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CHARACTERIZATION OF *Fusarium* sp. ASSOCIATED WITH AFRICAN EGGPLANTS (*Solanum aethiopicum* L. and *Solanum macrocarpon* L.) IN BURKINA FASO

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ABSTRACT

Eggplants *Solanum aethiopicum* L. and *Solanum macrocarpon* L. are packed with essential nutrient constituents necessary for nutritional balance and health maintenance. However, Fusarium infections characterized by leaf yellowing and necrosis, plant wilting and desiccation, as well as fruit rot represent a major constraint to production. This study aims to characterize *Fusarium* isolates from diseased eggplant plants. This would allow better management of African eggplant production, maintain crop quality, significantly reduce yield losses and above all contribute to ensuring food security. The virulence of 28 *Fusarium* isolates was assessed by seed inoculation from four *S. aethiopicum* genotypes and four *S. macrocarpon* genotypes. Two highly virulent isolates were identified based on the characteristics of mycelium on PDA culture medium, conidia under the microscope and sequences from the ITS region (ITS4 and ITS5). An analysis of variance (ANOVA) was conducted, and mean comparisons were performed via the Newman Keuls test at the 5% threshold. The results showed that all isolates produced symptoms and the most virulent were E38FUS and E41FUS. These two isolates generated respectively high incidence, an average rate of 30.42% in *S. aethiopicum* and 31% in *S. macrocarpon*. The same was true for severity with respective indices of 21.13% in *S. aethiopicum* and 22.63% in *S. macrocarpon*, further confirming their harmfulness. *Fusarium flagelliforme* and *Fusarium falciforme* are the two identified species, representing E38FUS and E41FUS respectively. This study highlights important alternatives, like identification of molecules of interest for biological and chemical treatments, and also varietal screening against Fusarium wilt.

Keywords: African eggplants, Fusarium wilt, pathogenic fungi, molecular identification, *F. flagelliforme*, *F. falciforme*.

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INTRODUCTION

Fungi are one of the phytopathogenic microorganisms responsible for the loss of about 20 to 40% of crop yield before harvest and 1 to 20% after harvest (Rakotoarimanga *et al*., 2014). Among the existing diversity of fungal diseases, fusariosis remains the most important vascular disease of vegetable crops. It is caused by fungi of the genus *Fusarium*. According to Villeneuve *et al*. (2016), the losses induced by these pathogens of land-based origin have been very important in eggplant and melon cultures for many years. These are essentially yield losses. The same observation is made in onion cultivation, the damage to which is frequently very considerable both in nurseries and in plots after transplantation (Haougui *et al*., 2020). These different impacts are linked to symptom variability, especially leaf yellowing, plant wilting, plant drying and fruit rot, characterized respectively by yellowish and necrotic discoloration of the leaves, loss of plant turgor, extreme dehydration of the plant and fruit decomposition. Various studies have allowed a morphological characterization of this telluric pathogen, in particular that of Chihat (2012) on the date palm, who characterized about forty isolates of *Fusarium oxysporum* f. sp. *albedinis* on the basis of cultural and morphological aspects such as the shape and color of the mycelium as well as the radial growth of the colonies. The same macroscopic and microscopic parameters allowed morphological identification of *Fusarium* in eggplant and tomato (Ould, 2017; Abdelhadi and Bachir, 2021). In addition, morphological variability exists within this genus (Boisson, 1991). It has a microconidium (spore) of small size, generally ovoid to ellipsoid, unicellular, sometimes multicellular (1 to 3 septa). The macroconidium is large, spindle-shaped and partitioned. According to Boisson (1991), various coloration and appearance of mycelium characterize this genus allowing them to be grouped into different morphological types or morphotypes: sporodochial; sclerotial; pioneer; downy morphotype; cottony morphotype; mucosal ras morphotype; senescent ras morphotype and wicking morphotype.

For molecular characterization, an ITS primer variant is used. Kaboré (2019) used ITS1 and ITS4 primers to identify various fungi, including the genus *Fusarium* isolated from fungal samples of the eggplant *Solanum macrocarpon*. ITS5 and ITS4 primers were used by Tiendrebeogo *et al*. (2023) to characterize the diversity of tomato fungus and especially *Fusarium*. In Iran, the same ITS4 and ITS5 primers were used for the identification of *Fusarium* associated with wheat root and collar rot (Dehghanpour-Farashah *et al*., 2019). These different pathogens mentioned have been the subject of numerous studies, discriminating isolates according to their pathogenicity in wheat (Dehghanpour-Farashah *et al*., 2019), African eggplant (Kaboré, 2019), tomato, cucumber and bean (Rakotoarimanga *et al*., 2014).

The genus *Fusarium* is economically very important because it is likely to attack a large number of speculations via these mycotoxins by compromising their food quality. It attacks the ear of barley by causing an alteration of the seeds which results in a significant loss of yield (Abdelhadi and Bachir, 2021). The same is true for other cereal crops such as wheat, for which this pathogen alters the germination of seeds by causing a sharp decrease in yields. The technological and sanitary quality of wheat flour is also denatured by this pathogen (Siou, 2013). Speculations such as the bean are also confronted with vascular fusariosis attributable to the fungus *Fusarium oxysporum* f. sp. *phaseoli*, with symptoms that manifest themselves on all the organs of the plant (Goudjo *et al*., 2023). *Fusarium Oxysporum* f. sp. *albedinis* (Killian & Maire) W.L. Gordon, (*F.o.a*) is the agent responsible for bayoud disease in Moroccan and Algerian palm groves, resulting in the deaths of 10 and 3 million trees, respectively (Chihat, 2012). The same applies to the Banana tree which is attacked by a genetically stable telluric fungus called *Fusarium oxysporum* f. sp. *cubense* (Foc) (Saravanan *et al*., 2007).

In onions, this disease is called basal rot or fusarean burn with a damage rate greater than 50%. It is recognized as one of the major constraints of onion cultivation and begins in the field with symptoms such as late pre-emergence and post-emergence emergence. It also has other symptoms such as seedling melt, growth retardation, chlorotic leaves, necrosis, discoloration of roots and bulbs, rotting and death of the plant (Kintega *et al*., 2020). *Fusarium oxysporum*, *Fusarium solani*, and *Fusarium proliferatum* are the most frequently implicated fusariosis agents in basal onion rot. It has a negative impact on tomato and pepper production (Rabah *et al*., 2006). According to Both (1971), the most serious and frequent fusariosis is that caused by *Fusarium oxysporum* f. sp. *lycopersici* on the aerial parts of the plant. Similar attacks are strongly observed in African eggplants, reducing yields and forcing growers to abandon cultivation (Kaboré, 2019).

The proliferation of these *Fusarium* variants depends on several epidemiological factors, including climatic factors, including pH, humidity and temperature that condition the germination and infection of the fungus, and wind that promotes the survival and dispersion of the primary inoculum (Beyer *et al*., 2004; Siou, 2013; Abdelhadi and Bachir, 2021). The spread of these pathogens is also influenced by physiological and agronomic factors, including the presence of a cultural precedent susceptible to Fusarium wilt and potentially infected, which promotes the maintenance of the primary inoculum in the plot (Siou, 2013). The physiological characteristics of the plant (size, foliage density), its state of stress, its stage of development, its flowering date and duration, and its level of resistance influence the development and intensity of Fusarium wilt.

