejo de plagas, nematodo lesión, *Meloidogyne*, Martinica, nematodo, control de nematodos, nematodos reservorio, multitunel, *Pratylenchus*, nematodo reniforme, nemátodos agalladores, *Rotylenchulus reniformis*, nematodo espiral, vegetales, malas hierbas.

INTRODUCTION

Weeds have long been recognized as competitors to cultivated plants for energy resources and as pest and pathogen reservoirs, especially of nematodes (1,5,6). They are often neglected from the standpoint of nematode management. In Martinique, as a consequence of climatic conditions (heavy rainy seasons and strong winds), farmers rely on large plastic polytunnels to grow various vegetables (16). This situation leads to intensive culturing in these polytunnels which favors the proliferation of various pests and pathogens. The nematode problem is critical and needs continuous attention from farmers (12). Farmers often permit weeds to grow between two successive crops. Consequently, a survey was conducted from April to June 1994 in the different areas of Martinique, where farmers grow vegetables in plastic polytunnels, to identify some of the weed hosts of nematodes. The objective of this survey was to estimate the nematode infestation potential of these weeds in order to improve the nematode control strategies in vegetables cultivated in plastic polytunnels.

MATERIALS AND METHODS

Nineteen representative plastic polytunnels were selected in different regions of Martinique with respect to climatic and soil conditions (northern Atlantic coast, central region, western Caribbean coast, southern region). At these sites, at least 5 samples of each main weed were collected at random in and between crop rows, amounting to a total of 275 samples taken to the laboratory for nematological analysis. Each sample comprised the aerial part of the plant and the corresponding roots with the adhering soil carefully collected between 5 and 30 cm depth. After identification of the plant to species (7), the nematodes were extracted from a fresh root subsample (20 g) in a mist chamber (17). Nematode population levels were determined in a counting dish with a stereomicroscope and expressed as the number of nematodes per gram of dry root (at 60° C in a drying oven after the 2-week period in the mist chamber). The "percentage of similarity" was calculated among the weed communities encountered in the different geographic regions and is defined as: $PS = \Sigma$(lowest percentage of occurrence of a weed species) over all species (20). According to the numbers of nematodes per g of dry root, differential host status of weeds was arbitrarily defined for each nematode genus encountered and rated as: Poor Host, 0-10 (*Helicotylenchus* spp.), 0-100 (*Meloidogyne* spp., *R. reniformis, Pratylenchus* spp.); Good Host, 10-100 (*Helicotylenchus* spp.), 100-1 000 (*R. reniformis, Pratylenchus* spp.), 100-10 000 (*Meloidogyne* spp.); Excellent Host, >100 (*Helicotylenchus* spp.), >1 000 (*R. reniformis, Pratylenchus* spp.), >10 000 (*Meloidogyne* spp.).

RESULTS

Weeds associated with vegetables: During this survey, 33 weed species in 26 genera contained in 15 families were collected in the different vegetable growing areas (Table 1). These weeds belong mostly to 5 families: Asteraceae 21.5%; Amaranthaccae 15.4%; Poaceae 11.1%; Euphorbiaceae 10.7%, and Portulacaceae 8.9%. Among these weeds, 6 species were very common and found in almost all geographic areas sampled: *Portulaca oleracea* (8.9%), *Amaranthus viridis* (8.6%), *Eleusine indica* (5.7%), *Leonotis nepetifolia* (5.3%), *Euphorbia heterophylla* (5.3%), and *Bidens pilosa* (5.3%).

