

# SUGARCANE SMUT IN SOUTH AFRICA: CURRENT CONTROL RECOMMENDATIONS

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## Abstract

In the northern, irrigated areas of the industry smut is widely distributed, and, although the incidence of the disease is generally low, smut is regarded as a threat to continued production of the dominant variety, NCo 376. Recent sporadic outbreaks of smut in susceptible varieties in other areas are a cause of concern. An integrated system of control measures for smut is described. Key recommendations are those aimed at the production of disease-free seedcane and at reducing the incidence of smut by roguing or eradicating affected fields. Spot applications of Roundup (glyphosate) have proved to be a rapid and effective method of roguing smut-infected stools.

## Introduction

Although the first record of smut affecting sugarcane occurred in Natal in 1877, the South African sugar industry has been relatively free of this important disease for much of its history. Apart from the first outbreak of the late 19th century the only period when smut has been a serious problem in Natal was in the decade around 1950. Then smut was widespread in Zululand and the Natal north coast, on the very highly susceptible variety Co 301. With the phasing out and eventual withdrawal of Co 301 as a released variety the smut problem again receded.

It has become evident that much of the South African cane belt is less favourable to epidemic smut development than more northerly areas in South and Central Africa. Thus it has been possible for susceptible varieties, such as NCo 293, NCo 310, N55/805 and NCo 382, to become established as important varieties in many areas of Natal.

The recently developed northern areas of the Eastern Transvaal and Pongola, together with Swaziland, however, have proved more favourable to smut than much of Natal. Serious levels of smut developed in the northern areas from the mid 1960's. Despite the implementation of control measures, the deteriorating situation eventually necessitated the phasing out of NCo 310 from production in order to protect the less susceptible and increasingly predominant variety NCo 376. This process is now almost complete, although some fields of NCo 310 still occur in the Pongola area.

Events of the last two seasons indicate what may be the start of a further general smut outbreak, unless corrective action is taken. At least, recent outbreaks have demonstrated that severe smut can develop in Natal on several important varieties, and in the northern areas on NCo 376. The present situation, therefore, leaves no room for complacency. This paper briefly outlines the present smut situation in South Africa and discusses the control measures that are being recommended to contain the problem.

## Current Status of Smut

From the point of view of proneness to smut and the implementation of control measures, including varietal considerations, the irrigated northern areas are considered to be distinct from the remainder of the industry.

### Northern areas

The phasing out of production of NCo 310 and other highly susceptible varieties from the northern areas is almost complete, and NCo 376 now constitutes more than 90% of the crop. In South Africa NCo 376 is regarded as being much less sus-

ceptible to smut than NCo 310. NCo 376 is also considered less susceptible here than it is in neighbouring countries. To some extent this difference in the smut rating of NCo 376 probably reflects a greater favourability of, for instance, the Rhodesian lowveld to smut than is shown even by our northern areas, but it may also be due in part to a generally more severe exposure to the disease elsewhere than in South Africa.

Recent surveys have shown that smut is widely distributed in NCo 376 throughout the northern areas. The incidence of the disease is generally low and losses in yield are negligible, but most fields, including many seedcane fields, do have a slight degree of infection. In some areas, particularly in Swaziland, smut has reached serious levels in NCo 376 and there are at present problems in obtaining seedcane of an acceptably smut-free standard. There are, therefore, indications that smut has the potential to cause severe yield losses in NCo 376. A further indication of the potential problem is the severity of the disease on this variety in neighbouring countries.

The northern areas, therefore, are considered favourable to epidemic development, and smut is regarded as endemic and unlikely to be eradicated. In the present circumstances of reliance on one variety there are risks of serious yield losses. Fortunately there is evidence from the Rhodesian lowveld, where much work on the smut problem and its control has been conducted, that a widespread, co-ordinated programme of control can enable the production of NCo 376 to continue. A smut control scheme was initiated in Pongola and the Eastern Transvaal in 1976-77, and a similar scheme that has been in progress in Swaziland for a number of years has recently been amended. The recent release of the highly smut resistant variety N52/219 and the imminent release of a further variety should also improve the varietal status of the northern areas from the viewpoint of smut control.

### Natal

In the area south of Hluhluwe occasional, minor instances of smut have occurred from time to time ever since the demise of Co 301, particularly in Zululand, but, in the last two seasons, the number of these sporadic outbreaks has increased. In 1975-76 smut was found on a number of farms around Empangeni and, in 1976-77, further outbreaks have occurred in other areas, from northern Zululand to the Midlands.