Fusarium wilt remains a challenge in this case African aubergines. Given the diversity of *Fusarium* species tackling said speculations, it would be imperative to identify the most virulent *Fusarium* that are subservient to it, in order to start control strategies.

MATERIALS AND METHODS

Study area: The work was carried out at the INERA/Farako-Bâ research station, specifically in the mycology laboratory of the Regional Centre of Excellence in Fruit and Vegetables (CRE-FL) located in Bobo-Dioulasso, Burkina Faso. Morphological characterization took place from late September to October 2023, while molecular characterization and sequencing took place from June to December 2024.

Isolation of African eggplant fungal isolates: The different fungal isolates were derived from incubated symptomatic fragments of *S. aethiopicum* and *S. macrocarpon* (Table 1). An observation of said samples with a binocular magnifying glass and then with a microscope was made. The fungi were subcultured on PDA (Patatose Dextrose Agar) culture medium for possible growth.

Table 1. Incubated samples

	Symptoms			
Species	**LYN**	**PW**	**PD**	**FR**
S. aethiopicum	10	11	7	5
S. macrocarpon	6	14	14	5

Caption: LYN: *Leaf yellowing and necrosis;* ***PW:*** *Plant wilt;* ***PD:*** *Plant drying;* ***FR:*** *Fruit rot.*

Virulence assessment of *Fusarium* sp.: In view of the diversity of the fungal material obtained, a choice of 28 isolates was fairly made according to the symptoms of yellowing and leaf necrosis (LYN), wilting of the plant (PW), drying of the plant (PD) and fruit rot (FR) (Table 2).

The plant material consisted of eight genotypes of African eggplants, four genotypes of *S. aethiopicum* and four genotypes of *S. macrocarpon* (Table 3). These genotypes were derived from the germplasm of INERA/Farako-Bâ and were collected locally in different provinces of Burkina Faso, not reflecting the totality of the genetic diversity of the two species on a regional or global scale. These were chosen on the basis of their susceptibility to Fusarium wilt. After a sanitary test, the seeds of said genotypes were disinfected with 2% sodium hypochlorite (bleach) then deposited on the different isolates aged 10 days of culture (Fig. 1a), and incubated for the contamination of the seeds by fungi. Twelve hours later, June 18, 2023, the seeds were sown in sterilized cells previously filled with sterile industrial potting soil (Fig. 1b). The experimental design is a completely randomized design (CRD). The seeds of the four previously contaminated genotypes were sown in trays with 32 cells (8 cells per genotype). Each cell represented a replicate, for a total of eight replicates. Each tray corresponded to one isolate, containing the four genotypes. The work was carried out under the ambient temperature of the laboratory, i.e. 25-28°C.

The data collection concerned the number of days at emergence (NDE), which is the date on which 50% of stakes were raised, the percentage of seedlings emerged at 21 days after sowing (EA21), the incidence of the disease (ID) which is the percentage of infected seedlings (the number of seedlings attacked out of the total number of seedlings examined relative to one hundred), then the severity (SEV) of the disease which was evaluated according to a 5-class scale described by Abawi and Pastor-Corrales (1990). Incidence scores from the sixth week were used for the analysis. The same applies to the average severity indices whose scores were calculated by the formula used by Williams and Singh (1981) and the result expressed as a percentage. In short: $SEV = \sum (\frac{Xixni}{NxZ}) x100$ with: SEV : Disease severity index, Xi: Severity i of the disease on the plant, ni: Number of plants of severity i, N: Total number of plants observed ($N = 8$) and Z: Highest Severity Scale, Grade 9.

Adapted scale: according to Abawi and Pastor-Corrales (1990)

1- No visible symptoms

2- One to three leaves, representing only 10% of the foliage are withered and chlorotic

5- Approximately 25% of leaves and branches are wilted and chlorotic

7- Approximately 50% of leaves and branches are wilted and chlorotic

9- Approximately 75% of leaves and branches show wilting, Chlorosis, and defoliations, with possible death of the plant.

Finally, a heat map was developed from said severity data, characterizing the virulence of the isolates used by genotype. A virulent strain of *Fusarium falciforme* served as a positive control, responsible for the basal rot of the onion (Sarwadnya *et al*., 2023). The virulence of the different isolates was directly compared to that of this reference strain named IBFF-10.

Table 2. List of *Fusarium* isolates used

Provinces	Symptoms			
	LYN	**PW**	**PD**	**FR**
Nahouri	E7 FUS	E4 FUS	E2 FUS	E3 FUS
Zoundwéogo	E11 FUS	E15 FUS	E9 FUS	E7’ FUS
Sanguié	E34 FUS S.m	E41 FUS S.m	E18 FUS	E11’ FUS
Sissili	E47 FUS S.m	E65 FUS S. m	E36 FUS	E21 FUS
Oubritenga	E57 FUS	E76 FUS	E58 FUS	E34 FUS
Houet	E64 FUS	E85 FUS	E70 FUS	E38 FUS
Comoé	E81 FUS	E95 FUS	E71 FUS	E41 FUS

Caption: ***LYN:*** *Leaf yellowing and necrosis;* ***PW:*** *Plant wilt;* ***PD:*** *Plant drying;* ***FR:*** *Fruit rot;* ***EFUS:*** *Fusarium isolate code (obtained from Solanum aethiopicum);* ***EFUS S.m:*** *Fusarium isolate code (obtained from Solanum macrocarpon)*.

Table 3. List of African eggplant genotypes used

Species	**Genotype code**							
		Origin		**Origin**		**Origin**		**Origin**
Solanum aethiopicum	4AL4	Bazèga	12AL4	Houet	13AL5	Ioba	16AL2	Koulpélogo
Solanum macrocarpon	LS13	Sissili	RT7	Sanguié	TG1	Nahouri	BD4	Sissili

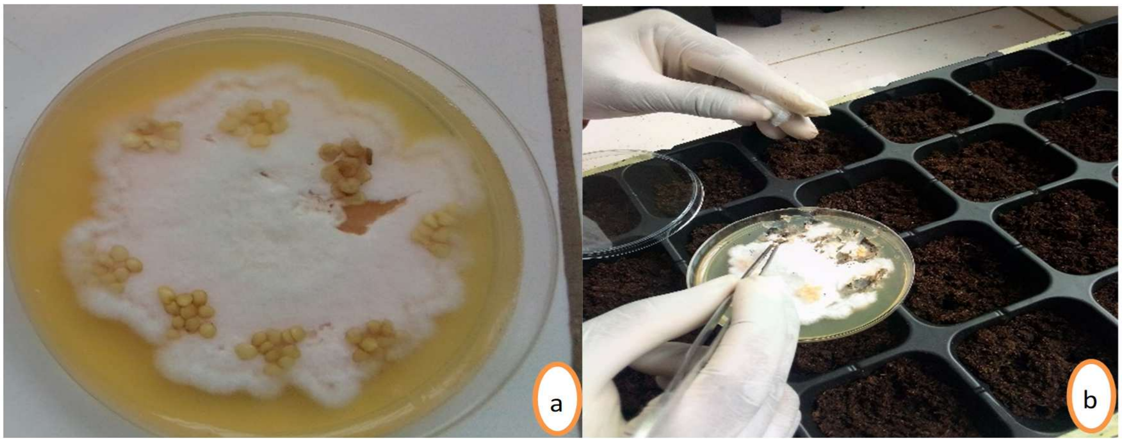

Fig. 1. Contamination of seeds and preparation of sowing plates: (a) seeds brought into contact with cultures of the fungi and (b) sowing of the seeds in the alveoli

Morphological characterization of more virulent isolates: At the end of the pathogenic test carried out with various fungi of the *Fusarium* genus, two more pathogenic isolates were selected for the rest of the study. These two isolates were each subcultured on PDA culture medium contained in a Petri dish with a 90 mm lid and 85 mm reverse.