Table 1. Weeds encountered in association with vegetables grown in plastic polytunnels in Martinique with their common and vernacular names and location.[z]

Plant species	Common and vernacular names	Location[z]
Acalypha arvensis Poepp. & Endl	Ortie bâtarde	WC, S
Aeschynomene americana L.	Jointvetch, Honteuse femelle	NA
Ageratum conyzoides L.	Goat weed, Blue top, Herbe à femme	C
Amaranthus dubius Mart.	Calalu, Epinard pays	NA, C
Amaranthus spinosus L.	Prickly calalu, Epinard rouge	NA, WC
Amaranthus viridis L.	Pigweed, Epinard rampant	NA, WC, S
Artemisia cf. *vulgaris* L.	Armoise	C
Bidens pilosa L.	Beggar tick, Herbe (z')aiguille	NA, C
Cleome aculeata L.	Grand caya	WC
Cleome rutidosperma DC.	Feefee, Caya blanc	WC
Cleome viscosa L.	Caia, Caya jaune	S
Commelina diffusa Burm.	Pond grass, Herbe grasse	NA, C
Eleusine indica (L.) Gaertn	Cheddah, Pied de poule	NA, C, WC
Emilia fosbergii Nicholson	Cupid's paint brush, Goutte de sang	NA, C
Euphorbia heterophylla L.	Red milkweed, Grosse malnommée	NA, WC, S
Galinsoga quadriradiata R. & P.	Petite marguerite	C
Laportea aestuans (L.) Chew	Stinging nettle, Ortie brûlante	NA
Leonotis nepetifolia (L.) R. Br.	Lion's tail, Pompon soldat, Pompon cadet	NA, C
Mimosa pudica L.	Shame weed, Marie honte	S
Parthenium hysterophorus L.	Barley flower, Matricaire	NA
Phenax sonneratii (Poir.) Wedd.	Ortie batârde	C, WC
Phyllanthus amarus Schum. & Thonn.	Seed under leaf, Graines en bas feuilles blanc	WC
Phyllanthus urinaria L.	Seed under leaf, Graines en bas feuilles rouge	S
Physalis angulata L.	Cow pops, Herbe à poc	WC, S
Portulaca oleracea L.	Purslane, Pourpier	NA, C, WC, S
Rottboellia cochinchinensis (Lour.) Clayton	Itch grass, Herbe à canne	S
Setaria barbata (Lam.) Kunth	Corn grass, Herbe canot	WC
Spermacoce assurgens R. & P.	Button weed, Macornet	NA
Spermacoce confusa Rendle	Button weed, Macornet	S
Spermacoce latifolia Aubl.	Gros macornet	WC
Stachytarpheta jamaicensis (L.) Vahl	Vervain, Verveine queue de rat	NA, C
Torulinium odoratum (L.) Hoop.	— — — — —	C, WC
Vernonia cinerea (L.) Less	Inflammation bush, Bouton blanc	NA

[z]Locations: NA = Northern Atlantic Coast; C = Central Region; WC = West Caribbean Coast; S = Southern Region.

Weed communities from the northern Atlantic coast and central regions were very similar but were clearly different from those originating from the West Caribbean coast and southern regions of Martinique (Table 1). Except *Amaranthus* sp. and *Portulaca oleracea*, which are ubiquitous, weed distribution follows the family membership: many species belonging to the Asteraceae are present in the northern Atlantic coast and central regions but absent from the West Caribbean coast and southern regions. Weeds from the Euphorbiaceae are mainly present in the latter regions. The calculation of the "percentages of similarity" based on the weed species occurrence (20) confirms this observation (Table 2). The highest percentage of similarity being observed between West Caribbean coast and southern regions (75%) and the lowest between the central and the southern regions (19.5%).

Nematodes associated with weeds: Nematode species from 4 genera were extracted from the weed roots: *Meloidogyne* spp. (*M. incognita*, *M. arenaria*, and *Meloidogyne* sp.), *Pratylenchus* spp. (*P. zeae* and *P. coffeae*), *Helicotylenchus* spp. (*H. dihystera* and *H. erythrinae*), and *Rotylenchulus reniformis*. Only 4 weed species of 33 were found to be nematode free, therefore 85% of the weeds were hosts for at least one nematode species. As with weeds, the frequency and abundance of nematode genera differed according to geographic area (Fig. 1). *Rotylenchulus reniformis* was the predominant nematode encountered. The root-knot nematode, *Meloidogyne* spp., was more abundant and more frequently encountered in the northern Atlantic and central regions. When present, levels of root infection by *Meloidogyne* spp. always outnumbered the other species. According to the number of nematodes per g of dry root, differential host status of weeds was arbitrarily defined for each nematode genus encountered (Table 3).

