Curvularia leaf spot on white fonio accessions in the commune of Boukoumbe in north Benin

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1 ABSTRACT

Fonio cultivation in West Africa relies only on traditional accessions, which are less productive, and their resistance to Curvularia leaf spot, one of the major constraints, are not well documented. The objectives of this study were to determine the distribution of the leaf spot of white fonio (*Digitaria exilis*) in the commune of Boukoumbe in north Benin, to identify its causal agent and to evaluate white fonio accessions for their resistance to the leaf spot. A survey was conducted in July 2018 in the 6 districts of the commune of Boukoumbe. Two to three sites were surveyed per district and at each site, 30 plants were randomly selected on two diagonals through the field to evaluate the disease incidence. Ten of these plants were used to assess the disease severity. Samples of the diseased plants were taken to the laboratory for isolation. Additionally, an experiment was conducted in a greenhouse at the experimental farm of the faculty of agronomy of the University of Parakou (Benin) where twenty-three accessions were inoculated with two virulent isolates of the pathogen, and evaluated for disease severity and seed weight losses due to the disease. The experiment followed a split plot design with accession as main factor and isolate as secondary factor in 3 replicates. For the survey, there were a significant difference in disease incidence and severity. The district of Boukoumbe had the least disease incidence (74.44%) and severity (24.54%). The districts of Manta, Korontiere and Dipoli had the highest disease incidence (100%) and the district of Manta recorded the highest disease severity (53.08%). There were significant difference in disease incidence ($p = 0.004$) between the accessions of farmers during survey whereas all the accessions did not differ significantly from each other in respect to disease severity. After isolation, cultures observed were identified as *Curvularia* sp. For the experiment, 3 accessions were resistant, 6 were moderately resistant, 6 were moderately susceptible and 8 were susceptible. Moreover, a significant correlation between disease severity and seed weight were observed ($r = -0.81$ and $p = 2.2e^{-16}$), and seed weight loss due to the disease up to 45% was reported. In conclusion, Curvularia leaf spot is a constraint to fonio cultivation in the commune of Boukoumbe in the north Benin and resistant accessions exist and could be recommended to the farmers.

2 INTRODUCTION

White fonio (*Digitaria exilis* Stapf) is a neglected native crop within the West African sub-region (Bakasso *et al.*, 2010). It grows fast and thrives on very poor soils extending from 8° to 14° N latitude and from Senegal to Lake Chad (Cruz *et al.*, 2011). It is cultivated from sea level up to 1500 m altitude and mainly in areas receiving annually 700 to 1000 mm rainfall, however in critical rainfall deficiency conditions its limit is at the annual isohyet of 150 mm. The optimal growing temperature range is 25-30° C with approximately 12 h daylight (Haq and Ogbe, 1995). In Benin, fonio is produced in the communes of Boukombé, Cobly, Toucoutounan, Tanguiéta and Natitingou in the northwest of the country with the commune of Boukombè providing 74% of the national production (Dramé and Cruz, 2002; MAEP, 2010). It is cultivated under sudano guineen climate where rainfall ranges from 800 to 950 mm/year (Vodouhè *et al.*, 2003). Fonio is considered as the most nutritious cereals in Africa (Jideani, 1990) and can contribute to nutrition security as it contains all twenty amino acids in particular two essential ones (methionine and cysteine) (Vietmeyer *et al.*, 1996). It is the main food during traditional ceremonies (Adoukonou-Sagbadja *et al.*, 2006). Available statistics show that 631246 t of fonio are produced from 912721 ha by the world three largest producers Guinea, Nigeria and Mali. In Benin 1155 t of fonio were produced from 1868 ha (FAO Stat, 2017). Fonio yield depending on countries ranges between 200 and 900 Kg/ha (Vodouhè *et al.*, 2003). Fonio has a large diversity of accessions with different life cycle duration, which could play an important role in preventing food shortages (Blench, 2012; Gessain, 1989).