Macroscopic characterization: From a macroscopic point of view, the parameters relating to the appearance and colour of the mycelium were described after seven days of culture on PDA medium contained in Petri dishes. To assess mycelial growth, the two pathogens were individually cultured in 10 Petri dishes each representing replication. Thus, each isolate was subcultured in the center of the Petri dish containing the PDA culture medium, and according to two perpendicular diameters plotted on the reverse of said Petri dish (Fig. 2). The dishes were then incubated at room temperature in the laboratory (25 to 28°C). Radial growth rate was measured on the 2nd, 4th, 6th, 8th, 10th, 12th, 14th, 16th, 18th, 20th, and 22nd days after replanting (DAR). This measurement of mycelial growth was made by considering the diameters, using a double decimeter. The average mycelial growth of each isolate was calculated from the average diameters according to the following formula (Dianda, 2019):

$\boldsymbol{D = \frac{d1+d2}{2}}$ with d1 and d2: measurement of the two perpendicular straight lines; and D: mean diameter of the isolate in a Petri dish.

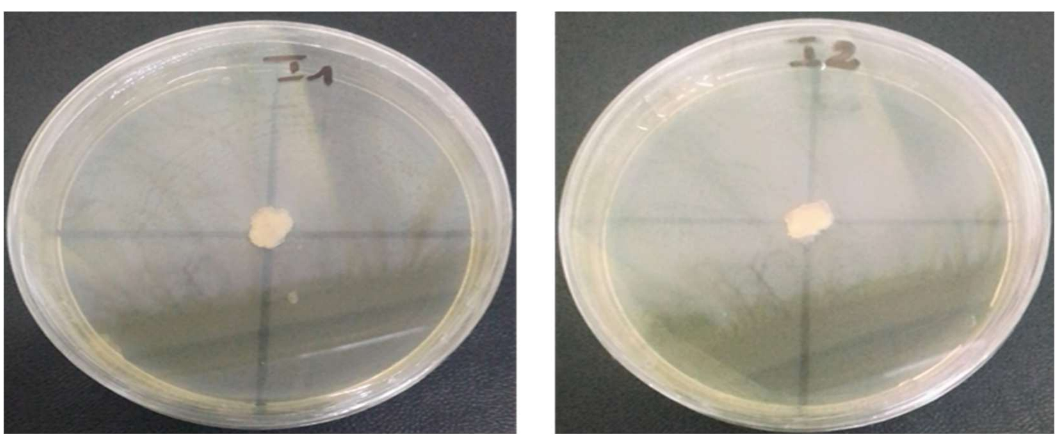

Fig. 2. Transplantation of isolates to assess mycelial growth.

Microscopic characterization: The main parameters measured microscopically were the size, colour of the conidia and also the presence or absence of septa in the conidia. These were determined using a binocular magnifier and an optical microscope equipped with a camera (euromex, Holland) connected to the Image Focus Plus software (Fig. 3A). For this, conidial suspensions were prepared by pouring 10 ml of distilled water onto isolates cultured on PDA medium at two weeks of incubation. Measurements were performed on 50 randomly selected conidia per isolate (Fig. 3B).

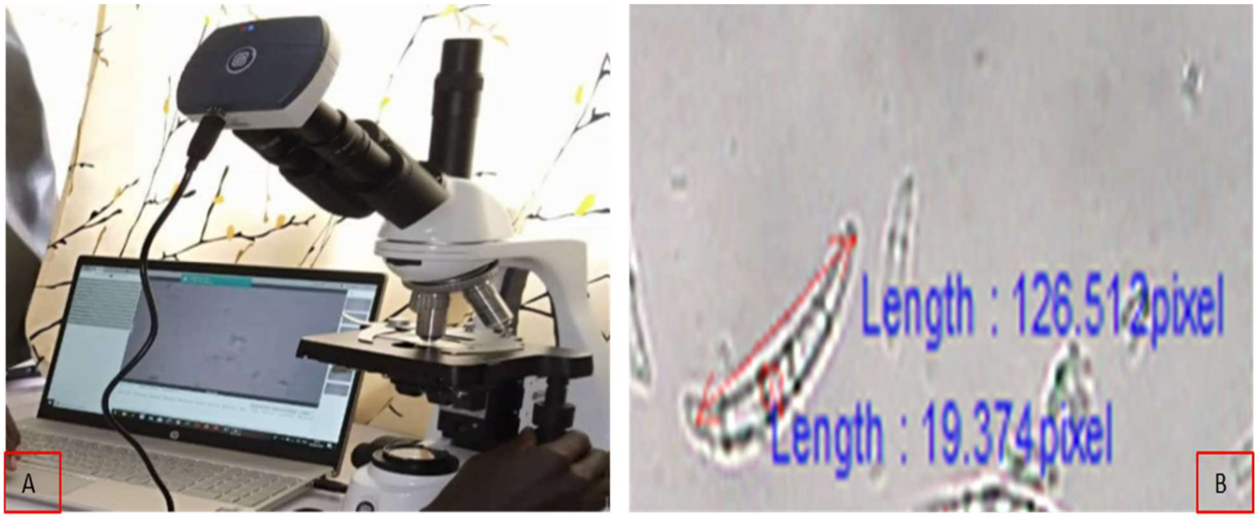

Fig. 3. Evaluation of microscopic parameters: (A) device used; (B) conidial measurement.

Molecular characterization and sequencing of more virulent isolates: The fungal total DNA was extracted using the CTAB method (Permingeat *et al*., 1998) with a slight adaptation, from the mycelium on PDA medium incubated at 25°C for ten days (Dianda *et al*., 2020). PCR was carried out in a reaction volume of 50 µL containing 10 µL of Mixed Fire Hot, 5 µL of each of the two primers ITS4 (TCCTCCGCTTATTGATATGC) (10 µM) and ITS5 (GGAAGTAAAAGTCGTAACAAGG) (10 µM) (Fofana *et al*., 2021), 10 µL of template DNA diluted to 2/10th and 20 µL of sterile distilled water. The PCR cycles were: (i) an initial denaturation step of 95°C for 5 min; followed by (ii) 35 cycles comprising denaturation at 95°C for 15 seconds; hybridization at 55°C for 20 seconds; extension at 72°C for 30 seconds; and (iii) a final step of 72°C for 7 min. After amplification, the electrophoresis of the PCR products was carried out in a 1% (w / v) agarose gel (Ultra Pure TM agarose, Invitrogen, Spain) in a 1 x Tris-Acetate-EDTA (TAE) buffer at 0.5X. The molecular weight of the amplicons was estimated using a 100 bp scale (Solis Biodyne Data Sheet).

