RESEÑA—REVIEW

AN OVERVIEW OF NEMATOLOGICAL PROBLEMS IN CUBA[†]

Modesto Fernández Díaz-Silveira and José Ortega Herrera

Institute for Fundamental Research on Tropical Agriculture, Ministry of Agriculture, Calle 1, esq. 2, Santiago de las Vegas, Ciudad de la Habana. Current address of Senior Author: Environmental Policy Directorate, Ministry of Science, Technology and Environment, Capitolio Nacional, Prado y San Jose, Ciudad de la Habana, Cuba.

ABSTRACT

Fernández, M., and J. Ortega. 1998. An Overview of Nematological Problems in Cuba. Nematologica 28:151-164.

Research during the past 30 years has revealed the main economically important nematode species in Cuba, and identified serious nematode pests that warrant quarantine exclusion from the country. Nematodes appear to cause few problems in sugarcane, the foremost crop in Cuba. *Meloidogyne arenaria, M. javanica* and especially *M. incognita* race 2 are responsible for yield reduction in tobacco as high as 27% when the crop is grown on sandy soil. Various species of root-knot nematode also damage coffee, guava, soybean, and various field and vegetable crops. Loss of citrus yield to *T. semipenetrans* averages 9-11% in older orchards with high population densities. *Pratylenchus coffeae* is the dominant pathogen among other commonly encountered members of the genus such as *P. brachyurus*, and *P. pratensis*. *P. coffeae* damages coffeae, banana and plantain in the eastern provinces, and *P. zeae* is sometimes a problem on rice grown in non-flooded conditions. *Radopholus similis* is also a serious pest of banana, primarily in the western provinces. The incidence of *Rotylenchulus reniformis* has increased in recent years, and its status as a pest in numerous crops is under evaluation. *Heterodera glycines* (soybean cyst), *Radinaphelenchus cocophilus, Meloidogyne* spp. capable of parasitizing citrus, and the citrus race of *R. similis* have not been detected in Cuba. Nematicides are not widely used to manage nematodes in Cuban crops, with the exception of tobacco and guava. Management is primarily by means of host-crop resistance/tolerance, sanitation, and various cultural practices. Use of biological control organisms is practiced to some extent. Most notably, *Paecilomyces lilacinus* is used in some nurseries and at planting to help manage *R. similis* on banana.

Key words: crop loss assessment, Cuba, IPM, nematode control, nematode distribution, nematode survey, plant parasitic nematodes.

RESUMEN

Fernández, M., y J. Ortega. 1998. Una revisión de los problemas nematológicos en Cuba. Nematrópica 28:151-164.

Las investigaciones realizadas durante los ultimos 30 años, han revelado las principales poblaciones de nematodos economicamente importantes en Cuba, e identificado plagas severas de los mismos, garantizando así su exclusión cuarentenaria del país. Los nematodos parecen causar pocos problemas en la caña de azúcar, principal cultivo en Cuba. *Meloidogyne arenaria, M. javanica* y especial-

[†]This paper was presented at the International Congress of Tropical Nematology (June 4-9, 1995, Rio Quente, GO, Brazil). Appreciation is expressed for support by the Organizing Committee of the Congress and CENARGEN-EMBRAPA.

mente *M. incognita* raza 2 son responsables por una reducción del rendimiento del tabaco en un 27%, cuando este se cultiva en suelo arenoso. Varias especies del nematodo agallador tambien causan daños en café, guayaba, frijol de soja y en varios campos y vegetales. Perdidas del 9-11% en el rendimiento de los cítricos debido a *T. semipenetrans*, ocurren en los huertos más antiguos con altas densidades poblacionales. *Pratylenchus coffeae* es el patogeno dominante entre otros miembros del genero comúnmente encontrados tales como, *P. brachyurus*, y *P. pratensis*. *P. coffeae* daña al café, bananas y plátano en las provincias orientales, y *P. zeae* es en ocasiones un problema en el arroz crecido sin anegación. *Radopholus similis* es tambien una plaga seria de bananas, principalmente en las provincias occidentales. La incidencia de *Rotylenchulus reniformis* ha aumentado en años recientes, y su estado como plaga en numerosos cultivos está bajo evaluación. *Heterodera glycines* (quiste del frijol de soja), *Radinaphelenchus cocophilus* y *Meloidogyne* spp., capaces de parasitar cítricos, y la raza cítrica de *R. similis* no han sido todavía detectados en Cuba. Los nematicidas no son ampliamente usados en los cultivos cubanos, con la excepción del tabaco y la guayaba. El manejo es principalmente a travez de resistencia/tolerancia entre huesped-cultivo, sanidad, y varias prácticas culturales. El uso de organismos como control biológico se práctica en alguna medida. *Paecilomyces lilacinus* se usa en algunos viveros y al plantar, para ayudar en el manejo de *R. similis* en banana.

Palabras claves: control de nematodos, Cuba, distribución de nematodos, evaluación de perdida de cultivos, manejo integrado de plagas (IPM), muestreo de nematodos, nematodos parasitadores de plantas.

INTRODUCTION

Cuba, a country of 110 992 km^2, lies in the Caribbean Sea, at 24° north latitude, near the boundary of the Tropic of Cancer. Cuba is comprised of 2 main islands and 4195 small islands and keys. Two seasons, rainy (from May to October) and dry (from November to April), can be differentiated each year. Temperatures commonly exceed 30°C in summer and 15°C in winter. There is great variability in Cuban soils, due to climatic characteristics. Ferralitic soils and brown soils with carbonates predominate, but fersialitic, ferritic and humic calcimorfic soils can also be found in the Cuban territory.

