A NOTE ON THE EFFECT OF USING A NEMATICIDE ON SUGARCANE PLANTED IN A SANDY SOIL PREVIOUSLY CROPPED TO EUCALYPTUS TREES

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Abstract

Nematicides are often required to control nematodes in order to improve the growth of sugarcane on the sandy soils of the South African Sugar Industry. Growers are advised that a nematicide should be used where the clay content of the soil is less than 6% and where the previous crop of cane showed symptoms of nematode damage. But what should be done when the previous crop was something other than sugarcane? Such a query was posed by a cane grower on the KwaZulu-Natal north coast, who was about to plant sugarcane in a Clansthal sand with a 5% clay content that had previously been under gum trees (*Eucalyptus grandis*) for six years. No previous trial data were available on which to base a recommendation and, although a variety of nematode species were present in the soil after the gum trees had been removed, the numbers of individuals were low. A field trial was conducted on the site to assess the effect of nematode control on the plant crop and the first ratoon of sugarcane variety N16. Both crops were harvested at 12 months. Aldicarb applied at 3 kg/ha at planting and again to the recently cut first ratoon increased the yield of both crops by more than 20%. From planting to the first harvest there was an increase in the numbers of *Helicotylenchus* spp, *Meloidogyne incognita, M. javanica*, *Paratrichodorus* spp and *Xiphinema* spp (mainly *X. elongatum*). From the first to the second harvest only the populations of *Pratylenchus zeae* and *Xiphinema* spp increased. By the time the third ratoon was cut, four years after planting, numbers of all the common genera except *Meloidogyne* had increased to more than 125 per 100 ml soil.

Introduction

Plant-parasitic nematodes are an important growth constraint in the cultivation of sugarcane on the Recent sands of the South African sugar industry (Donaldson, 1988; Spaull and Cadet, 1990). When growing cane on these soils it is often necessary to apply a nematicide at planting and again to each subsequent ratoon crop (Moberly and Clowes, 1981). The advice given to cane growers is that on the very sandy soils (those with less than 6% clay), where the previous crop of cane showed above and below ground symptoms of nematode damage, a nematicide should be applied (Anon, 1997). But what should be done when the previous crop was something other than sugarcane? Such a situation occurred in 1993 on the farm Greenlands at Compensation on the KwaZulu-Natal north coast, where sugarcane was about to be planted in sandy soil that had previously been under gum trees (*Eucalyptus grandis*) for six years. No trial data were available on which to base a recommendation. Gum trees are not good hosts of the nematodes commonly found in South African sugarcane soils (Atkinson *et al.*, 1991) and *E. grandis* is resistant to *Meloidogyne incognita* and *M. javanica* (Ferraz and Lordello, 1982), both of which are serious pests of sugarcane grown on poor sandy soil. To find out whether a nematicide should be used in this situation a field trial was conducted at this site on the sugarcane plant crop and the following ratoon.

Methods

The trial was located within a 30 hectare area of the above-mentioned farm. The trees had been removed in 1992. Prior to the gum trees the land had been under sugarcane for more than ten years. The soil was a Clansthal containing 5,3% clay. To select a suitable site the land was roughly divided into 12 parts, delineated according to position and slope. Twenty soil cores, 24 mm diameter to a depth of 220 mm, were collected from each area in April 1993. The nematodes were extracted from the soil using the decanting-sieving method of Brown and Boag (1988). The site chosen was on a north facing mid-slope that had a nematode fauna reasonably representative of the field.

The land was planted to variety N16 in October 1993. Plots were arranged in a randomised block design with 5 rows, 10 m long, with a row spacing of 1,2 m (3 rows x 8 m net plot).

Treatments were as follows: two untreated controls in both the plant crop and the first ratoon; aldicarb (as Temik 15G) at 3 kg/ha (0,36 g/m row) applied over the row to both crops; and an untreated control in the plant crop followed by aldicarb at 3 kg/ha applied over the row to the first ratoon. The aldicarb was applied four days after planting and 38 days after harvesting the plant crop.

Soil samples were taken at intervals during the course of the trial and the nematodes extracted as indicated above. Additional soil samples were collected from all the plots in August 1997, just after the third ratoon had been harvested.

The plant crop and first ratoon crop were sample-harvested at 12 and 12,3 months of age respectively. The harvesting procedure was as follows: 40 adjacent stalks were taken from a predetermined point from each of the three 8 m net rows in each plot. The leaves and tops were removed and the stalks weighed. A representative 12-stalk subsample was taken for

sucrose analysis. Just prior to harvesting the cane a count was made of the number of stalks in the net rows. Mass of cane and sucrose/ha were derived from these measurements. Harvest data for the plant crop were from six of the untreated control plots and the six aldicarb treated plots, and for the ratoon crop from the 12 untreated control plots and the 12 aldicarb treated plots.

Rainfall data were from the nearby meteorological site.

Results

Rainfall

One hundred and fifty-seven millimetres of rain fell in the month before the cane was planted. Rain in the subsequent four months (November 1993 to February 1994) and for the duration of the plant crop was just over 90% of the long term mean (LTM). Rainfall was poor for the first four months of the ratoon crop (35% LTM, November 1993 to February 1994), but good falls were recorded in March and April 1995 bringing the total to 90% of the LTM.

