A REVIEW OF PLANT-NEMATOLOGICAL RESEARCH CONDUCTED IN TRINIDAD AND TOBAGO

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ABSTRACT

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This paper reviews plant-nematological research conducted in Trinidad and Tobago during 1932–1985. Red ring disease of coconut caused by *Rhadinaphelenchus cocophilus* has been one of the most intensively researched nematode problems, and current approaches to control of this nematode by the use of attractants and biological agents are discussed. The root-knot nematode *Meloidogyne incognita* is the most economically important nematode of vegetable crops. Research findings on cultural and chemical control of *M. incognita* are also presented. Important nematode problems of sugar cane, fruit, root crops and legumes include *M. incognita, Rotylenchulus reniformis, Tylenchulus semipenetrans,* and *Helicotylenchus dihystera.* Results of a recent survey of plant-parasitic nematodes in forage crops are presented.

Key words: cassava, coconut, cowpea, *Helicotylenchus dihystera Meloidogyne incognita,* nematicides, pigeon pea, research institutions, resource personnel, *Rhadinaphelenchus cocophilus, Rotylenchulus reniformis,* sugar cane, survey, tomato, *Tylenchulus semipenetrans.*

RESUMEN

Bala, G. 1988. Una reseña de la investigación fitonematológica en Trinidad y Tobágo. Nematrópica 18: 75–85.

Este trabajo presenta un resumen de la investigación fitonematológica realizada en Trinidad y Tobago durante 1932-1985. La enfermedad del anillo rojo causada por *Rhadinaphelenchus cocophilus* ha sido uno de los problemas más intesamente investigado y se discute las medidas actualmente empleadas para el control de este nematodo usando atrayentes y entidades biológicas. El nematodo nodulador *Meloidogyne incognita* es el nematodo que tiene más importancia económica en los cultivos hortícolas. Se incluyen también resultados sobre el combate químico y agronómico de este nematodo. Nematodos de importancia en caña de azúcar, raíces y tuberculos, y leguminosas incluyen *M. incognita, Rotylenchulus reniformis, Tylenchulus semipenetrans* y *Helicotylenchus dihystera.* Se presentan los resultados de un reconocimiento reciente de nematodos fitoparásitos en cultivos forrajeros.

Palabras claves: caña de azúcar, casava, cocotero, frijol, gandul, *Helicotylenchus dihystera,* institutos de investigación, *Meloidogyne incognita,* nematicidas, reconocimiento, recursos de personal, *Rhadinaphelenchus cocophilus, Rotylenchulus reniformis,* tomate, *Tylenchulus semipenetrans.*

INTRODUCTION

The development of plant-nematological research in Trinidad and Tobago has been determined, partly, by the effects of economic losses to important agricultural crops. Some of the earliest nematological research addressed the problem of red ring disease which afflicted the coconut industry several years after the disease was observed.

Subsistence agriculture, practiced by the native Caribs and Arawaks during the pre-colonial era, gave way to the plantation system in which sugar cane (*Saccharum officinarum* L.) and tobacco (*Nicotiana tabacum* L.) were the main crops. Before 1940, the economy depended substantially on agriculture in which sugar cane, cocoa (*Theobroma cacao* L.), coconut (*Cocos nucifera* L.), and citrus (*Citrus* spp.) featured prominently. After 1940, a steady decline in agriculture occurred and the situation worsened as a result of the windfall in revenue from petroleum during the 1970's. By 1976, agriculture was contributing only 3.5% to the Gross Domestic Product (23).

Sugar cane and cocoa cultivation occupies 58% (approximately 47 500 ha) of the cultivated lands in Trinidad and Tobago (16). However, sugar cane production will be scaled down to meet domestic demands, leaving a small amount for export. Lands available from sugar cane production will be utilized for food and tree crops as part of the diversification program planned for the country.

Vegetable production has stabilized over the last few years, and during the dry season, when conditions are favorable, production is sufficiently high to satisfy local demand.

