THE RELATIONSHIP BETWEEN EXTENT OF COLONISATION BY *LEIFSONIA XYLI* SUBSP *XYLI* AND YIELD LOSS IN DIFFERENT SUGARCANE VARIETIES

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Abstract

Large-scale yield trials have traditionally been used to rate the reactions of released sugarcane varieties to ratoon stunting disease (RSD). These trials are time-consuming and require large tracts of land and are therefore not suitable for incorporation into a routine programme of disease screening of new genotypes.

Using a tissue blot-enzyme immunoassay (TBIA) to determine the percentage of colonised vascular bundles (CVB) in RSD-infected stalks, it is possible to estimate both the incidence of infection and likely severity of the disease. In previous work, the ranking of a number of released varieties for their reaction to RSD using TBIA has correlated well with estimates of yield loss in field trials, but it was necessary to confirm these findings in one trial comparing both methods of variety evaluation.

A good correlation between yield loss and percent CVB in six varieties, N12, N14, N16, N27, N29 and N35, was obtained from the results of a rainfed field trial conducted at Mount Edgecombe. Using both methods of varietal assessment, N35 and N27 were found to be the most resistant of the varieties tested while N14 was the most susceptible. The results from this study indicate that the TBIA can provide an effective and more efficient method for evaluating varieties for their reaction to RSD and that it has potential for application in the disease screening programme at SASEX.

Keywords: RSD, ratoon stunting, sugarcane, disease screening, tissue blots

Introduction

For many years, the reaction of different sugarcane varieties to ratoon stunting disease (RSD), caused by the bacterium *Leifsonia xyli* subsp *xyli*, has been based on large, replicated yield loss trials grown over a number of years under rainfed and irrigated conditions. Although these trials provide valuable information, they are time-consuming and require large areas of uniform land. They are therefore not suitable for incorporation into a routine disease-screening programme. As a result, the susceptibility of only a small number of commercial South African varieties to RSD is currently known (Bailey and Bechet, 1986, 1995). Alternative approaches to yield loss trials for screening new sugarcane genotypes for resistance to RSD have been investigated, but the most efficient and simple method currently available is the tissue blot immunoassay (TBIA) developed in the USA by Harrison and Davis (1988) and modified by Davis *et al.* (1994). This technique is now used routinely in Florida to screen varieties for RSD resistance (Comstock *et al.*, 1995).

With TBIA, it is possible to determine the proportion of vascular bundles colonised by *L. xyli* subsp *xyli* in individual stalks so estimate both the incidence and severity of RSD. The ranking of a number of released South African varieties for their reaction to RSD using TBIA has correlated well with that of previous yield loss trials (McFarlane, 2001), but it was necessary to confirm these findings in one trial.

Materials and Methods

The trial was conducted under rainfed conditions on a deep sandy-clay-loam soil at the South African Sugar Association Experiment Station (SASEX), Mount Edgecombe. The varieties tested were N16, N27, N29 and N35. N12 (intermediate to susceptible) and N14 (highly susceptible) were included as controls. Seedcane for the trial was obtained from the plant crop of specially grown propagation plots of both healthy, hot water treated cane and RSD-infected cane. The propagation plots were tested for RSD using phase contrast microscopy and all the healthy plots were found to be free from the disease. Since the level of RSD in some of the varieties grown in the infected propagation plot was low, the setts of seedcane for planting the diseased plots were inoculated with *L. xyli* subsp *xyli* by dipping the ends immediately after cutting into juice from infected stalks.

The trial was planted in October 2000. A split plot design with six replications was used, with varieties as whole plots and diseased or healthy seedcane as sub-plots. Each sub-plot consisted of four rows, 7 m long with a row spacing of 1,2 m.

One week before harvest in October 2001, twelve stalks were collected from each sub-plot. Sap was expressed from the lowest undamaged internode for routine RSD diagnosis (McFarlane *et al.*, 2000). A longitudinal tissue core was taken from the third internode of all stalks sampled from the diseased sub-plots and these were used for TBIA, as described by Davis *et al.* (1994). The impressions of all vascular bundles were visible on the developed membranes, with those colonised by *L. xyli* subsp *xyli* appearing as distinct blue dots. The number of infected stalks and the percentage of colonised vascular bundles (CVB) per stalk were determined for each plot. Cane yields were determined using all four rows in the sub-plots.

Results and Discussion

Between 75 and 100% of the stalks tested in the diseased plots were infected with *L. xyli* subsp *xyli*. The lowest levels of RSD were detected in plots of N27 and N35. Despite precautions to avoid contamination when planting the trial, low levels of RSD were detected in the healthy plots of N14 (3 plots), N27 (1 plot), N29 (1 plot) and N35 (1 plot). The healthy propagation plot has since been retested for RSD and found to be infected.