Nematodes

When samples were taken in April 1993, more than four months after the gum trees had been removed, few nematodes were recovered from the soil (Table 1). Individuals of *Helicotylenchus* spp, including *H. dihystera,* were the most frequent and numerous.

All the genera identified from the 30 ha area, together with *Rotylenchulus parvus*, were recorded at one time or another from the trial area. However, only those listed in Table 2 were recovered in noteworthy numbers and frequency and are considered in this paper. The species of *Helicotylenchus* and *Tylenchorhynchus* were relatively numerous in October 1993, five days after the cane had been planted (Table 2). In contrast, few *Meloidogyne incognita, M. javanica, Paratrichodorus* spp, *Pratylenchus zeae* and *Xiphinema* spp (mainly *X. elongatum*) were recovered (Table 2). Within 20 weeks of planting, populations of these nematodes, except *P. zeae* and *Tylenchorhynchus* sp, had increased considerably. The populations were maintained or increased through to the harvest of the plant crop. Treatment with aldicarb had no apparent effect on any of the nematode populations 20 weeks after application to the plant crop (Table 2).

In the ratoon crop at 16 weeks and when the cane was harvested after 12 months, there were fewer *M. incognita* and *M. javanica* than were recovered from the soil in the plant crop. In contrast, there was a marked increase in the numbers of *Xiphinema,* and the large numbers of *Helicotylenchus* were maintained (Table 2). Relatively few *P. zeae* and *Tylenchorhynchus* sp were present in the soil during the growth of the first ratoon crop. Populations of all the common species were reduced 10 weeks after treatment with aldicarb in the first ratoon crop ($p<0,05$) (=P16, Table 2). The effect of the treatment on *P. zeae* and *Xiphinema* spp persisted through to harvest, but for *Paratrichodorus* spp much greater numbers were recorded when the first ratoon crop was cut. By the time the third ratoon was harvested populations of most of the nematodes, except the species of *Meloidogyne* and *Tylenchorhynchus*, had increased considerably (Table 2).

Sugarcane

In both the plant crop and the first ratoon the yield of cane and sucrose was greater in plots treated with aldicarb ($p<0,05$) (Table 3). Length of stalks was also greater in both crops but only in the plant crop were there more stalks in the treated plots. Sucrose content of the stalks in the plant crop was improved by treatment with aldicarb. Despite the poor rainfall received during the first four months of the ratoon crop, absolute yield and yield relative to rainfall were greater than in the plant crop.

Table 1. Number of nematodes per 100 ml soil recovered from soil samples collected in April 1993 after the gum tree stumps had been removed (trial site located in area 9).

Sample area No.	1	2	3	4	5	6	7	8	9	10	11	12	M*
Pratylenchus	–**	–	–	–	–	–	–	–	–	–	–	–	0
Tylenchorhynchus	3	–	–	–	–	–	3	–	–	–	–	–	<1
Scutellonema	–	–	3	3	–	–	–	–	–	–	–	–	<1
Helicotylenchus	6	3	–	12	12	12	21	6	36	27	12	6	13
Meloidogyne	–	–	–	–	–	–	–	3	–	–	–	–	<1
Criconematids	–	3	9	–	–	–	–	–	–	–	–	–	1
Xiphinema	3	6	9	–	–	–	3	–	9	9	12	6	5
Longidorus	–	–	–	3	–	–	–	–	–	–	–	–	<1
Paralongidorus	–	–	–	3	–	–	–	–	–	–	–	–	<1
Paratrichodorus	6	–	–	–	3	6	–	–	–	–	–	–	1

*M = Mean number ** = genus not recorded

Table 2. Number of nematodes per 100 ml soil: initial populations (Pi), populations at 20 weeks in the plant crop (P20) and at 16 weeks in the first ratoon (P16) and final populations (Pf) in the plant crop, first and third ratoon. The Pf of the plant crop is equivalent to the Pi of the first ratoon.

Treatment		*Meloidogyne*						*Pratylenchus*					
		Plant crop			1st Ratoon		3rdR	Plant crop			1st ratoon		3rdxdR
P#	1stR	Pi	P20	Pf	P16	Pf	Pf	Pi	P20	Pf	P16	Pf	Pf
C	C	2	120	93	20	47	35	1	8	7	15	31	153
C	C		147		19	55	47		4		12	26	101
C	T		194		3*	42	22		14		4*	11*	151
T	T		198	104	5*	40	16		4	9	1*	4*	63
LSD (p<0,05)			143		13	39	67		9		8	13	74

Treatment		*Tylenchorhynchus*						*Helicotylenchus*					
		Plant crop			1st Ratoon		3rdR	Plant crop			1st ratoon		3rdR
P	1stR	Pi	P20	Pf	P16	Pf	Pf	Pi	P20	Pf	P16	Pf	Pf
C	C	29	23	27	48	55	33	45	168	143	141	193	350
C	C		22		27	24	28		191		159	190	312
C	T		11		1*	16	27		146		31*	174	354
T	T		37	60	5*	7	22		131	184	60*	180	425
LSD (p<0,05)			19		21	34	29		83		58	107	226