Perennial crops in Cuba occupy 3 621 602 ha (ca. 80% of cultivated land areas) and include sugar cane (55%), turf and pasture (20%), coffee (14%), citrus (4%), banana and plantain (3%), and other fruit trees (3%). Annual crops occupy 781 542 ha (ca. 17% of cultivated land areas), being mainly rice (26%), tobacco (7%), and a variety of root, tuber, and vegetable (mainly tomatoes and common beans) crops (58,4%). Sugar cane is the most extensively grown and economically important crop in Cuba (IES-UNEP, 1998).

The first reports of plant parasitic nematodes in Cuba date from the beginning of the century, at the former Estación Experimental Agronómica de Santiago de las Vegas, known today as INIFAT. Most of the early references are in institutional annual reports (i.e. Calvino, 1920). Based on simple, but fundamental observations, biological and ecological studies were made of nematode parasites of vegetables such as tomatoes and cucumber, grain legumes such as common beans and soybeans, and root and tuber crops such as potatoes, sweet potatoes and yam. The most common nematodes studied were in the genera *Meloidogyne, Pratylenchus and Rotylenchulus.* During the past 3 decades, research has focused on plant varietal resistance (Fernández, M., 1975), biological control (Fernández, E. *et al.*, 1994), and nematode

management through cultural practices (Fernández and Ortega, 1986b; Fernández *et al.*, 1986, 1989a,b). Because of this work, nematode management in Cuba today emphasizes integration of tactics to achieve a reasonable balance between nematode population levels and adequate crop yields.

Plant-parasitic nematode problems in Cuba are not dissimilar to those of most other countries with sub-tropical climates. An absence of low winter temperatures to reduce pest pressures seasonally, is the primary cause for the diversity and magnitude of nematode problems in sub-tropical cropping systems of the islands. For example, *Meloidogyne incognita* produces as many as 13 generations during 12 months, under the influence of Cuba's climatic conditions (Fernàndez, 1991).

The purpose of this paper is to provide an overview of the status of nematology in Cuba, by describing the most important nematode problems in Cuban agriculture and the state of knowledge about crops losses and nematode management. References have been provided to extend the information beyond that which can be provided in this review.

DISTRIBUTION OF ECONOMICALLY IMPORTANT NEMATODES IN CUBA

The most economically important nematode species reported in Cuba are summarized in Table 1. A more comprehensive treatment of nematode/plant associations in Cuba is given by Fernández and Ortega (1986a), who reported 134 nematode species, in association with 197 plants species. More recent reports concern mainly those nematode species associated with new hosts.

Ectoparasites: A large number of *Helicotylenchus* spp. are widely distributed in Cuba. *H. multicinctus* is the most economically important species, but *H. dihystera* and *H. erythrinae* are also frequently present in soil samples. *Xiphinema diversicaudatum* and *X. americanum* are commonly associated with some graminaceaous crops in nearly all regions of the country.

Migratory endoparasites: Radopholus similis is distributed quite evenly in the western provinces of Cuba and in parts of the central ones, but is encountered less frequently in the eastern region of the country. *Pratylenchus coffeae* has a distribution pattern opposite to that of *R. similis*; it is found mainly in the eastern provinces, and infrequently in the western ones. The nematode is highly pathogenic on certain crops. In addition to *P coffeae, P. zeae* and *P. brachyurus.* occur widely across Cuba on a number of crops.

The epigeal species, *Rhadinaphelenchus cocophilus* has not been detected in Cuba. It is unlikely that this pest inhabits the country, considering its devastating symptoms on palms, and widespread efforts that were made to detect it during the 1960's in important areas of coconut production (Fernández and Mijailova, 1973).

Sedentary endoparasites: Nematodes in the genus *Meloidogyne* are the most frequently encountered species and are also responsible for the greatest amount of economic loss in the largest number of crops. *M. incognita* is the predominant species in the country, and has been reported in all 14 Cuban provinces, including Isla de la Juventud (Isle of Youth). Races 1-4 are present in Cuba, with race 2 predominating. *M. arenaria* and *M. javanica* are reported from different provinces of the country, but cause less damage than *M. incognita.*

There are two cyst-forming nematode species reported in Cuba, both belonging to the genus *Cactodera.* The indigenous nematode species *Cactodera amaranthii was* described in Cuba from specimens parasitizing *Amaranthus* spp. (Stoyanov, 1973). Fortunately, study of a large number of

Table 1. Main plant-parasitic nematode species reported to be associated with various plants in Cuba.