Nematode-host associations: Seventeen weed species (51.5%) were found to be hosts of *Meloidogyne* species. However, only 3 weed species exhibited the typical characteristics of *Meloidogyne* infestation with numerous galls and deformed roots: *Amaranthus spinosus*, *Leonotis nepetifolia*, and *Vernonia cinerea*. The other weed species exhibited either slight thickening of the roots or no apparent symptoms. The Amaranthaceae and the Asteraceae are particularly good hosts for *Meloidogyne* spp. Within these families, and especially on *Amaranthus spinosus*, *Amaranthus viridis*, *Ageratum conyzoides*, and *Vernonia cinerea*, the nematode infection was always very high (more than 1 000 eggs and juveniles per g of dry roots).

Table 2. Table of the "percentage of similarity" among the different weed communities (PS = Σ(lowest percentage) over all species.

Regions	Northern Atlantic Coast	Central	West Caribbean Coast	Southern
Northern Atlantic Coast	—			
Central	65.5%	—		
West Caribbean Coast	45.4%	26.4%	—	
Southern	32.4%	19.5%	75.0%	—

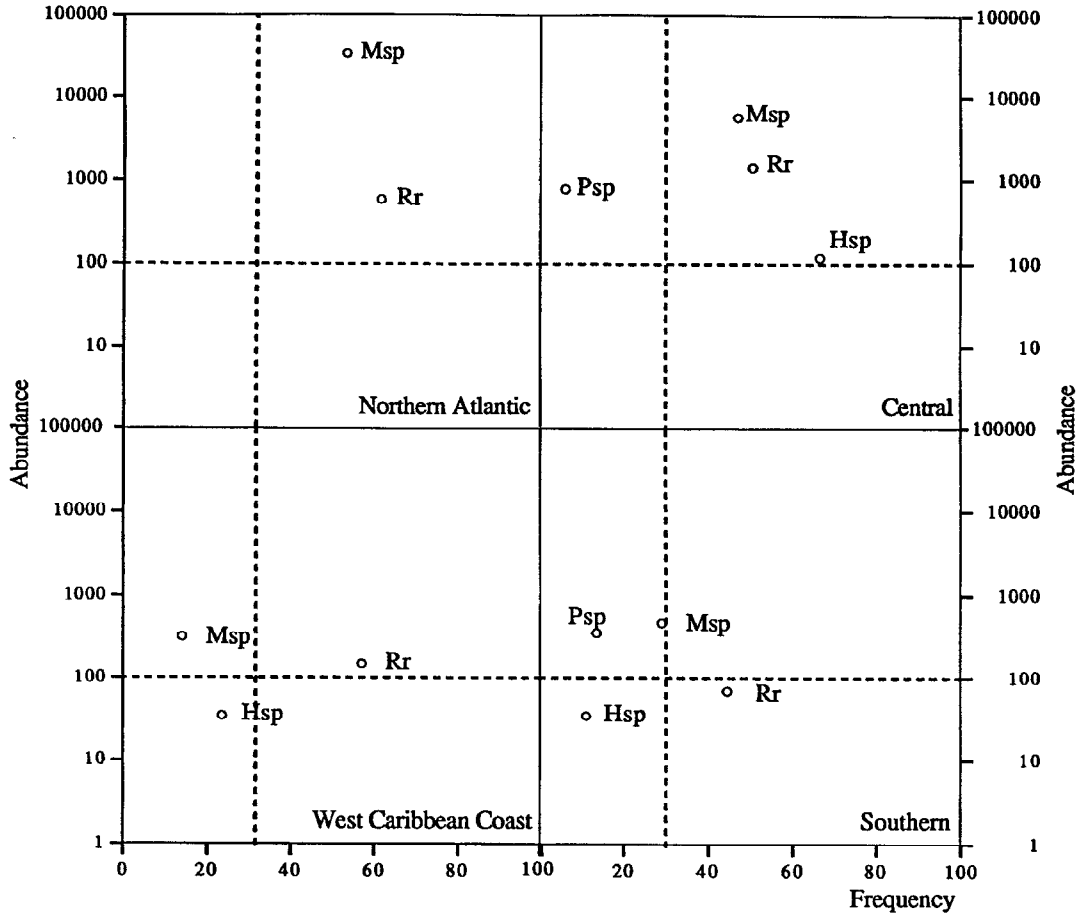

Fig. 1. Abundance per g dry weight and frequency of the plant parasitic nematodes extracted from weed roots in the different vegetable growing areas under polytunnels in Martinique (Msp = *Meloidogyne* spp.; Rr = *Rotylenchulus reniformis*; Hsp = *Helicotylenchus* spp.; Psp = *Pratylenchus* spp.). Dashed lines represent an abundance of 100 individuals per g dry weight of root and a frequency of 30%.

Twenty-five weed species (75.8%) were found to be hosts of *Rotylenchulus reniformis*. Infection by this species was equally distributed among the weed families. Levels of root infection was always lower than those observed for *Meloidogyne*, but *Bidens pilosa* and *Phenax sonneratii* were excellent hosts for *R. reniformis* with root infection >1 000 