Besides socio-economic factors, plant diseases have contributed significantly to the decline of the agricultural sector. Plant-parasitic nematodes reduce yields in several important crops in Trinidad and Tobago, and institutions have been established to conduct research on the many problems caused by these organisms.

RESEARCH INSTITUTIONS AND RESOURCE PERSONNEL

Over the years, work has been done in plant nematology in several national and regional research institutions. Of the national institutions, the Red Ring Research Division of the Ministry of Food Production, Marine Exploitation, Forestry and the Environment (MFPMEFE) and the Coconut Research Ltd., were established to investigate red ring disease. Significant contributions were made by Fenwick, Blair, and Griffith. The MFPMEFE recently constructed a laboratory at the Central Experiment Station where research on nematological problems is conducted.

The Imperial College of Tropical Agriculture and later the University of the West Indies, Faculty of Agriculture, have done research in

plant nematology. The Regional Research Centre, which later became known as the Caribbean Agricultural Research and Development Institute, marked the beginning of a new era when there was an increase in nematological research conducted in Trinidad and Tobago. Brathwaite, Singh, and Phelps made outstanding contributions to research activities of this institution. Research on the citrus nematode *Tylenchulus semipenetrans* Cobb was initiated at the Citrus Research Unit of the University of the West Indies. On a per capita basis, Trinidad and Tobago rank high among developing countries in the number of researchers and research institutions involved in nematological research during the last half century.

CROPS

Sugar cane: Although sugar cane is the most important crop in Trinidad and Tobago, little research has been done on nematodes associated with this crop. In fact, sugar cane production began in 1627 (15), but the first nematological studies were initiated in 1973 when Singh (32) associated *Helicotylenchus dihystera* (Cobb) Sher, *Meloidogyne incognita* (Kofoid & White) Chitwood, *Pratylenchus zeae* Graham, and *Tylenchorhynchus martini* Fielding, with root damage and areas of poor growth in fields. Soil populations of these species reached their highest levels during August and September which coincided with the rainy season (42). In 1980, Brathwaite (10) concluded that *Pratylenchus* spp. and *Helicotylenchus* spp. were contributing to sugar cane decline experienced in the Golconda area of South Trinidad.

Currently, work on determining the qualitative and quantitative population densities of plant-parasitic nematodes associated with sugar cane is being done. More work in this area is needed before other spheres of research are pursued.

Tobacco: Like sugar cane, tobacco was cultivated extensively in Trinidad during the colonial era, but was not reported as a host of *Meloidogyne* until 1955 (4). Later, Singh (33) showed that large populations of *Pratylenchus* sp. and *Meloidogyne* sp. were associated with stunting, chlorosis, root lesions, galls, and root rot. Additional work by the same author demonstrated that ethoprop, DD, and DD + methyl isothiocyanate application resulted in effective control of plant-parasitic nematodes (35,37).

Vegetables: Except for the work on coconut, vegetable crops have received the most intensive nematological investigations. One of the earliest records of plant-parasitic nematodes on vegetables in Trinidad and Tobago is that by Briant in 1932 (14) who reported *Meloidogyne* on tomato (*Lycopersicon esculentum* Mill.) roots. More recently, Singh (31) and Bala (2) associated 23 and 19 plant-parasitic genera, respectively,

with vegetables. In 1974, Singh (36) reported 77 plant species, including many important vegetable crops, as hosts of the reniform nematode *Rotylenchulus reniformis* Linford & Oliveira.

The most important plant-parasitic nematodes of vegetable crops in Trinidad and Tobago are the root-knot nematodes *Meloidogyne* spp. A host-range, including weed hosts, was reported (4).