Nematode species	Plant associates
Aphelenchoides besseyi Christie, 1942 = A. oryzae Yokoo, 1948	*Fragaria vesca, Nicotiana tabacum, Oryza sativa, Saccharum officinarum*
Cactodera amaranthi (Stoyanov, 1972) Krall & Krall, 1978	*Amaranthus* spp.
Criconema sp. Hofmänner & Menzel, 1914	*Citrus sinensis, Cocos nucifera, Saccharum officinarum*
Ditylenchus dipsaci (Kühn, 1857) Filipjev, 1936	*Saccharum officinarum*
Ditylenchus intermedium (de Man, 1880) Filipjev, 1936	*Citrus sinensis, Cocos nucifera, Mangifera indica, Musa* sp., *Oryza sativa, Saccharum officinarum*
Dolichodorus obtusus Allen, 1957	*Saccharum officinarum*
Helicotylenchus canadensis Waseem, 1961	*Saccharum officinarum*
Helicotylenchus dihystera (Cobb, 1893) Sher, 1961	*Allium cepa, Ananas comosus, Cocos nucifera, Mangifera indica, Musa* sp., *Nicotiana tabacum, Paspalum notatum, Psidium guajava, Saccharum officinarum*
Helicotylenchus egyptiensis Tarjan, 1964	*Musa* sp., *Saccharum officinarum*
Helicotylenchus erythrinae (Zimmerman, 1904) Golden, 1956	*Ananas comosus, Capsicum frutescens, Capsicum annuum, Coffea arabica, Musa* sp., *Saccharum officinarum, Sorghum saccharatum*
Helicotylenchus multicinctus (Cobb, 1893) Golden, 1956	*Allium cepa, Beta vulgaris, Brassica napus, Brassica oleracea, Cajanus cajan, Canavalia ensiformis, Citrullus lanatus, Cocos nucifera, Cucumis melo, Cucurbita moschata, Cucurbita pepo, Daucus carota sativa, Glycine max, Gossypium hirsutum, Hibiscus cannabinus, Hibiscus esculentus, Ipomoea batatas, Lactuca sativa, Lycopersicum esculentum, Musa martinii, Musa* spp., *Phaseolus lunatus, Phaseolus vulgaris, Pisum sativum, Raphanus sativus, Ricinus communis, Saccharum officinarum, Sesamum indicum, Solanum melongena, Vigna sesquipedalis, Vigna sinensis*
Longidorus elongatus (de Man, 1876) Thorne & Swanger, 1936	*Ananas comosus, Cocos nucifera, Musa* sp.
Meloidogyne arenaria (Neal, 1889) Chitwood, 1949	*Allium cepa, Arachis hypogea, Beta vulgaris, Brassica oleracea, Capsicum annuum, Capsicum frutescens, Cassia occidentalis, Cicer arietinum, Citrullus lanatus, Daucus carota sativa, Glycine max, Hibiscus cannabinus, Lycopersicum esculentum, Manihot utilissima, Musa sapientum, Nicotiana tabacum, Phaseolus vulgaris, Pisum sativum, Psidium cattlienum, Psidium friedrichsthalianum, Psidium guajava, Psidium molle, Raphanus sativus, Secale cereale, Solanum melongena, Xanthosoma sagittaefolium*

Table 1. (Continued) Main plant-parasitic nematode species reported to be associated with various plants in Cuba.

Nematode species	Plant associates
Meloidogyne hapla Chitwood, 1949	*Allium cepa, Arachis hypogea, Beta vulgaris, Brassica oleracea, Capsicum annuum, Capsicum frutescens, Daucus carota sativa, Fragaria vesca, Helianthus annuus, Ipomoea batatas, Lycopersicum esculentum, Mentha arvensis, Mentha* spp., *Phaseolus vulgaris, Pisum sativum, Psidium guajava, Raphanus sativus, Solanum melongena, Solanum tuberosum, Vitis vinifera*
Meloidogyne incognita (Kofoid & White, 1919) Chitwood, 1949	*Allium cepa, Allium sativum, Ananas comosus, Antirrhinum majus, Apium graveolens, Beta vulgaris, Brassica oleracea, Canavalia ensiformis, Capsicum annuum, Capsicum frutescens, Carica papaya, Cassia obtusifolia, Cicer arietinum, Citrullus lanatus, Citrus limon, Coffea arabica, Corchorus capsularis, Cucumis melo, Cucumis sativus, Cucurbita moschata, Cucurbita pepo, Daucus carota sativa, Glycine max, Gossypium hirsutum, Helianthus annuus, Hibiscus cannabinus, Hibiscus esculentus, Hibiscus rosa-sinensis, Lactuca sativa, Lycopersicum esculentum, Manihot utilissima, Matricaria chamomilla, Musa paradisiaca, Musa sapientum, Musa* sp., *Nicotiana tabacum, Oryza sativa, Petroselinum crispum, Phaseolus vulgaris, Physalis angulata, Pisum sativum, Psidium cattleianum, Psidium guajava, Psidium molle, Raphanus sativus, Saccharum officinarum, Secale cereale, Solanum melongena, Solanum tuberosum, Vigna sinensis, Vitis vinifera, Xanthosoma sagittaefolium, Zea mays*
Meloidogyne javanica (Treub, 1885) Chitwood, 1949	*Allium cepa, Apium graveolens, Beta vulgaris, Chenopodium ambrosioides, Citrullus lanatus, Coffea arabica, Corchorus, Daucus carota sativa, Glycine max, Helianthus annuus, Hibiscus cannabinus, Hibiscus sabdariffa, Lycopersicum esculentum, Phaseolus vulgaris, Pisum sativum, Raphanus sativus, Ricinus communis, Secale cereale, Solanum nodiflorum, Vigna sinensis, Vitis vinifera, Zea mays*
Mesocriconema Andrassy, 1965	*Annona muricata, Annona reticulata, Chrysophyllum cainito, Citrus sinensis, Coffea arabica, Hibiscus cannabinus, Mangifera indica, Nicotiana tabacum, Persea americana, Phaseolus vulgaris, Prunus amygdalus, Psidium guajava, Saccharum officinarum, Sorghum saccharatum, Tamarindus indica*
Mesocriconema rusticum (Micoletzky, 1915) Loof & DeGrisse, 1989	*Oryza sativa*
Paratrichidorus nanus (Allen, 1957) Siddiqi, 1974	*Nicotiana tabacum*
Pratylenchus pratensis (de Man, 1880) Filipjev, 1936	*Ananas comosus, Mangifera indica, Musa* sp., *Oryza sativa, Saccharum officinarum*
Paratrichodorus minor (Cobran, 1956) Siddiqi, 1974	*Oryza sativa*
Pratylenchus scribneri Steiner, 1943	*Musa* sp., *Nicotiana tabacum, Saccharum officinarum*

Table 1. (Continued) Main plant-parasitic nematode species reported to be associated with various plants in Cuba.