Despite its importance, fonio production faces several challenges as poor soil fertility, use of low-yielding cultivars, inadequate weeding, pests and diseases, high harvest losses, laborious post-harvest management and low socio economic appraisal (FiBL, 2013). Although leaf spot have been reported on the crop caused by the fungi *Phyllachora sphearosperma*, *Helminthosporium* spp, *Curvularia* spp, *Puccinia cahuensis* and *Fusarium* spp. (Adoukonou-Sagbadja, 2010; Mamza *et al.*, 2013; Akanmu *et al.*, 2013), very little research work has been performed to confirm the causal pathogen. In addition, fonio cultivation relies only on traditional accessions, which are less productive, and their resistance to leaf spot are not well documented. However, a good management strategy of the leaf spot required selection of productive and resistant fonio accessions. Thus, the objectives of this study were to determine the distribution of the leaf spot of the white fonio in the commune of Boukoumbe, to identify its causal agent and to evaluate white fonio accessions for their resistance to the leaf spot.

3 MATERIALS AND METHODS

3.1 General survey: A disease survey was conducted in 19 sites of the commune of Boukoumbe in Benin during the sheaving period (July) in 2018. Two to three sites were surveyed per district within the 6 districts of the commune. The sites with at least 0.5 ha and 5km distance from each other were selected (Fig. 1).

