LEAF SCALD DISEASE OF SUGARCANE IN SOUTH AFRICA

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Abstract

The history of leaf scald disease is briefly traced in South Africa and in other countries. Symptoms, transmission and control measures are described and observations made on varietal resistance in South Africa.

Historical Introduction

The bacterial disease now known as leaf scald is considered to be one of the most destructive diseases which infect sugarcane, and in Queensland last year was described as potentially the industry's most dangerous disease (Anon 1969)[1].

Leaf scald probably originated in the East Indies and was confined for many years to the Eastern Hemisphere. In Java the disease was first known as "Hundred Brown disease" indicating the susceptibility of a variety of that name. It was later called 'gomziekte' or gum disease and thought to be identical with gummosis (Wiehe 1951)[9]. They were subsequently found to be two distinct diseases and the Java gum disease was recognised as being identical with the Australian leaf scald. The name leaf scald was then adopted for the disease, the causal organism being the bacterium *Xanthomonas albilineans* (Ashby) Dowson.

Leaf scald probably occurred in Australia before 1900 having possibly been introduced from Java or New Guinea. The disease was subsequently recorded for other Eastern Hemisphere countries - Fiji (1911), Taiwan (1919), Philippines (1921), Mauritius (1928) and Malagasy (1936).

The disease arrived in the Western Hemisphere by way of Brazil between 1926 and 1930 and was probably introduced into Guyana during the same period. In the South American and Caribbean regions leaf scald has been recorded in Argentina, Dutch Guiana, Martinique, Puerto Rico and St. Lucia.

The first report of leaf scald in Hawaii came in 1930, but evidence suggests that the disease had been present for some years prior to this.

Within the last few years leaf scald has been found for the first time in a number of countries. In Africa it was found in Rhodesia in 1965. Since then it has been reported in Ghana, Tanzania, Malawi, Mocambique, Swaziland and South Africa (Thompson 1969)[7].

In countries abroad, the disease was recorded in 1968 in both Florida and Barbados.

In 1965 leaf scald was intercepted in the Durban quarantine glasshouse on a variety imported from Argentina eight months previously and has recently been discovered a second time on a variety introduced from Reunion. In Kenya the disease has appeared on two occasions on canes being held in quarantine (Sheffield 1969) [6].

Leaf scald in South Africa and Swaziland

Leaf scald was first recorded from South Africa and from Swaziland towards the end of 1968 (Thomson 1969)[7][8].

Specimens of the varieties N.50/211 and N.53/216 from Ubombo Ranches in Swaziland were sent to the Experiment Station in 1968 for diagnosis after reports of die-back of isolated stools in the field. None of the characteristic chronic phase symptoms of leaf scald was present on the samples and a thorough examination failed to reveal the cause of the problem. It was only after a stool of N.50/211, planted in the glasshouse for further observation, developed typical symptoms that leaf scald was finally diagnosed.

Early in 1969 a propagation plot of the variety N.6 at Mhlume Sugar Company in Swaziland developed sideshoots for no apparent reason. These sideshoots later showed the typical white lines, scalded appearance and reddened vascular tissues of leaf scald disease. On the same estate N.51/168 and N.53/216 were also found infected. At Ubombo Ranches the variety N.6 also exhibited typical leaf scald symptoms in a young ratoon crop.

Specimens of CB.36/14 from an estate in the Natal portion of the Pongola settlement were also diagnosed as cases of leaf scald but only after replanting in the glasshouse.

In the Eastern Transvaal the first positive identification of leaf scald came from a series of demonstration stools of N.50/211 and N.53/216 in November 1968 while three months later the disease was found in a stool of N.51/539.

Two ratooning variety trials in the Eastern Transvaa ldeveloped leaf scald symptoms in N:Co.334, N.50/211, CB.36/14 and N.6 while propagation plots of the latter were also found to be infected.

In Natal leaf scald has now been reported from single fields of CB.36/14 in the Umzinto district of the South Coast and in the Eshowe area, and in the varieties N:Co.310, N.53/216., N.55/805, CB.36/14 and N.6 in the Glendale Valley of the North Coast.

Symptoms

Leaf scald as a bacterial, vascular disease can occur in two distinct phases, known as the chronic and acute forms respectively (Martin and Robinson 1961)[5].

