

# COPING WITH DISEASE PROBLEMS

Changing approaches to the challenges presented to the South African sugarcane crop by diseases

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## Introduction

A number of features of the sugarcane plant and the way the crop is grown make it vulnerable to a wide range of pathogens:

- Sugarcane is vegetatively propagated, i.e. by means of seedcane. Systemic diseases, which include smut, mosaic and RSD, are readily spread in seedcane. They can also spread into new plantings if infected volunteers persist from old crops (cane is difficult to eradicate completely).
- The crop is grown as a monoculture and can be regarded as a perennial that is harvested periodically. Systemic diseases persist and build up from crop to crop with ratooning. Also, once a disease does appear, the widespread occurrence of the crop, often of one dominant variety, favours epidemic development.
- Crop rotation, which is important in controlling diseases in many crops, is not used in sugarcane in southern Africa. Further, where irrigation is practised, it is traditional for replanting to follow almost directly after destruction of the old crop. This gives short term economic gains, but at what long term cost?
- New sugarcane varieties cannot be produced quickly to meet new disease challenges because of the long term nature of the variety development process (crossing and selection) and the slow rate at which new varieties can be disseminated to replace old ones (due to the logistics of seedcane propagation and the high cost of ploughing out and replanting large areas). Therefore, once diseases have built up, particularly systemic ones, they remain serious for a long time (eg smut, RSD).

## Sugarcane/pathogen relationships

There is a large range of diverse pathogens belonging to several different groups of micro-organisms that can infect sugarcane. A total of almost 40 pathogens have been identified in South Africa and more than double that worldwide. More are being discovered each year.

The relationship between the sugarcane crop and its co-evolved pathogens is essentially dynamic. Micro-organisms are genetically adaptable and can evolve in response to the changing genetic make up of the new varieties that are bred and released. Examples include:

- the many strains within the SCMV group
- the recent evolution of new pathogenic races of the gumming bacterium *Xanthomonas campestris* pv *vasculorum* in Mauritius
- different sero/pathotypes of *X. albilineans* (leaf scald)
- evidence for different strains of rust (*Puccinia melanocephala*)
- a number of previously unknown pathogens that have recently appeared in new commercial hybrids in Papua-New Guinea.

The risk of challenges from new pathogens, to which it may be impossible to select for resistance in advance, will always be with us.

Table 1

History of outbreaks of major diseases in the South African sugar industry

|                           |   |
|---------------------------|---|
| 1877                      | Smut first reported. in China canes   |
| 1910-20                   | Mosaic first reported: production restricted to resistant Uba   |
| 1930s                     | Streak virus ubiquitous in Uba: serious yield losses  |
| 1940s                     | Co281 crashed – RSD subsequently identified as the cause<br>Smut re-appeared. in Co301<br>Rust first recorded. in Co301                         |
| 1960s                     | Smut serious in NCo310 in the north<br>Mosaic spreading in NCo376 in cool areas   |
| Mid 1970s                 | Rust re-appeared. severe in N55/805<br>Leaf scald identified as a hazard  |
| Early 1980s               | Smut severe and getting out of control in NCo376 in the north<br>Mosaic severe in NCo376 and NCo293 in cool areas<br>RSD found to be widespread |
| Late 1980s to early 1990s | Reduced levels of major diseases in most areas  |
| Mid 1990s                 | New virus diseases found (SCBV, SCMMV, the reovirus)  |

## The changing cane disease situation in South Africa

Smut, mosaic and rust – diseases of serious economic concern over the last two decades – are no longer of immediate concern to most growers. However, the pathogens that cause these and other common diseases remain in the industry and occur in high frequencies in new genotypes at selection sites. They will always remain a threat to production and so resistance to them will always be necessary.

Recent success in reducing the effects of or hazards presented by most diseases has followed the implementation of an integrated disease management policy. Components of this policy have included improvements to:

- seedcane health
- crop destruction practices
- the general resistance of the varieties grown.

Additionally, the grower community, both through Pest and Disease Control Committees and also through a greatly improved awareness by growers of the need to control diseases, has played an important role. Improved grower awareness of the need for disease control followed effective promotion of the results of applied research on disease occurrence, economic effects and control methods.