At the end of the visualization by electrophoresis, of the presence of the amplicons with the universal primers (ITS4 and ITS5), the PCR products of the two isolates were sent to the company Macrogen in Netherland for sequencing.

Statistical analysis: All data was organized with the EXCEL 2016 spreadsheet. The averages obtained were compared by an one-way ANOVA at the 5% threshold carried out with the RStudio 2024.04.1+748 software via the agricultural package version 1.3.7 under R version 4.4.0. The Newman Keuls test enabled the comparison of averages. The factor studied was the isolate, and the variables were the date at which 50% of the stakes were raised, the percentage of seedlings emerged at 21 days after sowing, the incidence and severity. This same software was used to develop the isolate virulence heat map. The raw sequencing data was analyzed with BioEdit software. The consensus sequences obtained were blasted on the National Center of Biotechnology Information (NCBI) platform.

RESULTS

Pathogenicity of *Fusarium* sp. isolates on emergence parameters: Seed contamination with pure mushroom crops impacted the genotypes concerned in terms of the number of days at emergence, and the emergence of seedlings (Table 4). In *S. aethiopicum*, for the parameter number of days at emergence (NDE), the E41FUS and E38FUS isolates strongly caused a delay in emergence, i.e. 13.5 days and 13 days, respectively compared to the other isolates then to the E0FUS control whose emergence was 7 days. The seedling emergence parameter (EA21) evaluated on the 21st day, showed a frequency of emergence of the seedlings at 72.25%, caused by E41FUS compared to the E0FUS control which emerged at 100%. In, *S. macrocarpon*, the E71FUS isolate caused a slight delay in lifting of 6.75 days for the parameter number of days at lifting (NDE) compared to the E0FUS control whose lifting is 6.25 days, and compared to the other isolates. As for the emergence parameter (EA21), this same isolate (E71FUS) caused a low emergence of seedlings at 94% compared to the E0FUS control which emerges at 100%, and compared to the other isolates. The same is true for the E41FUS and E38FUS isolates, at 94% and 84.75% respectively.

Table 4. Effect of fungi on 50% date of emergence and emergence of seedlings

Isolates	*S. aethiopicum*		*S. macrocarpon*	
	NDE	**EA21**	**NDE**	**EA21**
E0 FUS	7bc	100a	6.25ab	100a
E7 FUS	7.5b	97a	5.25ab	100a
E11 FUS	7.5b	100a	5.25ab	100a
E34 FUS S.m	7.75b	100a	6ab	100a
E47 FUS S.m	7bc	100a	6ab	100a
E57 FUS	8b	100a	5.5ab	100a
E64 FUS	7.75b	100a	5ab	97a
E81 FUS	7.5b	100a	5ab	100a
E4 FUS	7bc	100a	5.25ab	100a
E15 FUS	8.5b	100a	5.25ab	100a
E41 FUS S.m	7.5b	100a	4.5b	100a
E65 FUS S.m	8.5b	100a	4.5b	100a
E76 FUS	7.5b	100a	5.5ab	100a
E85 FUS	8.75b	100a	5ab	100a
E95 FUS	4.5c	100a	5ab	100a
E2 FUS	7.75b	100a	6ab	100a
E9 FUS	8.75b	100a	5.75ab	100a
E18 FUS	6.25bc	100a	6.25ab	100a
E36 FUS	7bc	100a	4.75ab	100a
E58 FUS	7.75b	100a	5.5ab	100a
E70 FUS	6.5bc	100a	6.25ab	100a
E71 FUS	5.75bc	100a	6.75a	94a
E3 FUS	8.75b	94a	4.75ab	100a
E7' FUS	7.5b	100a	4.75ab	100a
E11' FUS	6.75bc	100a	4.75ab	100a
E21 FUS	6.75bc	100a	4.75ab	100a
E34 FUS	6.5bc	97a	5.25ab	100a
E38 FUS	13a	97a	5.75ab	84.75b
E41 FUS	13.5a	72.25b	5.75ab	94a
F value	10.07	10.7	2.218	6.705
PR(>F)	<2e-16 ***	<2e-16 ***	0.00265 **	3.32e-12 ***

Legend: *The averages followed by different letters are significantly different according to the Newman Keuls test at the 5% threshold*. **NDE:** Date at which 50% of the stakes were raised; **EA21:** percentage of seedlings emerged at 21 days after sowing.

Disease Incidence

Case of *Solanum aethiopicum:* In, *S. aethiopicum*, E38FUS and E41FUS isolates had the highest incidence rates, respectively, compared to controls with a rate of 0% (Fig. 4). This included leaf yellowing and necrosis symptoms (50.25% and 41%, respectively), plant wilting (34.75% and 28.25%, respectively), and plant drying (28.5% for E41FUS only).

Case of *Solanum macrocarpon:* For *S. macrocarpon* the E38FUS and E41FUS isolates respectively caused strong incidences for the symptoms of leaf yellowing and necrosis (40.75% for E41FUS only), plant wilting (31.5% respectively), and plant drying (28.25% and 16%, respectively) (Fig. 5),.

Disease Severity

Case of *Solanum aethiopicum:* For *S. aethiopicum* the E38FUS and E41FUS isolates caused high severity rates (Fig. 6). This included symptoms of leaf yellowing and necrosis (22% and 19.75%, respectively), plant wilting (18.5% and 17.5%, respectively), and plant drying (35.75% for E41FUS only).

Case of *Solanum macrocarpon:* The high severity of the two isolates (E38FUS and E41FUS) was also observed in *S. macrocarpon*, i.e. 20% (E41FUS) for the yellowing and leaf necrosis symptom, 18% of the two respective isolates for the wilting of the plants, then 35.75% (E38FUS) and 24.75% (E41FUS) for the drying symptom of the plants (Fig. 7).

