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Occurrence and Distribution of *Alternaria* Leaf Petiole and Stem Blight on Sweetpotato in Uganda

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Abstract: Assessment of disease occurrence in relation to agro-ecological and cropping variables is essential for effective *Alternaria* leaf petiole and stem blight disease control. The occurrence and distribution of the disease was investigated in a systematic survey of the major sweetpotato producing districts in Uganda during two cropping seasons. The composition of the *Alternaria* sp. was determined from a random sample of diseased leaf tissues. Farmers' practices and perceptions on disease management were also investigated. A survey of the 35 districts in both years showed that *Alternaria* disease was widespread throughout Uganda. The predominant species observed were *A. bataticola* (55% of isolates) and *A. alternata* (40% of isolates). The severity of *Alternaria* disease was very low, however, the range in disease incidences were from 0 to 49.2%. The disease was more prevalent in the Lake Crescent Region than in the less humid regions of eastern and northern Uganda. No significant correlations were detected between altitude at which sweetpotato cultivars were grown and disease severity or yield. Among the sweetpotato cultivars surveyed, the lowest incidence of *Alternaria* disease was detected on cultivars Dimbuca and Silk. The study also noted that perception of farmers and disease practices were contributing factors to disease spread. These studies suggest that selective deployment of cultivars and cultural practices can limit the spread and damage attributed to *Alternaria* leaf petiole and stem blight disease of sweetpotato. This is the first record of *A. bataticola* on sweetpotato in Uganda.

Key words: Leaf petiole and stem blight disease, sweetpotato, disease distribution, lake crescent region, cultivars

INTRODUCTION

The pathogens belonging to the genus *Alternaria* have been recorded in many countries of the world (Rotem, 1994). The presence or absence of any individual *Alternaria* species in various countries could be due to a number of factors such as availability of host crops, optimal climatic conditions or management practices. *Alternaria* species occur either as saprophytes on various agricultural crops or pathogens. Nevertheless, their presence on various crops/regions does not indicate their economic importance in a given area. On potato (*Solanum tuberosum* L.), *Alternaria* is often observed on senescing plant parts towards the end of the growing season with little or no yield loss to the crop. On sweetpotato plants the disease is frequently observed at various stages of plant growth and reports have indicated variable disease losses (van Bruggen, 1984; Lenne, 1991; Rotem, 1994).

Unknown *Alternaria* spp. have caused epidemics on sweetpotato plantings in Kenya (Gatumbi *et al*., 1990; Skoglund *et al*., 1994), Uganda (Lenne, 1991; Bashaasha *et al*., 1995), Zambia (Angus, 1963) and Zimbabwe (Whiteside, 1966) with variable disease losses. Reports have also indicated presence of the disease in Brazil (Lopes and Boiteax, 1994), Burundi (Ndamage, 1988), Ethiopia (van Bruggen, 1984), Nigeria (Arene, 1988), Papua New Guinea (Lenne, 1991) and Rwanda (Simbashizweko and Perreaux, 1988). In Uganda, *Alternaria* leaf petiole and stem blight disease is arguably

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the most important fungal disease production constraint to sweetpotato in the country. Highest incidences (>50%) have been reported in the south-western parts of the country (Bashaasha *et al*., 1995; Low, 2000; Stathers *et al*., 2005).

Sweetpotato is widely cultivated in various regions of Uganda as a food security crop and as an important source of pro-vitamin A for malnourished children (Abidin *et al*., 2005; Yanggen and Nagujja, 2006). Despite the fact that five different *Alternaria* spp., including *A. alternata*, *A. capsici-annui*, *A. solani*, *A. tenuissima* and *A. tax* sp. IV, have been implicated as causal agents of the disease (Clark and Moyer, 1988), few research efforts have addressed etiological occurrences of the disease on sweetpotato in Uganda, in relation to management practices. Therefore, an understanding of disease dynamics in relation to species composition is critical to *Alternaria* disease management. A large percentage of sweetpotato in Uganda and the East African region are produced by small farm holders (Bashaasha *et al*., 1995). The evaluation and understanding of their perceptions and practices is particularly important for effective disease control. Furthermore, few studies have addressed the economic impact of this disease in the existing cropping systems. With the increase in utilization of improved sweetpotato clones and varieties, the extent to which the disease incidence and severity may impact crop production is not known. Therefore, this research was conducted to: 1) determine the incidence and distribution of *Alternaria* disease in the major sweetpotato production regions of Uganda, 2) evaluate farmers' perceptions and management practices associated with *Alternaria* leaf petiole and stem blight disease and 3) investigate and document the predominant species of *Alternaria* causing leaf petiole and stem blight disease on sweetpotato in Uganda.