Nematode species	Plant associates
Pratylenchus penetrans (Cobb, 1917) Filipjev & Schuurmans Stekhoven, 1941	*Oryza sativa, Saccharum officinarum*
Pratylenchus coffea (Zimmerman, 1898) Filipjev & Schuurmans Stekhoven, 1941	*Citrus sinensis, Musa nana, Musa paradisiaca, Musa sapientum, Musa* sp.
Pratylenchus zeae Graham, 1951	*Brassica oleracea capitata, Caperonia palustris, Cynodon dactylon, Byperus compressus, Cyperus iria, Digitaria adscendens, Digitaria decumbens, Echinochloa colona, Eleusind indica, Glycine max, Nicotiana tabacum, Oryza sativa, Panicum muticum, Saccharum officinarum, Sida glomerata, Solanum melongena, Solanum tuberosum, Sorghum saccharatum, Zea mays*
Pratylenchus goodeyi Sher & Allen, 1953	*Ananas comosus*
Pratylenchus vulnus Allen & Jensen, 1951	*Citrus sinensis, Cocos nucifera, Oryza sativa*
Radopholus similis (Cobb, 1893) Thorne, 1949	*Coffea arabica, Mangifera indica, Musa nana, Musa paradisiaca, Musa sapientum, Musa* sp., *Panicum maximum, Saccharum officinarum, Zea mays*
Rotylenchulus reniformis Linford & Oliveira, 1940	*Allium sativum, Amaranthus dubius, Amaranthus viridis, Ananas somosus, Arachis hypogea, Argemone mexicana, Beta vulgaris, Brassica napus, Brassica oleracea, Cajanus cajan, Canavalia ensiformis, Capraria biflora, Capsicum annuum, Carica papaya, Citrullus lanatus, Coffea arabica, Corchorus siliquosus, Cucumis melo, Cucurbita moschata, Cucurbita pepo, Daucus carota sativa, Dioscorea polygonoides, Emilia sonchifolia, Fragaria vesca, Glycine max, Gossypium hirsutum, Helianthus annuus, Hibiscus cannabinus, Hibiscus esculentus, Ipomoea batatas, Lactuca sativa, Lepidium virginicum, Lycopersicum esculentum, Mangifera indica, Manihot utilissima, Momordica balsamina, Musa martinii, Musa sapientum, Nicotiana tabacum, Panicum maximum, Parthenium hysterophorus, Petroselinum crispum, Phaseolus lunatus, Phaseolus vulgaris, Philodendron mexicanum, Pisum sativum, Portulaca oleracea, Pueraria phaseoloides, Raphanus sativus, Ricinus communis, Rottboellia exaltata, Saccharum officinarum, Sesamum indicum, Sida rhombifolia, Solanum melongena, solanum nodiflorum, Solanum torvum, Solanum tuberosum, Sonchus oleraceus, Stizolobium deeringianum, Turbina corymbosa, Vernonia cinerea, Vigna sesquipedalis, Vigna sinensis, Xanthosoma sagittaefolium, Zea mays*
Rotylenchulus robustus (de Man, 1876) Filipjev, 1936	*Ananas comosus, Citrus sinensis, Cocos nucifera, Nicotiana tabacum, Saccharum officinarum*
Scutellonema bradys (Steiner & Le Hew, 1933) Andrássy, 1958 = *Scutellonema blaberum* (Steiner, 1937)	*Dioscorea alata*
Trichodorus obscurus Allen, 1957	*Oryza sativa*

Table 1. (Continued) Main plant-parasitic nematode species reported to be associated with various plants in Cuba.

Nematode species	Plant associates
Trichodorus primitivus (de Man, 1880) Micoletzky, 1922	*Ananas comosus, Citrus sinensis, Cocos nucifera, Nicotiana tabacum, Saccharum officinarum*
Tylenchorhynchus capitatus Allen, 1955	*Cocos nucifera*
Tylenchorhynchus digitatus Das, 1960	*Ananas somosus*
Tylenchorhynchus dubius (Butschli, 1873) Filipjev, 1936	*Cocos nucifera*
Tylenchorhynchus martini Fielding, 1956	*Nicotiana tabacum, Oryza sativa*
Tylenchorhynchus obscurus Allen, 1955	*Saccharum officinarum*
Tylenchorhynchus zeae Sethi & Swarup, 1968	*Oryza sativa*
Tylenchulus semipenetrans Cobb, 1913	*Aegle marmelos, Atalantia citroides, Citropsis gilletiana, Citrus amblycarpa, Citrus aurantifolia, Citrus aurantium, Citrus ichangensis, Citrus limon, Citrus maxima, Citrus medica, Citrus paradisi, Citrus reticulata, Citrus sinensis, Citrus* sp., *Fortunella japonica, Fortunella margariata, Swinglea glutinosa*
Xiphinema americanum Cobb, 1913	*Fragaria vesca, Mangifera indica, Musa* sp., *Saccharum officinarum*
Xiphinema basiri Siddiqi, 1952	*Brassica oleracea, Capsicum annuum, Capsicum frutescens, Lycopersicum esculentum, Sorghum saccharatum*
Xiphinema brasiliense Loredello, 1951	*Musa* sp., *Saccharum officinarum*
Xiphinema cubensis Razjivin, O'Relly, & Perez, 1973	*Saccharum officinarum*
Xiphinema diversicaudatum (Micoletzky, 1927) Thorne, 1939	*Saccharum officinarum*
Xiphinema elongatum Schuurmans Stekhoven & Teunissen, 1938	*Cocos nucifera*
Xiphinema ensiculiferum (Cobb, 1893) Thorne, 1937	*Saccharum officinarum*
Xiphinema italiae Meyl, 1953	*Cocos nucifera*

crops has so far demonstrated only *Amaranthus* spp. to be a host of *C. amaranthii*. The soybean cyst nematode, Heterodera schactii Schmidt, is not present in Cuba.

Sedentary semi-endoparasites: The distribution and incidence of *Rotylenchulus reniformis* has increased in recent years in Cuba, and it is now commonly encountered in a number of economically important crops throughout the island. The pathogenicity of the nematode on many crops is under assessment.