After nematode problems were identified, research to develop control methods in several important vegetable crops was initiated. The use of black polyethylene mulch resulted in significant reduction of populations of *R. reniformis* and *M.incognita* associated with tomato (44). In 1972, Singh (30) obtained several tomato cultivars and one melongene (*Solanum melongena* L.) cultivar resistant to *M. incognita*. Gowen (18) subsequently studied the mechanism of resistance of certain tomato cultivars to *M. incognita* and the interaction of *M. incognita* and *Pseudomonas solanacearum* Smith.

The use of nematicides resulted in significant reduction in nematode populations and increases in yield of several vegetable crops. Oxamyl reduced nematode populations associated with tomato (38), whereas MBR-chloropicrin and ethoprop reduced populations associated with cabbage (*Brassica oleracea* var. *capitata* L.) (34). MBR-chloropicrin, ethoprop, fenamiphos and DBCP increased sweet pepper yields by 7–28% (35).

Research to achieve economic control of plant-parasitic nematodes associated with vegetable crops is continuing. Recommendations for nematode control in tomato using granular nematicides are forthcoming. Integrated pest management studies involving plant-parasitic nematodes associated with cash crops will emphasize cropping systems, interactions involving plant-parasitic nematodes, and reduced nematicide application. Evaluation of cultivars for resistance to root-knot nematodes, in particular, will receive greater attention.

Legumes: Several plant-parasitic nematodes including *M. incognita* and *R. reniformis* were associated with pigeon peas (*Cajanus cajan* (L.) Millsp.) (39), but reduction in plant growth was not reported. *M. incognita* and *R. reniformis* separately and in combination, significantly reduced top and root dry weight of soybean (*Glycine max* (L.) Merr.) 10 weeks after inoculation (41). Resistance to *R. reniformis* in Bengal bean (*Stizolobium aterrimum* Piper & Tracy) was suggested by Lum Chow & Brathwaite (25). Application of phenamiphos resulted in substantial increases in yield of cowpea (*Vigna unguiculata* (L.) Walp.), grown in soil in which the reniform nematode was the dominant species (9). Oxamyl application to soil in which the reniform nematode was the dominant species resulted in 40 and 65% increases in seed weight of 'Jupiter' and 'Improved Pelican' soybean, respectively (3).

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life-cycle of approximately 8 weeks. Preliminary investigations of chemical control of the nematode were initiated, but conclusive results are unavailable.

The potential of pangola grass (*Digitaria descumbens* Stent) and *Tagete* spp. as agents with nematicidal properties was investigated (27). Studies on chemical control of the nematode using liquid and granular DBCP and aldicarb indicated that these nematicides were effective (27,29).

Because of institutional problems, work on the citrus nematode ceased during the early 1970's, but with plans to rejuvenate the industry, attention must be paid to this important nematode. Studies will focus on the evaluation of resistant rootstocks and the use of granular nematicides for achieving economic control.

Two surveys associated several species of plant-parasitic nematodes with various fruit crops (2,31.). The reniform nematode was found on roots of severely diseased papaya trees (*Carica papaya* L.) (43). Since an increase in food crop hectarage is anticipated, further work is necessary to determine the important plant-parasitic nematodes in production of exotic fruits.

Miscellaneous crops: In 1982, a 1-ha plot of plantains (*Musa* AAB cv. Horse), located at Freeport, exhibited poor growth (Bala, unpubl.). Plants displayed stunting, poor anchorage, chlorotic leaves and bore small bunches of four 'hands', each with few, small fingers. Numerous lesions were observed on roots and, in some instances, roots were rotted. Abundant patches of dark-brown necrotic areas were observed on the surface of rhizomes and when they were sectioned, the necroses were observed to extend 2–4 cm deep. Nematodes associated with the debilitated plants were *Pratylenchus coffeae* (Zimmermann) Filipjev & Schuurmans Stekhoven, *H. dihystera, Peltamigratus luci* Sher, and *R. reniformis.*

In spite of the importance of cocoa and coffee (*Coffea arabica* L.) to agriculture, little work was done on the nematode problems associated with these crops. Tapia-Arnoz (45) suggested that museum specimens of root galls found on coffee in 1925 may be the first record of *Meloidogyne* in Trinidad. Several plant-parasitic nematodes of cocoa and coffee have been reported by Singh (31) and Bala (2).