MATERIALS AND METHODS

Study sites: The study was conducted in the major sweetpotato producing districts in Uganda during the 2000 and 2001 cropping seasons. The districts represent various agro-ecological zones of the country consisting of the forest (Lake Basin), humid grasslands and the savannah. The average elevations in the surveyed districts range from 1,500 to 4,000 m above mean sea level (m.a.s.l). The annual rainfall ranges from 1000 to 2000 mm.

Disease survey: A questionnaire and checklist were administered to provide information on farmer perception of the *Alternaria* leaf petiole and stem blight disease and cultural practices among small farm holders. These consisted of the number and types of varieties or cultivars grown, susceptibility or resistance of the varieties, disease control practices and yield loss attributed to the disease. The questionnaire and geographical positioning system for the survey were pre-tested in Mpigi district, an area with high sweetpotato production and close proximity to Makerere University. For the diagnostic survey, three to six representative sub-counties with relatively high sweetpotato production were selected in each district in consultation with district extension staff of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). The number of fields surveyed in each sub-county ranged from 3-6 depending on the size and density of sweetpotato production in any particular sub-county. Similarly, through discussions held with local agricultural officials in each sub-county, parishes were selected on the basis of records of sweetpotato production in the previous season. In each sub-county, three parishes were selected. Where information on sweetpotato production was not available, sub-counties and parishes were randomly selected using random numbers which determined the distance (km) from a parish center to the nearest sweetpotato field (2-4 months after planting) and that point was sampled.

During the survey, the presence or absence of *Alternaria* symptoms on sweetpotato plants was recorded. In each field, 50 plants selected on the field diagonals were assessed (25 plants on each diagonal) for disease incidence. Disease severity was assessed using a visual scale of 0 to 5, where, 0 = no disease, 1 = < 5%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = >50% disease severity (Van Bruggen, 1984). Assessment for disease severity was also done by visually rating the percent of leaf petiole, or stems blighted with typical symptoms of *Alternaria* infection. Data on field size, variety cropped, plant age and cropping pattern were also obtained. Other characteristics including history of fields and source of vines were also noted. A geographical positioning system (Magellan GPS 315) was used to obtain the specific location and altitude of each sweetpotato field surveyed and was recorded.

Laboratory studies and characterization of Alternaria species isolated from sweetpotato: Vines and leaves showing characteristic symptoms of *Alternaria* leaf petiole and stem blight disease were collected, placed in icebox coolers and transported to Makerere University for isolation and identification of *Alternaria* spp. In the laboratory, small pieces of infected leaves and stem/vine tissues were surface sterilized using 0.5% sodium hypochlorite solution, rinsed in sterile distilled water and incubated in moist chambers for 48 h to induce sporulation (Van Bruggen, 1984). Single conidia were isolated and picked from lesions with a sharp sterile needle before seeding on water agar. The conidia were incubated at room temperature (22-27°C) and plates were observed daily for conidial germination. On germination, single germinated conidia were cut out and seeded onto sweetpotato leaf decoction media (SLDM) (Anginyah *et al*., 2001) for 14 days at room temperature and 12 h light. Cultures of the isolated fungi were maintained as follows: Four millimetre SLDM chunks bearing actively growing single-spore cultures were cut out and transferred into 20 mL of sterile SLDM in sealed universal bottles and stored in the refrigerator (4-7°C).

Fungal identification was carried out using a modified slide culture and other identification techniques previously described (Riddel, 1950; Simons, 1967; Elis and Holliday, 1970). After suitable growth and adequate sporulation, samples were mounted on slides with cover slip in a drop of lactophenol and examined microscopically. The nature of mycelia growth, conidiophore formation and morphology, arrangement of conidia on conidiophores and shape and size of conidia; type and number of conidia septae were noted and used for identification. Microscopic observations were repeated when samples were mounted in sterile distilled water for colour observation of conidia and conidiophores. The size of conidia (length and width) was determined using a compound microscope. The representative isolates were also sent to CABI Biosciences, United Kingdom Center for confirmation of the species identity. To confirm that the isolates obtained were the causal agent and pathogenic, artificial inoculation of *Alternaria* leaf petiole and stem blight disease was conducted on sweetpotato cultivar New Kawogo (CIP 441743), a white fleshed and spreading cultivar. The Inoculated plants were incubated for 8-10 days at 28°C in screen house and then examined for symptoms.

