STUDIES ON THE RELATIONSHIP BETWEEN NEMATODES AND SUGARCANE IN SOUTH AND WEST AFRICA : RATOON CANE

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In a previous paper (Cadet & Spaull, 1985) we reported on the noteworthy difference between the response of the plant crop of sugarcane to treatment with nematicide in Burkina Faso and South Africa. On sandy soils in both localities there is a large increase in yield but whereas in Burkina Faso this is due largely to an increase in the number of stalks, in South Africa it results more from an increase in the length of the stalks. The situation in ratoon cane is the same in South Africa but not in Burkina Faso. Data from several nematicide trials show that whereas there was little or no increase in yield following treatment with nematicide in ratoon crops in Burkina Faso, there was a large increase in South Africa (Table 1). The effect of nematicides on the number of stalks was similar in the two localities and the considerable yield response in South Africa resulted primarily from an increase in the length of stalks (Table 1). The difference in the reaction of the cane is independent of cane variety. Stalk diameter is not significantly affected in either locality (Thompson, 1983; Cadet, 1985).

Why, in Burkina Faso, should nematodes affect the number of stalks so markedly in the plant crop and have relatively little effect in ratoon cane, when in South Africa their effect on the number and length of stalks is broadly similar in both crops? In this paper we examine data from a field trial in Burkina Faso and a field trial in South Africa and attempt to explain this difference. The rider given in the introduction to our previous paper (Cadet & Spaull, 1985) is applicable here; in particular, that the two trials constitute not one but two experiments, each conducted separately but with the same aim.

Table 1

Response of ratoon cane to treatment with nematicide in Burkina Faso and South Africa*

	Increase in yield in tons cane/ha	*Increase in number of stalks*	*Increase in length of stalks*
South Africa (n = 7)	66 %	13 %	25 %
Burkina Faso (n = 6)	11 %	15 %	2 %

* From Cadet (1985), Spaull and Donaldson (1983) and unpublished data from SA Sugar Association Experiment Station.

Methods

The trials were established on first ratoon crops of variety NCo376 on a 4 % clay soil in Burkina Faso and variety N55/805 on a 6 % clay soil in South Africa. The preceding plant crops had shown typical symptoms of nematode damage. The trials consisted of an untreated control and a nematicide treatment, viz, 10.5 kg liquid carbofuran/ha applied over the row at harvest in Burkina Faso and 11 kg aldicarb/ha applied in equal quantities over the row one week after harvest and again four weeks later in South Africa. Very high rates were used to ensure good nematode control. Treatments were randomised in blocks with six replicates. Soil and root samples were taken at monthly intervals for 3 months in Burkina Faso and for 17 months in South Africa; the duration of sampling corresponded with the period during which damage was predicted. The methods of sampling and extraction were the same as those used previously (Cadet & Spaull, 1985) except that in South Africa a modified decanting - sieving - Baermann tray method was used for the soil and a mist chamber was used for the roots. When extracting the endoparasites, the roots of the preceding crop (= stool roots) were separated from the roots of the developing crop (= shoot roots). It should be noted that new shoots develop throughout the life of the crop. These shoots and their roots normally die through insufficient light except, that is, the shoots that develop at the time the cane is harvested. Thus new shoot roots are present at the point of transition from a plant crop to a ratoon crop. Number of stalks and, in South Africa, length of stalks were recorded at intervals during the growth of the crops. The stalks were cut and weighed after 12 months in Burkina Faso and after 17.2 months in South Africa.

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Results and discussion

The endoparasites were dominated by *Meloidogyne incognita* (62 % of the endoparasitic nematode fauna) and *Hoplolaimus pararobustus* (30 %) in Burkina Faso and by *M. incognita* and *M. javanica* (64 %) and *Pratylenchus zeae* (36 %) in South Africa. The dominant ectoparasites were *Helicotylenchus dihystera* (87 % of the fauna) in Burkina Faso and *Xiphinema elongatum, X. vanderlindei* (71 %) and *Paratrichodorus* sp. (11 %) in South Africa.

In Burkina Faso treatment with nematicide reduced the number of *H. dihystera* but an effect on the endoparasites was not detected, presumably because numbers of these were very low (Fig. 1 B). In South Africa the nematicide provided excellent control of the nematodes in both the soil and roots (Fig. 1 E, F).