The Chronic Phase

In young newly-infected plants the initial symptom of the chronic phase is the development of long, narrow white leaf stripes which are at first sharply defined running parallel to the veins (see Plate 1). With age, the white lines become more diffuse in outline and some reddening of the white tissue occurs. The widening stripes wither from the leaf tip downwards and in curling upwards and inwards produce the characteristic "scalded" appearance ' Prominent features of the chronic phase are the sideshoots which develop at

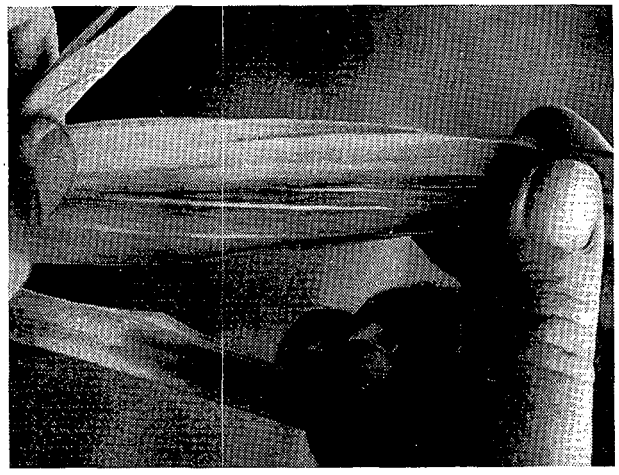

PLATE 1: Young shoot showing the sharp, white lines typical of the chronic phase of leaf scald disease.

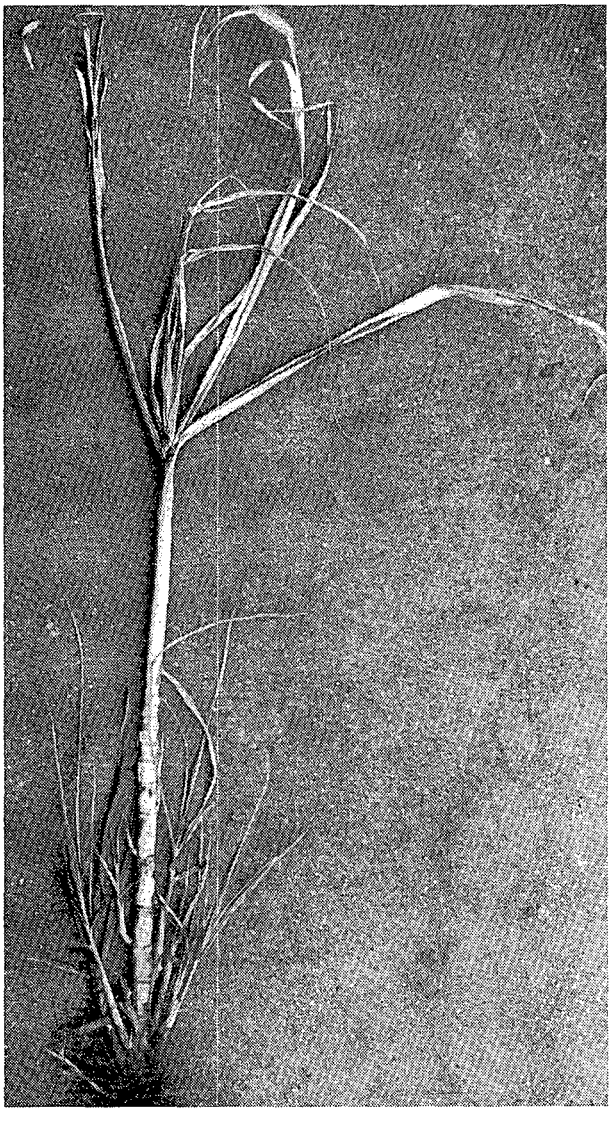

PLATE 2: A stalk infected with leaf scald disease showing the scalded appearance of the leaves and the sideshoot development from the basal nodes.

first from the basal nodes. (see Plate 2) These sideshoots usually bear all the symptoms found on the main stalk such as the white lines and scalding, and, being rather weak, they soon wither and die. Chronically-infected stalks cut longitudinally show bright red streaks in the nodal tissue and in particular at the junction of the sideshoots with the main stem.

