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Survey of Nematodes Associated with Sugarcane in Nigeria

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ABSTRACT

Commercial sugarcane production started in Nigeria in 1956 with the establishment of the Nigerian Sugarcane Company, Bacita. The first record of nematode association with sugarcane in Nigeria was given by Caveness in 1967. Research efforts since then have centred on varietal and chemical screening for the control of the main nematode diagnosed as *Heterodera sacchari* Luc and Merny. Current investigations have indicated the involvement of more than one nematode genus with sugarcane. It also showed that nematode incidence and density aligned very closely with cropping pattern than with location.

INTRODUCTION

Sugarcane is grown in more than 80 countries throughout the tropics and subtropics. In some countries like Jamaica, Mauritius, and Swaziland it is the principal source of revenue (Spaull and Cadet, 1990).

From 1982 to 1987 mean annual world production of cane sugar exceeded 63 million tons with Brazil being the largest single producer closely followed by Cuba and India (Ahlfeld, 1987). These three countries, together with Australia, China, Mexico, South Africa and Thailand produced more than 60% of the world total. In all these countries, sugarcane is monocropped on vast acreages. Similar cultural practices-cultivation, water management and pest control are followed. Consequently, extensive researches into all aspects of pests and diseases have been done to assist cane growers.

In most developing countries, large sugarcane plantations are very few primarily because the importance of sugarcane in agricultural in these countries is less emphasised. As a result, there are limited information on various aspects of this crop.

Nematodes are widely recomised as limitting factors in crop production including sugarcane (Apt and Koike, 1962; Williams, 1970). The first record of nematode association with sugarcane and other food crops in Nigeria was given by Caveness in 1967, and later by Parsons (1970). Between then and now, local and exotic sugarcane accessions in the Institute's germplasm were screened against two plant parasitic

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nematode genera such as - *Meloidogyne* spp. and *Heterodera* spp. mainly. All exotic commercial cultivars and most of the local accessions screened were ascertained to be susceptible to the root-knot nematode, *(Meloidogyne incognita)* (Salawu, 1986; NCRI, 1990), *Heterodera sacchari* (Onapitan, 1979: Salawu, 1992) *and Helicotylenchus pseudorobustus* (Onapitan and Amosu, 1982). Between 1985 and 1988, a survey was conducted on nematodes associated with sugarcane in Nigeria. The goal was to identify the extent of nematode problems and association of specific nematode with cropping pattern, soil and agroecology.

MATERIALS AND METHODS

One hundred and twenty-six farms were visited. Visits were split over the sample period for effective coverage of production area. Choice of farms visited were made with the assistance of Zonal Extension Officers of the Agricultural Development Projects in each State. Selected farmers were questioned to obtain background information on their cane fields. The cropping pattern at the time of sampling was also noted. In all, a total of 350 soil samples were collected from which nematodes were extracted and plant-parasitic nematodes were identified. Samplings sites were rated for cane vigour and general plant health on a scale of 1-10 where 10 = withered/dead canes and 1 = healthy and vigorous canes. Soil samples were collected, labelled and packed in baft bags while in transit to protect them from sunlight.

Back at the Institute, they were stored at room temperature (25^0C) for not more than five days before extraction. Nematodes were extracted using a modification of Whitehead and Hemming tray method (Whitehead and Hemming, 1965). Incidence of each nematode genus in each location was determined as number of a genus in a sample/total number of nematodes in a sample x 100 after Norton (1978).

RESULTS AND DISCUSSION

All sugarcane growing areas mostly in small subsistence status were sampled in 16 out of 31 (Figure 1) states in the federation over a period of two years. For ease of reference after sample analysis, the area surveyed were divided into zones namely:

Zone 1: Sothwestern states (Oyo, Ondo, Ogun, Osun, Edo Delta)
Zone 2: Southeastern states (Cross River, Abia, Imo, Anambra)
Zone 3: Western middle belt states (Kwara, Kogi, Niger)
Zone 4: Eastern middle belt states (FCT, Benue, Plateau)

Table 1 shows the plant-parasitic nematodes found from sugarcane soils during the entire survey while Table 2 shows the average population and relative density of more common genera by zones. A total of twenty-one nematode general were found to be associated with sugarcane cultivation. Of these, seven namely:

Meloidogyne spp. Goeldi 1987, *Tylenchus* spp. Bastian 1965, *Pratylenchus* spp. Filipjev 1934, *Helicotylenchus* spp. Steiner 1945, *Tylenchorhynchus* spp. Cobb 1913, *Heterodera* spp. Schmidt 1871 and *Xiphinema* spp. Cobb 1913 were most abundant.

