SHORT NON-REFEREED PAPER

ABUNDANCE AND DIVERSITY OF NEMATODE GENERA PRESENT IN THE SOUTH AFRICAN SUGAR INDUSTRY

RAMOUTHAR PV

South African Sugarcane Research Institute, P/Bag X02, Mount Edgecombe, 4300, South Africa
prabashnie.ramouthar@sugar.org.za

Abstract

The roots of sugarcane plants in South Africa can be attacked by as many as 23 different genera of soil dwelling plant parasitic nematodes. Some genera are more damaging than others and damage to the plant is dependent on the composition of the nematode community present. Identifying the different genera that inhabit the soils is therefore very important, as it has implications for control. Based on data collected in 2012, this paper examines the different nematode genera present in the South African sugar industry. Fifteen different nematode genera were observed in the soil samples analysed, whilst four nematode genera were found in the roots. *Pratylenchus* was the most frequently encountered genus in sugarcane soil and roots. *Meloidogyne*, responsible for up to 30% yield loss in sugarcane, occurred in just 24% of the soil samples analysed but, when found, its levels were yield limiting. The results from this study provided valuable insight into the nematode genera currently present in the SA sugar industry. Future studies of this nature will help monitor trends in the industry.

Keywords: nematode diversity, *Meloidogyne*, abundance, yield loss

Introduction

Nematodes are the most abundant multicellular organisms on Earth (Bernard, 1992). There are usually two different kinds of nematodes found in the soil, the first being free living nematodes or beneficial nematodes that contribute to nutrient recycling in the soil. The second are plant parasitic nematodes (PPN) that feed on the plant roots. These are of significant economic importance in agriculture. Sugarcane is attacked not by a single PPN genus but by a wide number of genera in the soil, forming communities (Cadet and Spaull, 2005). Some genera are more damaging than others, thus identification of the genera within the communities is important as it has implications for control strategies. *Pratylenchus* is the most common PPN associated with sugarcane and together with *Meloidogyne* is considered the most damaging of the PPNs associated with sugarcane (Cadet and Spaull, 2005). Although *Helicotylenchus* is a parasitic nematode genus, high proportions of this nematode in a community are usually associated with better sugarcane growth (Rutherford *et al*., 2003).

This study aimed to establish the nematode genera currently present in the South African sugar industry and the prevalence of each of the genera. This was achieved through analysis of sampling data generated during 2012 at the South African Sugarcane Research Institute (SASRI).

Materials and Methods

The data set used for this study consisted of soil and root samples collected in and analysed by the Nematology department at SASRI during 2012. The samples were a mixture of those taken by SASRI research staff from research trial sites and those sent in by growers for analysis and nematicide advice. For SASRI trial samples, both soil and roots were taken at 5-15 cm depths at the base of sugarcane stalks at two locations along a 10 m row. For grower-collected samples, the method is undetermined; however, growers are recommended to use the same method as for trial samples. If sugarcane is not present, soil is collected from at least five random locations within a field. The field boundaries and area is determined by the grower. Nematodes in the soil and roots were extracted using the Seinhorst (1962) elutriation and Seinhorst (1950) mist chamber techniques, respectively. Nematodes were counted and identified to genus level using a dissecting microscope. A total of 1240 soil samples and 1038 root samples were analysed in 2012. These were from 40 different sites, and some sites were sampled more than once. There were samples from all the different sugar growing regions in South Africa.

Three parameters were used to analyse the data: (i) the average abundance per genus (Equation 1), (ii) the frequency of each genus (Equation 2) and (iii) the maximum abundance (highest recorded number).

$$Average\ abundance = \frac{Sum\ of\ genus}{Number\ of\ samples\ containing\ genus} \qquad \text{(Equation 1)}$$

$$Frequency = \frac{Number\ of\ samples\ containing\ genus}{Total\ number\ of\ samples} \qquad \text{(Equation 2)}$$

Results and Discussion

Analysis of the sampling data identified 15 different PPN nematode genera in the soil samples and four different genera in the root samples analysed in 2012 (Table 1). Similar studies conducted by Spaull (1981) and Berry (2006) found 23 and 18 different genera, respectively, in the soil. Free living nematodes were found in all the soil samples analysed (Table 1).