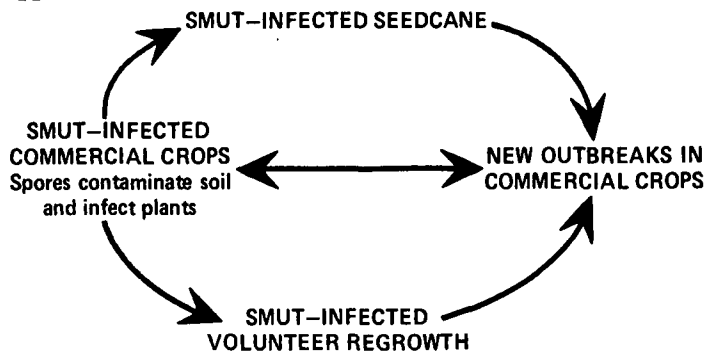
Although the dominant variety in most areas is NCo 376, other more susceptible varieties form a significant proportion of the crop. This is particularly the case in the Umfolozi and Empangeni-Felixton areas, where NCo 310, N55/805 and NCo 382 are important varieties, and in the Midlands North area, where NCo 293 and NCo 382 predominate. Outbreaks of smut have occurred in varieties NCo 293, NCo 310, N55/805, NCo 382 and N8, all of which are highly susceptible. Outside the northern areas smut has not been detected in NCo 376, and the outbreaks have so far been only sporadic. In much of Natal, therefore, the disease is not regarded as endemic. However, the severity of certain outbreaks indicates a potential for severe smut development in a significant proportion of the varietal spectrum over wide areas. An increasing incidence of smut must also be considered as eventually presenting a threat to other, as yet unaffected, varieties like NCo 376.

The consequences of widespread, severe smut outbreaks need little elaboration. Apart from the direct costs incurred

by growers from losses in yield (Fig. 3), more frequent replanting and the need for intensive control measures, a serious, indirect consequence would be a restriction in the choice of suitable varieties. A high proportion of present production is obtained from susceptible varieties and, should the future production of NCo 376 also be widely jeopardized, these varietal considerations become even more important. It is, therefore, considered essential that control measures are implemented by all affected growers at this early stage, before the situation deteriorates into one that can not be easily controlled.

### Control

The development of an epidemic of a disease like sugarcane smut is an exponential process, in that the greater the incidence the more rapidly does further spread occur. With smut the fact that seedcane stocks become increasingly contaminated as the epidemic progresses aggravates this self-generating aspect of the disease. The process is also essentially cyclic, in that severely infected commercial fields increase the likelihood of both seedcane fields and volunteers becoming infected, with reciprocal effects. These concepts are represented in Fig. 1, from which various important field control possibilities become apparent.



**FIGURE 1** Schematic representation of the sources of infection occurring during an epidemic of sugarcane smut.

From Fig. 1 it can be seen that, for success to be most readily achieved, all the various aspects of control must be applied in an integrated fashion. For example, concentration of effort on seedcane health, although vital, must be accompanied by a reduction in the general level of smut inoculum in order to avoid rapid infection of newly planted cane.

Before discussing the various aspects of control it must be pointed out that the recommendations are intended to cater for two different situations. In the irrigated, smut-prone, northern areas smut is widely distributed and is a relatively greater threat to cane production than in the generally cooler, rain-grown cane areas of much of Natal. Thus, although the principles of control are common to both areas, it is necessary to apply different standards and occasionally specific recommendations for certain aspects.

### Seedcane health

The planting of healthy seedcane is regarded as the key to smut control, without which other aspects of control will have a greatly reduced effect, but which becomes increasingly difficult to achieve as an epidemic progresses.

It is recommended that all nurseries and fields used to supply seedcane should be inspected, line-by-line, at least three times. Smut is most easily recognised in young cane during the summer months of September to March, and inspection should commence at an early stage and continue until the cane is approximately two metres tall. Smut is easily recognised by the characteristic whips (Fig. 2), while incipient whips (stalks from which whips have not yet emerged) can be recognised by their thin, unthrifty appearance, with long internodes and small leaves. In susceptible varieties numerous whips may be pro-

duced from each infected stool, which may degenerate into clumps of short, grassy, unproductive shoots (Fig. 3).

All stools suspected of being infected in seedcane fields should be eradicated, either by digging out the stools for subsequent removal and burning, or by spraying with an effective herbicide. This latter method is described more fully under "Roguing commercial fields".

As smut can be present in cane without being immediately apparent, any field with an appreciable incidence of smut should, despite roguing, be considered unsuitable for the supply of seedcane. A suggested tolerance for all areas is 150 smut whips/ha (approximately 0.1% of stalks affected) at any inspection, although, where possible, seedcane should always be taken from the most healthy fields or nurseries.

Growers in Swaziland are at present formulating comprehensive plans for the production of healthy seedcane of NCo 376 in areas that are less favourable to smut than the lowveld production areas.

