NOTES ON THE OCCURRENCE OF YELLOW LEAF SYNDROME OF SUGARCANE IN SOUTHERN AFRICA

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Abstract

Symptoms of yellow leaf syndrome (YLS) were first observed in South Africa in late 1994. Since mid-1995, YLS has been found in most parts of the South African sugar industry in a wide range of commercial varieties on growers' farms, new genotypes undergoing selection and a number of foreign varieties in variety collections. At the same time YLS was found to be widespread in the Swaziland sugar industry. The symptoms have been common in a number of varieties in most areas. Symptoms most frequently appeared in maturing cane during the cooler, drier months and in cane suffering stress or other damage. Varieties differed in the intensity of symptoms and the duration of symptom expression. Most South African commercial varieties appear to be relatively resistant or tolerant. Symptoms have not been or have only rarely been observed in varieties N12, N16 and N21. In varieties N14, N19 and NCo376, symptoms became less marked and eventually disappeared with the onset of better growing conditions in the spring and summer of 1995-96, even in mature cane. In other varieties conspicuous symptoms persisted until harvest. Symptoms of YLS were not associated with noticeably reduced growth in most varieties.

Keywords: sugarcane, diseases, yellow leaf syndrome

Introduction

Symptoms similar to those reported from Hawaii, Brazil and the United States as YLS (Schenk and Hu, 1991; Borth *et al*, 1992; Comstock *et al*, 1994) were first observed in South Africa in November 1994 (Anon., 1995). This first observation was in two new genotypes in the final stages of selection at the South African Sugar Association Experiment Station's (SASEX) selection site at Pongola in northern KwaZulu-Natal. The two genotypes were each represented by only one small plot and these remained the only cases of YLS to be found for approximately eight months. It is now clear from the conspicuousness and persistence of the symptoms that the two genotypes were highly susceptible.

From mid-1995, symptoms of YLS were seen with increasing frequency in a large number of varieties and in a wide range of situations, both in South Africa and Swaziland. The appreciation that this new condition was apparently the same as that reported from other countries as YLS, a report that YLS had caused reductions of 20-30% in the yield of variety SP71-6163 in Brazil (W Burnquist, personal communication) and evidence that it is a systemic disease transmitted through seedcane caused concern. Additionally, delegates at the International Workshop on Sugarcane Germplasm and Exchange, held in Brisbane in June 1995, concluded that YLS was one of the most serious potential disease hazards facing sugarcane internationally (Whittle and Twine, 1996).

Research into YLS was therefore initiated at SASEX in mid-1995 and crop inspections commenced to determine its distribution. These showed that YLS was present in the majority of the propagation plots of pre-release varieties N26 in the northern, irrigated production areas and N27 in rainfed areas. As a precautionary measure and because little was then known about the distribution of YLS and its effects on local varieties, the decision was made in August 1995 to postpone the release of N26 and N27 for commercial production.

Although it is possible that YLS is a new condition in South Africa, it has apparently been present in Kenya for at least the last four years (GL James, personal communication). YLS is similar to and may be the same as the condition known as yellow wilt that was reported in a number of countries in central and east Africa in the decade following 1962. Descriptions of the symptoms of yellow wilt, for example by Ricaud (1968), original notes by James from Zimbabwe (GL James, personal communication) and unpublished reports by SASEX staff after visits to Malawi, Mozambique, Kenya and Tanzania in the period 1967-1970, are identical to those for YLS and are a strong indication that the two names describe the same condition (the term "yellow wilt" appears to have been a misnomer, as none of the numerous early descriptions mention wilting).

Yellow wilt was reported to have caused losses of 10% to 25% in some varieties in east Africa (Ricaud, 1968; Rogers, 1970) and it was initially regarded as a serious problem. No pathogen was demonstrated for yellow wilt and it was concluded that its occurrence was most probably related to soil conditions (Rogers, 1970). If YLS and yellow wilt are the same condition, its apparent disappearance from sugar industries in Africa for approximately 20 years is difficult to explain. However, from the late 1960s there was an accelerating change from NCo310 and other varieties to NCo376 in most of these sugar industries, NCo376 eventually becoming the predominant variety over much of the subcontinent. NCo310 was reported to develop more conspicuous symptoms of yellow wilt than NCo376, and current observations show that the same applies to symptoms of YLS (see comments under Varieties). It is possible that the symptoms simply became less obvious and, as concern faded, were no longer recognised as a distinct condition.