Tylenchulus semipenetrans is the only nematode pest of citrus of economic importance in Cuba. It is present primarily in Pinar del Río province to the west, and in Ciego de Avila and southern La Habana provinces. The nematode is encountered less frequently on the Isle of Youth, a very important citrus production area.

Cuba has unexplored potential for nematologists regarding the likely number of its undescribed nematode species (Table 2). New species described from Cuba during the past quarter century include 17 species of *Helicotylenchus* (Fernández *et al.*, 1980; Schliephake *et al.*, 1985), 4 species of *Hirschmanniella* (Razjivin *et al.*, 1981), one of *Zygotylenchus* (Razjivin and O'Relly, 1978), and one of *Pratylenchus* (Razjivin and O'Relly, 1976). Unfortunately, research on nematode taxonomy and systematics has diminished recently, as resources are channeled into areas such as host-plant resistance and other forms of nematode management. This trend, common to most countries, is of concern because knowledge of nematode systematics is essential to scientific efforts to develop adequate control measures for these pests.

Table 2. Nematode species described from Cuba during the past quarter century.

Helicotylenchus
H. sacchari Razjivin *et al.*, 1973b
H. reynosus Razjivin *et al.*, 1973b
H. oryzae Fernández *et al.*, 1980
H. sparsus Fernández *et al.*, 1980
H. unicum Fernández *et al.*, 1980
H. subtropicalis Fernández *et al.*, 1980
H. atlanticus Fernández *et al.*, 1980
H. acunae Fernández *et al.*, 1980
H. similis Fernández *et al.*, 1980
H. pseudopaxilli Fernández *et al.*, 1980
H. mucrogaleatus Fernández *et al.*, 1980
H. curvicaudatus Fernández *et al.*, 1980
H. inifatis Fernández *et al.*, 1980
H. lissocaudatus Fernández *et al.*, 1980
H. acutucaudatus Fernández *et al.*, 1980
H. bifurcatus Fernández *et al.*, 1980
H. verrucosus Fernández *et al.*, 1980
Hirschmanniella
H. truncata Razjivin *et al.*, 1981
H. asteromucronata Razjivin *et al.*, 1981
H. furcata Razjivin *et al.*, 1981
H. obesa Razjivin *et al.*, 1981
Pratylenchus
P. cubensis Razjivin and O`Relly, 1976
Zygotylenchus
Z. biterminalis Razjivin and O`Relly, 1978

KEY NEMATODE PESTS OF MAJOR CROPS IN CUBA

Nematologists in Cuba generally subscribe to the idea that economic losses caused by plant parasitic nematodes far exceed the highly visible damage caused by the most virulent nematodes to a few crops. Rather, we are concerned with reducing the large amount of cumulative crop loss, due to moderate damage to many crops over widespread areas of the country. An important goal in nematology is to create awareness of the insidious damage caused

by nematodes that is commonly overlooked by farmers, researchers, and agricultural specialists. With the exception of localized damage by *Meloidogyne* spp. to crops such as tobacco, coffee, or tomatoes, most other nematode problems remain unrecognized by growers. The main nematode problems faced by growers of Cuba's major crops are described in the following sections.

Sugarcane (Saccharum *spp.*): Approximately 1.5 million hectares are planted to sugarcane each year in Cuba, making it the most economically important crop by virtue of the export revenue it produces. The nematodes associated with sugarcane in Cuba are not known to cause serious yield reduction. Species in the genera *Helicotylenchus, Pratylenchus,* and *Xiphinema* are frequently encountered in samples from cane fields. *Meloidogyne incognita M. javanica, and Ditylenchus dipsaci* are of minor importance, although localized damage by *M. incognita* was reported in Matanzas Province (O'Relly, 1979).

Pratylenchus zeae reduces the length of sugarcane stems, thereby reducing the tissue available to produce sugar. *P. zeae* is seldom the only nematode encountered in the roots of the plant, frequently occurring with other *Pratylenchus* spp. and with *Helicotylenchus* spp., which is nearly ubiquitous in the sugarcane rhizosphere (O'Relly, 1979).

Tobacco (Nicotiana tabacum): Exports of tobacco and tobacco products produce the second largest amount of revenue from agriculture in Cuba. *Meloidogyne incognita, M. arenaria and M. javanica* are the most serious nematode pests of this crop. While it is not uncommon to find *M. arenaria* or *M. javanica* associated with *M. incognita,* the former species generally occur at lower population levels.

Meloidogyne incognita race 2 causes most of the losses in the traditional production areas, such as the Región de Vueltabajo in Pinar del Río province, where the highest quality tobacco for cigars is produced. Economic losses estimated as high as 27.5% of the crop potential of flue cured tobacco has been reported by several authors (Garcìa and Pèrez, 1987). Highest losses occur in cultivars planted on the sandiest soils (Garcìa, 1982; Garcìa and Espinosa, 1982). Thus, losses are estimated at only 7.8% in black tobacco which is traditionally grown on heavier soils than is flue cured tobacco. In 1982-83, tobacco losses due to *M. incognita* race 2 in Pinar del Río province were estimated to be 10.9% of total potential production, a loss of approximately 7 000 tons of tobacco (Garcia and Pérez, 1987). Yield losses of black tobacco were estimated by linear regression of yield against *M. incognita* infestation level. For each of eleven increasing levels of nematode population density, there was an increased loss of 112 kg/ha of tobacco cv. Criollo, and 115 kg/ha of tobacco cv. Habano Ligero (García, *et al.*, 1986).

Reducing the population density of nematodes attacking seedlings is key to managing tobacco losses. Healthy seedlings are indispensable for obtaining acceptable yields. Planting in soils virgin to tobacco and use of bare fallow (up to 5 months) are commonly practiced to reduce numbers of *M. incognita* and achieve healthy tobacco stands (Acosta and Veitía, 1988).