Table 1. Distribution of plant-parasitic nematodes associated with sugarcane in some states of Nigeria.

Nematode Genus	STATES															
	OYO	OSUN	ONDO	OGUN	DELTA	EDO	IMO	ABIA	ANABRA	CROSS RIVER	KWARA	KOGI	NIGER	FCT	BENUE	PLATEAU
Aphelenchus	+	+	+	-	-	-	+	+	-	+	+	+	+	+	+	+
Belonolaimus	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Criconema	-	-	+	+	+	+	-	-	-	+	+	+	+	+	+	+
Criconemella	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-
Dolichodorus	-	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-
Helicotylenchus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hemicaloosia	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Hemicriconemoides	+	+	+	-	-	-	+	+	-	-	+	+	+	+	-	-
Hemicycliophora	-	-	-	-	-	-	+	+	-	-	-	-	+	+	-	-
Heterodera	-	-	-	+	+	+	+	+	-	+	+	+	+	+	+	+
Hirschmanniella	-	-	-	-	-	-	+	+	-	-	-	-	+	-	-	-
Hoplolaimus	-	-	-	+	-	-	+	+	-	-	+	+	-	+	+	+
Longidorus	+	+	+	+	-	-	-	-	-	-	-	-	-	+	+	+
Meloidogyne	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pratylenchus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rotylenchus	-	-	-	+	-	-	+	+	-	-	+	+	+	+	+	+
Scutellonema	+	+	-	-	+	+	+	+	-	-	-	-	+	-	+	-
Trichodorus	+	+	+	+	-	-	-	-	-	-	+	+	+	+	+	-
Tylenchorhynchus	+	+	-	+	+	+	+	+	+	-	+	+	+	+	+	+
Tylenchus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Xiphinema	-	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+

+ = nematode present; - = nematode absent

Table 2. Average population[a] and relative density (%)[b] by survey zone of some selected plant-parasitic nematodes associated with sugarcane in Nigeria.

	Zone 1	Zone 2	Zone 3	Zone 4	ALM**
Aphelenchus	5(0.72)	4(0.49)	29(2.43)VI	33(2.93)	71.00(1.64)
Criconema	3(0.43)	2(0.25)	5(0.42)	4(0.35)	3.50(0.36)
Helicotylenchus	146(21.07)II	192(23.65)I	396(33.17)I	321(28.43)I	263.75(26.58)
Heterodera	56(8.08)IV	101(12.44)III	298(24.96)II	247(21.88)II	175.50(16.84)
Hirschmanniella	0(0.00)	2(0.25)	6(0.50)	0(0.00)	2.00(0.19)
Hoploloimus	21(3.03)VIII	26(3.20)VIII	19(1.59)	32(2.83)	24.50(2.66)
Meloidogyne	220(31.75)I	185(22.78)II	120(10.05)III	109(9.65)III	158.50(18.56)
Pratylenchus	38(5.48)VI	54(6.65)V	43(3.60)V	50(4.43)VI	46.25(5.04)
Scutellonema	9(1.30)	33(4.06)VIII	7(0.59)	43(3.81)VII	23.00(2.44)
Trichodorus	4(0.58)	0(0.00)	15(1.26)	17(1.51)	9.00(0.84)
Tylenchorhynchus	83(11.98)III	90(11.03)IV	93(7.79)III	103(9.12)IV	92.25(9.98)
Tylenchus	48(6.93)V	53(6.53)VI	62(5.19)IV	71(6.29)V	58.50(6.24)
Xiphinema	9(1.30)	13(1.60)	21(1.76)VII	27(2.39)	17.50(1.76)
Others*	51(7.40)	57(9.62)	80(6.70)	72(6.38)	65.00(6.88)
Total	693	812	1194	1120	957

* Species listed in Table 1 but not reflected above
** ALM = Across location mean
a = Population levels are averaged from appropriate samples (No. 200g soil)
b = Relative density (= incidence) expressed in % after Norton, 1978.
Figures in parenthesis refer to relative density while the open figures are the average nematode population/200g soil samples.