Only limited information is available on YLS and no information on the etiology of the disease has been published in refereed journals. The cause of YLS remains unknown. A group of workers in the United States has reported evidence of a luteovirus being associated with YLS symptoms in Brazil and the United States but not Hawaii (Lockhart *et al*, 1996). In research at SASEX, evidence of a virus has not been found in YLS cane from southern Africa. However, one of us (CPRC) has found that a phytoplasma is consistently associated with YLS symptoms in material from a number of countries. The phytoplasma has been demonstrated by transmission and scanning electron microscopy in samples from southern Africa (South Africa, Swaziland, Malawi, Zimbabwe) and also from Brazil, Colombia and Mauritius. The pathogenicities of the luteovirus and the phytoplasma have yet to be demonstrated and it is possible that both organisms are involved in the syndrome. Should a luteovirus be involved in the etiology of YLS, this implies transmission by aphids, whereas phytoplasmas are invariably transmitted by plant hoppers.

This paper summarises the current YLS situation in South Africa and Swaziland after approximately one year's experience with the disease in the field and presents a preliminary assessment of its severity.

Symptoms

The symptoms of YLS seen in southern Africa are generally consistent with those described by Comstock *et al* (1994) and others. The most typical symptom is a yellow discolouration of the leaf midribs, best seen on the lower leaf surfaces. This discolouration may vary from pale to bright yellow and it may have a distinct reddish tinge, partly depending on variety. The yellowing may extend from the midrib into the lamina; this may be conspicuous in some varieties but is absent in others. The yellow discolouration is mainly restricted to leaves three to seven or eight from the top of the stalk and is best developed in leaves four to six (Figure 1).

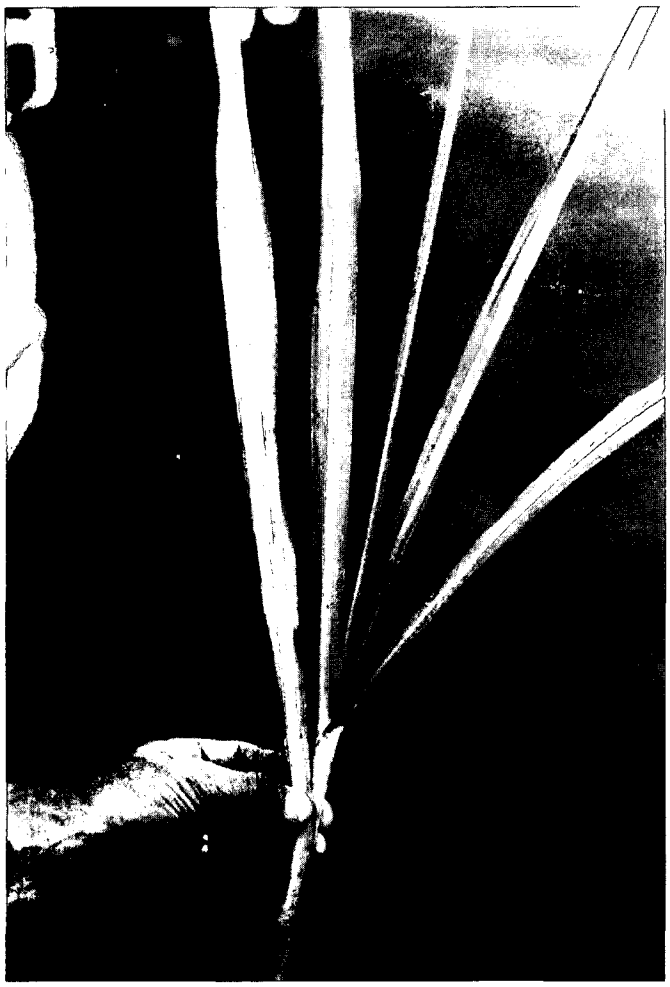

FIGURE 1: The most typical symptom of YLS is a yellow colouration of the leaf mid-ribs. Yellowing of the leaf lamina and die-back from the leaf tips may occur.