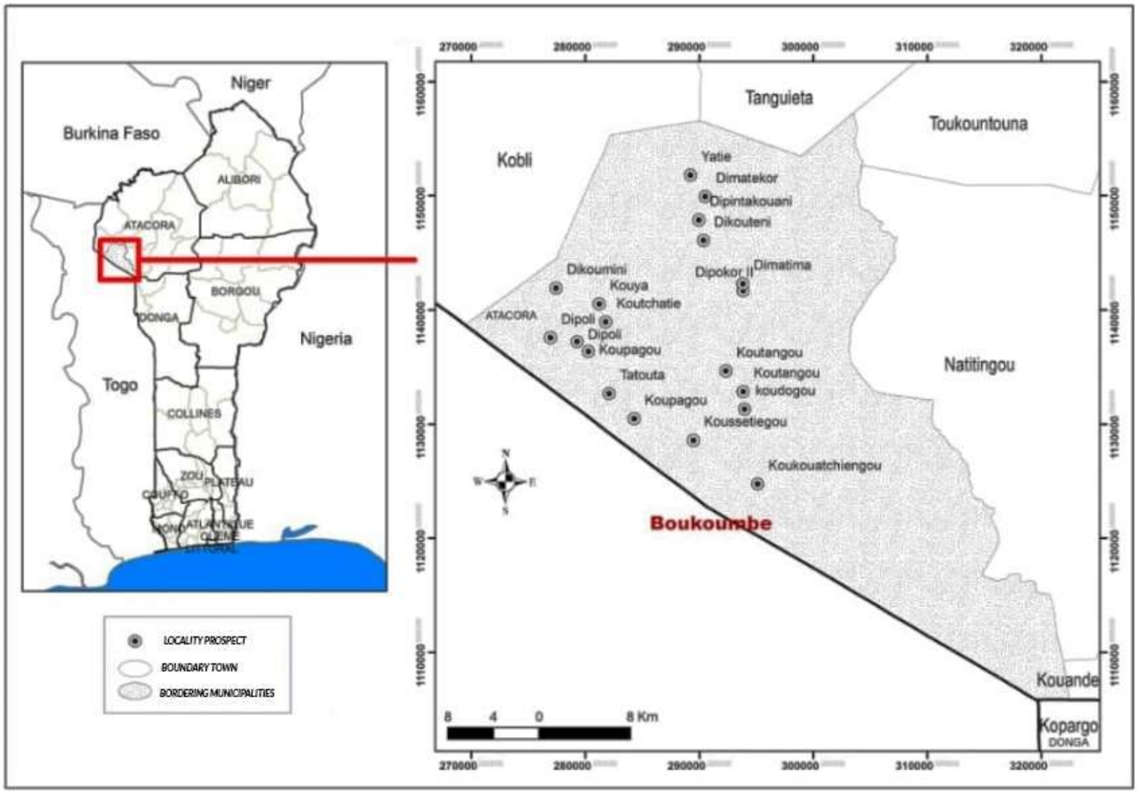

Fig. 1: White fonio production sites surveyed in the commune of Boukoumbe

4 RESULTS

The commune of Boukoumbe is located in the Northwest of Benin in the Department of Atacora. It's ranged between 10° and 10°40' N latitude and 0°754 and 1°30'E longitude in the Sudanian zone. The climate is Soudan-Guinean type and characterized by a rainy season from April to October and a dry season from November to March (Afrique Conseil, 2006). Disease symptoms with reddish brown spots or lesions occurs which may increase in size and become irregular. At each site, 30 plants were randomly selected on two diagonals through the field to evaluate the disease incidence. Ten of these plants were used to assessed index by scoring individual plants using a 1-9 scale described by Subrahmanyam *et al.* (1995) where 1= 0% of symptoms on leaves, 2= 1-5% of leaves infected (l.i.), 3= 6-10% of l.i., 4= 11-20% of l.i., 5= 21-30% of l.i., 6= 31-40% of l.i., 7= 41-60% of l.i., 8= 61-80% of l.i., 9= 81-100% of l.i. These assessments were used to calculate the disease severity as follow:

$$S = \frac{\sum n}{\text{N x 9}} \text{x } 100$$

with **S** = Disease severity, **n** = individual index, **N** = Total number of plant assessed, **9**: High index value.

These quantitative survey data were coupled with global position systems (GPS) and geographic information systems (GIS) technologies to map surveyed sites. Leaves with symptoms were collected and pathogens isolated.

4.2 Isolation and identification of *Curvularia* spp.: The disease leaves were cut and washed in thrice in sterile distillated water. The pieces were surface disinfected in a solution of 1% of sodium hypochlorite (NaOCl) for one minute and further rinsed in sterile distilled water and blotted dry. About 2mm^2 of leaf surface containing the disease and the healthy parts were cut and placed on Potato Dextrose Agar (PDA) supplemented with three drops of citric acid in Petri dishes. These dishes were then incubated at 25°C for 72h and sub-cultures were done. The plates were incubated for 25°C for 7-10 days. Fungal structures are suspended in water and then in lactophenol on microscopic slide and observed under the microscope. Identification of the fungi was done using a key based on microscopic characteristics (nature of mycelium, morphology and formation of the conidiosporus, the arrangement of the conidia on the conidiosporus, the shape and size of the conidia, the type and number of conidia) (Watanabe, 1994).

4.3 Evaluation of white fonio accessions for resistance to *Curvularia* spp. experiment

4.3.1 Experimental design: Trials were conducted with twenty-three accessions coming from the seed stock at the Faculty of Agronomy (University of Parakou in North Benin) from July to October 2018. The experiment followed a split plot design with the fonio accession as main factor and the isolate as secondary factor. The system consisted of three replicates (blocks) subdivided into three sub-blocks established in a greenhouse at 21-32°C and 60-96%. Each sub-block was composed of twenty-three elementary plots (1 plot represented 2 pots 1.5dm^3). The soil substrate was sterilized at 65°C for 72 h, then mixed with compost at the ratio of ¾ (soil) and ¼ commercial compost. No fertilizer was applied.

4.3.2 Inoculum preparation, inoculation and disease assessment: Conidia suspensions were prepared with sterilized distilled water and adjusted to 2 10^4 conidia/ml using a hemacytometer. The prepared inoculum was applied to leaf surfaces with a hand sprayer after adding one drop of Tween 20. Plants spayed with sterilized distilled water served as control. The inoculation was made from two virulent isolates of *Curvularia* spp. out of twenty-three accessions at the rate of three replicates per isolate. Two weeks after inoculation, disease index were evaluated on greenhouse plants by scoring individual plants using a 1-9 scale described by Subrahmanyam *et al.* (1995). Four disease index assessment were performed at two weeks apart. The values from these assessments were used to calculate the disease severity per plot and then the area under severity curve as follow:

$$AUSPC=\sum i\ [(S_i+ S_{i-1}) * (t_i - t_{i-1}]\ /2$$

with **ti** = date of assessment, **Si** = average of severity at ti (Shaner and Finney, 1977; Jeger and Viljanen Rollinson, 2001).