Citrus (Citrus *spp. and closely related genera*): Citrus is the third of Cuba's most economically important crops. *Tylenchulus semipenetrans* is common in older citrus orchards. Estimated yield losses caused by these nematodes range from negligible to as high as 40-50% when population densities are high. Yield loss in the range of 9-11% appears to be more the norm, and occur when populations are in the commonly encountered range of 1 000 juveniles/100 cm^3 of soil.

Screening trials using numerous varieties of *Citrus aurantium, C. aurantifolia, C. grandis, C. limon, C. paradisi, C. reticulata, and C. sinensis,* as well as varieties of tangelo and the closely related *Fortunella spp.,* have failed to reveal varieties resistant to *T. semipenetrans* (Stoyanov, 1968).

Unlike some parts of Asia, Cuba does not harbor *Meloidogyne* spp. that threaten citrus. *Meloidogyne incognita* is occasionally found on sour orange (*Citrus sinensis*) rootstocks, especially in nurseries on older plants unsuitable for grafting. However galls on roots are few, and studies showed that juveniles that penetrate roots cause tissue necrosis within galls, which prevents the nematode from completing its life cycle (Stoyanov, 1968).

Coffee (Coffea *spp.*): Twenty four species of plant-parasitic nematode are reported to be associated with coffee in Cuba (Fernández and Ortega, 1986 a). However, major damage to the crop is caused only by *Meloidogyne* spp., and primarily by *M. incognita.* As in tobacco, *M. arenaria* and *M. javanica* are also found in coffee, but to a lesser extent. In surveys of nematodes in coffee plantations, *M. arenaria* was detected in fewer than 1% of the samples, primarily in the provinces of Santiago de Cuba (on cv. Caturra), Sancti Spíritus (on cvs. Caturra and Típica), and Cienfuegos (on cvs. Tradicional and Borbón) (Sampedro *et al.*, 1989).

Yield of coffee is reduced by *M. incognita,* both in the traditional, mountainous coffee production areas, and in the more recently-planted areas on the plains. The nematode damage is so severe that stem cracking frequently accompanies the loss of root quantity and function. In a study of coffee grown in 7 provinces, 9.8% of the sampled areas revealed critical damage to trees by *M. incognita* and 6.3% of trees sustained medium to minor injury levels (Sampedro *et al.*, 1989).

Pratylenchus spp. appear to incite necrosis in the secondary root-system of coffee plants. This type of damage is widespread throughout Cuba, and occurs heavily in the eastern provinces (Sampedro *et al.*, 1989). Although *P. brachyurus* and *P. pratensis* are frequently found in coffee roots, *P. coffeae* is the predominant species, occurring at moderately high populations densities in 18.9% of all orchards sampled in one study (Sampedro *et al.*, 1989).

*Banana and plantain (*Musa *spp.):* Both crops are extremely important in the Cuban diet. Historically, nematological research has probably been greatest on these crops. Nematode damage to *Musa* spp. is usually caused by complexes formed by *Helicotylenchus multicinctus,* together with *Radopholus similis* in western provinces, and *Pratylenchus coffeae* in eastern provinces. *Meloidogyne* spp. (generally *M. incognita*) and *Rotylenchulus reniformis* are also sometimes found in these communities.

The damage caused by *H. multicinctus* is not dramatic in banana and plantain. However, on these crops the species is primarily endoparasitic, and it is now recognized that the damage caused to the root cortex significantly affects the root capacity to acquire nutrients and water. Although unrecognized as a serious pathogen for many years, the nematode is now considered to be a major cause of declining yield in banana (Stoyanov, 1967).

Damage to banana by *Rotylenchulus reniformis* is frequently overlooked. However, the high population densities sometimes attained by the nematode appear to cause significant loss of feeder roots to the detriment of the crop (Authors, personal observations).

Pratylenchus coffeae is a serious problem on plantains in eastern Cuba, where high population densities cause toppling of plants, and limit production of the crop. Attention to plant nutrition is important in

managing the problem. In soils with high fertility, economic threshold densities of the nematode have been estimated at 5 000-10 000 nematodes/100g of roots, whereas levels of 1 000-5 000 nematodes/100g of roots constitute a threshold in soils of low fertility. It was also estimated that 1 900 nematodes/100 g roots are required to cause lesions on 1% of the root surface (Sampedro and Gandarilla, 1985).

The banana race of *Radopholus similis* is found in Cuba, where it has been intensively studied. The citrus race of this nematode has never been detected in the country. *R. similis* damages both roots and stems of banana. Although the nematode generally migrates from roots to the stem, we have occasionally observed it penetrating directly through the stem tissues. Severe attack destroys part of the underground stem resulting in toppling which is symptomatic of either *R. similis* or *Pratylenchus coffeae.*

Guava (Psidium guajava): During the past 15-20 years, the amount of land suitable for growing guava has diminished significantly, due to increasing pressure by *Meloidogyne incognita* in most production areas of the country. Plantations can become non-productive within five years. This problem was exacerbated by the practice of replanting directly on the site of dead trees. Currently, nematicides are being used to manage nematodes in old sites and growers are increasingly planting guava in virgin soil. (Fernández *et al.*, 1987). Nursery management practices have also changed to avoid sites infested by *M. incognita,* and to grow young seedlings in clean soil and containers. In orchards, rootstocks with some degree of resistance to *M. incognita* (particularly *Psidium friedrichsthalianum*) hold promise to provide some relief to growers (Fernández, 1975).

Soybean (Glycine max): Although soybean it is still not widely planted in Cuba, it is grown in small areas in every province, and considerable research is currently conducted on the crop.