Treatment with nematicide had no significant effect on the cane in Burkina Faso but in South Africa it increased the maximum number of stalks as well as cane yield and the number and length of stalks at harvest ($p < 0.01$) (Fig. 1 A, D). In South Africa disproportionate damage to the cane in the control plots by the stalk borer, *Eldana saccharina*, during the latter part of the crop, together with the high rate of application of the nematicide increased the response to treatment above that of the average for ratoon cane (Fig. 1 D; Table 1).

BURKINA FASO

In Burkina Faso the density of the endoparasites in both the stool roots and the shoot roots of the cane in the treated and control plots remained at a low level during the entire period of shoot establishment (Fig. 1 A, B). During the same period in the plant crop the size of the endoparasite populations increased dramatically in the sett roots (Cadet & Spaull, 1985). The density of *H. dihystera* changed greatly over the 3 month period of sampling but it was not associated with a decline in the number of stalks (Fig. 1 A, C).

Since the endoparasites were present at such low numbers they could not be expected to have influenced root growth and thus shoot development. We presume that the ectoparasites in Burkina Faso would have had no effect on the number of stalks, or indeed the length of stalks, because they were dominated by *H. dihystera* which is considered a weak pathogen of sugarcane (Cadet & Spaull, 1985).

SOUTH AFRICA

In South Africa few endoparasites were recorded in the roots during the first month after harvest. [In three other trials such a situation persisted for 2 months (Spaull & Donaldson, 1983)]. Thereafter numbers increased considerably, particularly in the new shoot roots, before declining during the cooler winter months (Fig. 1 E). A second peak in numbers appeared in the shoot roots in the following summer. Fewer endoparasites were recorded in the stool roots; these roots eventually disappeared just over a year after harvest (Fig. 1 E). Large numbers of ectoparasites were present throughout the growth of the crop (Fig. 1 F).

It seems probable that there were too few endoparasites in the stool and shoot roots during the first month after harvest to have affected early root growth. But it was during the first month that the difference between the number of stalks in the control and treated plots was established (Fig. 1 D). Thus other nematodes are implicated. The most likely candidates are the species of *Xiphinema* as they were present in relatively large numbers at this time (Fig. 1 F).

The increasing difference between the length of stalks of untreated sugarcane and of cane treated with nematicide was associated, initially (February-April), with large numbers of endoparasites in the shoot roots and, later, with increasing numbers of ectoparasites (Fig. 1 D, E, F). Both groups are therefore implicated but, as in plant cane (Cadet & Spaull, 1985), the presence of marked symptoms of damage on the roots normally associated with *Xiphinema* and *Paratrichodorus*, suggests that they were the primary pathogens.

From the foregoing we conclude that the reason why the ratoon cane showed a marked response to treatment with nematicide in South Africa but not in Burkina Faso was the presence in the former of an ectoparasitic fauna dominated by *Xiphinema* and *Paratrichodorus* and that in the latter the density of the endoparasites remained low during the entire period of shoot establishment. But why was there no apparent increase in the number of endoparasites in Burkina Faso? Coincidentally the same phenomenon has been observed in other varieties in Burkina Faso, *viz* B54 142 and NCo310. Possibly these varieties and NCo376 are resistant to *M. incognita*, although data from South Africa indicates that NCo310 is not resistant (Anon., 1981). Or is it related to the way the cane is harvested in Burkina Faso (Cadet, 1986)? Here the cane is cut about 50 to 100 mm above ground level and most of the shoots develop from the uppermost buds on the stubble. The shoots emerge soon after harvest and develop rapidly. However roots from these new shoots develop more slowly and it is some 6 to 8 weeks before they reach the ground and grow down below the surface layer of the soil. Presumably, therefore, most of the shoots rely for some time on the large, but relatively inactive, stool root system. Such inactive roots would be less attractive to the endoparasites (Bird, 1962; Bilgrami, Ahmad & Jairajpuri, 1985). Subsequent growth of the shoot roots proceeds very rapidly and the increasing root mass presumably obscured any increase in the number of nematodes within the roots.