4.4 Statistical analysis: The disease incidence, severity and seed weight data (survey and greenhouse trial) which were log-transformed and subjected to analysis of variance (ANOVA) using the generalized linear model (GLM) procedure in R version 3.5.0 software (R Core Team 2018). Tukey test was performed to compare mean values of disease incidence, severity and seed weight. Values given in tables are original means with corresponding standard errors. Pearson correlation was analysed between disease severity and seed weight.

4.5 Distribution of Curvularia leaf spot and disease reaction of accessions of fonio in the commune of Boukoumbe: White fonio leaves collected during the survey showed symptoms with reddish brown spots or lesions occurs which may increase in size and become irregular (Fig. 2). The fungus isolated from diseased leaves was *Curvularia* sp. Mycelia were black presenting irregular borders and cottony growth and conidia were poroporous, subelliptial, cylindrical mainly 4-celled, dark brown and larger in central 2 cells (Figs. 3a, 3b). There were a significant difference in disease incidence and severity ($p<2e^{-16}$). The district of Boukoumbe had the least disease incidence (74.44%) and severity (24.54%). The districts of Manta, Korontiere and Dipoli had the highest disease incidence (100%) followed by the districts of Natta (96.67%) and Tabota (95.83%). However, the district of Manta recorded the highest disease severity (53.08%) followed by the districts of Korontiere (44.93%), Dipoli (40.86%), Tabota (42.22%) and Natta (35.43%) (Table 1).

Table 1: Disease incidence and severity of Curvularia leaf spot of fonio in the commune of Boukoumbe

District	Incidence (%)	Severity (%)
Boukoumbe	74.44 ± 4.62 **a**	24.57 ± 1.17 **a**
Dipoli	100.00 ± 0.00 **b**	40.86 ± 1.16 **c**
Korontiere	100.00 ± 0.00 **b**	44.93 ± 1.15 **c**
Manta	100.00 ± 0.00 **b**	53.08 ± 1.69 **d**
Tabota	95.83 ± 1.83 **b**	42.22 ± 1.23 **c**
Natta	96.67 ± 1.90 **b**	35.43 ± 1.28 **b**
Average	94.56 ± 0.95	40.29 ± 0.64
Probability (P)	$2e^{-16}$	$2e^{-16}$
CV	0.24	0.38

Means with the same letter in column are not significantly different at 5% threshold for Turkey test

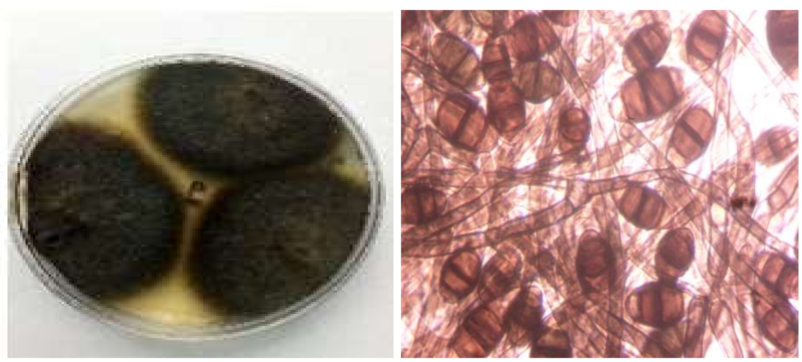

Fig. 2: Brown spots on leaf Fig. 3: (a) *Curvularia* sp. on PDA and (b) Conidia on microscope (1000 X)

Farmers sowed five accessions during our survey period (Ikantoni, Ipomoani, Iponi, Iporapia and Iprawan). There were significant differences in disease incidence (p = 0.004) between the accessions whereas all the accessions did not differ significantly from each other in respect to disease severity with accession Ipomoani having the highest (45%). Accessions Ikantoni, Ipomoani and Iponi recorded high incidence and were at par with each other (100%) followed by accessions Iporapia and Iporawan having the least (95.33% and 91.11%, respectively) (Table 2).