### Eradicating severely affected fields

The general level of smut must be reduced to delay further spread of the outbreak and to allow the maximum benefit from planting healthy seedcane to be realised. As an extreme measure, ploughing out of all plantings of a susceptible variety may be recommended, as occurred with Co 301 and, more recently, with NCo 310 in the northern areas. Additional measures of this type are not contemplated in the present situation, but severely affected fields are a major source of infection to other fields and farms, and this source of infection can not readily be eliminated other than by ploughing out.

In the northern areas, the level at which ploughing out after harvest is at present advised is 10 000 smut whips/ha or 10% infected stools at any one inspection, but this level is likely to



**FIGURE 2** Smut is easily recognised by the distinctive curved whips that develop from infected stalks.



**FIGURE 3** Severely infected stools (right) may produce few millable stalks compared to healthy stools (left).

be reduced in future seasons to 5 000 whips or 5% stools. Few fields have smut levels as high as this, but the serious effect of severely smutted fields acting as sources of spread is again stressed.

In other areas of the industry, where smut is not firmly established, the relative importance of severely affected fields is even greater, and here the level at which ploughing out is recommended is 3 000 whips/ha, or 3% stools. Several fields of NCo 382 and N55/805 in Zululand and NCo 293 in the Midlands have greatly exceeded this figure during the last two seasons.

The replanting of badly smutted fields which are otherwise producing well may not readily be accepted by growers. The latent nature of smut (that it may be present to a greater degree than is apparent), the role of these fields is spreading the disease, the lack of effective alternative control methods and the eventual risk of yield losses in these fields are all points to consider. Growers are, therefore, urged to place some degree of priority on smut levels in their fields when planning replanting programmes.

#### *Roguing commercial fields*

The roguing or eradication of smutted stools from all affected fields is a further step towards reducing the general incidence of the disease, and has for many years been recommended as a smut control measure. Roguing entire stools is a labour-intensive operation and is not practicable where severe outbreaks occur over large areas. The alternative method of roguing by removing smutted stalks only is widely practised in Rhodesia and has recently been recommended in South Africa (Anon<sup>1</sup>). This whip roguing has similar effects on control to stool removal (James<sup>3</sup>) and is less labour-intensive, but has the disadvantage that new whips are eventually produced from treated stools.

At the Experiment Station, a new method of roguing smutted stools, based on spot applications of the herbicide Roundup,

has now been proved to be effective. Affected stools or clumps of smutted stalks are sprayed with approximately 5 ml of a 10% solution of Roundup using a small, low pressure hand sprayer (Fig. 4). A range of suitable sprayers is available, the one tested having a capacity of two litres and an adjustable nozzle. Sprayed stools die rapidly, and this method has the advantages of low cost, rapidity and effectiveness, in that killed stools do not regenerate and produce more whips. Drift has been found to be negligible. Spot spray roguing is rapidly being adopted by Swaziland growers and, pending any necessary registration formalities, is generally recommended in South Africa.

Several roguing operations are advised and are best carried out in young cane, up to approximately two metres in height, during the summer months. Up to this stage the majority of potential whips will have emerged and applications of Roundup are most likely to be effective, while later operations tend to be both ineffective and damaging to the crop.

It is recommended that all commercial fields in affected areas should be inspected and rogued. Roguing should take place in all severely affected fields and is particularly advised in all plant and early ratoon crops, as control in these early crops achieves the maximum effect on epidemic development. Older ratoon crops are closer to eventual re-establishment and, in addition, there is a tendency for a natural decline in apparent smut incidence to occur with increased ratooning (James<sup>3</sup>).

#### *Volunteers*

The necessity for complete eradication of volunteer regrowth from previously smutted crops before replanting is obvious, as infected volunteers can immediately nullify the benefits of planting healthy seedcane. Spot spraying with Roundup now provides an effective method of killing regrowth which has not been eradicated during land preparation.

The maintenance of smut in volunteers of Co 301 has probably been an important factor in the resurgence of the disease in Zululand, while infected NCo 310 volunteers are frequently seen in the northern areas.



**FIGURE 4** Killing a smut-infected stool with a spot application of Roundup.

### Stress

The aggravating effect of unfavourable growing conditions on the incidence of smut can frequently be observed in the field and several of the more serious, recent outbreaks in Zululand have been associated with stress factors, such as inadequate nutrition and weed control. A correlation between smut incidence and moisture stress has been reported by James<sup>3</sup>. Striking effects of moisture stress have recently been demonstrated at Pongola (Bailey<sup>2</sup>), smut incidence being increased more than ten times under conditions of severe moisture stress in ratoon crops of the susceptible variety N55/805.