The acute phase

Plants affected by the acute phase of leaf scald suddenly wilt and die as if affected by drought, without necessarily exhibiting any of the symptoms of the chronic form of the disease. This collapse may involve the whole stool, or only a few stalks in a stool, and the leaves dry out with a characteristic inward curling, while tillers bearing typical chronic stage symptoms often develop at the bases of affected plants.

The Causal Organism

The bacterium causing leaf scald disease is now accepted as being *Xanthomonas albilineans* (Ashby) Dowson.

This pathogen is a short rod and is mobile by a single polar flagellum (see Plate 3). It is strictly aerobic, Gram negative, possesses a capsule and does not form spores.

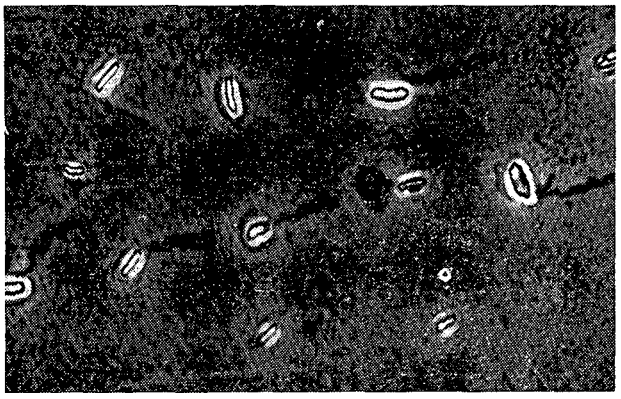

PLATE 3: Photomicrograph of *Xanthomonas albilineans* showing the typical long, polar flagellum in comparison with the relatively short bacterial rod.

Under field conditions the bacterium has not been found infecting plants other than sugarcane. It is however capable of producing strains which differ in their characteristics and which complicate the assessment of variety reaction to the disease.

The pathogen is confined largely to the leaf and stalk vascular tissues which are often blocked with a gum-like substance (see Plates 4 & 5). The infection is generally confined to the xylem vessels but in advanced stages of infection the bacteria may invade other tissues. The reddening of stalk vascular tracts which is seen mainly at the nodes is due to invasion by the pathogen.

Transmission

Spread of leaf scald disease takes place mainly by infected seedcane and by infective juice adhering to the knife after a diseased plant has been cut at harvest or during the preparation of seed material.

The organism does not remain viable in the soil for very long and there is little danger of its persisting in fallow fields in the absence of plants susceptible to infection.

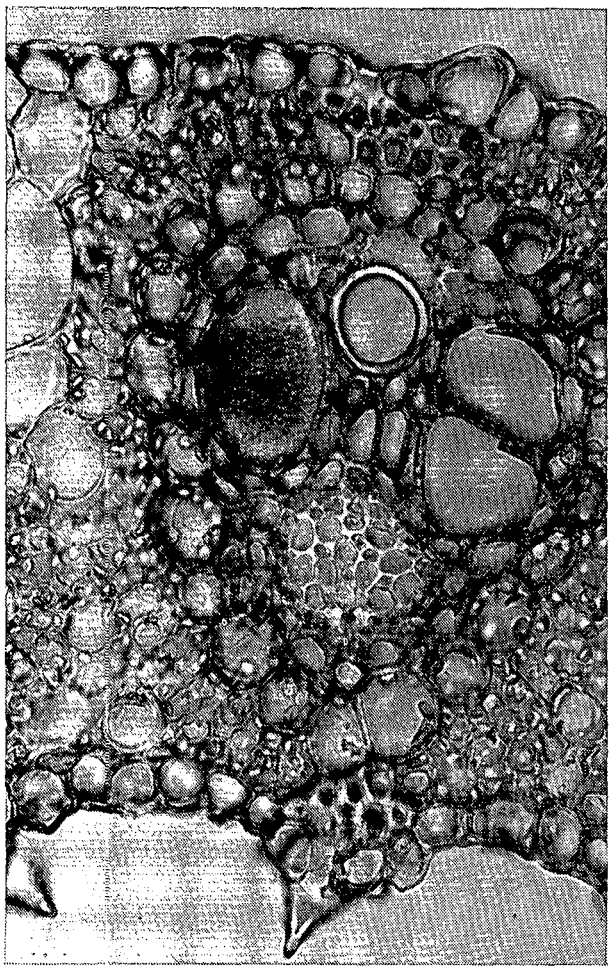

PLATE 4: Transverse section through a diseased leaf showing an early stage in the invasion of the vascular tissues by the pathogen.

