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Prevalence of Finger Millet Diseases in Kaberamaido Subcounty, Soroti District, Uganda

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Abstract

A survey of finger millet (*Eleusine coracana*) diseases was conducted in Kaberamaido subcounty, Soroti district, Uganda, in 1984. Three diseases, namely finger millet blast *(Pyricularia grisea),* tar spot *(Phyllachora eleusines)* and sclerotium wilt *(Sclerotium rolsfii)* were prevalent on all the cultivars grown in the area. Tar spot and sclerotium wilt were of little economic significance but neck and head blast infections caused up to 10.8 % loss in seed yield. Of the four common cultivars of finger millet grown in the area - *Emiroit, Ebaati* (late maturity, with large leaves and open fingers), *Okwete* and *Ekama* (early maturity, with small leaves and closed fingers) - *Ebaati* was the most susceptible and *Ekama* the least susceptible to blast.

Key words: Finger millet, *Eleusine, Pyricularia, Sclerotium, Phyllachora,* diseases.

Introduction

Finger millet [*Eleusine coracana* (L) Gaertn] is widely grown in Eastern, Northern, and Western Uganda (Dunbar, 1969). Because of its small seed, the crop stores well, for up to ten years, compared to other grains like maize and sorghum which succumb quickly to high humidity and storage pests (Aclands, 1973).

Although finger millet suffers from relatively few diseases, significant yield losses have been reported (Uchendu and Anthony, 1975). Yield losses of up to 50% have been attributed to blast (Emechebe, 1975) and to blast, tar spot, and Cercospora leaf spot (Adipala, 1980). Disease damage is highly influenced by cultivar resistance, plant morphology, and the crop growth period (Adipala, 1980). Leakey (1970) observed that with adoption of improved husbandry practices such as the use of nitrogenous fertilizers, diseases would probably become important constraints to increased yield.

In Uganda, as in many other parts of the world, the most important disease of finger millet is blast caused by the fungus *Pyricularia grisea* (Cook) Sacc (Adipala, 1980; Emechebe, 1975; MCrae, 1922). Tar spot, caused by *Phyllachora eleusines* P. Hen, is common on finger millet approaching maturity especially in cooler and wetter areas of Uganda (Hen, 1970).

Other diseases recorded on finger millet in Uganda include leaf spots, caused by *Cochliobolus nodulosum* and *C. leucostylum;* bacterial blight caused by *Xanthomonas campestris* pv. *coracanae* (Desai *et al,* 1965); sclerotium wilt caused by *Sclerotium rolfsii* Sacc., and Cercospora leaf spot, previously identified as Cylindrosporium leaf spot (Adipala, 1980). These diseases probably cause significant yield losses but no detailed studies have been conducted on them in Uganda.

Apart from the few published studies (Adipala, 1980; Ekwamu, 1990), there is limited literature on finger millet diseases in Uganda. Information is more scanty on the actual disease status on farmers' fields. Because of the importance of finger millet in Uganda, and the reported damage by blast and other diseases, it is essential to determine the prevalence of diseases on farmers crops. Such information would assist to develop appropriate research priorities for finger millet improvement.

The objectives of this study were to identify diseases of economic importance on finger millet and to quantify yield loss due to blast.

Materials and Methods

Prevalence of finger millet diseases was studied in Kaberamaido subcounty during the first rains of 1984. Prior to the commencement of the actual study, a preliminary survey was conducted to identify the most common cultivars of finger millet grown. Four common cultivars were identified in the preliminary study. Based on the preliminary study, twelve farmers' fields in four parishes (locations) were selected for the detailed study. In each location, four fields, planted to each of the four cultivars, were selected. The experiment was conducted as a randomised complete block design with locations serving as blocks, and cultivars (fields) as treatment units.

Within each experimental unit (field) five subplots, approximately 10 m apart and measuring 2 x 2 m, were selected in a zigzag manner and used for data collection. From each sampling unit, five plants were randomly selected and the number of leaf blast spots recorded and averaged approximately two weeks before heading. Similarly, average number of tar spots per five plants were determined for each field approximately three weeks after heading. Sclerotium wilt was identified by the presence of sclerotia on bases of wilted plants; the number of wilted plants at 50% flowering was determined for each sampling area.

At the milk stage, the number of plants infected by neck blast, and the number of blast infected fingers were determined for each sampling area. At maturity, fifty healthy and fifty blast infected heads were harvested separately from each sampling area. Dried heads were threshed, winnowed, and weighed. Yield loss due to head blast infection was estimated by expressing the difference in yield between diseased and healthy heads as a percentage of the yield of healthy plants.