The avoidance of stress conditions by a high standard of crop management, including optimum irrigation management in irrigated areas, can, therefore, be regarded as an effective method of smut control.

### Hot water treatment

Hot water treatment (HWT) of seedcane for the control of ratoon stunting disease (RSD) has been recommended throughout the industry since the mid 1950's, but a change in the advice regarding HWT to growers in the northern areas recently became necessary and was put into effect during 1976/77. It has recently been shown that HWT can cause a considerable increase in the incidence of smut in both NCo 310 and NCo 376. This effect is partly due to damage to the treated cane, which is then more susceptible when planted in smut-infested soil, but it also appears that the elimination of RSD itself may increase smut incidence (Bailey<sup>2</sup>, James<sup>4</sup>). In addition, RSD has been shown to have negligible effects on cane yield under irrigated conditions (Rossler<sup>5</sup>). HWT is, therefore, no longer recommended in the northern areas, because of the immediate nature of the smut threat and widespread occurrence of infested soils.

This advice regarding the cessation of HWT applies solely to the northern areas under present circumstances. RSD control may well be reintroduced in the future, depending on such factors as improvements in varietal resistance to smut or alternative methods of controlling either disease. Throughout the remainder of the industry RSD control remains essential. In these rain-grown areas losses in yield due to RSD can be high, whereas, on account of the very infrequent occurrence of severely contaminated soils, HWT will have little effect on smut incidence.

### Resistant varieties

The use of resistant varieties is, of course, the most satisfactory method of controlling smut. The Experiment Station has long recognised the need for resistant varieties in the northern areas and has devoted increasing resources to this end. A considerable proportion of the plant breeding selection programme is conducted at Pongola, with smut resistance as a primary objective, and all advanced selections undergo intensive smut screening tests. Plans for the increased field testing of advanced selections in the northern areas are also now being put into effect.

The overwhelming dependence of the northern areas on NCo 376 has already been partly eased by the release in 1975 of the highly smut resistant variety N52/219. The impending release of N11 in 1977 will further aid in improving the situation. Future released varieties from the expanded northern areas selection programme will, of course, be highly smut resistant. Growers in northern areas are urged to become familiar with all new smut resistant varieties, and to determine where they can be used as alternatives to or improvements on NCo 376 in the cropping programme.

The varietal situation throughout the remainder of the industry is not considered critical. Although many of the present varieties are ranked as susceptible, the degree of development

of smut and the efficacy of control measures in any area are also functions of the favourability of that area for disease development. It is considered that the present sporadic outbreaks in Natal can readily be controlled without recourse to large scale changes in the varieties grown. However, where a previously severely affected field is to be replanted, consideration should be given to planting a more resistant variety if, under the specific circumstances, an equally suitable alternative variety is available. For the guidance of growers the approximate ranking of the more common varieties in terms of reaction to smut is as follows :

Highly susceptible	NCo 293		NCo 376
	N55/805		NCo 334
	NCo 310	Slightly susceptible	N53/216
Susceptible	NCo 382		J59/3
	N7	Resistant	N52/219
	N8		
	CB 36/14		

It is again emphasised that, with the possible exception of replanting smutted fields, large scale changes in the varieties grown in the rain-fed areas are not at this stage considered necessary. However, smut reactions, as determined by screening tests, will be considered when selecting varieties for future release to all areas of the industry.

### Conclusions

Although the present incidence of smut in the smut-prone northern areas is generally low, there is increasing evidence that the continued production of NCo 376 may be jeopardized in the absence of effective control measures. Similarly, in the less smut-prone, southern areas, severe outbreaks in recent seasons indicate a potential for yield losses in many of the current varieties. It is essential, therefore, that efforts are made throughout the industry at this early stage in order to prevent the possible deterioration of the smut problem into one that is not readily controllable. Such a situation would have far-reaching consequences.

Key factors in the control of smut are the planting of smut-free seedcane, the routine roguing of diseased stools from all fields and the eradication of severely affected fields and volunteers. These measures will exert the greatest effect if applied in an integrated fashion by all growers in affected areas.

Frequent crop inspections are necessary to monitor the situation and to provide a guide to the control measures that are necessary. The post of Disease Control Officer was created in 1976 in order to provide an inspection and advisory service to growers in the Eastern Transvaal and Pongola areas, similar to the smut control scheme that operates in Swaziland. Growers elsewhere in the industry can request assistance from the Experiment Station, through their regional Extension Officers, on field and nursery inspections and training in control procedures.

It is considered that, until such time as further high yielding, smut resistant varieties are available, the control measures presented can contain the smut problem and allow production of the present varieties to continue in all areas.

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