Table 2: Disease reaction of different accessions of fonio to Curvularia leaf spot during the survey in the district of Boukoumbe

Accession	Incidence (%)	Sévérité (%)
Ikantoni	100.00 ± 0.00 **b**	38.51 ± 1.30 **a**
Ipomoani	100.00 ± 0.00 **b**	45.00 ± 1.43 **a**
Iponi	100.00 ± 0.00 **b**	36.67 ± 1.77 **a**
Iporapia	95.33 ± 1.72 **ab**	40.89 ± 1.12 **a**
Iporawan	91.11 ± 1.73 **a**	39.71 ± 1.08 **a**
Average	94.56 ± 0.95	40.29 ± 0.64
Probability (P)	0.00441 **	0.0635
CV	0.24	0.38

Means with the same letter in column are not significantly different at 5% threshold for Turkey test

4.6 Screening of white fonio accessions for resistance to *Curvularia* spp in semi-controlled conditions: There were significant differences in disease severity (AUSPC) of the two isolates (Bouk-S2 and Bouk-S3) and of some accessions. The disease severity ranged from 1,768 to 2,351 for the isolate Bouk-S3 and from 1,805 to 2,750 for the isolate Bouk-S2. The least disease severity was recorded on the accession AS4 for the isolate Bouk-S3 and on the accession AS3 for the isolate Bouk-S2. The highest disease severity were observed on accessions AS8, AS14, AS15 and AS21 for the isolate Bouk-S3 and AS2 and AS17 for the isolate Bouk-S2) (Table 3). Thus, the accessions were separated in four groups : accessions AS3, AS4 and AS22 were resistant, accessions AS5, AS9, AS10, AS11, AS12 and AS23 were moderately resistant, accessions AS6, AS7, AS16, AS18, AS19 and AS20 were moderately susceptible, accessions AS1, AS2, AS8, AS13, AS14, AS15, AS17 and AS21 were susceptible (Fig. 4). Analysis of the Pearson correlation between disease severity and seed weight showed a significant negative correlation ($r = -0.81$ and $p = 2.2e^{-16}$). Analysis of the different accessions showed that the two isolates reduced the weights compared to the control except for accession AS17. Weight losses ranged from 4.65 to 41.82% for the isolate Bouk-S3 and from 0.39 to 45.18% for the isolate Bouk-S2 (Table 4).

Table 3: Disease severity (AUSPC) of two isolates of *Curvularia* sp. on 23 white fonio accessions in semi-controlled conditions