eggs/juveniles per g of dry root. Nineteen weed species (57.6%) were found to be hosts of *Helicotylenchus* spp. As observed for *R. reniformis*, this genus is also equally distributed among the weed families encountered. *Artemisia* cf. *vulgaris*, *Commelina diffusa*, and *Portulaca oleracea* were particularly good hosts for this genus.

Only 6 weed species (18.2%) were found to be hosts of *Pratylenchus* spp. in this study. *Artemisia* cf. *vulgaris* and *Leonotis nepetifolia* were good hosts of *P. coffeae* in the central area while *Rottboellia cochinchinensis* were found to be a good host of *P. zeae* in the southern region. Three weed species, *Artemisia* cf. *vulgaris*, *Galinsoga quadriradiata*, and *Leonotis nepetifolia*, were found to be good hosts for all 4 nematode gen-

Table 3. Host status of weeds for some plant parasitic nematodes listed alphabetically by plant family, genus, and species.[z]

	Meloidogyne spp.	*Rotylenchulus reniformis*	*Helicotylenchus* spp.	*Pratylenchus* spp.
AMARANTHACEAE				
Amaranthus dubius		**	**	
Amaranthus spinosus	***	**	*	
Amaranthus viridis	***	*		
ASTERACEAE				
Ageratum conyzoides	***	*	**	
Artemisia cf. *vulgaris*	**	*	***	***
Bidens pilosa	**	***	*	
Emilia fosbergh		**	**	
Galinsoga quadriradiata	**	**	**	*
Parthenium hysterophorus		**		
Vernonia cinerea	***	**		
CAPPARIDACEAE				
Cleome aculeata		*	**	
Cleome rutidosperma				
Cleome viscosa	*	*	*	*
COMMELINACEAE				
Commelina difusa		**	***	
CYPERACEAE				
Torulinium odoratum	**		*	
EUPHORBIACEAE				
Acalypha arvensis	*	**	**	*
Euphorbia heterophylla		*		
Phyllanthus amarus		*		
Phyllanthus urinaria				
FABACEAE				
Aeschynomene americana		*	*	
MIMOSACEAE				
Mimosa pudica				
LAMIACEAE				
Leonotis neptifolia	**	*	**	***
POACEAE				
Eleusine indica	**	*	**	

[z]Host status: Poor Host*, Good Host**, Excellent Host***.