Data analysis: Frequencies of occurrence of *Alternaria* species, incidence (%) and severity (%) among districts and regions were analyzed using Proc Means (SPSS, 2002). The frequency distribution of pathogen occurrence was also analyzed using the same statistical software. The relationships between geographical parameters crop age, number of varieties infected per field, severity of *Alternaria* stem blight and altitude at which crops were grown were determined by using Pearson's Correlation Analysis. Analysis of variance was computed to determine the significance of the occurrence of disease incidences and severity among districts and within districts.

RESULTS

Disease incidence and severity: A total of 338 fields in 35 districts were surveyed for *Alternaria* leaf petiole and stem blight disease (Table 1). The number of fields surveyed varied in each district and generally ranged from five to 14 fields based on the level of sweetpotato production. Disease occurrence was recorded in 23 of 35 districts examined (Table 1). No disease was detected in 12 districts consisting of Pallisa, Tororo, Bugiri, Kamuli, Jinja, Iganga, Apac, Lira, Kibaale, Kisoro, Bushenyi and Kasese (Table 1). *Alternaria* disease incidence ranged from 0.3 to 49%. Low disease severity was detected and less than 5% severity was noted in most fields (Table 1).

Geographical distribution of leaf and stem blight disease: The highest incidence of *Alternaria* leaf petiole and stem

Table 1: Mean incidence (%), severity of *Alternaria* leaf petiole and stem blight disease of sweetpotato and altitude of sweetpotato fields surveyed in Uganda

District	No. of fields surveyed	Incidence[W] (%)	Severity[X]	Mean altitude
Bugiri	5	0.0a[Y]	0.00	1145
Kamuli	10	0.0a	0.00	1082
Jinja	5	0.0a	0.00	1173
Iganga	10	0.0a	0.00	1150
Pallisa	10	0.0a	0.00	1099
Tororo	10	0.0a	0.00	1137
Apac	11	0.0a	0.00	1033
Lira	12	0.0a	0.00	1087
Kisoro	10	0.0a	0.00	2044
Ntungamu	8	0.0a	0.00	1496
Bushenyi	10	0.0a	0.00	1572
Kasese	8	0.0a	0.00	1181
Kapchorwa	6	0.3a	1.03	1836
Kiboga	9	0.4a	1.00	1149
Nebbi	11	0.4a	1.01	1233
Mbale	12	0.5a	1.89	1182
Kabale	8	1.0a	1.03	1915
Arua	13	1.1a	1.02	1082
Masindi	12	1.3a	1.03	1014
Mubende	9	1.8a	1.07	1245
Runkungiri	10	2.0a	1.03	1423
Busia	5	2.0a	1.06	1201
Kibaale	10	2.4a	1.05	1257
Rakai	8	2.5ab	1.06	1226
Nakasongola	10	3.0ab	1.05	1089
Soroti	11	3.6ab	1.08	1088
Kumi	14	4.1ab	1.19	1114
Fortportal	9	4.4ab	1.12	1436
Katakwi	9	5.1ab	1.10	1107
Masaka	10	6.8ab	1.19	1236
Mbarara	9	7.8ab	1.16	1367
Luwero	10	9.6ab	1.14	1158
Hoima	10	12.2b	1.36	1122
Mukono	12	20.2bc	1.40	1191
Mpigi	12	49.2d	2.05	1194
Means	338	4.6	1.13	1259
SE	-	0.78	0.027	14.46

[W]Incidence-refer plants diseased/total plants × 100%, [X]Severity-based on a scale of 0-5, where 0 = no disease, 1<5%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50% and 5 = 50% disease severity, [Y]Means followed by the same letter(s) are not significantly different at p<0.05%

blight was observed in Mpigi district (49%) followed by Mukono district (20%). Moderate disease incidences of 12.2, 9.6, 7.8 and 6.8% were recorded at Hoima, Luwero, Mbarara and Masaka districts respectively. The lowest incidence of *Alternaria* leaf petiole and stem blight disease (0.3%) was recorded in Kapchorwa district (Table 1). In general, very low disease severity was detected during the two cropping seasons. There were no significant differences in disease severity occurrences among the districts which ranged from 1.01 to 2.1%. The mean altitudes of fields surveyed ranged from 1014 to 2044 m.a.s.l (Table 1). Disease incidences were higher at Mpigi and Mukono districts where average elevations were low; compared to Kabale and Kisoro districts where elevations were higher.

Variation in disease occurrences were recorded among geographic regions (Table 2). Significant differences in disease incidences were detected among regions (p = 0.0001). The highest average disease incidence (13.32%) was observed in central region and the lowest disease was detected in northern region. No significant differences in disease severity (%) were detected among geographical regions (p = 0.23). Variation in disease incidences were also recorded amongst sweetpotato varieties in the regions (Table 3). Among varieties, disease incidences ranged from 2 to 60%, 2 to 40%, 14 to 16% and 4 to 50.8% in central, eastern, northern and western regions, respectively (Table 3).