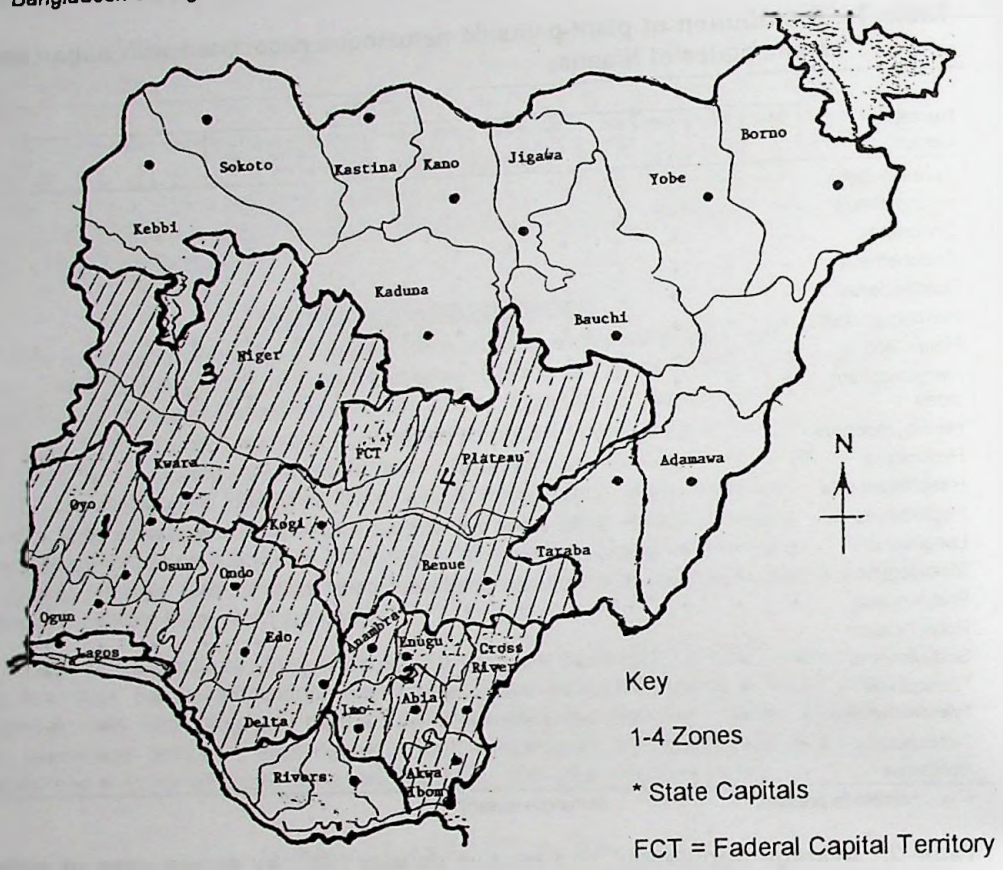

Figure 1: Map of Nigeria showing area covered by the survey report.

Zone 1: *Meloidogyne* spp. generally referred to as the root-knot nematode was found to dominate this region, followed by the spiral nematode, *Helicotylenchus* spp. and an aberrant ecto-parasite- *Tylenchorhynchus* spp. The root lesion nematode, *Pratylenchus* spp. though found in all samples collected from this zone (Table 1) had a lower relative density than *Meloidogyne* spp. or *Helicotylenchus* spp. (Table 2) both of which were similarly well distributed in the zone. The sugarcane cyst nematode, *Heterodera sacchari* was found in 50% of the samples. Its occurrence in location where found were however high thus imposing a high mean relative density value.

Zone 2: The dominant nematode was *Helicotylenchus* spp. closely followed by *Meloidogyne* spp. Soils from this zone are generally reddish-clay loam. The area shares with zone 1, a bimodal pattern of rainfall allowing cropping activities to be carried out virtually all the year round. As in zone 1, there was no record of awareness of nematodes for nematode-induced problems by cane farmers. As such, the use of nematicides has never been contemplated. *Tylenchus, Pratylenchus* and *Helicotylenchus* all had 100% distribution (Table 1), *Helicotylenchus* spp. predominated numerically, followed by *Meloidogyne* spp. The sugarcane cyst nematode *Heterodera sacchari* was not encountered at all.