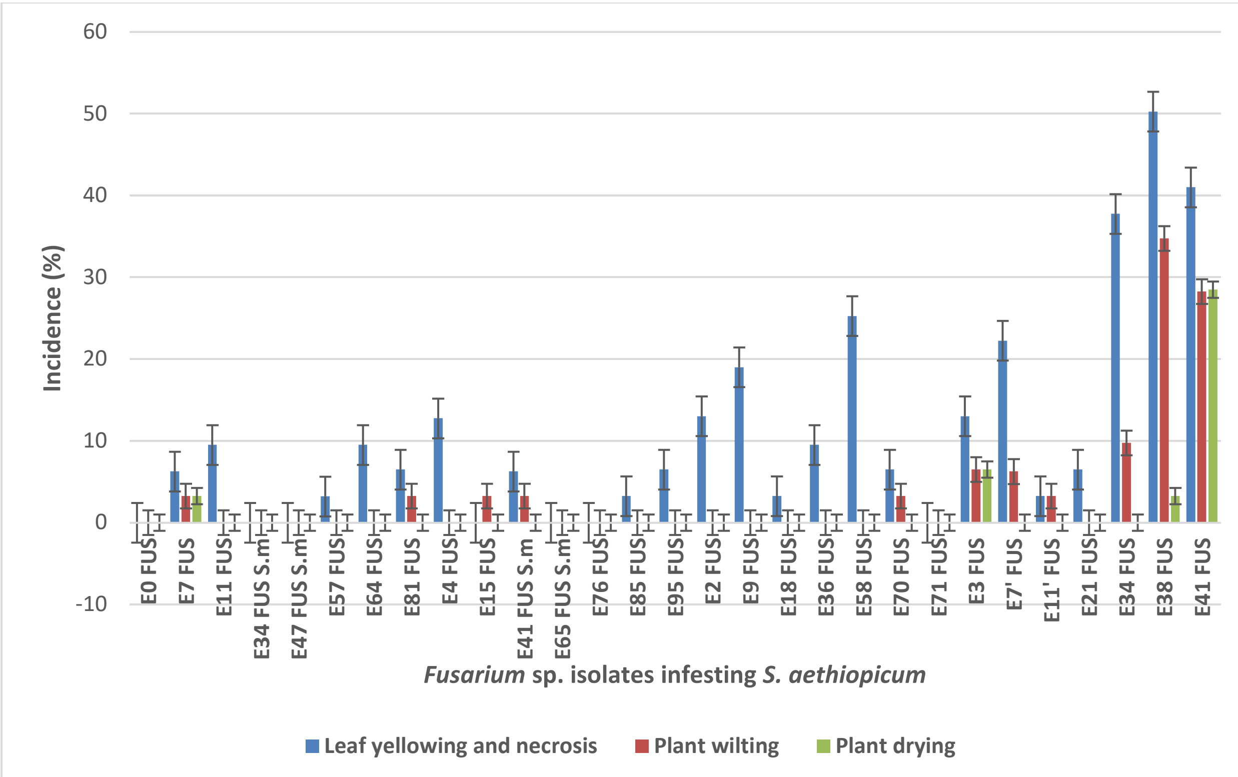

Fig. 4. Symptom-specific incidence of *Fusarium* sp. isolates in *Solanum aethiopicum*.

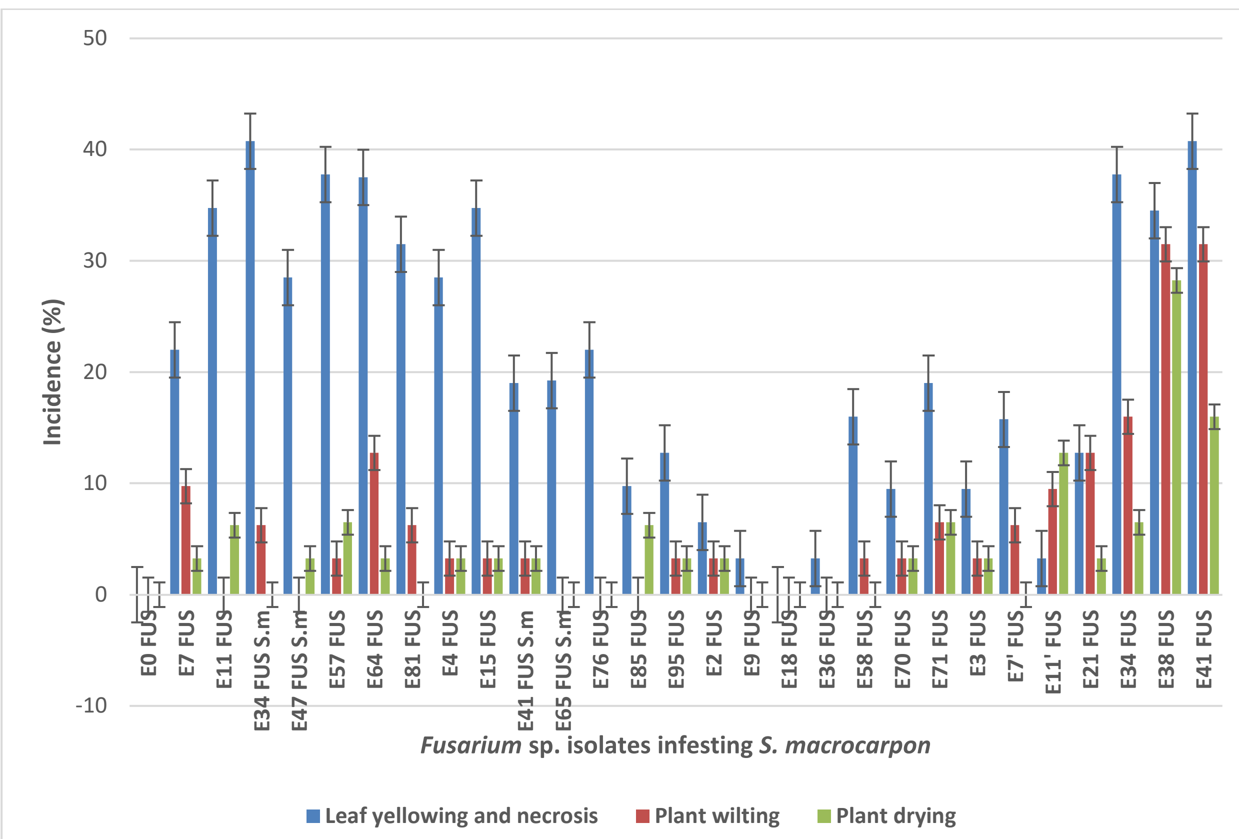

Fig. 5. Symptom-specific incidence of *Fusarium* sp. isolates in *Solanum macrocarpon*.

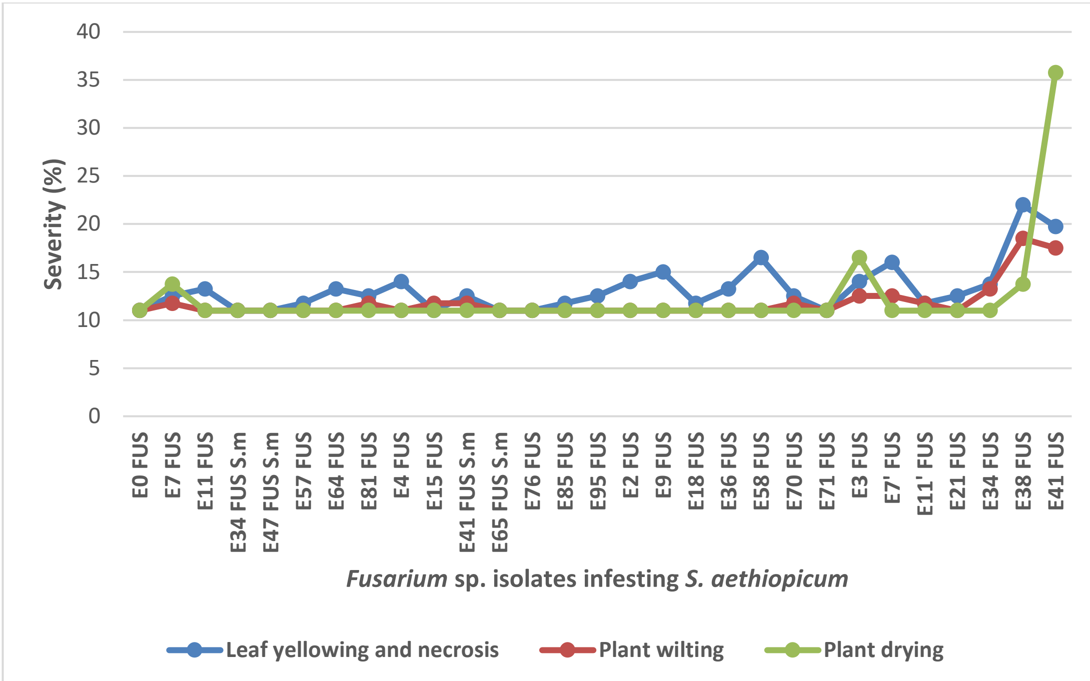

Fig. 6. Severity of *Fusarium* sp. isolates based on symptoms in *Solanum aethiopicum*