Accession local Name	*Accession number*	*Isolate Bouk-S3*	*Isolate Bouk-S2*	*Average AUSPC*	*F*	*P*
Yoro	**AS1**	2240.74 ± 96.66 ab **A**	2592.59 ± 137.10 ce **A**	2416.67 ± 116.88 c	4.399	0.0522
Iporni	**AS2**	2166.66 ± 166.08 ab **A**	2685.18 ± 129.38 e **B**	2425.93 ± 147.73 c	6.066	0.0255
Iporda	**AS3**	2138.88 ± 112.83 ab **A**	1796.29 ± 66.76 a **B**	1967.59 ± 89.81 a	6.828	0.0188
Affésiamon	**AS4**	1768.51 ± 38.73 a **A**	2287.03 ± 139.65 ae **B**	2027.78 ± 89.19 ab	12.8	0.00251
Lamba	**AS5**	2305.55 ± 63.64 ab **A**	2027.77 ± 53.79 abcd **B**	2166.67 ± 58.72 ac	11.11	0.00421
Not identified	**AS6**	2055.55 ± 109.36 ab **A**	2379.63 ± 157.20 ae **A**	2217.59 ± 133.28 bc	2.864	0.11
Ipormondé	**AS7**	2287.03 ± 134.73 ab **A**	2287.03 ± 181.14 ae **A**	2287.04 ± 157.94 bc	0	1
Ikantoni	**AS8**	2351.85 ± 88.69 b **A**	2361.11 ± 121.87 ae **A**	2356.48 ± 105.28 cd	0.004	0.952
Iporgnirmè	**AS9**	2268.51 ± 144.85 ab **A**	1861.11 ± 70.81 ab **B**	2064.81 ± 107.84 ab	6.384	0.0224
Iporawan	**AS10**	2175.92 ± 110.62 ab **A**	1981.48 ± 45.59 abc **A**	2078.70 ± 78.11 ab	2.641	0.124
Iporapia	**AS11**	2129.63 ± 86.85 ab **A**	2009.25 ± 113.21 abc **A**	2069.44 ± 100.04 ab	0.712	0.411
Iporapia	**AS12**	1935.18 ± 116.84 ab **A**	2314.81 ± 161.83 ae **A**	2125 ± 139.34 ab	3.617	0.0754
Iporapia	**AS13**	2277.77 ± 114.53 ab **A**	2388.88 ± 205.06 ae **A**	2333.33 ± 159.80 cd	0.224	0.643
Ipomonpiété	**AS14**	2324.07 ± 100.58 b **A**	2675.92 ± 123.79 de **B**	2500 ± 112.1876 c	4.866	0.0424
Tignonpété	**AS15**	2314.81 ± 45.59 b **A**	2370.37 ± 131.10 ae **A**	2342.59 ± 88.35 cd	0.16	0.694
Iporawan	**AS16**	2268.51 ± 145.52 ab **A**	2175.92 ± 133.53 ae **A**	2222.22 ± 139.53 bc	0.22	0.646
Yoro	**AS17**	2259.25 ± 80.32 ab **A**	2750.00 ± 103.00 e **B**	2504.63 ± 91.66 c	14.12	0.00172
Tignonpété	**AS18**	2287.03 ±78.70 ab **A**	2268.51 ± 131.59 ae **A**	2277.78 ± 105.15 bc	0.015	0.905
Iporni	**AS19**	2203.70 ± 114.62 ab **A**	2231.48 ± 150.72 ae **A**	2217.59 ± 132.68 bc	0.022	0.885
Iporawan	**AS20**	2101.85 ± 79.51 ab **A**	2509.25 ± 81.51 be **B**	2305.55 ± 80.51 cd	12.8	0.00251
Iporapia	**AS21**	2333.33 ± 70.81 b **A**	2379.63 ± 149.01 ae **A**	2356.48 ± 109.9 cd	0.079	0.783
Tignonpété	**AS22**	2000.00 ± 105.77 ab **A**	1805.55 ± 79.78 a	1902.78 ± 92.78 a	2.154	0.162
Iporni	**AS23**	2092.59 ± 77.88 ab **A**	2157.40 ± 74.07 ae **A**	2125 ± 75.98 ab	0.364	0.555
	Average AUSPC	**2186.39 ± 22.73**	**2273.75 ± 30.97**			
	F	**1.939**	**4.667**			
	P	**0.00974**	**0.00000000175**			

Means with the same letter in column and in row are not significantly different at 5% threshold for Turkey test

