FUNGICIDE SPRAYS TO CONTROL BROWN RUST (*PUCCINIA MELANOCEPHALA*) GAVE VARIABLE CANE AND SUGAR YIELD RESPONSES IN THE SOUTH-EAST LOWVELD OF ZIMBABWE

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Abstract

Four triazole fungicides cyproconazole (50 ppm), propiconazole (250 ppm), triadimefon (750 ppm) and triadimenol (250 ppm) applied as foliar sprays at 14-day intervals significantly reduced naturally occurring brown rust infections on sugarcane leaves in 1996. In trials undertaken in 2002/03 and 2003/04, triadimenol applied on varieties NCo376, N14 and ZN6 provided only partial rust control, with mean disease ratings in the most susceptible variety, ZN6, falling from 37% leaf coverage in unsprayed to 16% in sprayed crops. Cane and sugar yields of ZN6 increased by 18% and 16% respectively in 2002/03, but there was no increase in 2003/04. Cane and sugar yields of the more resistant NCo376 and N14 varieties were not affected by brown rust in both trials.

Keywords: sugarcane, rust, disease control, fungicide, cane yields, sugar yields.

Introduction

Sugarcane brown rust (*Puccinia melanocephala* H. and P. Syd.), previously known as common rust, was present in South Africa and possibly Zimbabwe prior to 1941 (Bailey, 1979). The disease was considered minor in Zimbabwe because it was only prevalent in winter when the potential for cane growth, and ostensibly its impact on cane yields, were low. Brown rust, however, continues to cause major concerns to growers because of its spectacular symptoms on susceptible varieties. The disease now occurs in most sugarcane growing areas of the world, but its reported importance varies (Anon, 2001; Comstock *et al*, 1992; Taylor *et al*, 1986). Rust has led to the discard of previously high yielding varieties in some countries (Bernard, 1980).

Field assessment of yield losses caused by diseases with sporadic occurrence, such as brown rust, are difficult because disease incidence and severity are highly dependent on ambient conditions. Moreover, maintaining disease-free controls under such conditions is difficult (Comstock *et al,* 1992; Madden, 1983). This has led to yield loss studies being undertaken under controlled conditions in greenhouses (Comstock *et al,* 1992). Brown rust control has been achieved in some instances through fungicide application, but resistant varieties as well as manipulation of cultural practices have remained the more common commercial control methods (Anon, 2003; Raid and Comstock, 2006 edis.ifas.ufas.edu/SC007 website).

In Zimbabwe, brown rust is common from May to August in February or March-planted crops. Disease incidence decreases with cane age and with canopy closure. Plant crops usually show more infection than ratoon crops. Generally, the severity of the disease depends on length of cool (mean daily temperature of around 20ºC) and humid (70-90% RH) weather conditions, especially when these coincide with susceptible plant growth stages (Comstock and Ferreira, 1986). In Zimbabwe, cane crops that are three to five months of age are most affected, with disease severity decreasing after August. However, variety ZN6, released for commercial production in 1999, exhibits significant rust disease throughout the year (Anon, 2003). It is not known by how much rust reduces the yields in crops of ZN6.

This paper reports the results of a fungicide screening trial and two experiments to assess the effect of brown rust on cane and sugar yields of varieties NCo376, N14 and ZN6 grown commercially in the south-east lowveld of Zimbabwe.

Materials and Methods

Fungicide efficacy: efficacy of four triazole fungicides

The trial was set up in June 1996 at Mwenezana Sugar Estate. A crop of five-month-old N14, irrigated using furrows and having a severe natural rust infection level, estimated at >70% leaf cover, was used for the tests. The fungicides tested were triadimenol (250 ppm), triadimefon (750 ppm), propiconazole (250 ppm) and cyproconazole (50 ppm). A randomised block design with six replications was used. Each plot consisted of four rows, each 7,5 m long and with a row spacing of 1,5 m. The canopy of treated plots was sprayed with four litres of fungicide mixture on 6 and 20 June, using a knapsack sprayer. The control plots were sprayed with water only. Assessments of percentage leaf area affected were undertaken 10, 20, 40 and 60 days after the second spraying, using a pictorial key devised for cereal rusts. Only the top two exposed leaves below the spindle were assessed for rust.

Yield loss trials: Bayfidan 250 EC® (triadimenol) and the varieties NCo376, N14 and ZN6

Two fungicide yield loss trials were planted, one on 6 March 2002 and the other on 16 March 2003 at ZSAES. Soil type was a PE.1 sandy clay loam derived from gneiss, with total available moisture of about 102 mm. The treatments consisted of three varieties, NCo376 (resistant), N14 (moderately resistant) and ZN6 (susceptible) and two spray regimes - with water only (control) and triadimenol at 500 mL/ha. The six treatments were arranged in a completely randomised block design with six replications. Each plot consisted of four rows 1,5 m apart and 15 m long.