Data were subjected to analyses of variance (ANOVA) and means separated using the Least Significant Difference (LSD) at 5% probability level. Yield was also related to leaf, neck, and head blast infections by correlation analysis.

Results

The most common cultivars grown in Kaberamaido were Ebaati, Ekama, Okwete, and Emiroit. These cultivars had in common, five fingers per head. Emiroit was the taller cultivar (100 cm) and often lodged. It had dark large leaves, open fingers, and matured approximately five months after germination. Ebaati was similar to Emiroit in most attributes: it was tall (90 cm), with large leaves, open fingers, and matured in four and half months. The third cultivar, Ekama, measured 90 cm and was characterised by smaller and narrower leaves; the fingers were compact and the cultivar matured in four months. Okwete was the shortest cultivar (80 cm) with many tillers; leaves were small and the fingers were closely packed together. It matured in three months.

The most important diseases in the study area were blast, tar spot, and sclerotium wilt. These diseases were prevalent in all fields surveyed. Sclerotium wilt, recorded mostly during the early plant growth stages (before anthesis), was not common. Emiroit had significantly ($P \leq 0.05$) more plants affected by sclerotium wilt than the other three cultivars (Table 1). Tar spot infection was more prevalent after flowering, Ebaati and Emiroit being significantly ($P \leq 0.05$) more infected than Okwete and Ekama (Table 2). Ekama was more ($P \leq 0.05$) infected than Okwete.

Table 1: Average number of plants with sclerotium wilt/m² on four cultivars of finger millet grown in three locations of Kaberamaido, Uganda, 1984.

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	3	5	5	4^{b}
Okwete	6	5	7	6^{b}
Ekama	5	3	3	4^{b}
Emiroit	16	11	7	11^{a}
Mean	8^{a}	$6^{n.s}$	$6^{n.s}$	6
LSD	2.558			
CV (%)	40.4			

Location or cultivar means with the same superscript are not significantly different at $P \leq 0.05$.
n.s = not significant.

Table 2: Average number of tar spots/plant on four cultivars of finger millet grown in three locations of Kaberamaido, Uganda, 1984.

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	70	56	61	62^{a}
Okwete	52	29	38	38^{c}
Ekama	61	39	40	47^{b}
Emiroit	71	49	61	60^{a}
Mean	64^{a}	43^{b}	49^{c}	52
LSD	3.575			
CV (%)	6.9			

Location or cultivar means with the same superscript are not significantly different at $P \leq 0.05$.

Leaf blast was observed on plants from two weeks after germination. Cultivars differed significantly ($P \leq 0.05$) in susceptibility to leaf blast spot (Table 3). Leaf blast was more common on Emiroit, a cultivar with large leaves, and relatively few on Okwete, a cultivar with narrower leaves. Similarly, cultivar type significantly affected severity of head blast infection. Ebaati had significantly ($P \leq 0.05$) more fingers infected with head blast than the other three cultivars (Table 4) followed by Okwete which had ($P \leq 0.05$) more infection than Ekama and Emiroit. Severity of head blast was similar ($P > 0.05$) on Ekama and Emiroit. Generally, head blast infection was lower on cultivars with closely packed fingers than on cultivars with open fingers. Incidence of neck blast was relatively low and no significant differences were detected among the cultivars (Table 5).

Effect of head blast infection on grain yield is shown in Table 6. Head blast caused significantly higher yield loss on Ebaati (16 %) compared to on Okwete (9%). Ebaati was not different ($P > 0.05$) from Emiroit, which was not different ($P > 0.05$) from Okwete. The lowest yield loss attributed to head blast was recorded on Ekama (7%) and was not different ($P > 0.05$) from that recorded on Okwete. Although location did not significantly influence yield of blast infected heads (Table 6B), it affected the percentage yield loss (Table 6C).

Significantly ($P \leq 0.05$) lower yield losses were recorded at Okapel compared to at Acanpi and Olelai. However, there was considerable variation in yield loss within and between locations and this resulted into a high coefficient of variation (41.6%). Yield loss was more positively correlated to head blast (0.78) than to neck blast (0.53) or leaf blast (0.48).

Discussion

The differences in the degree of infection by leaf blast among the four cultivars were attributed to leaf sizes. Cultivars with larger leaves were more susceptible than the narrow-leaved cultivars. Large leaves probably provide more surface for disease development. In a previous study, Adipala (1980) also found leaf infection more severe in plants with larger leaves. Damage to the leaves reduces the photosynthetic area and this limits assimilates available for grain filling. This may partly explain higher yield losses recorded on the large-leaf cultivars, Ebaati and Okwete. However, according to Adipala (1980), yield losses due to leaf blast are relatively low (<5%).