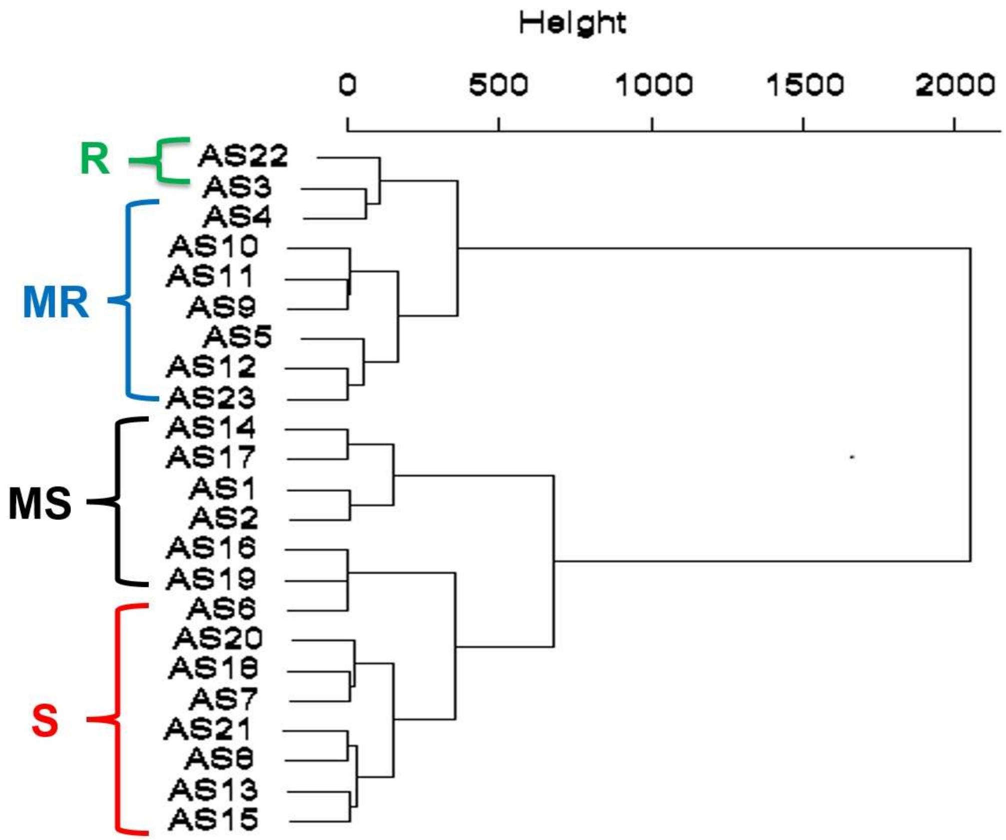

Fig. 4: Dendogram showing the disease severity (AUSPC) reaction groups of white fonio accessions after inoculation with two isolates of *Curvularia* sp. in semi-controlled conditions

Table 4: Seed weight (g) and seed weight loss (%) of 23 white fonio accessions after inoculation with two *Curvularia* sp. isolates

Accession local Name	Accession number	Seed weight (g) Control	Seed weight (g) for inoculated plants by isolate Bouk-S3	Seed weight loss (%) for inoculated plants by Bouk-S3	Seed weight (g) for inoculated plants by isolate Bouk-S2	Seed weight loss (%) for inoculated plants by Bouk-S2
Yoro	**AS1**	11.80 ± 0.99 abA	8.80 ± 0.92 aB	-25.42	9.24 ± 0.85 bB	-21.69
Iporni	**AS2**	12.36 ± 0.56 bA	7.45 ± 0.21 aB	-39.72	7.84 ± 0.90 aB	-36.57
Iporda	**AS3**	12.00 ± 0.6 abA	9.33 ± 1.15 aB	-22.25	7.96 ± 0.07 aB	-33.67
Affésiamon	**AS4**	12.46 ± 0.49 bA	7.79 ± 0.69 aB	-37.48	6.83 ± 0.30 aB	-45.18
Lamba	**AS5**	12.36 ± 0.84 bA	11.18 ± 1.44 aB	-9.55	9.59 ± 0.29 bB	-22.41
Non Identifié	**AS6**	10.60 ± 0.86 aA	8.37 ± 0.69 aB	-21.04	8.34 ± 1.06 aB	-21.32
Ipormondé	**AS7**	12.12 ± 0.51 abA	9.14 ± 0.64 aB	-24.59	9.45 ± 0.27 bB	-22.03
Ikantoni	**AS8**	9.56 ± 0.96 aA	8.37 ± 1.01 aB	-12.45	6.52 ± 0.92 aB	-31.80
Iporgnirmè	**AS9**	12.28 ± 0.92 bA	9.25 ± 0.48 aB	-24.67	9.59 ± 1.36 bB	-21.91
Iporawan	**AS10**	12.56 ± 0.46 bA	8.80 ± 0.23 aB	-29.94	8.93 ± 0.68 abB	-28.90
Iporapia	**AS11**	12.36 ± 0.74 bA	10.56 ± 0.72 aB	-14.56	9.07 ± 0.75 bB	-26.62
Iporapia	**AS12**	12.28 ± 0.76 bA	9.26 ± 0.25 aB	-24.59	8.86 ± 1.27 abB	-27.85
Iporapia	**AS13**	12.00 ± 0.75 abA	8.92 ± 1.11 aB	-25.67	9.59 ± 0.41 bB	-20.08
Ipomonpiété	**AS14**	12.28 ± 0.36 bA	9.37 ± 0.15 aB	-23.70	9.98 ± 0.67 bB	-18.73
Tignonpété	**AS15**	12.48 ± 0.81 bA	8.91 ± 0.96 aB	-28.61	8.36 ± 0.66 aB	-33.01
Iporawan	**AS16**	12.40 ± 1.2 bA	9.76 ± 1.48 aB	-21.29	9.72 ± 0.93 bB	-21.61
Yoro	**AS17**	10.32 ± 0.73 aA	10.80 ± 0.79 aB	4.65	10.36 ± 0.67 cB	0.39
Tignonpété	**AS18**	12.48 ± 0.79 bA	9.37 ± 1.22 aB	-24.92	9.01 ± 0.27 bB	-27.80
Iporni	**AS19**	12.28 ± 0.51 bA	8.67 ± 0.84 aB	-29.40	10.73 ± 0.19 cB	-12.62
Iporawan	**AS20**	12.20 ± 1.55 abA	10.06 ± 1.68 aB	-17.54	9.73 ± 1.43 bB	-20.25
Iporapia	**AS21**	12.10 ± 0.22 abA	7.04 ± 0.11 aB	-41.82	8.87 ± 0.33 abB	-26.69
Tignonpété	**AS22**	12.58 ± 0.69 bA	10.19 ± 0.78 aB	-19.00	10.32 ± 0.59 cB	-17.97
Iporni	**AS23**	12.38 ± 0.63 bA	7.90 ± 0.41B	-36.19	8.04 ± 0.84 aB	-35.06
F		1.923	1.346		1.877	
P		0.013	0.195		0.036	