Three-budded setts of nine-month-old seedcane of each of the three varieties were dipped for five minutes in water containing 250 ppm triadimenol to control smut, before double planting in the field. Bayfidan 250 EC (triadimenol) application commenced at the first sight of rust symptoms, and was repeated after 21 days when symptoms persisted. Four litres of the fungicide mixture were sprayed onto the canopy of standing cane in each plot, using a knapsack sprayer. The control plots were sprayed with water only. Sprays were discontinued when crops were more than eight months old and could not be accessed easily. Rust assessments were done once a month as described above.

Standard ZSAES practices for weed control, fertiliser application and irrigation of sugarcane were followed. The numbers of millable stalks, and their weights, were recorded at harvest to calculate cane yields. The lengths and diameters of stalks were also measured. Twenty-four stalk samples were drawn for ERC% Cane analysis. Analysis of variance and Duncan's Multiple Range tests were used to separate treatment means on collected data.

Results

Fungicide efficacy test at Mwenezana (1996)

Cyproconazole, propiconazole, triadimefon and triadimenol significantly reduced rust infection in N14 compared with the water control (Figure 1). There were no significant differences between the fungicides. After 40 days, disease levels in the control plots decreased to the point where they were not significantly different from the fungicide treated plots. The number of rust pustules decreased progressively as daily temperatures increased from August onwards.

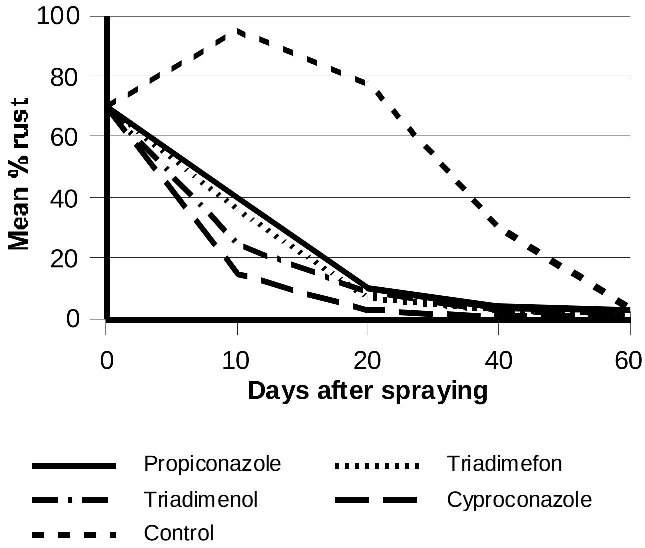

Figure 1: Reduction in mean % rust infections after spraying naturally infected sugarcane variety N14 with four triazole fungicides.

Yield loss studies with triadimenol – ZSAES

Brown rust incidence: In both seasons there was a lower rust incidence in NCo376 and N14 (about 10% leaf area covered at peak infection) compared to the more susceptible ZN6, such that fungicide application only marginally reduced disease levels (<5% leaf coverage). Rust incidence in both sprayed and unsprayed NCo376 and N14 was not detectable when crops were older than six months. In 2003/04, the intensity of rust in plots of the susceptible variety ZN6 during May to August was higher than in 2002/03, when mean temperatures during May to August were generally lower in 2003/04 (Table 1). ZN6 continued to show some small specks on leaves, which occasionally increased in number following prolonged wet spells.

Table 1. Mean monthly temperatures and mean % leaf area covered with rust during May to August in untreated plant crops of sugarcane variety ZN6. The crops were planted at ZSAES on 6 March 2002 and on 16 March 2003 and harvested on 6 May 2003 and 9 May 2004 respectively.

Season	May		June		July		August	
	Mean T (ºC)	Mean % rust	Mean T (ºC)	Mean % rust	Mean T (ºC)	Mean % rust	Mean T (ºC)	Mean % rust
2002/03	20.7	15	17.5	33	17.8	23	20.7	7
2003/04	19.8	26	17.6	41	16.0	33	18.7	11

Numbers, lengths and diameters of stalks

No differences were detected in stalk populations, lengths and diameters during both seasons, except for N14 in 2003/04, when the fungicide treatment reduced stalk diameter by 6% (Table 2).

Table 2. Stalk counts, stalk lengths and diameters of plant crop sugarcane varieties NCo376, N14 and ZN6 sprayed or unsprayed with Triadimenol 250 ppm to control rust. The crops were planted at ZSAES on 6 March 2002 and on 16 March 2003 and harvested respectively on 6 May 2003 and 9 May 2004.

Season	Variety	Stalks/ha (x1000)		Stalk length (m)		Stalk diameters (cm)	
		Sprayed	Unsprayed	Sprayed	Unsprayed	Sprayed	Unsprayed
2002/03	NCo376	129	129	3.02	2.88	2.51	2.49
	N14	100	100	3.20	3.00	2.76	2.76
	ZN6	105	97	3.09	2.97	2.59	2.60
	Means	111.3	108.7	3.10	2.95	2.62	2.62
	LSD (p=0.05)	16.0		0.32		0.23	
2003/04	NCo376	146	149	2.39	2.32	2.24	2.19
	N14	113	121	2.51	2.60	2.34	2.20
	ZN6	111	115	2.45	2.41	2.32	2.30
	Means	123.3	128.3	2.45	2.44	2.30	2.23
	LSD (p=0.05)	10.5		0.24		0.11	

Cane and sugar yields

On average cane and sugar yields were greater during 2002/03 than 2003/04. Treatment with fungicide significantly improved cane (18%) and sugar (16%) in ZN6, but not in the more resistant NCo376 and N14 during 2002/03. There were no yield differences during 2003/04.

Table 3. Cane yields (t/ha), ERC (t/ha) and % loss of plant crop sugarcane varieties NCo376, N14 and ZN6, sprayed or unsprayed with Triadimenol 250 ppm to control rust. The crops were planted at ZSAES on 6 March 2002 and 6 March 2003 and harvested respectively on 6 May 2003 and on 9 May 2004.

Season	Variety	Cane yield (t/ha)			ERC (t/ha)		
		Sprayed	Unsprayed	% loss	Sprayed	Unsprayed	% loss
2002/03	NCo376	182.65	176.83	3.3	22.88	20.07	14.0
	N14	183.87	190.78	-3.8	20.20	22.45	-11.1
	ZN6	179.62	152.06	18.1	23.45	20.17	16.3
	Means	182.05	173.22	5.1	22.18	21.23	4.5
	LSD (p=0.05)	22.91			2.75		
2003/04	NCo376	145.18	145.50	-0.2	16.60	17.89	-7.8
	N14	153.15	158.84	-3.7	20.39	20.95	-2.8
	ZN6	135.22	125.79	7.5	20.27	18.72	8.1
	Means	144.52	143.38	0.8	19.09	19.19	-0.5
	LSD (p=0.05)	16.99			3.04		

Discussion

This work has shown that the incidence of brown rust of sugarcane can be substantially reduced by repeated applications of triazole fungicides. The reduction in disease severity in treated crops did not always translate into increased biomass accumulation, despite the high disease level in the untreated controls in ZN6. This could be attributed to the low growth potential in sugarcane during winter months in the Zimbabwean lowveld, where on average 15,9% of crop growth occurs between May and August (Anon, 1998). This is also the period when rust is severe. Rust infections were very low after August, when maximum crop growth occurs. This fact seems to explain the apparent lack of effect on crop vigour accompanying rust incidence in most seasons in Zimbabwe.

Yield differences between sprayed and unsprayed ZN6 were greater during 2002/03 (18% cane; 16% ERC) compared with 2003/04 (7.5% cane; 8% ERC), even though rust severity was higher in 2003/04 (27.8% vs 19.5% mean leaf area affected respectively). Brown rust is reported to cause higher losses in other countries (Bernard, 1980; Comstock *et al*, 1992; Koike *et al*, 1979; Taylor *et al*, 1986). Lower rust severity was evident in NCo376 and N14 during winter in both seasons. This, coupled with lower disease levels in crops from August onwards, explained the lack of benefits from the triadimenol-associated rust control program. NCo376 and N14 yields were on average lower with triadimenol application – which could be indicative of phytotoxic effect. Such phytotoxicity has not been detected when the fungicide is routinely applied at similar rates as pre-plant sett dips for control of smut.

A fungicide spray program is unlikely to be commercially profitable because of the extended duration of the required spray program, the small yield responses obtained and the difficulty in applying the fungicide in crops older than six months. The Zimbabwe Sugar Association Experiment Station does not recommend commercial use of fungicides for the control of brown rust. Growers are advised to use cultural controls such as timing the planting of susceptible varieties to avoid the exposure of young crops to temperature and relative humidity conditions favourable to brown rust. The susceptible variety, ZN6, is currently losing popularity with growers because of its low stalk population in ratoon crops.

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