Necrosis of affected leaves may occur, commencing at the leaf tip. The extension growth of stalks with YLS symptoms is often reduced, resulting in a fan like appearance of the leaves (Figure 2). This, the yellow midribs and the yellowing of the lamina in some varieties are distinctive and easily recognised in the field. The yellow midribs serve to distinguish YLS from the general yellowing of the leaf canopy that is often common in the colder months in many parts of the South African industry – the so called "winter canopy".

FIGURE 2: The growth of stalks with YLS symptoms often slows, resulting in a concertina appearance.

Symptoms of YLS can occur at all times of the year and in cane of all ages, depending on variety, but experience so far indicates that they are most frequently observed in maturing cane in the cooler and drier months of winter and spring. This is consistent with reports from other countries.

An interesting phenomenon associated with YLS is that the midribs of affected leaves have an unusually high sucrose content, often detectable by taste. This is indicative of a possible disruption of the translocation of photosynthetic metabolites.

Distribution

Since its appearance in 1994, YLS has been observed in all parts of the South African industry. Only infrequent symptoms have so far been observed in the Midlands of KwaZulu-Natal but in all other areas YLS has been widespread and often common. Observations in Swaziland have also shown that YLS is widespread and often common, both in the elite seedcane plots at Malkerns and in commercial fields in the Swaziland lowveld (AG King, personal communication). More recently, identical symptoms to those in South Africa and Swaziland have been observed in material sent to SASEX from the Malawi and Zimbabwe sugar industries. Reports from those industries indicate a similar frequent occurrence in commercial varieties as in South Africa and Swaziland (A Alexander; P Zvoutete, personal communications).

Varieties

Symptoms of YLS have been observed in most commercial cane varieties in South Africa. The most conspicuous symptoms, including yellowing of the leaf lamina, have occurred in varieties CP66/1043, N22 and N26. Moderate yellowing of the midribs has occurred in other released varieties, including N17, N24 and N27, while midrib yellowing has been less conspicuous in widely grown varieties N14, N19 and NCo376. Symptoms have rarely been seen in varieties N12 and N16 and then only in severely stressed or damaged plants. So far symptoms have not been observed in varieties N18 and N21.

The more conspicuous the symptoms in different varieties, the earlier in the year they developed and the longer they persisted. Both in 1995 and 1996, symptoms in varieties such as CP66/1043 and N26 were observed as early as April, whereas symptoms in N14, N19 and NCo376 appeared later, from September onwards in 1995. The most conspicuous symptoms, seen in some unreleased and foreign varieties, persisted for many months and into mid-summer of 1995-96, whereas the mild symptoms typically seen in NCo376 and N14 persisted for only six to eight weeks in spring and early summer, after which they faded and normal extension growth resumed with the onset of better growing conditions. This temporary nature of mild symptoms of YLS in mature cane of some varieties has not previously been reported.

Table 1

Varieties with symptoms of YLS in South Africa, March 1996

Foreign varieties:			
B62347	CP63/588	H59/3775	Q65
BJ5928	CP65/357	Helius	Q82
	CP66/376		Q86
CL42/70	CP66/1043	J59/3/81/14	Q93
CL42/52	CP68/1026	J59/4/76/3	Q117
	CP68/1067	J59/4/84/3	Q119
Co290	CP70/321	J59/7/51/4	
Co301	CP70/1512	Jaronu59/5	R572
Co419	CP70/1527		ROC4
Co421	CP72/2086	KN73/247	ROC5
Co740	CP73/1547	KF75/398	SP71/799
Co745	CP74/2013	KF78/46	TUC80/07
Co979	CP75/1082		
Co980	CP75/1091	L62/86	ZN78/1610
Co997	CP75/1257	L62/96	ZN78/1807
Co990	CP75/1632	LCP81/30	ZN79/309
Co1186	CP76/331		ZN81/4021
	CP77/414	M292/70	ZN84/1061
CP31/588	CP77/1776	MQ72/5089	ZN84/3025
CP33/243	CP78/1610		ZN84/3055
CP36/18	CP78/1638	Mex52/29	ZN84/4235
CO36/171	CP78/2114	Mex52/56	ZN85/164
CP36/211	CP79/332	Midas	ZN85/167
CP43/47	CP79/348		ZN85/2064
CP43/64		NA6390	ZN85/2131
CP44/101	F36/819	NA76/128	ZN80/3340
CP53/5	F40/69	NiF4	ZN82/4029
CP56/59	Gemini	NiF5	ZN83/95
			ZN84/128
South African bred varieties:			
N11	N16	N22	N27
N12	N17	N24	NCo376
N14	N19	N26	NCo310