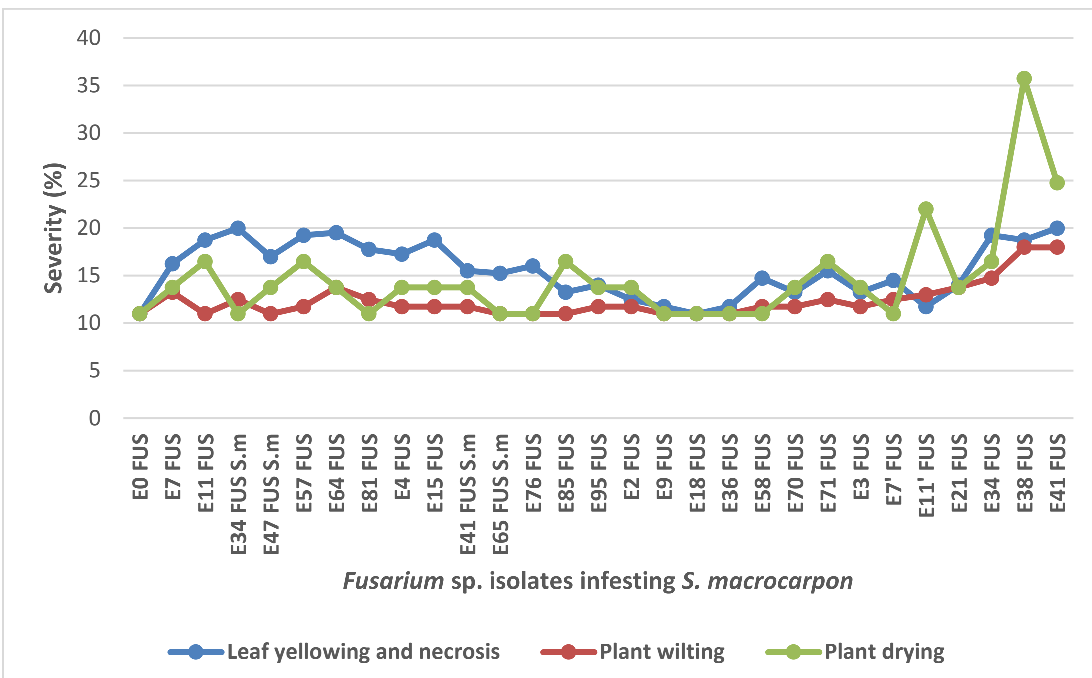

Fig. 7. Severity of *Fusarium* sp. isolates based on symptoms in *Solanum macrocarpon*

Virulence profile of isolates by genotype: The positive control (IBFF-10) had a 100% virulence rate.

Case of *Solanum aethiopicum:* In, *S. aethiopicum*, heat map analysis revealed that E38FUS and E41FUS isolates were overall the most virulent across all genotypes (Fig. 8). The virulence rate of these two isolates was lower than that of IBFF-10. These two isolates are grouped by dendrograms, suggesting comparable virulence on the four genotypes tested. The same applies for genotypes 4AL4 and 12AL4 which showed a similar sensitivity of about 35% to 45%, and genotypes 13AL5 and 16AL2 which showed a similar sensitivity greater than 50%, respectively.

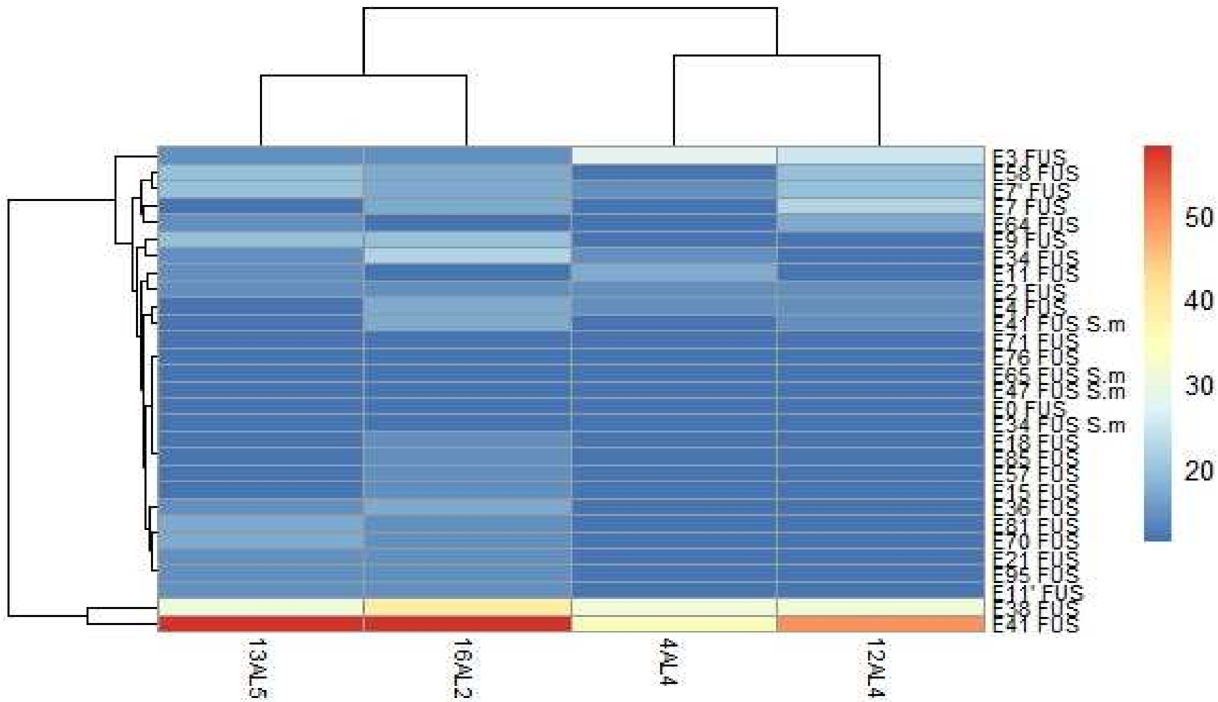

Fig. 8. Heat map of the virulence of *Fusarium* sp. isolates in *Solanum aethiopicum*.