Table 3. (Continued) Host status of weeds for some plant parasitic nematodes listed alphabetically by plant family, genus, and species.[z]

	Meloidogyne spp.	*Rotylenchulus reniformis*	*Helicotylenchus* spp.	*Pratylenchus* spp.
Rottboellia cochinchinensis		**	**	**
Setaria barbata		*		
PORTULACACEAE				
Portulaca oleracea	**	**	***	
RUBIACEAE				
Spermacoce assurgens	*			
Spermacoce confusa	**			
Spermacoce latifolia	**		*	
SOLANACEAE				
Physalis angulata		*		
URTICACEAE				
Laportea aestuans	*	**		
Phenax sonneratii		***	**	
VERBENACEAE				
Stachytarpheta jamaicensis				

[z]Host status: Poor Host*, Good Host**, Excellent Host***.

era, while *Cleome viscosa* and *Acalypha arvensis* supported low densities of all of these nematodes. High infection by *Meloidogyne* spp. was always associated with low or no infection by *R. reniformis* while the reciprocal was not observed when both nematodes occurred together.

DISCUSSION

Root-knot nematode and reniform nematode are the most damaging species to vegetables in the Caribbean Islands (11,14,15). Intensive crop cultivation in plastic polytunnels is greatly increasing the nematode problem (12). Nematode and weed populations interact in numerous ways and the persistence of weeds growing among vegetables or between two successive crops is an important source of nematode survival and infestation. Our survey found that 4 of the 10 weeds ranked worst in the world (10), *Eleusine indica, Portulaca oleracea, Amaranthus spinosus,* and *Ageratum conyzoides,* and support plant parasitic nematodes in vegetable growing areas of Martinique.

Rotylenchulus reniformis had the largest weed host range in this survey. This nematode species is known to parasitize numerous crops including banana, pineapple, ornamentals, and vegetables (2,13,18). It is often recovered from soil, but its parasitic status on plants is sometimes more difficult to determine due to the absence of typical symptoms and the fact that females and egg masses can be separated very easily from the roots during extraction. Moreover, the presence of this nematode has been intensively recorded only in areas

where it has regulatory importance (e.g., ornamental industries in Florida) (13) or economic importance (e.g., cotton producing areas in the southern United States) (19). The presence of this nematode species associated with roots of so many weeds are consistent with its polyphagic description.

Meloidogyne spp. often reached very high numbers of juveniles per g of dry root on some weeds and Amaranthaceae and Asteraceae were particularly good hosts. These results agree with the review of Bendixen (5).

This survey identified several important weeds that should be added to the summary of the weed hosts of *Meloidogyne* and *Pratylenchus* nematodes compiled by Bendixen (3,4,5). *Galinsoga quadriradiata, Torulinium odoratum, Acalypha arvensis, Leonotis nepetifolia,* and the 3 species of Spermacoce (*S. assurgens, S. confusa,* and *S. latifolia*) were hosts of *Meloidogyne* in this survey. Previously unnoted weed species that were found to be hosts of *P. coffeae* include *Artemisia* cf. *vulgaris, Galinsoga quadriradiata,* and *Leonotis nepetifolia,* while *Cleome viscosa* and *Rottboellia cochinchinensis* were hosts of *P. zeae.* The latter weed species was also reported to be an excellent host plant for *P. coffeae* in yam fields in Guadeloupe (8). *Helicotylenchus* spp. were also recovered from weed roots but always at low levels compared to *Meloidogyne* and *R. reniformis.* The Asteraceae seems to be a good host for this genus. *Pratylenchus* spp. was recovered from very few weeds except in areas where *P. coffeae*-infested crops such as yams and cocoyams had been cultivated and in the southern region where *P. zeae* is prevalent on some graminae and forage crops.

The results of this survey support previous finding (9) that, in contrast to cultivated plants, weeds infected with *Meloidogyne* spp. often display little or no galling. As reported for open fields in Guadeloupe (6), weeds are clearly an important reservoir of plant-parasitic nematodes in plastic polytunnels in Martinique. This study suggests also that some important weed species such as *Amaranthus spinosus, Leonotis nepetifolia, Vernonia cinerea, Artemisia* cf. *vulgaris,* and *Portulaca oleracea* should be considered as primary bioindicators to assess the presence of nematodes in vegetable fields or polytunnels prior to cultivation.

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