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SHORT COMMUNICATION

Gray leaf spot disease in Uganda

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Abstract

Two studies were carried out to assess the status of gray leaf spot (GLS) disease of maize in Uganda. Results from three surveys of 1994, 1995 and 1996 conducted in 21 districts showed that GLS was widespread with high incidence and severity of 94% and 3.8 respectively. In importance it was ranking high followed by maize streak virus and turcicum leaf blight. Separation of individual pathogens from overall leaf area infection using backward regression showed that GLS accounted for over 60% of the leaf area infection. Work on varietal evaluation showed significant differences in reaction with three varieties; SC 627, SC 625 and SC Expt 2 showing high levels of resistance while H 622, SC 621 and PAN 6193 severely got affected.

Keywords: Gray leaf spot, severity, incidence, infection and pathogens

Introduction

Several foliar maize diseases have been recorded to affect maize in Uganda. Recently however, gray leaf spot (GLS) caused by *Cercospora zea-maydis* Tehon & E.Y. Daniels has overtaken all the maize diseases in severity and spread. In the USA, GLS disease is reported to have become of economic since early 1970s (Beckman and Payne, 1982). Its increase and severity in the states has been linked with conservation tillage hence quite often referred to as a no-till disease (Rupe *et al*., 1982; de Nezareno *et al*., 1992). Continuous crop production, and extended periods of high relative humidity and dew points do favor the disease development and spread (de Nazareno *et al*., 1993). In Africa the disease was first reported in South Africa in 1988 (Ward *et al*., 1997) with a severe epidemic occurring in 1991/92 season (Gevers and Lake, 1994). Since then several African states started reporting severe epidemics. In the case of Uganda the first severe attack was noticed on farmers' fields in Mubende district during the first season of 1994 and this raised several concerns as many more fields and reports about the strange disease kept being reported to the National Maize Research Program at Namulonge Research Institute by extension agents and farmers who carried along specimens. Zimbabwe, and Kenya had the first epidemic in 1995/96 (Pixley, 1996) while Malawi and Cameroon experienced it in 1997 (P. Ngwira and Z. Ngoko personal communication).

The disease forms lesions which are gray to tan, rectangular 2-5 x 0.3-0.6 cm long x 0.3-0.6cm, and runs parallel to the leaf veins. During severe conditions, lesions may coalesce and blight the entire leaf. The disease thrives best during prolonged periods of hot and humid weather and is potentially more severe in fields where maize follows maize and where reduced tillage practices are used (de Nazareno *et al.,* 1993). The fungus within the infested debris produces conidia, which are eventually blown by wind and thus infecting the new crop. Varying yield losses have been reported depending on the location and genotype. Ward *et al.,* (1993) estimated a yield loss of 88% in South Africa while Saghi Maroof *et al*., (1996) estimated the loss in the USA to range between 10-50%. Gray leaf spot disease on the other hand is known to an environmentally dependant disease to the extent that even if the inoculum is present but once the weather conditions are not right the will be no disease development and this is the reason why in some seasons or years no disease is noticed (Beckman and Payne, 1982).

Following the unexplained epidemic in Uganda during the year 1994 and subsequent seasons it was found necessary to initiate some research activities to address the problem. The objective of the study therefore was to carry out a survey to ascertain the incidence, severity and distribution; and at the same time evaluate the elite materials and commercial varieties available.

Materials and methods

A countrywide survey of maize diseases in Uganda was carried out during the second seasons of 1994 and 1995, and in the first season of 1996. The districts surveyed included Mukono, Jinja, Iganga, Tororo, Mbale, Paliisa, Soroti, Apac, Lira, Masindi, Hoima, Nakasongola, Luwero, Mpigi, Mubende, Kiboga, Masaka, Mbarara, Bushenyi, Kabarole and Kasese. Field sampling was made along main road systems by stopping every 20 km. In each field 40 plants were selected, i.e.10 in each of the 4 different portions of the field from which incidénce and severity were taken. A scale of 1-5 was used to determine severity, where 1= no or very few lesions and 5= many lesions and leaves severely blighted. Total leaf area was visually estimated and expressed in percentages. Nitrogen deficiency was also visually estimated by assessing the amount of foliage showing deficiency symptoms. A similar scale of 1-5 was used; 1= no symptoms and 5= severe symptoms. In 1996 an intensive survey was carried out in Iganga district covering 3 counties (Luuka, Kigulu and Bunya). The same protocol was repeated except stops were being made every 5 km.

In an attempt to identify resistant varieties, 14 local and foreign hybrids mostly from private seed companies and 2 open pollinated varieties were evaluated in 2 locations; Namulonge and Kamenyamiggo. Test materials were planted in 2 row 5 metre plots in a randomized complete block design with 4 replications at a plant population of 53,000 plants per hectare. At V6 stage (Ritchie *et al.,* 1989), seedlings were inoculated with dry, ground infected leaves by placing a pinch into the whorls. Inoculation was repeated after one week. Eight plants were randomly selected and tagged from each plot for the assessment of percent ear leaf area affected (PLAA) as described by Freppon *et al.* (1996). Disease assessment commenced at R1 stage. A total of five assessments were done at an interval of 7-10 days. Severity was recorded at green maturity, using 1- scale as described in the survey.

Differences in severity and PLAA were determined by analysis of variance (ANOVA) and mean separation was based on Fisher's least significant differences procedure (LSD) at 5% level of probability. All analyses were performed with MSTATC statistical analysis software (Feed *et al.*, 1988).

