SHORT COMMUNICATION

EFFECT OF VARIETY COMBINATIONS ON YIELD OF SUGARCANE

SPAULL V W[1], CADET P[2] and BERRY S[1]

[1]*South African Sugarcane Research Institute, Private Bag X02, Mount Edgecombe, 4300, South Africa*
[2]*IRD, CBGP, CS 30016, Montpellier, France*
vaughan.spaull@sugar.org.za patrice.cadet@mpl.ird.fr shaun.berry@sugar.org.za

Abstract

Pests and diseases flourish where a susceptible host is abundant in both time and space. Hence monocropping can lead to considerable crop loss and even crop failure where no attempt is made to contain the pathogens. Conventionally, pathogens are controlled by means of chemicals, resistant cultivars and various agronomic practices that reduce infection. For some years interest has been given to cultivating mixtures of cultivars, or varieties, of the same plant species to reduce the incidence of disease. Combining cultivars that have different levels of disease susceptibility can disproportionately reduce the level of the disease in the field and thus improve yield. This short communication reports on outcomes of planting mixtures of sugarcane varieties. In one field trial, a combination of four varieties, N12, N21, N27 and N29, was planted in the same furrow. The yields of the second and third ratoons were greater than the averages of the varieties planted alone. The total yield benefit of the mixture over the five crops was 2.2 t ERC, equivalent to an average increase of 4.5%. In another trial on a soil where nematodes were a serious limiting factor, planting a mixture of NCo376, N12 and N31 or N39 in the furrow increased yield by about 40% over that of the average of the individual varieties planted alone.

Keywords: sugarcane variety mixtures, nematodes, yield

Introduction

Reports show that mixtures of varieties suffer less from diseases and abiotic stresses and are higher yielding than single varieties (Garrett and Mundt, 1999; Newton *et al*, 1997; Wolfe, 1985, 2000). Unpublished data from a recent study of the soil fauna and flora associated with sugarcane roots showed that different varieties have a marked influence on the composition of the plant-parasitic nematode community, as well as on the bacterial community. Certain varieties were resistant to the root-knot nematode, *Meloidogyne javanica,* others promoted the development of the less pathogenic species, *Helicotylenchus dihystera,* while some favoured nematode antagonistic bacteria. The question was posed: ‘To what extent could different cane varieties, planted together in the same furrow, benefit from the diversification of the microflora associated with the intermingling of the root systems of neighbouring varieties?’ Such a situation might, for example, slow down the yield decline that occurs with successive ratoon crops, and thus increase productivity and sustainability of the cane crop. This communication reports on some initial work on the effects of planting mixtures of sugarcane varieties on nematode populations and yields.

Material and Methods

Two trials were conducted, one at New Guelderland (NG) and the other at Compensation (Comp), both on the north coast of KwaZulu-Natal. The soils were sandy with less than 10% clay. The NG trial was planted at the end of September and harvested at approximately 12-month intervals up to the fourth ratoon. Four sugarcane varieties, N12, N21, N27 and N29, were planted alone, as single varieties, with double sticks cut into setts in the furrow. The same four varieties were planted as a mixture in the furrow. In this case, one sett of four to six internodes of each variety was placed one after the other in the 10 m furrow, and the process repeated in the opposite direction. With the double-stick planting, it was possible that by chance two setts of the same variety were situated next to each other. The NG trial was designed as randomised blocks, with six replicates per treatment. Each plot comprised five rows, each 10 m in length, separated by 1.2 m. The three middle rows were harvested green, weighed and analysed to determine t ERC per ha. The protocol for the Comp trial was similar, except that the four varieties that were grown alone were NCo376, N12, N31 and N39, and the mixture of varieties comprised NCo376, N12 and N31 in three replicates and NCo376, N12 and N39 in another three replicates. Only plant crop data are available for the Comp trial, which was planted in October and harvested a year later.

Before the third and fourth ratoons of the NG trial were harvested, the frequencies of the four varieties were estimated per plot. These actual proportions were used to calculate the expected numbers of nematodes according to those recorded in the single varieties planted alone. In both trials plots of the single varieties were either left untreated, as controls, or were treated with the nematicide, aldicarb, at 3 kg per ha. The plots were re-treated with the same rate of aldicarb in the following four ratoon crops. The mixture of varieties was treated with nematicide in the NG trial but not in the Comp trial. Soil samples were collected from each plot of both trials when the cane was about six months old. Nematodes were extracted from the soil and roots and enumerated under the microscope. Five species of nematodes were abundant at the two sites: *Meloidogyne javanica*, *Pratylenchus zeae*, *Helicotylenchus dihystera*, *Xiphinema elongatum* and *Paratrichodorus minor*.

Results

NG trial

The ERC yields of the second and third ratoon crops of the mixture of varieties at the NG trial were significantly greater than the average ERC yields from the individual varieties (Figure 1). The average yield benefit per crop over the five crops was 0.43 t ERC/ha. There was a 4% average response to nematicide treatment in the five crops at the NG site. The response in N12 was less than 1%. There was little change in the numbers of nematodes during the course of the trial although there was a general decrease in the proportion of *P. zeae* and *H. dihystera* within the nematode community in all plots. This decrease was significant for the mixture of varieties. Fewer *M. javanica* and *H. dihystera* were recovered in the plots of the mixture of varieties in the third and fourth ratoons than was expected according to the numbers from the varieties planted alone.

Comp trial

Variety N12 showed a 20% increase in yield in response to treatment with nematicide (Figure 2). The response was progressively smaller in NCo376 and N39, and was absent in N31. The yields of the two combinations of variety mixtures were about 40% greater than the average of the varieties planted alone (Figure 2).