The varieties grown in farmers' fields were numerous and variable. In the northern and eastern regions, most sweetpotato farmers cultivated one or two varieties; however, in the central and western regions, it was common to find more than five varieties in one field (Table 3). However, a monoculture of sweetpotato varieties was also common in various regions. In the northern and eastern regions, the varieties Karamoja, Mwanjule as well as Araka Red and Atesekur were predominant, respectively. In the central and western regions, New Kawogo, Dimbuca, Naspot 1 and Kahogo were the most common. The crop cultivation differed among regions. In the northern and eastern regions of the country cultivation and planting was predominantly on mounds, or on flat soil as opposed to ridges which were common in the highland areas of Kabale and other areas of south or western Uganda.

Relationships of disease incidence, severity and cropping variables: Significant (p<0.01) and positive correlation coefficients between disease incidence and severity were recorded. Disease incidence was also positively correlated with crop age of the fields surveyed. A negative correlation coefficient between altitude of Sweetpotato fields surveyed and disease incidence or severity was recorded (Table 4). Further, the simultaneous presence of *Alternaria* and Sweetpotato Virus Disease (SPVD) on the varieties was often observed in various fields. Variability in cultivar susceptibility to *Alternaria* disease and Sweetpotato virus diseases (SPVD) was observed (Fig. 1). The percentage of varieties which were found to be susceptible to *Alternaria* disease was 17.7, 19.2, 11.5 and 15.9% for the central, eastern, northern and western regions respectively. Similarly, varieties resistant to SPVD were detected in 41.6, 37.5, 50 and 50% for the same regions respectively (Fig. 1).

Farmer perceptions on Alternaria disease and management practices: Farmer's perceptions on *Alternaria* leaf petiole and stem blight disease were

Table 2: Occurrences of *Alternaria* leaf petiole and stem blight disease in various geographic regions of Uganda during 2001 and 2002 sampling periods

Region	Incidence (%)[X]	Severity (%)[Y]	Altitude[Z]
Central (80[W])	13.32±2.77	1.28±0.07	1185
Eastern (107)	1.50±0.58	1.14±0.09	1168
Western (104)	2.88±0.88	1.07±0.03	1426
Northern (47)	0.38±0.38	1.01±0.06	1107

[W]Number of fields surveyed in each region, [X]Number of diseased plants/total plants x 100%. The + refer to standard deviation, [Y]Percent leaf area diseased on a scale of 1-5, where 1= 5% and 5 = 50%., [Z]Meters above mean sea level of average of all fields

Table 3: Incidence of *Alternaria* disease on sweetpotato varieties from various geographical regions of Uganda

Regions	Sweetpotato varieties	Disease incidence (%)[X]
Central	Dimbuca	13.4
	Silk	2.0
	Kyebandula	4.0
	Bundukuza	5.0
	Mbalika	60.0
	Naspot 1*	25.0
	New Kawogo*	10.8
Eastern	Araka Red	32.0
	Ikola	42.0
	Silk	2.0
	Atesukur1	4.0
	Naspot 1*	6.0
Northern	Karamoja	14.0
	Mwanjule	16.0
Western	Old Kawogo*	50.8
	Rwabakiga	8.0
	Sukari	15.0
	Kahogo	12.0
	Kyebandula	4.0

*Improved variety or cultivar, [X]Number of diseased plants/total plants × 100%. Diseased plants were assessed based on visual symptoms from a sample size of 50 vines

Table 4: Pearson correlation coefficients (r) for the relationships of altitude, plant age, *Alternaria* leaf petiole and stem blight incidence and severity

Variable	Altitude	Crop age	Incidence (%)	Severity (%)
Altitude	-	-0.061	-0.059	-0.042
Plant age		-	0.311**	0.158**
Incidence			-	0.509**
Severity				-

** Significant at p<0.01, * Significant at the p<0.05

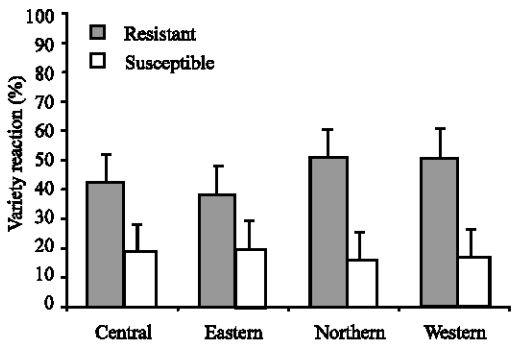

Fig. 1: Variety reaction and susceptibility to Alternaria disease and resistance to Sweetpotato virus disease (SPVD) in various geographical regions of Uganda