A major problem associated with leaf scald is its ability to remain dormant in tolerant varieties for considerable lengths of time and thus escape detection in planting material. It is reported to be the fastest-spreading major disease of sugarcane in recent times (Egan 1969)[2].

Varietal Reactions

Until a system of screening varieties is established in Natal our assessment of varietal reactions to leaf scald will be based on observations in the field and to some extent on reports from overseas countries. The latter must however be treated with some reservation because of the existence of different strains of the bacterium.

Observations made so far indicate that in South Africa and Swaziland the varieties N50/211, N51/168, N53/216, N.6 and CB36/14 are susceptible, while higher levels of resistance are shown by N:Co.310, N:Co.334, N:Co.376, N51/539, N55/805 and CB38/22.

In Rhodesia N:Co.310 and N:Co.376 are classed as resistant with N:Co.376 showing a higher degree of tolerance to infection (Koenic 1967)[4].

Although only a few isolated cases of leaf scald have been found in N:Co.376, the apparent tolerance of this variety is a matter of great concern in South Africa where this major variety may now possibly be acting as a carrier of leaf scald without showing readily diagnostic symptoms of the disease.

Preliminary Inoculation Experiments

A number of small-scale inoculation experiments have been carried out in isolation at Mount Edgecombe using cultures derived from specimens collected in the different areas where leaf scald has been recorded. The method used in the experiments was basically similar to that now employed in Queensland in routine resistance tests (Egan 1969)[3].

The method involves decapitating young, healthy primary shoots some distance above the growing point. The bacterial culture is then applied to the cut surface with a soft brush and the plants covered with plastic hoods to maintain a high atmospheric humidity around the inoculation wound.

These preliminary inoculation experiments produced good symptoms in most varieties whose reactions were known from the previous reports. With our own varieties however, variability in symptom expression and in the pattern of development of the disease suggested the presence in South Africa of more than one strain of the pathogen *Xanthomonas albilineans*.

Assessments based on the results of these experiments agreed fairly well with observations made so far in the field. Possible exceptions to this however are

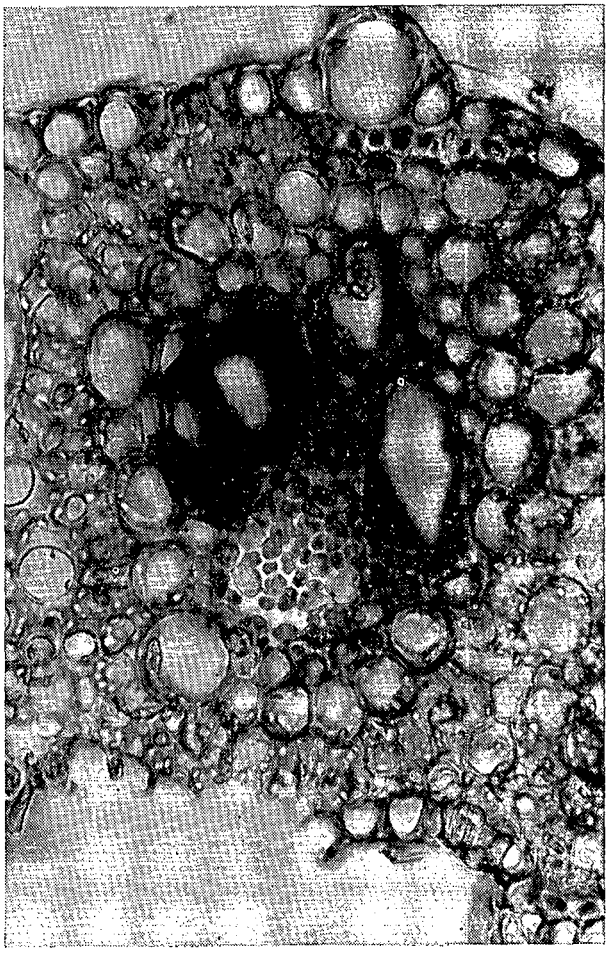

PLATE 5: A more advanced stage of infection showing blocking of the xylen vessels of the leaf by a gum-like mass.