In South Africa, where the cane is cut at or close to ground level, all the shoots and their roots are initiated below ground. Presumably, with the exception of the first month, growth of these roots is less rapid than in

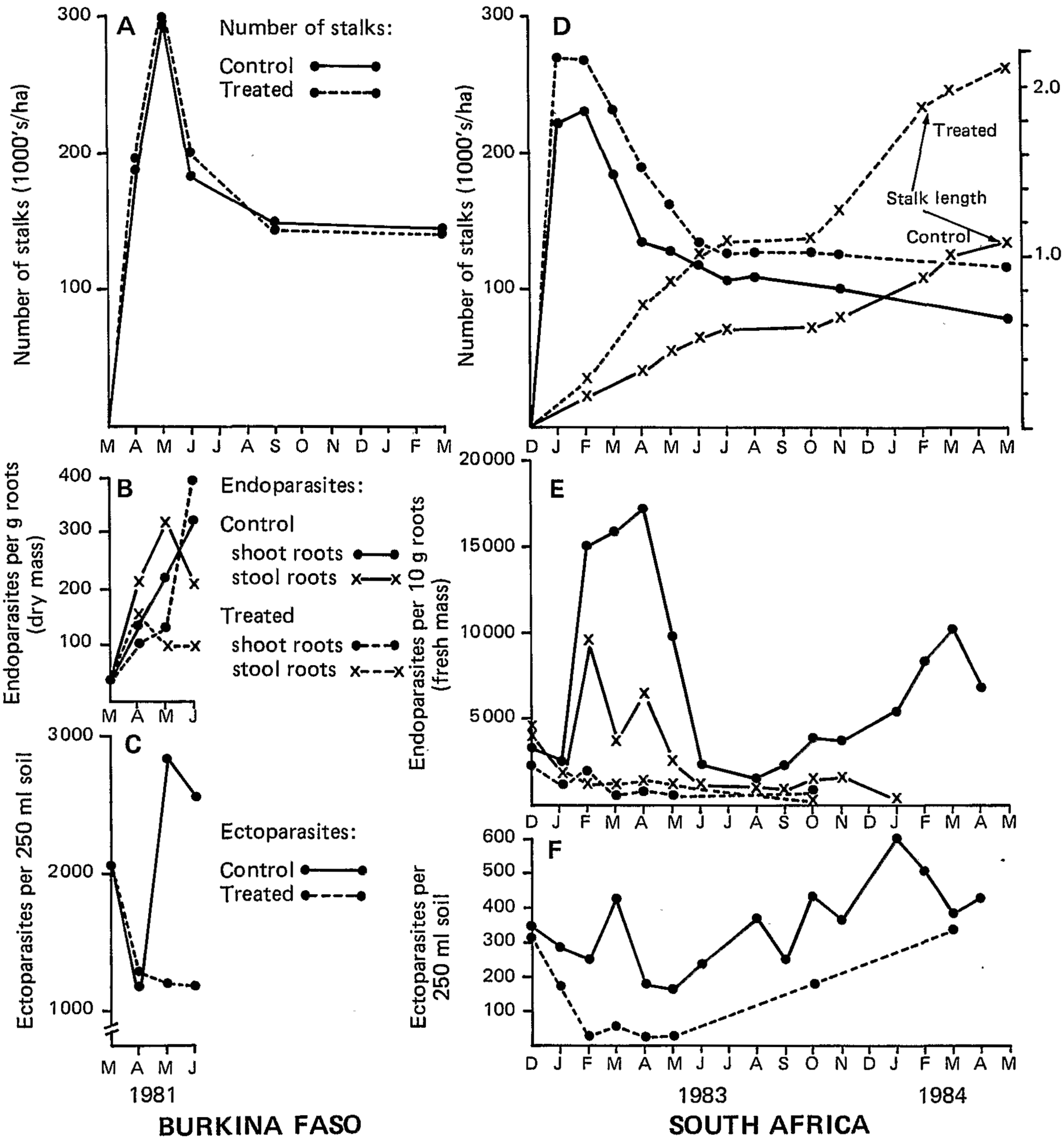

Fig. 1. Patterns of change in the numbers of ecto- and endoparasitic nematodes in relation to the patterns of change in the development of ratoon sugarcane in Burkina Faso and South Africa (Note that 10 g fresh mass of stool or shoot roots are equivalent to *c* 2.5 g dry mass).

Burkina Faso and the expanding populations of endoparasites are not diluted as the root system develops. These comments are largely conjecture though if true they would be of some relevance when breeding for tolerance to endoparasites.

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