Case of *Solanum macrocarpon*: In, *S. macrocarpon* results showed that the E38FUS and E41FUS isolates were the most virulent of all four genotypes (Fig. 9). The virulence rate of these two isolates was lower than that of IBFF-10 which is 100%. The dendrograms grouped these two isolates, reflecting an equivalent virulence on all the genotypes tested. These genotypes were grouped into three classes consisting of the TG1 and BD4 genotypes with a sensitivity of about 45% respectively, a class consisting only of LS13 with a sensitivity of about 49% and a class represented only by RT7 with a sensitivity well above 50%.

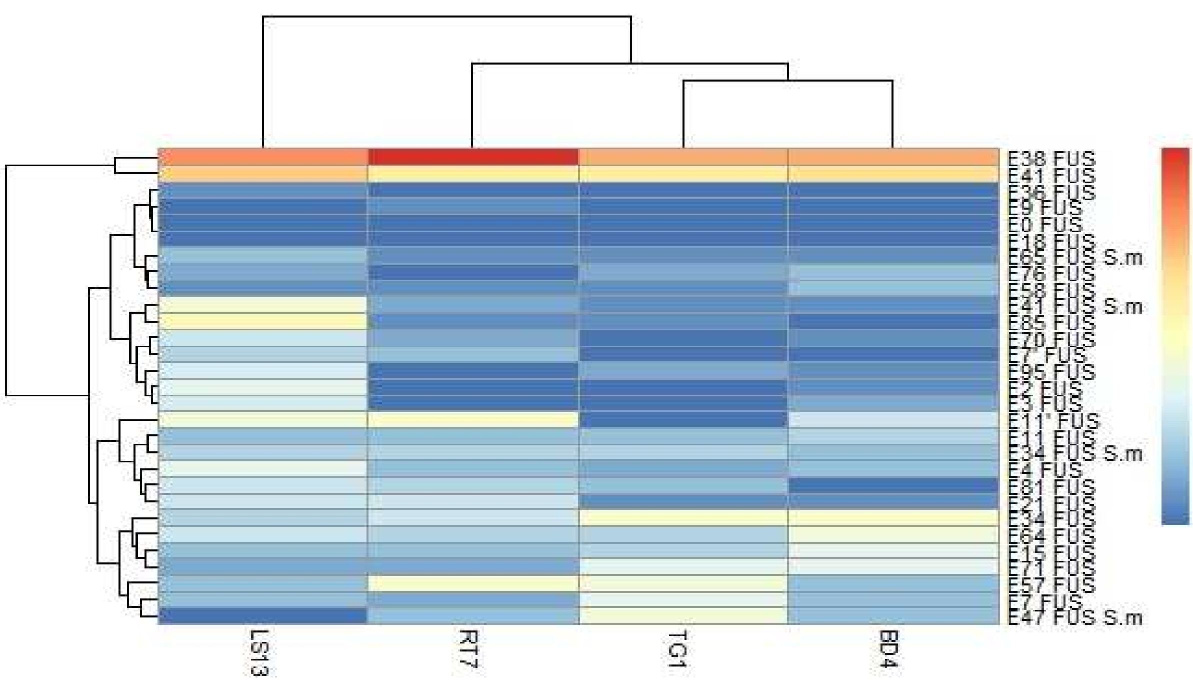

Fig. 9. Heat map of the virulence of *Fusarium* sp. isolates in *Solanum macrocarpon*.

Morphological identification

Macroscopic characters: The mycelial colony of the E38FUS isolate on PDA culture medium, had a cottony appearance of white-pink coloration (Fig. 10a), with an estimated average mycelial growth of 5.32 cm. For the E41FUS isolate, the colour of the mycelium is fluffy white, giving an average mycelial evolution of 5.38 cm (Fig. 10b).

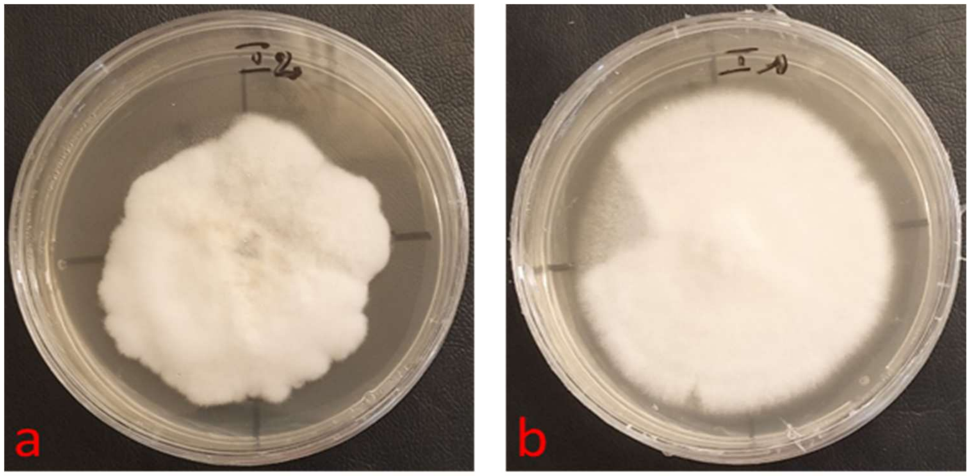

Fig. 10. Aspects of mycelium observed on PDA culture medium: (a) E38FUS isolate; (b) E41FUS isolate.

Microscopic characters: The conidia of the E38FUS isolate are black with an average size of 25µmX4µm (Fig. 11a), while E41FUS has grayish colored conidia with an average size of 35µmX5µm (Fig. 11b). The two isolates are partitioned with a variable number of septa (multiseptates).

Fig. 11. Aspects of conidia observed under an optical microscope: (a) E38FUS isolate; (b) E41FUS isolate.

Illustration of the measured morphological parameters: Table 5 shows a summary of the variability of the different morphological parameters recorded in the two *Fusarium* isolates.

Table 5. Macroscopic and microscopic variability of isolates

Isolates	Macroscopic characteristics				Microscopic characteristics		
	Appearance and color of mycelium on PDA	Mycelial growth (cm)			Medium length(µm)	Medium width (µm)	Colour of conidia
		2DAR	10DAR	22DAR			
E38FUS	Cottony; Rose-white	1.33	4.97	8.05	25	4	Black
E41FUS	Fluffy; White	1.46	5.55	7.84	35	5	Grey

Legend: *DAR: Day After Replanting*

Molecular identification: Conventional amplification PCR assays with universal primers of *Fusarium* sp. showed the presence of amplicons in both isolates (E38FUS and E41FUS) with an amplification size of about 500 bp (Fig. 12)

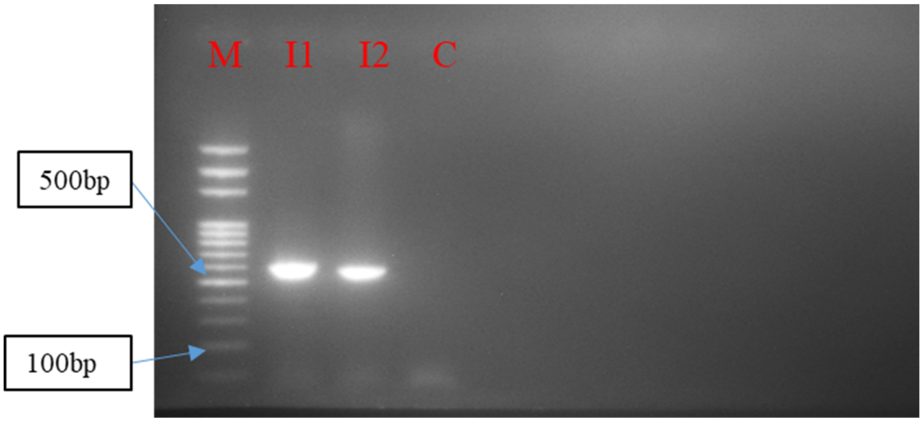

Fig. 12. Agarose gel (1%) revealing amplification of two *Fusarium* isolates. M: size marker; I1: E41FUS isolate; I2: E38FUS isolate; C: negative control.