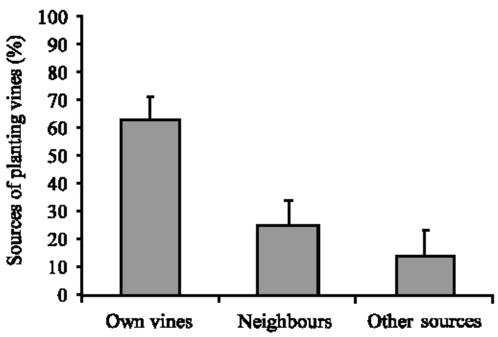

Fig. 2: Major sources of sweetpotato planting vines used by farmers

diverse and varied (Fig. 2 and 3). Although 60% recognized the disease based on symptoms, only 19% of the farmers interviewed had a local name in relation to the disease. The sources from which farmers accessed planting vines differed from farmer to farmer. Over 60% of the farmers indicated that planting vines were readily obtainable while most farmers obtained planting material from their own fields and maintained this from season to season (Fig. 2). The responses of sweetpotato farmers with regard to availability of planting vines, disease recognition and presence or absence of resistant varieties are presented in Table 5. Farmers' knowledge of disease prevalence and effect on yield loss varied among cropping seasons (Fig. 3A). Over 45% of the farmers interviewed mentioned that the disease caused large losses in tuber yield resulting from premature defoliation and death of highly infected vines (Fig. 3B). The farmers were also well informed on cultivar response (susceptibility/resistance) to *Alternaria* disease and SPVD. The strategies used by farmers for management of *Alternaria* leaf petiole and stem blight disease (Fig. 4)

Table 5: Farmer perceptions of *Alternaria* leaf petiole and stem blight disease of sweetpotato[X]

Response	Availability of planting vines	Knowledge of disease name	Disease recognition	Presence of resistantvariety
Yes	84	19.0	58.8	76.9
No	16	66.7	41.2	7.7
Don't know	0	14.3	0.0	15.4

[X]Number of farmers interviewed = 174. Data represents the percentage of farmers with positive and negative responses

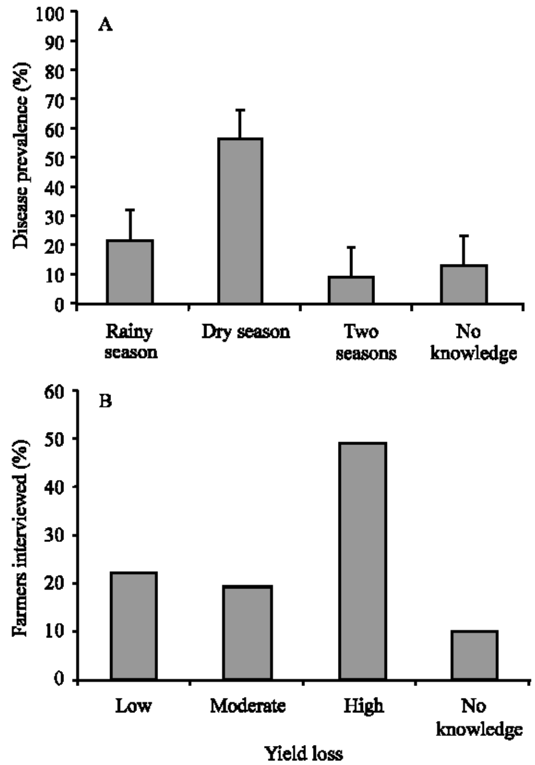

Fig. 3: Farmers' perceptions of disease prevalence and yield loss in various cropping seasons

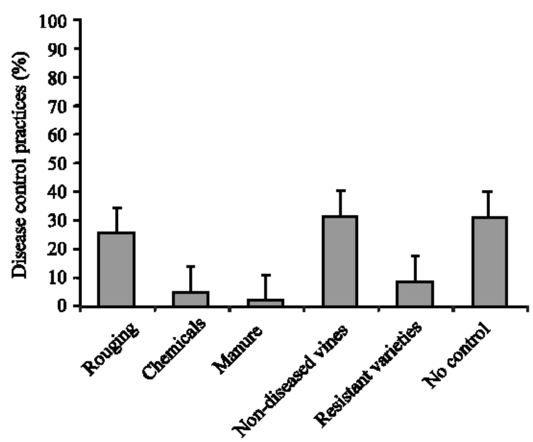

Fig. 4: Control strategies used by farmers for management of *Alternaria* leaf petiole and stem blight disease

revealed that disease control practices consisted of rouging of infected plants (25%), planting disease free vine cuttings (31%) and chemical control or use of resistant varieties. A number of farmers (30%) however, could not report of any management or control strategy.