Infection by leaf blast seemed not to influence subsequent infection by head blast because Emiroit which was the most susceptible to leaf blast was not the most susceptible to head blast. Our results are in agreement with those reported by Adipala (1980). Probably resistance to *P. grisea* at leaf blast and head blast stages might be controlled by different genetic factors.

Yield loss was highly correlated to head blast infection. According to Ekwamu (1990), the loss in yield as a result of head blast infection is due in part to a reduction in spikelet length, grain number, and grain weight. However, the amount of loss due to head blast depended on finger head architecture, i.e., whether open or closed. The low head blast infection on closely packed heads is probably due to limited exposure of the fingers to inocula.

We found a relatively low correlation between neck blast and yield loss. This was most likely due to the low incidence of neck blast on the four cultivars studied. Infection by neck blast usually destroys the vascular tissue of the neck region thereby impeding grain formation; total yield losses are common (Adipala, 1980; Ekwamu, 1990; Rath and Mishra, 1975).

The yield loss attributed to head blast reported in this study should be interpreted with caution. Estimation of actual yield losses usually require a study of two or more years, a wider area of study, relating yield to different levels of disease, and not simply comparing diseased versus healthy yields. In addition, the loss in yield was probably a cumulative effect of many foliar and finger millet head diseases. Therefore, more detailed studies are required to quantify losses caused by blast in Uganda. However, the present data do indicate that blast, particularly head blast, is of economic importance in Uganda. Other diseases were prevalent but were relatively minor.

Table 3: Average number of leaf blast spots/plant on four cultivars of finger millet at three locations of Kaberamaido, Uganda, 1984.

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	51	44	49	48^b
Okwete	32	20	23	25^d
Ekama	35	33	39	36^c
Emiroit	63	55	59	59^a
Mean	45^a	38^b	43^a	42
LSD	2.815			
CV (%)	6.71			

Location or cultivar means with the same superscript are not significantly different at $P \leq 0.05$.

Table 4: Average number of blast infected fingers/m² on four cultivars of finger millet grown in three locations of Kaberamaido, Uganda, 1984.

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	72	69	84	75^a
Okwete	59	53	49	54^d
Ekama	31	38	27	32^c
Emiroit	51	11	51	38^c
Mean	53^d	43^d	53^d	50
LSD	13.5			
CV (%)	26.4			

Location or cultivar means with the same superscript are not significantly different at $P \leq 0.05$.

Table 5: Average number of finger millet heads/m² infected with neck blast on four cultivars of finger millet grown at three locations of kaberamaido, Uganda, 1984.

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	23	9	21	18^{c}
Okwete	12	17	23	17^{c}
Ekama	22	19	16	19^{c}
Emiroit	24	3	12	13^{c}
Mean	20^{a}	12^{b}	18^{ab}	17
LSD	6.7			
CV (%)	40.0			

Location or cultivar means with the same superscript are not significantly different at $P \leq 0.05$.

Table 6: Relationship between head blast infection and yield of four finger millet cultivars grown at three locations of Kaberamaido, Uganda, 1984.

A: Yield (g/head) of blast-free heads.

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	98	102	78	93^{a}
Okwete	85	96	96	92^{a}
Ekama	95	80	92	89^{a}
Emiroit	50	80	93	74^{a}
Mean	81.8^{b}	89.5^{b}	89.8^{b}	87
LSD	29.95			
CV (%)	17.2			

B: Yield (g/head) of blast infected heads.

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	82	91	61	$79^{n.s}$
Okwete	78	87	87	$84^{n.s}$
Ekama	87	76	86	$83^{n.s}$
Emiroit	41	79	78	$66^{n.s}$
Mean	$72^{n.s}$	$84^{n.s}$	$78^{n.s}$	78
LSD	17.94			
CV (%)	18.8			

Table continued ☞

Table 6: ***Continued***

C: Percentage yield loss due to head blast infection[*]

Cultivar	Location			Mean
	Acanpi	Okapel	Olelai	
Ebaati	16	10	21	16[a]
Okwete	8	9	10	9[bc]
Ekama	8	5	7	7[c]
Emiroit	19	1	16	12[ab]
Mean	13[a]	6[b]	13[a]	11
LSD	4.485			
CV (%)	41.6			

Location or cultivar means with the same superscript are not significantly different at P≤0.05.

[*] Differences between yield of healthy and blast-infected heads (A-B) expressed as percentage of the healthy yield (A).

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