Discussion

Although the mixture of varieties had no major effect on nematode abundance in the NG trial, it did influence the nematode community structure. This was not unexpected as three of the varieties, N12, N21 and N27, are known to have contrasting influences on the nematode species (Cadet and Spaull, 2005). The large difference between the yield of the mixture of varieties and the individual varieties in the Comp trial compared with the NG trial may be related to the composition of the mixtures at the two sites. The yield benefit from the mixture was greater at the site where nematodes were a significant constraint to crop production. Clearly, variety combinations require further investigation.

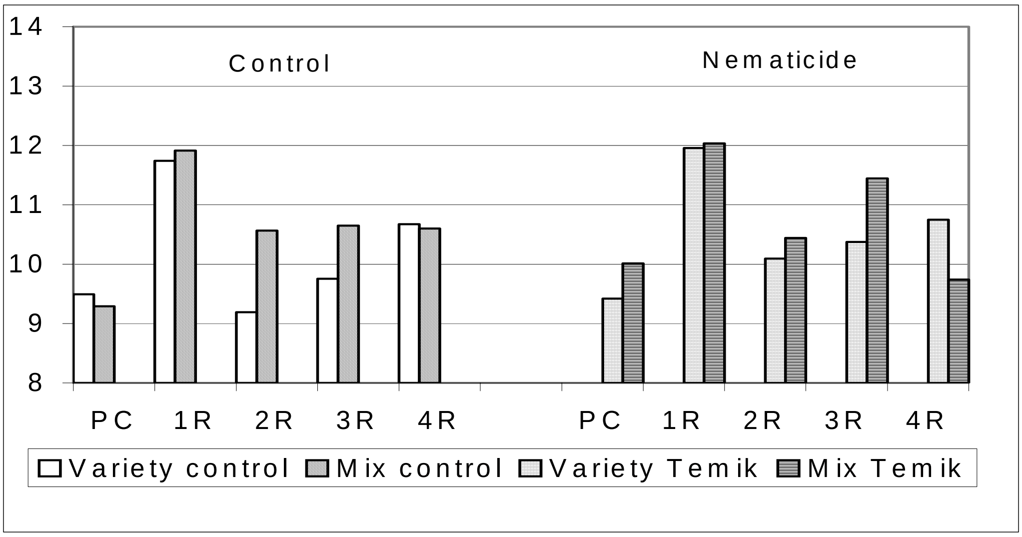

Figure 1. Average yield in tons estimated recoverable sugar/ha in untreated plots (left) and nematicide treated plots (right) of individual sugarcane varieties and mixture of varieties.

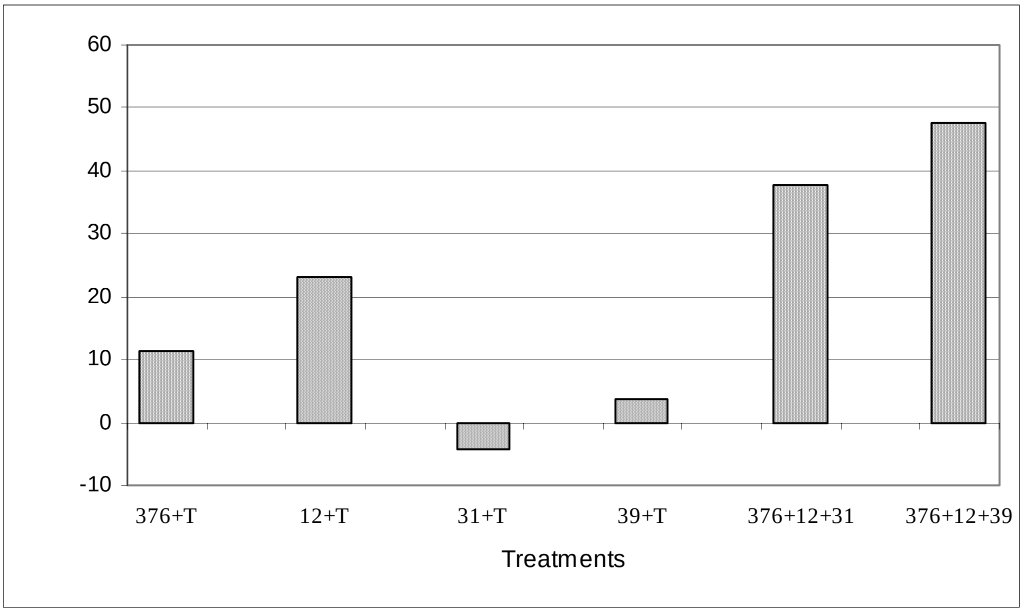

Figure 2. Percentage response in tons estimated recoverable sugar/ha following treatment of individual sugarcane varieties with nematicide and the percentage improvement in yield of the two mixtures compared with the average of the untreated, component varieties.

REFERENCES

Cadet P and Spaull VW (2005). Nematode parasites of sugarcane. pp 645-674 In: M Luc, RA Sikora and J Bridge (Eds), *Plant Parasitic Nematodes in Subtropical and Tropical Agriculture*. CAB International, Wallingford, UK.

Garrett KA and Mundt CC (1999). Epidemiology in mixed host populations. *Phytopathology* 89: 984-990.

Newton AC, Ellis RP, Hacket CA and Guy DC (1997). The effect of component number on *Rhynchosporium secalis* infection and yield in mixtures of winter barley cultivars. *Plant Pathology* 45: 930-938.

Wolfe MS (1985). The current status and prospects of multiline cultivars and variety mixtures for disease control. *Ann Rev Phytopathology* 23: 251-273.

Wolfe MS (2000). Crop strength through diversity. *Nature* 406: 681-682.