Zone 3: The spiral nematode, *Helicotylenchus* spp. was most abundant followed by the sugarcane cyst nematode, *Heterodera* spp. Other nematodes with descending relative density are *Tylenchus* spp., *Pratylenchus* spp., *Meloidogyne* spp., *Tylenchorhynchus* spp. and *Xiphinema* spp. The rice root nematode, *Hirschmanniella* spp. was found in cane soils in this zone. Its occurrence was limited to fields where rice and sugarcane were relay/inter-cropped.

The soils of the sugarcane growing areas of this zone are diverse in nature ranging from very heavy clay in some isolated fields through sandy clay in most "fadama" (inland valleys) to typical upland sandy loam in most areas. The zone also has the greatest sugarcane production area in terms of cultivated land.

None of the fields sampled had a history of nematicide usage. Except in corporate farms like NISUCO's at Bacita, most farmers claimed total ignorance of nematodes and nematode-induced problems. Most farms were monocropped. Total farm size was generally small, usually less than 1 acre. In all cases, there were no apparent symptoms of nematode damage. In the other two zones, (i.e zones 1 and 2) the local chewing cane varieties were planted mostly. In this zone, however, there are extensive plantations in which commercial cane varieties are grown for use in sugar processing industries. Except in these cane plantations, most local farmers plant the local chewing varieties, intercropping the sugarcane with one or two other crops at the planting or early stages of the cane. Rice, is a favourite crop were such intercropping is practised.

Zone 4: Sugarcane culture in this zone is not different from that practised by local farmers in zone 3. In all places, mature stands assumed monocropping status. Investigations, however, showed that at the early stages, they were intercropped with shorter gestation crops like maize, rice and vegetables. Most of the namatodes associated with sugarcane were found in all samples in this zone (Table 1). *Helicotylenchus* spp., *Heterodera* spp., *Meloidogyne* spp. and *Tylenchorhynchus* spp., were more abundant relative to other species (Table 2).

Since the first report of association of nematodes with sugarcane in Nigeria (Caveness, 1967), there has been random researches on effects of slected nematodes, especially root-knot nematodes on various food crops. Apart from *Meloidogyne* spp., the sugarcane cyst nematode, *Heterodera sacchari* has also been reported. Such reports were limited to the major commercial sugarcane plantations. The results fo this survey provide additional information to the findings, made by Caveness (1967) and Onapitan and Amosu (1982).

Meloidogyne spp., *Tylenchus* spp., *Pratylenchus* spp., *Tylenchorhynchus* spp., and *Helicotylenchus* spp. were detected in all areas sampled in zone 1. Distribution and relative density trend in zones 1 and 2 were similar although *Helicotylenchus* spp. had a higher relative density than *Meloidogyne* spp. in the latter. Both zones are in the same climatic and vegetational belt. Nematode distribution did not differ much in the othe two zones inspite of being in a differet in climatic and vegetational belt. This was probably because cane farms in these zones were located not too far from streams, assuring conducive soil microclimate for a greater part of the cane's life.

Odihirin (1976) stated that *H. sacchari* caused massive, destruction of cane fields at NISUCO, Bacita. There was no observable symptom (above-ground) of nematode attack on sugarcane in all the fields where samples were collected. Inspite of the ubiquity of *Meloidogyne* spp. on all sugarcane fields sampled, the relative density across location was not different from that of *Heterodera* spp. From the results of this survey, it is

evident that although *H. sacchari* is limited in spread, cultural practices on farms were found to be conducive to its development and reproduction which could readily become the major problem on sugarcane.

Virtually in almost all the zones, *Helicotylenchus* spp. had very high relative density compared to the other plant parasitic nematodes. The relatively higher density of *Helicotylenchus* spp. across location seems to imply that this genus is very important on sugarcane. This assumption probably accounts for the in-depth study on the pathogenicity and histopathology of this nematode- *H. pseudorobustus* on sugarcane by Onapitan and Amosu (1982). It should be noted that *Helicotylenchus* spp. which is an ectoparasitic nematode, have a lower pathogenic pressure than *Heterodera* spp. or *Meloidogyne*, which are sedentary endoparasites. But in a favourable condition conducive to population explosion, *Helicotylenchus* spp. could attain economic damage level in short time posing a threat to the cultivation of sugarcane.

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