A large number of nematode species are reported to parasitize soybean in Cuba, including *Rotylenchulus reniformis* and several *Pratylenchus* spp. (Fernández and Ortega, 1986a). The main nematode problem on soybean in Cuba is caused by *Meloidogyne spp.*, primarily *M. incognita.* Most of the varieties used in the country support reproduction by the nematode; nevertheless, some of the Cuban varieties produced at INIFAT possess some tolerance to nematode attack. Availability of tolerant varieties such as INIFAT-382 has fostered the use of soybean in plant rotation schemes with crops sensitive to *M. incognita* such as black tobacco in Pinar del Rio province (Fernández and Ortega, 1989). Soybean-rice rotation is also feasible in Cuba, but requires caution due to the damage that *Pratylenchus zeae* can cause to soybean roots following a crop of rice.

Rice (Oriza sativa): The practice of flooding rice plantations, common in Cuba, largely limits problems with most plant-parasitic nematodes in this crop. Nevertheless, nematodes like *Pratylenchus zeae* and *Tylenchorhynchus martini* are present in every rice production area of the country. Non-uniform flooding frequently impedes the establishment of anaerobic conditions in the soil needed to suppress nematode population levels. *P. zeae,* in particular, creates necrotic lesions on roots of rice plants, generally when plants are grown in non-flooded conditions (Fernàndez, M., 1987). *Aphelenchoides besseyi* is found occasionally in rice seeds produced in Cuba. Population levels of the nematode are low because of limited susceptibility of rice varieties used in Cuba, which originate or are descendants of varieties developed at the International Rice Research Institute (IRRI). The "white

tip" disease of rice has not been reported from Cuban plantations (Fernández, 1987).

MANAGEMENT OF PLANT-PARASITIC NEMATODES IN CUBA

A strategy used in Cuba to overcome a lack of awareness of nematode-induced crop losses, is to promote the use of crop varieties with resistance or tolerance to plant parasitic nematodes, and the adoption of proper agronomic and horticultural practices to help plants overcome stress caused by nematodes. Attention is also focused on sanitation practices to prevent nematode movement, population growth, or survival on weeds, crop debris, infested plant material, soil, and equipment, in crops such as guava, tobacco, soybean, and banana (Fernández and Ortega, 1986b; Fernández *et al.*, 1991). Use of nematicides receives much less emphasis than other management tactics, because of their cost, and because long term trials have demonstrated the success of IPM strategies in several crops (Authors, personal observations). However, nematicides continue to be used in a few crops such as tobacco, where nematode population densities must be reduced in the seedbeds. Nevertheless, even in this high value crop, cultural practices such as use of artificial seed beds is reducing the need for nematicides.

The use of biocontrol organisms has found some acceptance in Cuba. Most notably, the fungus *Paecilomyces lilacinus* is currently used to achieve some control of *Radopholus similis* on bananas, when this crop is grown from plants produced *in vitro*, a common practice in Cuba. Recommendations include adding the fungus to soil in bags containing young plants, a month prior to planting, and again to the planting hole when the banana plants are moved to the field. (Fernández *et al.*, 1994)

LITERATURE CITED

ACOSTA, O., and A. VEITIA. 1988. Variación de la población de *Meloidogyne incognita* con diferentes intervalos de preparación de suelos en áreas de semilleros de tabaco. Ciencia y Tecnica en la Agricultura. Protection de Plantas 11(4):59-64.

CALVINO, M. 1920. Informe de los años 1918-1919 y 1919-1920 de la Estación Experimental Agronómica de Santiago de las Vegas. Pp. 723-763 *in*, Secretarìa de Agricultura, Comercio y Trabajo de Cuba. Imprenta Graphical Arts, La Habana, Cuba.

FERNÁNDEZ, E. 1991. Los nemátodos del género *Meloidogyne* Goeldi, en el cultivo de la guayaba *(Psidium guajava* L.) y su control. Ph.D. Dissertation. Instituto Superior de Ciencias Agropecuarias de La Habana, Cuba.

FERNÁNDEZ, E., G. GONZALEZ, M. FERNÁNDEZ, and R. VAZQUEZ. 1987. Desinfección nematológica en los lugares de replante de guayabo. Ciencia y Tecnica en la Agricultura. Protection de Plantas 10(1):49-58.

FERNÁNDEZ, E., and J. CARRASCO. 1991. Malezas hospedantes de *Meloidogyne* spp. en plantaciones de guayabo (*Psidium guajava*). Ciencia y Tecnica en la Agricultura. Protection de Plantas 1(3-4):51-59.

FERNÁNDEZ, E. 1994. Nemátodos parásitos del plátano. Manejo y lucha biológica. Paper submitted to the VIII National Forumon Science and Technology. La Habana.

FERNÁNDEZ, M. 1975. El *Psidum friedrichsthalianum* como patrón para guayabo resistente a los nemátodos del género *Meloidogyne.* Revista de Agricultura 8(3):80-85.

FERNÁNDEZ, M. 1987. Los fitonemátodos en el cultivo del arroz, en las provincias occidentales de Cuba. Ph.D. Dissertation. Academy of Sciences of Cuba, La Habana, Cuba.

FERNÁNDEZ, M., and P. T. MIJAILOVA. 1973. Los nemátodos y su relación con la "pudrición del cogollo" del cocotero en Cuba. Serie Agrícola 29:1-10.

FERNÁNDEZ, M., and J. ORTEGA. 1986a. Lista de nemátodos fitoparásitos de Cuba. Editorial Científico-Técnica, La Habana, Cuba.

FERNÁNDEZ, M., and J. ORTEGA. 1986b. Posibilidad de la sucesión de cultivos soya-tabaco respecto a los fitonemátodos. II. Las plantas indeseables como reservorio natural de nemátodos. Ciencia de la Agricultura 27:39-42.