N51/539 and CB.38/22 both of which are rated as susceptible after inoculation but which seeem to be quite resistant in the field (see Table 1).

TABLE I
Reactions of Natal sugarcane varieties to leaf scald disease

Variety	Inoculation	Natural infection
N:Co.293	Resistant	Resistant
N:Co.310	Resistant	Resistant
N:Co.334	—	Resistant
N:Co.376	Resistant	Resistant
N:Co.382	Intermediate	Resistant
N.50/211	Susceptible	Susceptible
N.51/168	Susceptible	Susceptible
N.51/539	Susceptible	Resistant
N.53/216	Susceptible	Susceptible
N.55/805	Resistant	Resistant
N.6	Susceptible	Susceptible
C.B.36/14	Susceptible	Susceptible
C.B.38/22	Susceptible	Resistant

Control Measures

Resistant Varieties

In the long term the most effective control is derived from the development of varieties possessing a sufficiently high level of resistance to infection.

In the countries where routine leaf scald trials are carried out such experiments have proved difficult to assess because of anomalities in the control varieties and because of strain complications.

When leaf scald is introduced into the programme of routine disease resistance tests in Natal such screening will probably involve the shoot inoculation method mentioned above. As in this method most varieties display initial symptoms of infection on the inoculated leaves, only systemic symptoms which develop later should be considered when varieties are rated.

Field Control

The most important aspect of short term control of leaf scald is that of seedcane selection. The value of a strict seedcane selection policy has been repeatedly emphasized in dealing with all of our major diseases and it is certainly no less important in the case of leaf scald. In leaf scald-prone areas the cultivation of resistant varieties is of prime importance.

In the planning of seedbeds it must be remembered that, unlike ratoon stunting disease and chlorotic streak disease, leaf scald is not controlled by the standard hot water treatment, so that it is essential to ensure that the seedcane intended for the seedbed is free of leaf scald disease.

As in the case of ratoon stunting disease knives used in the preparation of seedcane must be treated with suitable chemicals to prevent transmission of the disease by means of infective juice.

In commercial fields where the degree of leaf scald infection is relatively low an attempt should be made to eradicate the disease by regular inspections and destruction of infected plants. Where infections are very severe making it unfeasible to eradicate individual stools it may become necessary to re-establish whole fields. In such cases it is of the utmost importance to ensure that all volunteer growth is eradicated before replanting the field.

References

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Discussion

Mr. King: It seems to me significant that the resistant varieties are related to one another and possibly account could be taken of this in the breeding programme.

Mr. Pearson: At what temperature is heat treatment effective and is there a better disinfectant for a knife than Jeyes fluid?

Dr. Roth: The bacterium is killed at a temperature of 52.5°C for ten minutes.

Mr. Thomson: With normal R.S.D. treatment you would probably get a partial kill but it would by no means be guaranteed to clear all the cane of the leaf scald organism.

Australian workers have tried antibiotics for this disease, and also soaking the cane in cold water for some hours before heat treatment.

We are working on chemicals for effective cleaning of knives.

Mr. Carnegie: Although insects are not normally associated with the transmission of bacterial diseases we have tried to transmit this with both Numicia and Perkinsiella without success.

Dr. Gosnell: Are the two phases caused by two different strains of bacteria or is it the same strain?

Mr. Thomson: Probably the same strain in different sets of conditions or different varieties.

Regarding Mr. Carnegie's remarks, in Australia it is believed that there may be other means of transmitting this disease. We also suspect this as some of our cane appears to have been infected neither by seed cane nor by knife.

Mr. du Toit: Leaf scald and R.S.D. — one is a virus and one is a bacteria. But if the cane has one is it more susceptible to the other?

Mr. Thomson: The weakening action of one might make the susceptibility to the other higher.

Dr. James: On a similar experiment to try and find a connection between smut and leaf scald we found both acted independently.

Mr. Watson: Mr. King from Australia visited Ubombo Ranches and he mentioned that leaf scald might be transmitted in drainage water.

Mr. Thomson: There does seem a possibility as the disease is being reported in the irrigation areas.

Mr. Harris: Have there been any encouraging results using antibiotics?

Mr. Thomson: Not yet, either here or in Australia.