The long term philosophy has been and remains to simplify disease control from the growers' point of view by implementing suitable strategies regarding variety resistance. For example, leaf scald, which was identified as a serious threat to production in the mid 1970s, was pre-empted by the implementation of appropriate screening and a suitable variety release policy before the disease became common in commercial varieties.

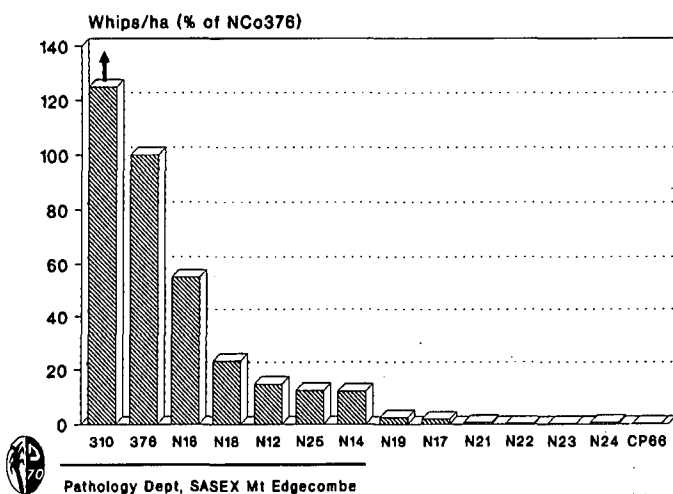
The successful control of smut and mosaic in the past decade has been mainly due to the selection and release of new resistant varieties as replacements for old susceptible ones. For example, the relative reactions of released varieties to smut is shown in the figure. It clearly shows that most varieties released since 1980 are much more resistant than the formerly widely grown varieties NCo310 and NCo376. Whereas more than 95% of the national crop crushed in 1978-79 was from highly smut-susceptible varieties, it is likely that less than 25% of the 1995-96 crop will be obtained from such varieties.

### New disease challenges

New diseases that have occurred locally include the reovirus, sugarcane bacilliform virus (SCBV) and sugarcane mild mosaic virus (SCMMV). SCBV is now known to be internationally widespread. The detection of peanut clump virus, yellow leaf syndrome and new strains of various pathogens in a number of countries is a cause of general concern.

There is an increasing awareness internationally of the risk of new pathogens being disseminated through variety exchange, and the need to improve the security of quarantine procedures for sugarcane is recognised.

**SUSCEPTIBILITY OF SA VARIETIES TO SMUT  
(relative to NCo376 =100%)**



### New tools – what can technology offer?

- NIR for detecting resistance.
- PCR-based and serologically based identification and diagnostics for important pathogens. These have application in quarantine, for surveys (disease monitoring) and research. Progress is being made towards the international exchange of diagnostics.
- Genetic markers for resistance or susceptibility to important pathogens. However, there is a need for caution when deciding what diseases to screen for – we cannot and should not screen for everything but must prioritise.
- Genetic engineering – for example, gene constructs for the SCMV coat protein to confer mosaic resistance might be introduced into suitable candidate varieties. Can we consider engineering N19 or NCo376 with mosaic resistance?

### Strategies for disease control

- Continue with successful policies regarding the release of new varieties having adequate resistance to the diseases to which the industry has been repeatedly shown to be prone.
- Stabilise the current improved situation with regard to smut and mosaic by continuing to encourage growers to adopt new varieties with improved resistance.
- Continue to encourage and facilitate improvements in the RSD situation through integrated disease management.
- Continue to investigate marker-based detection of resistance to smut and mosaic in particular, and also to rust, leaf scald and any other common disease which occur in the AA40 population. Implementing marker based screening for resistance would provide great savings in costs and manpower and enormous gains in selection efficiency.
- Investigate the feasibility of controlling RSD by means of variety resistance.
- Explore the benefits to South Africa and other countries of a co-operative approach to the control of sugarcane diseases in the southern/central African phytosanitary region. A possible first step would be the establishment of a regional quarantine station for the region at SASEX.

Table 1 summarises the history of important outbreaks of diseases in the South African sugar industry. It illustrates the cyclic occurrence in the long term of a number of serious diseases to which the cane crop is prone in southern Africa. It must be appreciated that the various 'events' were triggered by the release and adoption of varieties a decade or more before the epidemics assumed serious levels.