FERNÁNDEZ. M., J. ORTEGA, R. MARTINEZ, P. MEDINA PETEIRO, and P. MEDINA CLAUSELL.

1989a. Importancia de los restos vegetales y el laboreo en el mantenimiento de poblaciones de *Meloidogyne incognita* en la rotación soya-tabaco negro. Ciencias de la Agricultura 36:15-19.

FERNÁNDEZ, M., J. ORTEGA, and P. MEDINA. 1989b. Posibilidad de la sucesión de cultivos soya-tabaco respecto a los fitonemátodos. III. Tabaco negro. Ciencias de la Agricultura 36:20-28.

FERNÁNDEZ, M., J. ORTEGA, F. PEREZ, and H. DIAZ CARRASCO. 1986. Posibilidad de la sucesión de cultivos soya-tabaco, respecto a los fitonemàtodos. I. Tabaco rubio. Ciencias de la Agricultura 26:23-34.

FERNÁNDEZ, M., A. RAZJIVIN, J. ORTEGA, and A. QUINCOSA. 1980. Nuevas species de *Helicotylenchus* (Nematoda: Hoplolaiminae) asociadas al cultivo del arroz en Cuba. Poeyana 202:1-27.

GARCIA, O. 1982. Relación entre la infestación inicial de *Meloidogyne incognita* y el rendimiento en tabaco rubio. Ciencia y Técnica en la Agricultura 5(3):31-38.

GARCIA, O., and J. ESPINOSA. 1982. Evaluación económica de las pérdidas causadas por *Meloidogyne* spp. En tabaco rubio var. "Hicks 187". Ciencia y Técnica en la Agricultura 5(3):79-95.

GARCIA, O., and M. PEREZ. 1987. Pérdidas en cosecha producidas por *Meloidogyne incognita* en tàbaco de la provincia de Pinar del Río. Ciencia y Tecnica en la Agricultura. Protection de Plantas 10(3):85-98.

GARCIA, O., M. PEREZ, J. PEREZ, and E. FERNANDEZ. 1986. Relación entre las pérdidas producidas por *Meloidogyne incognita* y el nivel de infestación radical en tabaco negro. Ciencia y Tecnica en la Agricultura. Protection de Plantas 9(2):71-84.

IES (Instituto de Ecología y Sistemática)-UNEP (United Nations Environmental Programme) 1998. Estudion Nacional sobre la Diversidad Biológica en la República de Cuba. La Habana, Cuba.

O'RELLY, J. 1979. Análisis ecotaxonómico de los nemátodos de la caña de azúcar (*Saccharum* sp.) en Cuba. Ph.D. Dissertation. Academy of Sciences of Cuba, La Habana, Cuba.

RAZJIVIN, A., M. FERNANDEZ, J. ORTEGA, and A. QUINCOSA. 1981. Nuevas species de *Hirschmanniella* (Nematoda: Pratylenchinae) parásitas de plantas indeseables en plantaciones de arroz. Poeyana 216:1-11.

RAZJIVIN, A., J. O'RELLY, and J. R. PEREZ MILIAN. 1973a. Nueva especie de *Helicotylenchus* (Nematoda: Hoplolaimidae) encontrada en la caña de azúcar. Poeyana 105:1-4.

RAZJIVIN, A., J. O'RELLY, and R. R. PEREZ MILIAN. 1973b. Nuevas especies de nemátodos (Nematoda: Dorylaimidae y Hoplolaimidae) parásitos de la caña de azúcar en Cuba. Poeyana 108:1-12.

RAZJIVIN, A., and J. O'RELLY. 1976. *Pratylenchus cubensis* sp.n. (Nematoda: Pratylenchinae) encontrada en la rizosfera de la caña de azúcar en Cuba. Revista zoologica, Ed. Nauka, Moscú, Tomo LV (1). (In Russian).

RAZJIVIN, A., and J. O'RELLY. 1978. *Zygotylenchus biterminalis* sp.n. (Nematoda Pratylenchidae). Revista zoologica, Ed. Nauka, Moscú, No. 4. (In Russian).

SAMPEDRO, J., and H. GANDARILLA. 1985. Establecimiento del índice de lesiones radicales como método para evaluar los daños provocados por *Pratylenchus coffeae* en el cultivo del plátano. Ciencia y Tecnica en la Agricultura. Protection de Plantas 8(4):95-104.

SAMPEDRO, J., J. PEREZ, V. FOWLER, H. GANDARILLA, O. ACOSTA, E. LORENZO, M. BESTERRECHEA, I. GARCIA, B. O'CONNOR, and E. FERNANDEZ. 1989. Nemátodos parásitos asociados al cultivo del cafeto en Cuba. Ciencia y Tecnica en la dAgricultura. Protection de Plantas 12(4):59-72.

SCHLIEPHAKE, E., M. FERNADEZ, and J. ORTEGA. 1985. *Helicotylenchus paraconcavus* sp.n. (Nematoda: Hoplolaiminae), y la descripción de un macho de *Helicotylenchus microcephalus* Sher, 1966. Poeyana 295:1-5.

STOYANOV, D. 1967. Especies de nemátodos parásitos del plátano en Cuba y posibilidades de control. Revista de Agricultura 1(3):9-47.

STOYANOV, D. 1968. Algunos problemas nematológicos de los cítricos en Cuba. ACAD. DE CIENCIAS DE CUBA. DPTO. MEJORAMIENTO DE PLANTAS.

STOYANOV, D. 1972. *Heterodera amaranthii* sp. n. (Tylenchida: Heteroderidae) un nemátodo formador de quistes en Cuba. Poeyana 97.

STOYANOV, D. 1972. *Heterodera amaranthii.* Ciclo biológico, hospedantes y distribución. Poeyana 111:1-26.

Received: *26.V.1998*

Recibido:

Accepted for publication: *23.X.1998*

Acceptado para publicación: