IMPROVEMENTS IN THE SMUT SCREENING PROGRAMME AT THE PONGOLA RESEARCH STATION

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Abstract

In 1974 the first resistance screening trials for smut (*Ustilago scitaminea* H&P Sydow) were planted at the Pongola Research Station in northern KwaZulu Natal. Since then, with the continued breeding, selection and adoption of more smut resistant genotypes, there has been a gradual decrease in smut susceptible varieties grown in the Pongola area and, presumably, a decrease in smut spore inoculum. Certainly, increasingly low levels of infection had been recorded in the autumn (March) planted smut screening trials that rely on natural infection, even in the susceptible standard variety NCo376. The timing of the autumn planted screening trials has been a matter of convenience, being related to the availability of suitable planting material. However, previous observations had indicated that the susceptibility to smut was greater in cane planted in spring or summer than in autumn or winter. A trial was therefore conducted to compare the susceptibility of genotypes planted in March with the same genotypes planted in September. Results from the two planting dates, covering the plant crop and the first and second ratoon crops, confirm that higher and more consistent levels of smut infection are obtained when the cane is planted in spring.

Keywords: *Ustilago scitaminea*, Sugarcane, Screening, Pongola, Time of planting

Introduction

Smut caused by the fungus *Ustilago scitaminea* H&P Sydow is the most important fungal disease of sugarcane worldwide. It has been associated with the South African sugar industry since its first appearance on the North Coast in 1877 (Bailey, 1977). Conditions for smut development are more favourable in the northern areas of the industry, but outbreaks have occurred in other areas, particularly where highly susceptible varieties such as NCo310 and Co 301 were being grown (Bailey, 1977). The widespread occurrence of susceptible varieties presumably resulted in high levels of inoculum being present.

The proportion of the different varieties delivered to the mill at Pongola has been reported each year in the annual review of the milling season which is presented at SASTA congresses, (e.g. Lamusse, 1974; Lionnet, 1990; Lionnet and Davies, 1999; Lionnet, 2000). By combining these data with smut resistance ratings of the commercial varieties, the evolution of less susceptible varieties over time can be illustrated (Figure 1).

In the 1973/74 season, 98% of the cane crushed at Pongola was from highly susceptible or susceptible varieties. NCo310, NCo293, NCo382 and N55/805 constituted 52% of the crush and are highly susceptible; NCo376 and NCo334, two susceptible varieties, made up the remaining 46%. This trend continued for many years, and it was not until the introduction in the 1984/85 season of N14 (intermediate reaction to smut) that a decrease in smut prone varieties was evident. However, NCo310 was still grown in Pongola until 1989. Mixed and unknown varieties have not been included in Figure 1 but account for the balance of varieties grown. The adoption of N14 and other less smut prone varieties continued and reached a peak in the 1990/91 season, with N14 accounting for 77,5% of the crush. The last susceptible variety to be grown in Pongola, officially, was NCo376; its final demise came in the 1996/97 crushing season.

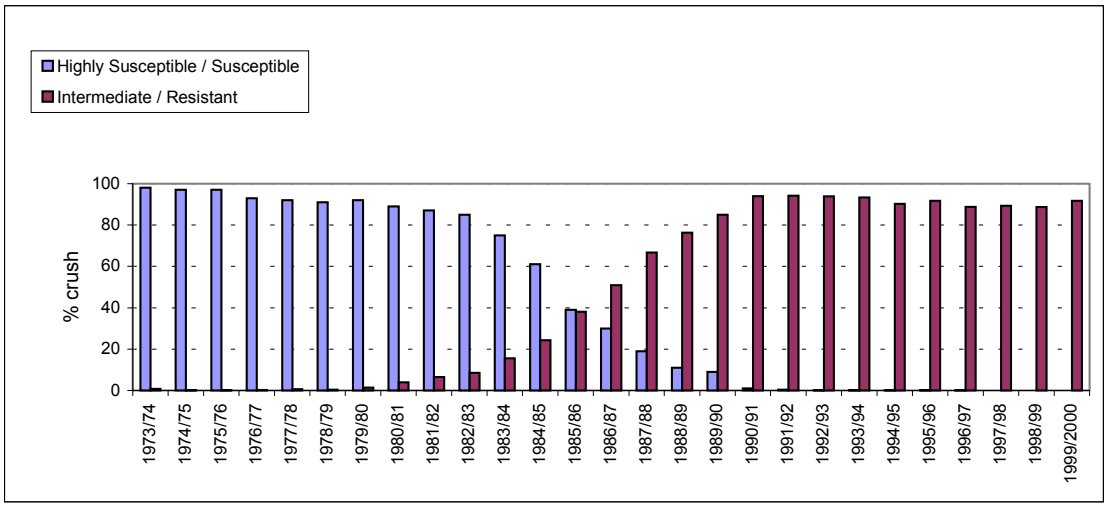

Figure 1. Percent varieties crushed in Pongola, with different reactions to smut 1973-2000.

Since 1974, new varieties from the Experiment Station's Plant Breeding Department that are resistant or moderately resistant to smut have been identified in smut screening trials conducted by the Pathology Department at the Pongola Research Station. Each year, for the past few years, some 620 genotypes are tested for resistance. The timing of one of the trials, the advanced stage, autumn planted, screening trial at Pongola has been a matter of convenience, being related to the availability of suitable planting material selected from the plant breeding programme. However, previous observations had indicated that the susceptibility of genotypes to smut was greater in trials planted in spring than in autumn (Anon, 1992). Although the advanced stage screening trial was not being planted at the ideal time for smut expression, the results had, until recently, been acceptable. However, since 1996 the levels of smut in the standard varieties with known susceptibility were low and erratic. Consequently the allocation of resistance ratings had become increasingly difficult and it could not be assumed that all genotypes that did not develop smut were resistant. Possibly this was a consequence of a decrease in smut spore inoculum resulting from a gradual decrease in smut susceptible varieties grown in the Pongola area.

To assess whether the poor performance of the trials was due to sub-optimal time of planting, a comparison was made between two trials, one planted in autumn and the other in spring. Also, in the spring planted trial, a comparison was made between the incidence of smut in sugarcane varieties inoculated with spores at planting and varieties exposed to natural infection.

Material and methods

In 1999 two trials were planted at the Pongola Research Station, one in autumn (March) and the other in spring (September) with the same 55 genotypes and eight released varieties as standards. The trials were arranged as a randomised lattice design. The seedcane planted in autumn and spring was 12 and 18 months old respectively. Each plot, representing one genotype or variety, comprised two rows of 5m at 1.4 m spacing, each established with ten three-budded setts and replicated three times. Natural infection of the susceptible varieties was facilitated by planting spreader rows of smut-infected NCo310 between each plot. Besides exposure to natural infection, additional planting material of the eight released varieties was inoculated with the fungus. Before planting, the three-budded setts were soaked in a smut spore suspension containing approximately 5 x 10^6 spores/ml for 15 minutes. The ends of these and other setts were dipped in Panoctine before planting to prevent pineapple disease. The cane in the autumn planted trial was harvested after nine months, in December 1999, whereas the cane in the spring planted trial was harvested after 15 months in December 2000. Thereafter the cane was cut annually. The number of smut whips was recorded at intervals and the data used to calculate the average maximum number of whips per genotype per hectare.

Results and Discussion

The incidence of smut was substantially higher in the plant crop and subsequent ratoons of the spring-planted trial (Table 1).

Table 1. The effect of different planting dates on the number and percent genotypes infected with smut.

Crop	March plant (P harvested Dec 1999)		September plant (P harvested Dec 2000)	
	Year assessed	No infected (%)	Year assessed	No infected (%)
Plant	1999	2 (4)	2000	21 (38)
1R	2000	8 (14)	2001	39 (71)
2R	2001	15 (27)	2002	37 (67)
3R	2002	17 (30)		

In the autumn-planted trial, only two genotypes had developed smut before harvest in December 1999. This number increased in the following ratoon crops. Twenty-one genotypes developed smut in the plant crop of the spring-planted trial, increasing to almost 40 genotypes infected in the first and second ratoon. Two previously uninfected genotypes developed slight smut in the second ratoon but had no reaction in the third ratoon crop of the spring-planted trial.

There was a rapid build up in the number of smut whips in the susceptible standard varieties planted in spring. Levels were notably higher in the inoculated plots (Table 2).

Table 2. The incidence of smut in the inoculated and naturally infected standard varieties and in the naturally infected genotypes planted in autumn and spring.

Standard	Maximum whips per hectare (x 10^{-6})									
	March plant				September plant					
	Natural infection				Plant		1R		2R	
	Plant	1R	2R	3R	Inoc	Nat inf	Inoc	Nat inf	Inoc	Nat inf
NCo310	6	27	36	54	17	1	43	32	63	66
NCo376	0	4	18	6	41	13	49	49	22	51
N12	0	7	2	1	10	0	3	3	3	5
N14	0	0	1	5	2	0	5	0	20	37
N16	0	0	1	1	37	7	50	14	16	7
N19	0	0	0	0	7	0	4	1	1	0
N22	0	0	0	0	0	0	0	0	1	0
N25	0	0	1	2	4	8	21	11	7	11
Genotypes	8	9	4	3	-	3	-	6	-	5

Smut levels were considerably lower in the susceptible standards, NCo376 and N16, planted in autumn. In the spring-planted trial, there was generally more smut recorded in the plant crop of the inoculated plots but by the first ratoon, with the exception of N16, levels were similar to the uninoculated plots.

Conclusion

The results indicate that a more accurate assessment of the susceptibility of genotypes to smut would be achieved if the advanced stage screening trial at Pongola were planted in September or October rather than March. Higher levels of infection are achieved in the plant crop if the seedcane is inoculated with spores than when natural infection takes place.

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