Laboratory studies and characterization of Alternaria species isolated from sweetpotato: A total of sixty isolates were obtained from the field survey conducted during two years of study. The isolates that were collected were from diverse geographical locations in which the survey was conducted. Most of the isolates were similar in colony appearance or morphology and conidia shape on potato dextrose agar (PDA) when examined microscopically. Based on morphological characteristics such as number of longitudinal and vertical septae, conidiophore as well as conidia length, width and shape of conidia, 55% of isolates were determined to be *Alternaria bataticola* and 40% of isolates were *A. alternata* (epithet originally *A. tenuis*; Simmons, 1967). Within 8 and 10 days following artificial inoculation on sweetpotato NASPOT 1 and New Kawogo, respectively, the fungus produced characteristic symptoms typical of *Alternaria* leaf petiole and stem blight. The pathogen was re-isolated from the host and Koch's postulate was accomplished. All isolates were pathogenic and differences in virulence were detected depending on isolate and conidial concentrations.

DISCUSSIONS

Differences in disease incidences among varieties were observed in this study. The variation may be attributed to susceptibility or resistance of varieties or cultivars to *Alternaria* leaf petiole and stem blight disease. The pattern of disease occurrence and distribution was attributed to climatic conditions which are favourable for pathogen infection and disease development, despite some variations in sweetpotato cropping methods. A case in point is the Lake Victoria Crescent (central region) which has considerably higher disease levels than other regions due to the favourable conditions for disease development. Average precipitation amounts to more than 1, 500 mm per year, average monthly relative humidity (>90 %) and average temperatures of 28°C are recorded in many months. Our research results are supported by earlier studies (Van Bruggen, 1984; Lenne, 1991; Mwanga and Mateeka, 1994; Anginyah *et al.*, 2001; Aritua *et al.*, 2007). These researchers reported increases in disease incidences and distribution in some parts of the East and Central African region. Although the occurrence of *Alternaria* spp. on sweetpotato was first reported in Uganda in 1945 (Hansford, 1945), the lack of observation and published data on *Alternaria* disease on sweetpotato was more likely due to limited research on the patho-system (Lenne, 1991; Rotem, 1994).

The relationships of disease levels to cropping variables and the elevations at which the crops were grown also differed. A positive and significant correlation coefficient of disease incidence and crop age was observed. This suggests that seedlings or younger vine plants are less susceptible to the disease compared to relatively mature vines (>4 months old). The negative and significant correlation coefficient of disease incidences and altitudes or elevations at which sweetpotato crop were grown imply that less disease was recorded at higher altitudes. In the highland tropics, cooler and lower temperatures are usually recorded at higher elevations (>1, 450 m.a.s.l) as opposed to lower elevations. Therefore, lower temperatures recorded at high elevations such as Kabale and Kisoro districts may have a limiting threshold effect on *Alternaria* stem blight as opposed to cropping areas at lower elevations such as Mpigi and Mukono districts. Present research is supported by previous studies which indicated that the optimum conditions for crop infection by *Alternaria* species are at higher ambient temperatures of 25-28°C (Rotem, 1994). This is in contrast to other findings in which higher incidences of *Alternaria* disease were reported at higher elevations (Lenne, 1991). The differences in our research results with that of Lenne (1991) could be attributed to other crop management variables such as pathogen virulence, temperature, sources of planting vines, variety characteristics and resistance, cultural practices and management options. These may all impact on the incidences and severity of the disease and affect disease development. However, increased disease incidence might also be due to the regular cultivation of sweetpotato at lower altitudes enhancing disease pressure.