In addition to its appearance in South African bred varieties in commercial situations throughout the South African and Swaziland industries, YLS has also been observed in a wide range of foreign varieties in collections at Mount Edgecombe. Table 1 lists all foreign varieties at Mount Edgecombe and local varieties, both at Mount Edgecombe and in commercial fields, in which YLS was observed up to March 1996. It is likely that other varieties will be added to this list from winter 1996 onwards.

During late 1995, YLS symptoms were recorded in a number of new genotypes undergoing selection at various SASEX selection sites. More than 10% of genotypes had symptoms in one of the selection stages at the Shakaskraal site on the North Coast of KwaZulu Natal. Selection against conspicuous YLS has been introduced into routine variety selection operations. The first screening trial to determine varietal responses to YLS was established in October 1994. This is based on natural spread to the varieties under test from infected spreader lines.

Other factors affecting symptom appearance

In addition to variety, cane age, season and growing conditions all influence the appearance of YLS. As already mentioned, symptoms are most common in maturing cane (6-9 months or older), in the latter half of the year (from autumn to early summer) and when cane is stressed. The last category includes cane grown on shallow soils, cane affected by drought stress and cane damaged by pests. Symptoms persisted in mature cane through the summer months of 1995-96 only in those varieties that developed the most conspicuous symptoms, and these were mainly new genotypes undergoing selection. Typical symptoms of YLS have often been seen to develop following damage to leaf midribs.

As was previously reported for yellow wilt (Ricaud, 1968; Rogers, 1970), YLS symptoms often first appear around plot or fields margins. In an interesting example at Mount Edgecombe, a plot of standover cane of variety N16, which has rarely exhibited symptoms, suddenly developed conspicuous symptoms in most plants in mid-summer 1996 following a severe outbreak of eldana borer. Similar cases have occurred in other varieties following severe drought stress. This general appearance of symptoms following sudden stress indicates that YLS may be very common in a latent form in most areas.

Effects on growth

YLS symptoms have been associated with severe reductions in growth only in a few new genotypes undergoing selection and in some plots of CP66-1043. In all South African released and pre-release varieties, including N26 and N27, no obvious association between YLS and reduced growth has been observed.

Discussion and Conclusions

YLS appears to be common in many commercial varieties and in most parts of the South African sugar industry. Evidence that symptoms can suddenly appear following crop damage indicate that it may be very common in a latent form.

Since YLS appears to be common in most areas and since new varieties N26 and N27 do not appear to be unduly susceptible, these varieties are to be released to growers in spring 1996.

Although common in commercial fields, YLS has not caused obvious effects on the growth of most released varieties. Symp-

toms in many important varieties, including N14, N19 and NCo376, are relatively mild and often temporary in appearance. Symptoms have only rarely been observed in important varieties N12 and N16 and so far not in N21.

It appears therefore that YLS is not having a significant effect on industrial productivity and that most currently available varieties are relatively tolerant. However, research is required to determine if there are significant effects on growth or sucrose quality in different varieties. Because YLS can apparently spread rapidly, such research can only be conducted under controlled conditions and when an accurate diagnostic test for the disease is available, rather than relying on the appearance of symptoms.

Although much remains to be learned about YLS, the initial serious concern that was raised by its appearance has eased.

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