The most frequently occurring PPN nematode genera in the soil were *Pratylenchus*, *Scutellonema*, *Helicotylenchus*, *Paratrichodorus* and *Xiphinema* which occurred in 88.4, 81.8, 78.9, 78.5 and 71.6% of all the samples respectively (Table 1). Berry (2006) also found the same five genera as being the most frequently associated with sugarcane soil. *Meloidogyne*, responsible for up to 30% yield loss in sugarcane (Cadet and Spaull, 2003), was found in 24% of the samples tested, a lower percentage than that found by Berry (2006). However, despite the lower frequency, when present, *Meloidogyne* was in high enough numbers to potentially cause yield losses (Stirling and Blair, 2000).

All nematode genera were found on average in numbers >100 per 200 cm^3 soil, except *Criconematids* (49), *Dolichodorus* (20), *Hoplolaimus* (12) and *Paratylenchus* (50) (Table 1). Nematode thresholds are not well defined but numbers of *Pratylenchus* and *Meloidogyne* >100 could be yield limiting (Stirling and Blair, 2000; Cadet and Spaull, 2003). Maximum numbers per soil sample were also low for *Dolichodorus*, *Hoplolaimus* and *Paratylenchus* (< = 30) (Table 1), indicating that these nematodes occur very infrequently and in very low numbers, thereby causing little damage. *Criconematids*, on the other hand, have a frequency of <50% and an average abundance of <50, but their maximum number is in excess of 1000 nematodes per 200 cm^3 soil (Table 1). This indicates that, where conditions are favourable, these nematodes can flourish. However, large numbers of these nematodes are not of concern in sugarcane, as this genus is described as widespread but moderately or weakly pathogenic (Stirling and Blair, 2000). Other genera found in the study that fit into this category are *Helicotylenchus*, *Scutellonema*, *Rotylenchulus*, *Hemicycliophora*, *Hoplolaimus* and *Tylenchorhynchus*. The remaining genera identified in this study (Table 1) do not cause significant damage in sugarcane.

The most frequently occurring genus in the roots was *Pratylenchus* (75%). This was followed by *Helicotylenchus* (24.3%) and *Meloidogyne* (20.6%). Similar to the soil, when *Meloidogyne* was present it was in high enough numbers to potentially cause yield losses (Stirling and Blair, 2000).

Table 1. Average abundance, maximum abundance and frequency per nematode genus found in the soil and roots in 2012 (nematode numbers expressed in 200 cm^3 of soil or per gram of root dry weight).

Genus	Average abundance		Maximum abundance		Frequency	
	Soil	Roots	Soil	Roots	Soil	Roots
Pratylenchus	128	153	1400	11000	88.4	75.0
Helicotylenchus	275	32	3980	667	78.9	24.3
Meloidogyne	128	246	2230	6667	24.9	20.6
Xiphinema	118		1750		71.6	
Paratrichodorus	141		1550		78.5	
Criconematids	49		1130		44.4	
Scuttellonema	359	16	3990	17	81.8	0.2
Rotylenculus	146		2620		26.1	
Dolichodorus	20		20		0.1	
Hemicycliophora	131		2040		13.7	
Hoplolaimus	12		30		1.0	
Tylenchorhynchus	171		3500		9.8	
Tylenchulus	158		230		0.3	
Longidorus	111		600		17.4	
Paratylenchus	50		50		0.2	
Free living nematodes	457		6000		100	

The results from this study provide valuable information on the current status of the different nematode genera present in the South African sugar industry. Although several genera previously detected by Spaull (1981) and Berry (2006) were not detected in this study, the trends of the remaining genera are similar to the previous studies. Compared to the previous studies, there appears to be a decrease in the frequency of *Meloigogyne* in the industry, but further studies are required to confirm this. It must also be noted that when *Meloigogyne* was found, its numbers were yield limiting. The presence of free living nematodes in all the soil samples is encouraging; however, without differentiation of these nematodes into the different feeding groups, further inference cannot be made regarding their effect on soil health.

Regular studies such as the one described here will facilitate continuous monitoring of the different nematode genera present in sugarcane soils and roots. This will enable informed decisions regarding yield loss and associated control options.

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