Sequencing of the two virulent fungi: Table 6 presents the blast results of the sequences obtained from the two isolates of *Fusarium* sp. It appears that the sequence of the fungus E41FUS was 100% similar to *Fusarium falciforme*, while that of E38FUS was very close (99.63%) to *Fusarium flagelliforme*. After the sequences are deposited to Genbank with accession numbers i.e. PV363622 for E41FUS (*Fusarium falciforme*), and PV363863 for E38FUS (*Fusarium flagelliforme*) (Table 7).

Table 6. Blast of the consensus sequences of the two *Fusarium* sp. isolates on (www.ncbi.nlm.nih.gov)

Code of Isolates	Source	Corresponding species	Size (bp)	Accession on Genbank	Similarity rate (%)
E41FUS = I1	African eggplant rotten fruit	*Fusarium falciforme*	493	MH859035.1	100%
E38FUS = I2	African eggplant rotten fruit	*Fusarium flagelliforme*	1131	GQ505734.1	99.63%

Table 7. Summary of *Fusarium* sequences deposited in GenBank

Name of Isolates	Corresponding species	Accession number on GenBank	Version	Size (bp)
E41FUS-I1BF	*Fusarium falciforme*	PV363622	PV363622.1	569
E38FUS-I2BF	*Fusarium flagelliforme*	PV363863	PV363863.1	551

DISCUSSION

Healthy production of African eggplantsm, *S. aethiopicum* and *S. macrocarpon* remains an important challenge in Burkina Faso due to recurrent fungal attacks. Fusarium wilt is the most common of said diseases caused by various species of *Fusarium* whose impact is considerably variable. According to Rabah *et al*. (2006), Fusarium wilt is among the most common and serious fungal diseases of some Solanaceae such as tomato and pepper. For Rongai *et al*. (2012), the genus *Fusarium* is one of the main fungal genera responsible for diseases on several crops, including grasses, legumes and horticultural crops.

From the virulence test carried out, the harmfulness of the isolates in the two species of African eggplants (*S. aethiopicum* and *S. macrocarpon*) was manifested on several parameters. The slight delay could be due to the effect of the strains in question, more noticed with the E38FUS and E41FUS isolates. These results are in line with those of Kaboré (2019), which found that fungi of the genus *Fusarium*, in particular the species *Fusarium oxysporum*, have a longer emergence time (about 14 days) in certain morphotypes of *S. macrocarpon* compared to the other two morphotypes and the uninoculated control. The same is true of the results of Rakotoarimanga *et al*. (2014) who found that fungal strains of the genus *Fusarium* significantly inhibited the germination of cucumber, bean, and tomato seeds when infection is carried out at pre-emergence. The inhibition frequencies were equivalent to 84.32% for cucumber seeds, 84.61% for bean seeds, and 88.88% for tomato seeds. This inhibition was also observed in post-emergence with the reduction of rootlet growth for all forms of contamination. These germination-inhibiting strains undoubtedly had an effect on the emergence of seedlings. The low plant emergence rate caused by the two isolates E38FUS and E41FUS is linked to the high virulence of said *Fusarium* strains, which further highlights the pathogenic power of this fungal genus. The pathogenicity test carried out by Kaboré (2019) confirms that *F. oxysporum* and *Fusarium* sp. strongly affected plant emergence in at least two of the four morphotypes of *S. macrocarpon* used.

The two *Fusarium* isolates E38FUS and E41FUS were distinguished from the other isolates by a high prevalence rate. Thus, remarkable rates of incidence and severity were assessed on the basis of many symptoms related to the pathogenicity of these two fungal desires. Similar symptoms, had previously been observed on plants of the genus *Solanum* in particular *S. macrocarpon* (James *et al*., 2010; Sikirou *et al*., 2011). The results of Rotino *et al*. (2004) illustrated that leaf wilt due to *F. oxysporum* is one of the most serious diseases in eggplant culture as it induces speculation vascular wilt and causes heavy yield losses (Altinok, 2005). Rakotoarimanga *et al*. (2014) had also shown that contamination of young tomato plants by the most virulent *Fusarium* isolate not only caused rapid wilting of said seedlings, but also mortality of up to more than 80%. In short, *Fusarium* isolates E38FUS and E41FUS had shown their pathogenic powers on the two local eggplant species (*S. aethiopicum* and *S. macrocarpon*). In this sense, the high contamination of all genotypes could reflect their increased sensitivity to Fusarium wilt.

The morphological and molecular identification showed that the E38FUS isolate is similar to *Fusarium flagelliforme*, while the E41FUS isolate is identical to *Fusarium falciforme*. For the species *F. flagelliforme*, the work of Zelechowski *et al*. (2021) showed that it would contaminate the soya beans in Poland. In China, this fungus has been identified on herbaceous plants in grasslands (Gao *et al*., 2025). As for the *F. falciforme*, it had already been isolated from horticultural plants, and would contribute enormously to inhibit the emergence of the onion (Sogoba *et al*., 2023), this pathogen has an inhibitory effect on the growth of coleoptiles. These two identified *Fusarium* species would have respectively more or less similar characteristics to *Fusarium equiseti* and *Fusarium solani*. The latter would be well known for their devastating nature of agricultural production, especially vegetable crops. These pathogens have already been isolated from tomatoes by Tiendrebeogo *et al*. (2023) and considered responsible for significant yield losses in said speculation. The results of Ouali *et al*. (2024) highlight not only the high pathogenicity of *F. equiseti*, but also a high frequency of this species in sesame seeds. Kaboré (2019) isolated *F. solani* from the leaves of *S. macrocarpon*, responsible for the huge production losses of African eggplants. In addition, the pathogens *F. flagelliforme* and *F. falciforme* would undoubtedly be well known for their very considerable economic importance in agriculture.

Conclusion: Phytopathogenic fungi of the genus *Fusarium* are one of the major constraints for the production of African eggplants in Burkina Faso. The most virulent fungi are manifested by a variability of symptoms observable at different stages of plant development. The two isolates concerned, E38FUS and E41FUS, would respectively have the same characteristics as that of *F. flagelliforme* and *F. falciforme*, confirmed by molecular characterization and sequencing. Thus, the confirmation of the identity of these two pathogens is an important step in initiating control strategies, including genetic control.

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