Treatment		*Xiphinema*						*Paratrichodorus*					
		Plant crop			1st Ratoon		3rdR	Plant crop			1st ratoon		3rdR
P	1stR	Pi	P20	Pf	P16	Pf	Pf	Pi	P20	Pf	P16	Pf	Pf
C	C	11	34	68	149	144	126	5	55	179	14	73	232
C	C		21		103	144	110		42		13	60	220
C	T		28		27*	85	132		61		1*	122*	254
T	T		19	79	21*	78*	83*		65	192	2*	125*	202
LSD (p<0,05)			18		49	63	39		37		6	46	79

#Symbols denote treatment in the plant crop (P) and in the ratoon crop (1st R)
C = not treated, T = treated with aldicarb at 3 kg/ha
*Statistically different from untreated controls, p<0,05

Table 3. Yield data from the plant crop and the first ratoon crop of variety N16 planted after six years of gum trees (treatments replicated six times in the plant crop and 12 times in the ratoon crop).

Treatment	Tons cane/ha	Ers%	Tons ers/ha	Number stalks/ha (10^{-3})	Stalk length (cm)
PLANT CROP					
Control	38,3	13,87	5,3	108	111
Aldicarb	47,5*	14,37*	6,8*	116*	121*
% Response	24	4	28	7	9
CV%	9,1	2,2	10,6	3,0	5,1
SED	2,25	0,18	0,37	1,9	3,4
LSD (p<0,05	4,5	0,36	0,74	3,9	6,9
FIRST RATOON					
Control	47,4	12,38	5,9	113	133
Aldicarb	57,9*	12,46	7,2*	119	146*
% Response	22	1	22	5	10
CV%	18,9	4,6	20,1	9,8	7,3
SED	4,07	0,23	0,54	4,6	4,1
LSD (p<0,05	8,1	0,47	1,08	9,3	8,2

*Significantly different from the control (p<0,05)

Discussion and conclusions

The cost of treatment with 3 kg aldicarb/ha is equivalent to about 5 tons of cane. With a response of 9,1 tons cane in the plant crop and 10,5 tons in the first ratoon, treatment in both crops was economically warranted.

Shortly after the tree stumps had been removed very few nematodes were recovered from the soil (Table 2). This agrees with the report by Atkinson *et al.* (1991) that there were, with few exceptions, low to extremely low numbers of nematodes associated with *E. grandis*. Similarly, in their survey of nematodes of forest soils, which included the soils of eucalyptus plantations, Marais and Buckley (1993) found that none of the nematode species was present in large numbers. However, the preceding six years of gum trees on the trial site did not have an irreversible effect on the plant-parasitic nematode fauna; within a few months, the quantitative and qualitative composition of the fauna was fairly typical of that found in poor sandy soils cropped to sugarcane (Spaull and Cadet, 1990). Presumably the response to treatment with aldicarb in the plant crop was a consequence of root damage in the untreated cane caused by the expanding populations of *Xiphinema, Paratrichodorus* and, in particular, *Meloidogyne* spp. However, samples taken 20 weeks after planting showed no difference between the numbers of nematodes in the treated and untreated plots (Table 2). Possibly mortality went undetected because the populations had recovered by the time the samples were taken. Certainly, in the ratoon crop much lower numbers were recovered from the aldicarb treated plots 10 weeks after treatment. Species of *Tylenchorhynchus* and *Helicotylenchus* are not considered to be serious pathogens of sugarcane (Birchfield, 1984; Cadet, 1986).

The large numbers of *Meloidogyne* in the plant crop did not persist (Table 2). This agrees with the observation that variety N16 is resistant to, or intolerant of, *M. javanica* (McArthur and Spaull, 1995) and *M. incognita* ([1]unpublished observation).

Although the initial population density of most of the species was much higher at the start of the ratoon crop, compared with the plant crop, the response to the nematicide was similar (Tables 2 and 3). This may have been due to ratoon cane, with its much more extensive initial root system, being less susceptible to the damage caused by nematodes (Cadet, 1985; Spaull and Cadet, 1990).

The results from the plant crop show that, although very low numbers of nematodes were present when the cane was planted, there was still a noteworthy response to treatment with aldicarb. A similar situation occurred in three of five trials on plant cane in sandy soil where the previous crop was sugarcane with symptoms of nematode damage and where, at the time of planting, few individuals of the principal pest species (*X. elongatum, Paratrichodorus* spp, *P. zeae, M. incognita* and *M. javanica*) were recovered from the soil ([1]unpublished data).

At each of these five sites a significant response to treatment was expected. The absence of a notable response at two of the sites was possibly due to the considerable inherent variability in the growth of sugarcane on sandy soil masking any differences between the treatments. That being so, it could be inferred that, whatever the nature of the preceding crop, a nematicide should be used whenever sugarcane is planted in poor, sandy soil containing the principal pest species.

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