Means with the same letter in column are not significantly different at 5% threshold for Turkey test

5 DISCUSSION

This study highlights the importance of the Curvularia leaf spot in the commune of Boukoumbe. The disease incidence and severity differed across sites. The highest incidence and severity values at Dipoli, Korontiere and Manta showed that these districts are more vulnerable to fonio leaf spot. This may be due to environmental conditions (temperature, relative humidity and level of soil fertility). This finding confirmed the report of Manza *et al.* (2013) in Riyom, Plateau State of Nigeria where highest disease incidence and severity of Curvularia leaf spot occurred on some sites. In addition, Ou (1985) and Percich *et al.* (1997) stated that these factors influence the expression of the disease aggressiveness. Aouali and Douici-Khalfi (2013) reported that disease severity depends on the climatic conditions, the variety and the stage of development of the plant at the time of the attack. Moreover, the production system of fonio in the commune of Boukoumbe based generally on monoculture without crop rotation on the same land and on the none elimination of weeds or crop residues that are potential sources of inoculum. The lowest incidence value was observed on the accession Ipordawan while the highest was observed on the accessions Ikantoni, Ipormi and Ipomoani. This could be explained by the duration of the cycle of these different accessions. In fact, Sekloka *et al.* (2016) stated that Ikantoni and Iporni belong respectively to the short cycle, extra early (2.5 to 3 months) and late cycle (5 months) accession groups unlike Ipordawan has a duration cycle from 3.5 to 4 months. In addition, Aouali and Douici-Khalfi (2013) who noticed that wheat leaf spot severity depend on several parameters including the development stage of the plant during the infection process have done the same report. All management strategies for fonio disease control required selection of productive and resistant accessions. Thus, in this study twenty-three accessions of fonio tested in the greenhouse to Curvularia leaf spot reacted differently to the disease. Among them, 3 accessions were resistant, 6 were moderately resistant, 6 were moderately susceptible and 8 were susceptible. The observed diversity in disease reactions of accessions were obtained by Manza *et al.* (2013) with sixteen accessions of *D. iburua* in Nigeria. The results corroborate those obtained by Oubda (2014) in Burkina Faso and Ramathani (2010) in Uganda who reported variability between some varieties of maize and sorghum tested against leaf spot. This variability could be due to differential responses of the resistance genes or not (Saifuila, 1994; Datnoff and Lentini, 1994; Rai *et al.*, 2004). The polymorphic SSRs currently available for white fonio (Clément and Leblanc, 1984; Barnaud *et al.* 2012; Olodo *et al.*, 2018) could be used for accurate genetic studies in relation to Curvularia leaf spot. Also, a significant negative correlation between disease severity and seed weight, and seed weight losses up to 45% were observed showing that Curvularia leaf spot is an important disease, which negatively affect fonio production.

6 ACKNOWLEDGEMENTS

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