Results and discussion

Five diseases were commonly found in almost all locations surveyed and with varying degrees of severity and incidence; GLS, maize streak virus, northern leaf blight (*Exserohilum turcicum*), sternocarpella leaf spot (*Sternocarpella macrospora*) and southern leaf blight (*Bipolaris maydis*). Of all theses, GLS ranked high in severity, distribution and incidence in all the three seasons with an average incidence of 90.6% and severity of 3.4 (Table 1). It was followed by maize streak and northern leaf blight whose average incidence and severity was 14.9%, 1.8 and 9.7%, 1.4 respectively. Gray leaf spot incidence was highest in 1996 for instance in Bunya all 30 fields surveyed had GLS with an average severity of 3.9, in Luuka incidence from the 27 fields was 91.8% and a severity of 3.9 while in Kigulu incidence was 87.2% from 19 fields with an average severity of 3.3. Many plants were found lodging and others without cobs. Brief interaction with farmers showed that they had come to know that the bizarre appearance of their fields was due to some disease or pest although in 1994 and 1995 they thought it was due to drought. Sporulation of *C. zeae-maydis* was quite evident on many leaves. Effects of nitrogen deficiency were observed in many fields for instance, in 1994 its incidence was 9.2% while in 1996 it was recorded as 7.1%

Separation of individual pathogens from the overall leaf area infection using backward regression on data of 1996 showed that GLS was responsible for 60% of leaf infection observed (Table 2). This clearly confirms the fact that GLS was the most devastating disease then. It was followed by northern leaf blight and maize streak virus.

Table 1. Foliar disease severity and percentage of fields infected in Uganda between 1994-1996.

Disease	Percentage of fields infected			Disease severity (1-5 scale)		
	1994	1995	1996	1994	1995	1996
GLS[a]	87.6	89.3	94.8	3.2	3.8	3.3
MSV	17.6	12.9	14.1	1.8	1.6	1.9
NLB	12.3	7.0	9.9	1.5	1.3	1.5
Smac	3.7	4.7	5.6	1.0	1.2	1.5
Ndef	9.2	3.8	7.1	1.2	1.1	1.2
SLB	1.4	1.6	2.3	1.0	1.0	1.1
Mean	22.0	19.9	22.3	1.6	1.7	1.8
LSD (0.05)	15.3	11.6	14.4	0.3	0.4	0.4

[a]GLS=gray leaf spot, MSV= maize streak virus, NLB= northern leaf blight, Smac= sternocarpella macrospora, Ndef= nitrogen deficiency and SLB= southern leaf blight.

Varieties evaluated against *C. zeae-maydis* in the two locations showed varying levels of susceptibility with clear significant ($P<0.01$) differences. Pattern of reaction was consistent to the extent that varieties found either susceptible in Namulonge were equally susceptible in Masaka. The same is true for the resistant varieties. Three hybrids SC 625, SC 627 and SC Expt 2 were exceptionally resistant as reflected by their severity scores and percent leaf area affected (Table 3) while PAN 6193, SC 621, NZ 1 and H 622 were extremely susceptible. The present commercial variety Longe 1 was noted to be susceptible a similar situation found in the field. These findings were gratifying because there was hope that some varieties were resistant not only to GLS but to other common diseases in the country particularly maize streak virus and northern leaf blight; and in addition they were high yielders. For Longe 1 the commercial variety research focus was going to aim at improving its level of resistance using the recurrent selection method.

Table 2. Contribution of individual pathogens to overall leaf area infection (y) in Iganga, during the second season of 1996, using backward regression.

Variable	b	T	Sign. T
Smac[a]	4.77	2.26	0.000
NLB	4.31	7.69	0.007
MSV	9.24	4.53	0.000
GLS	15.26	19.82	0.000
Ndef	5.83	3.47	0.004
Intercept	-23.75	-6.18	0.000
$R2 = 0.68$			

[a]Smac= sternocarpella macrospora, NLB= northern leaf blight, MSV= maize streak virus, GLS= gray leaf spot and Ndef= nitrogen deficiency.

Table 3. Severity and percent ear leaf area affected (PLAA) by gray leaf area spot disease on maize genotypes at Kamenyamiggo and Namulonge during the second season of 1997

Maize	Kamenyamigo		Namulonge	
genotype	Severity[a] (1-5 scale)	PLAA[B]	Severity (1-5 scale)	PLAA
NZ 4	4.0	45.0	3.6	44.4
Longe 1	3.9	40.5	3.0	40.8
H 622	4.7	41.3	4.5	45.0
Katumani	3.9	42.0	3.2	43.9
H 512	3.7	40.3	3.6	45.0
H 511	3.0	43.0	3.1	44.7
PAN 6193	4.3	42.5	4.4	45.0
LP 16	3.1	42.3	3.3	43.9
PAN 67	3.5	40.5	3.4	44.4
SC 621	3.1	36.6	3.1	38.1
SC 625	1.2	10.1	1.2	7.9
SC 627	1.6	14.9	1.8	17.9
SC Expt2	1.0	7.9	1.2	9.7
NZ 1	4.7	45.0	4.7	45.0
NZ 2	3.9	42.5	3.5	40.7
NZ 3	3.5	41.9	2.9	39.9
EVS 885[c]	-	-	3.2	43.6
Mean	3.3	36.5	3.2	37.8
LSD (0.05)	0.6	10.1	3.2	18.6

[a]Severity taken 90 days after inoculation [b]Percenta ear leaf area taken 90 days after i..oculation[c]Genotype EVS 855 was not tested at Kamenyamiggo.

The study clearly showed that GLS was widely distributed in the country and with a potential to cause considerable yield losses. As to whether it would remain a big problem, this would be determined by a number of factors like failure to avail resistant varieties and put in place feasible integrated control management options. In addition, since the disease is known to be weather dependant (Beckman and Payne, 1982; Rupe *et al.*, 1982 and Freppon *et al.*, 1998), the common weather patterns frequently experienced are bound to play a significant role on its impact.

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