The overall cane yield for all varieties from the healthy plots was satisfactory with a mean of 75 tons per hectare in the plant crop. The mean for the diseased plots was 67 tons cane per hectare. Yield losses were significant (P=0,05) in N14 (-15%) and N29 (-15%), (Table 1). Although yield losses were substantially higher in N16 (-13%) and N12 (-11%) than in N27 (+2%) and N35 (-4%), they were not significant.

The mean percentages of CVB in N27 (21%) and N35 (33%) were significantly lower than in the other varieties, while N14 (81%) had the highest percentage of CVB. This variety has consistently been found to be highly susceptible to and intolerant of infection by *L. xyli* subsp *xyli* in other SASEX field trials, under both rainfed and irrigated conditions (Bailey and Bechet, 1986, 1995). N12, (intermediate to susceptible) and N29 had significantly less CVB than N16.

A good correlation was achieved between the mean percent loss in yield and percent CVB in the six varieties tested despite the fact that yield loss was based on all the stalks in the plot while percent CVB was based on a small sample (Figure 1). Varieties N27 and N35 were found to be the most resistant of those tested. The results from the TBIA indicated that N29 was significantly less susceptible to RSD than N14 but according the yield loss data, both were equally susceptible, suggesting that N29 is intolerant to infection. The high degree of variability in the percentage of CVB in N29 may have resulted in this discrepancy.

Table 1. Ranking of six sugarcane varieties using per cent yield loss and per cent vascular bundles colonised by *L. xyli* subsp *xyli* (CVB) as indicators of reaction to RSD (plant crop, 12 months).

Ranking	Variety	Cane (t/ha)		Variety	% CVB	Std dev
		Healthy	Diseased			
Resistant	N27	68	69 (+2%)a	N27	21a	4,7
	N35	74	72 (-4%)a	N35	33b	6,6
	N12	79	70 (-11%)a	N29	54c	10,0
	N16	75	66 (-13%)a	N12	57c	4,3
	N29	74	63 (-15%)b	N16	65d	6,8
Highly susceptible	N14	81	69 (-15%)b	N14	75e	6,5
LSD (0,05)		11		8		
CV%		13		7		

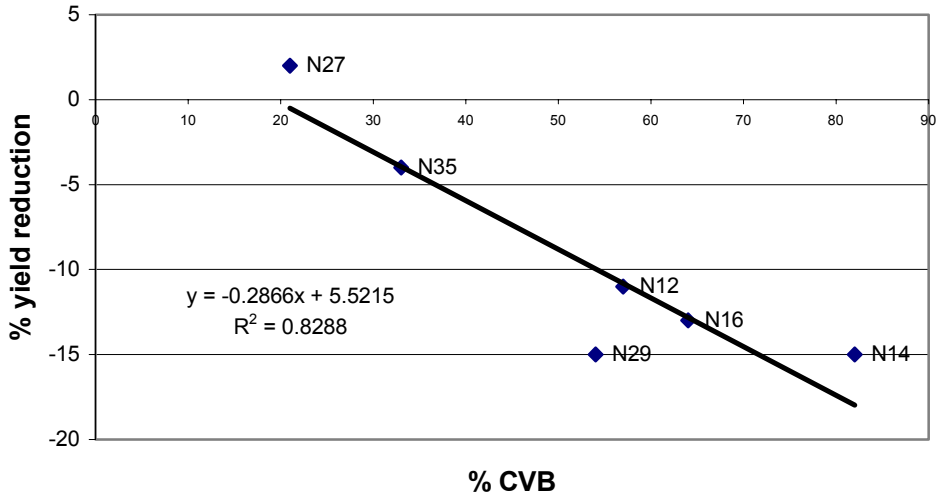

Figure 1. Relationship between yield loss due to RSD and percent vascular bundles colonised by *L. xyli* subsp *xyli* (CVB) in six sugarcane varieties.

The variability in yield loss in the diseased plots of some varieties was high and this affected the ranking of the varieties according to this parameter. The trial will be carried through to the third ratoon and by that time it is hoped that the yield loss for each variety will be more uniform. This will allow for a more reliable estimate of the actual yield loss in the six varieties.

Conclusions

The correlation between yield loss and CVB was high. According to both the TBIA results and the extent of yield loss, the varieties tested for their reaction to RSD in this trial are ranked as follows: N27 and N35 (moderately resistant); N12 and N16 (susceptible) and N14 (highly susceptible). The results for N29 were conflicting, and the variety should be considered susceptible to highly susceptible.

The results from this and previous trials indicate that the TBIA provides an effective, more efficient method for distinguishing susceptible varieties from those that are more resistant to RSD. The technique has potential for application in the disease-screening programme at SASEX, in the final stages of the variety selection programme. It will give a useful indication to growers as to how varieties will react to RSD in the commercial situation. However, yield loss trials will continue to provide valuable information on the effect of RSD on released varieties.

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