Farmers' perception and management practices of *Alternaria* disease on sweetpotato varied among districts and regions. This may suggest that sweetpotato farmers may access supplemental knowledge on production techniques and pest management through participatory methods from neighbours, on-farm visits, district agricultural personnel, non-governmental agencies or other sources. The farmer field school participatory methods or experiential learning (learning by doing) has previously been used in Eastern Uganda and other sweetpotato production regions (Namanda *et al.*, 2006; Van der Fliert *et al.*, 2002). The use of vines from neighbours, cuttings from previous or current crop may reflect farmers' perception of planting vines, as cuttings which are readily accessible and available regardless of disease status or quality. This may actually enhance disease spread to adjacent fields if the vines are infected with *Alternaria* leaf and stem blight. Similarly, the use of multiple varieties in the same field, cropping in multiple or subsequent plantings imply their perceptions of low disease risks that could possibly occur. While multiple varieties or crop diversity may interfere with disease spread, this may actually lead to difficulty in crop management due to differences in maturity dates and may not actually lead to disease control, unless the varieties with different resistance to *Alternaria* petiole and stem blight are deployed to maximise their resistance characteristics. The cultural practices in which farmers predominantly plant their sweetpotato vines from one season to the next may actually ensure continuity of foliage for disease perpetuation through out the year. Previous research has indicated that this perception of farmers on use of cuttings for planting regardless of disease status is a contributing factor to limitation of sweetpotato production and lower yield in the country (Abidin *et al*., 2005). Almost 27% of the farmers did not use any disease control methods and less than 30% of the farmers surveyed understood that use of non-diseased vines is an effective method to control *Alternaria* on sweetpotato. The variation of farmers' perception of yield loss and disease control practices suggests that these avenues could be exploited to increase tuber yield.

Present data on the species composition of *Alternaria* isolated from sweetpotato revealed that the predominant species were *A. alternata* and *A. bataticola.* The low species diversity detected may indicate that our sample size of sixty isolates from various regions of Uganda may not have been adequate sample size for detection of species variation. This may also suggest that the environmental conditions and agro-ecological factors may not have been sufficiently variable for species diversity. Intensive sampling and isolations during sweetpotato cropping cycles may give a robust sample size for species characterization. This may also reflect our inability to adequately determine pathogen species based on morphological and cultural characteristics. Perhaps, the use of molecular techniques such as restriction fragment length polymorphism (RFLP) or random amplified polymorphic DNA (RAPD) may be a better tool for isolate characterization in addition to morphological characteristics.

In conclusion, this study investigated the occurrence and distribution of the Alternaria leaf petiole and stem blight in Uganda during two cropping seasons. Farmers' practices and perceptions on disease management were also investigated. Results showed that *Alternaria* disease was widespread throughout Uganda but was found to be more prevalent in the Lake Crescent Region than in the less humid regions of eastern and northern Uganda. No relationships were detected between altitude at which sweetpotato cultivars were grown and disease severity or yield. The predominant species observed were *A. bataticola* (55% of isolates) and *A. alternata* (40% of isolates). The study also noted that perception of farmers and disease practices were contributing factors to disease spread. These studies suggest that selective deployment of cultivars and cultural practices can limit the spread and damage attributed to *Alternaria* leaf petiole and stem blight disease of sweetpotato. This is the first disease record of *A. bataticola* on sweetpotato in Uganda.

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REFERENCES

Abidin, P.E., F.A. Van Eeuwijk, P. Stam, P.C. Struik, M. Malosetti, R.O.M. Mwanga, B. Odongo, M. Hermann and E.E. Carey, 2005. Adaptation and stability analysis of sweet potato varieties for low-input systems in Uganda. Plant Breed., 124: 491-497.

Anginyah, T.J., R.D. Narla, E.E. Carey and R. Njeru, 2001. Etiology, effect of soil pH and sweetpotato varietal reaction to *Alternaria* leaf petiole and stem blight in Kenya. Afr. Crop. Sci. J., 9: 287-292.

Angus, A., 1963. Plant Pests and Diseases in Northern Rhodesia. Part 5, Mt. Makulu, Northern Rhodesia, pp: 33.

Arene, O.F., 1988. The taxonomy, evolution and genetic diversity of sweetpotatoes and related species. In: Exploration, Maintenance and Utilization of Sweetpatato Genetic Resources. A report of the 1st Sweetpotato Planning Conference, February 1987, Lima, Peru. CIP., pp: 27-60.

Aritua, V., B. Bua, E. Barg, H.J. Vetten, E. Adipala and R.W. Gibson, 2007. Incidence of five viruses infecting sweetpotatoes in Uganda; the first evidence of Sweet potato caulimo-like virus in Africa. Plant Pathol., 56: 324-331.

Bashaasha, B., R.O.M. Mwanga, C.N.O. P'Obwoya and P.T. Ewell, 1995. Sweetpotato in the farming and food systems of Uganda: In: Proceedings of the Fifth Triennial Symposium of International Society of Tropical Root Crops Africa Branch (ISTRC-AB) 22-28 November 1992, Kampala Uganda, pp: 225-228.

Clark, C.A. and J.E. Moyer, 1988. Compendium of Sweetpotato Diseases. American Phytopathological Society Press. Minnesota, USA., pp: 74.