The only known survey of rice (*Oryza sativa* L.) for nematodes suggests that they are not important in rice production in Trinidad (Bala, unpubl.). Samples of paddy, root and soil were taken from rice fields during 1982–1984. Plant-parasitic nematodes of known economic importance were not found. Nematodes that were recovered included *Helicotylenchus* sp., *Criconemella* sp. and *Tylenchorhynchus* sp.

Since maize is of minor importance, little research has been devoted to this crop. Singh (pers. comm.) found that applications of calcium carbonate decreased nematode populations and increased yields of maize by 10–50%.

Singh (40) reported yield increases of 40, 39, 35, 9, 12, and 18% in maize, when soil infested with nematodes was treated with DD-methyl isothiocyanate, DD, fenamiphos, oxamyl, bunema, and ethroprop, respectively.

Forage crops are important to the dairy industry of Trinidad and Tobago. However, no attention was given to the nematodes associated with these crops until 1982 when a survey of elephant grass (*Pennisetum pupureum* Schumach.), pangola grass and tanner grass (*Brachiaria* sp.) was conducted (1). Eight genera of plant-parasitic nematodes associated with these grasses are presented in Table 1. Large populations of

Table 1. Plant-parasitic nematodes associated with forage crops in Trinidad.

Nematode	Crop	Location[z]
Helicotylenchus sp.	pangola grass	
	Digitaria decumbens Stent	CF
Helicotylenchus concavus Roman	elephant grass, *Pennisetum purpureum* Schumach.	E
H. dihystera (Cobb) Sher	tanner grass, *Brachiaria* sp.	E
	elephant grass	E,T,CE,WF
H. pseudorobustus (Steiner) Golden	tanner grass, pangola grass	CF
	elephant grass	CF,E,T,WF
Hemicriconemoides mangifera Siddiqi	tanner grass	CF
Criconemella onoensis (Luc) Luc & Raski	tanner grass	CF
Paratrichodorus christiei (Allen) Siddiqi	elephant grass	T
Paratylenchus sp.	elephant grass	CE
Paratylenchus sp. probably *P. serricaudatus* Raski	tanner grass	E,CF
Pratylenchus sp.	elephant grass	CE
	pangola grass	E
P. zeae Graham	tanner grass	E,CF
	pangola grass	CF
	elephant grass	CF,T,WF
Rotylenchulus reniformis Linford & Oliveira	elephant grass	CE
Tylenchorhynchus annulatus (Cassidy) Golden	elephant grass	T,WF,CF

[z]CF = Carlsen Field; CE = Centeno; E = Esmeralda; T = Turure; WF = Waller Field.

Pratylenchus sp., *Paratylenchus* sp., and *R. reniformis* were associated with stunted, chlorotic elephant grass in experimental plots at Central Experiment Station, Centeno.

CONCLUSION

Much research in plant nematology has been done in Trinidad and Tobago, but it will be challenging to find solutions to the many problems that exist. Research to find an effective solution to red ring disease is continuing. Further work is needed to determine the role of plant-parasitic nematodes on the growth of a wide range of crops including fruit and forage crops.

Screening of vegetable cultivars for resistance or tolerance to root-knot nematodes should receive high priority. In view of recent attempts to rejuvenate the citrus industry, consideration should be given to recommence research on the citrus nematode. Much emphasis has been placed on the expansion of the rice industry. Serious efforts should be made to ensure that this industry is protected from introductions of serious pests including *Aphelenchoides besseyi* Christie.

Undoubtedly, plant nematological inputs are vital to the achievement of self sufficiency in food. Strengthening the established research base and consideration by administrators and researchers of biological control, integrated pest management, technology transfer, and training, are important components of a future plant-nematological research progam.

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