Elis, M.B. and P. Holliday, 1970. CMI descriptions of pathogenic fungi and bacteria, No. 248.

Gatumbi, R.W., A.W. Kahurani and L.G. Skoglund, 1990. Current status of sweetpotato diseases in Kenya. In: Proceedings of the 4th East and Southern Africa Root Crops Workshop, Manda Zambia, 29 October-2 November, 1990.

Hansford, C.G., 1945. Ugandan plant diseases. Part IV. Diseases of sweetpotato. East Afr. Agric. J., 10: 126-127.

Lenne, J.M., 1991. Diseases and Pests of Sweetpotatoes: South East Asia, the Pacific and East Africa. Nat. Res. Instit. Bull., No. 46.

Lopes, C.A. and L.S. Boiteux, 1994. Leaf spot and stem blight of sweetpotato caused by *Alternaria bataticoli*; a new record to South America. Plant Dis., 78: 1107-1109.

Low, J.W., 2000. Prospects for sustaining potato and sweetpotato cropping systems in the densely populated highlands of southwest Uganda. Social science working paper 2000-1. International Potato Center (CIP), Lima, Peru.

Mwanga, R.O.M. and B. Mateeka, 1994. Sweetpotato Germplasm Evaluation and Utilisation in Uganda. In: Akoroda, M.O. (Ed.), Root Crops for Food Security in Africa. Proceedings of the Fifth Symposium of the International Society for Tropical Root Crops-Africa Branch, 22-28 November 1992, Kampala, Uganda.

Namanda, S., R.O.M. Mwanga, G. Khisa and R. Kapinga, 2006. Manual for sweetpotato integrated production and pest management farmer fields schools in sub-Saharan Africa. International Potato Center, Kampala, Uganda, pp: 168.

Ndamage, G., 1988. Development and improvement of sweetpotato production in Rwanda. In: Improvement of sweetpotato in East Africa. Report of a workshop on Sweetpotato improvement in East Africa. CIP, Nairobi Kenya, September, 23-28 1987, pp: 167-184.

Riddel, R.W., 1950. Permanent stained mycological Preparations obtained by slide culture. Mycologia, 42: 265-270.

Rotem, J., 1994. The Genus Alternaria: Biology, Epidemiology and Pathogenicity. The American Phytopathological Society, St. Paul Minnesota, pp: 326.

Simbashizweko, A. and D. Perreux, 1988. Sweetpotato anthracnose: Descriptions of causal agent and development of a screening method for sweetpotato in Rwanda. In: Improvement of Sweetpotato in East Africa. Report of a Workshop Improvement in Africa. ILRAD, Nairobi Kenya, September 23-28 1987. CIP, Lima Peru.

Simmons, E.G., 1967. Typification of *Alternaria*, Stemphylium and Ulocladium. Mycologia, 59: 67-92.

Skoglund, L.G., R.W. Gatumbi. and A.W. Kihurani, 1994. Non-viral foliar pathogens and disorders of Sweetpotato in Kenya. Int. J. Pest Manage., 39: 452-458.

SPSS, 2002. Complete end-to-end analysis with SPSS 11.0. The end to end analytical process: A standard for improved results. SPSS Inc. Michigan, USA., pp: 34.

Stathers, T., R. Gibson, B. Odongo, R. Mwanga, D. Coyne and C. Riches, 2005. Pests, Diseases and Agroecosystems. In: Manual for Sweetpotato Integrated Production and Pest Management Farmer Field Schools in Sub-saharan Africa. Namanda, S., R.O.M. Mwanga, G. Khisa and R. Kapinga (Eds). International Potato Center, Kampala, Uganda, pp: 168.

Van Bruggen, A.H.C., 1984. Sweetpotato stem blight caused by *Alternaria* sp; a new disease in Ethiopia. Netherlands. J. Plant Prot., 90: 155-164.

Van der Fliert, E., G. Thiele, D. Camilan, O. Ortiz, R. Orrego, M. Olanya and S. Sherwood, 2002. Development and linkages of farmer field schools and other platforms for participatory research and learning. In: International Learning Workshop on Farmer Field Schools (FFS): Emerging issues and challenges, 21-25 2002, Yogyakarta, Indonesia, pp: 21.

Whiteside, J.O., 1966. A revised list of plant diseases in Rhodesia. Kirkia, 5: 87-196.

Yanggen, D. and S. Nagujja, 2006. The use of orange-fleshed sweetpotato to combat vitamin A deficiency in Uganda. A study of varietal prefences, extension strategies and post-harvest utilization. Social Sciences Working Paper No. 2006-2, International Potato Center (CIP), Lima, Peru.

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