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Research Article

Inhibition of *Fusarium* Pathogens in Millet by Extracts of Jatropha Curcas and Mangifera Indica

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Abstract

This study investigates the phytofungicidal potentials of aqueous extracts of *Mangifera indica* and *Jatropha curcas* on the *Fusarium* pathogens of millet seedlings in southwestern Nigeria. Aqueous extracts of *M. indica* and *J. curcas* prepared at 0.15, 0.30 and 0.45 mg/ml concentration levels were evaluated *in-vitro* using standard methods, while the *in-vivo* experiment was carried out using soil inoculation method in a completely randomized design with three replications. Data on percentage mycelia inhibition, growth characters, disease incidence and severity were obtained, and statistically analyzed using SAS 9.1 statistical software. Based on the *in-vitro* experiment, *J. curcas* significantly ($p<0.05$) inhibited the mycelial growth of *Fusarium* pathogens at increasing concentrations better than *M. indica*. The *in-vivo* result showed that *J. curcas* at 0.15, 0.30 and 0.45 mg/ml concentrations significantly ($p<0.05$) suppressed *F. anthophilum, F. verticillioides* and *F. oxysporum*. Similarly, *M. indica* at 0.30 and 0.45 mg/ml concentrations was observed to show significant ($p<0.05$) effect on *F. verticillioides* and *F. scirpi*. However, both extracts significantly ($p<0.05$) reduced the incidence and severity of disease caused by *F. anthophilum* and *F. oxysporum* at concentration levels tested in comparison to the controls. The inhibitory effects of the extracts were negative and insignificantly ($p<0.05$) correlated with days of observation *in vitro* and with the growth characters *in vivo*. Fusarium spp showed negative and significant ($p<0.05$) association with disease severity while positive and significant ($p<0.05$) relationship existed between the extracts and disease severity. Therefore, the botanicals of *J. curcas* and *M. indica* were considered effective against *Fusarium* pathogens of millet seedlings. Hence, they could be employed in large scale farming for sustainable millet production in Nigeria.

INTRODUCTION

Millets are staple cereal crop that is widely cultivated in Africa, Asia, India, China and Near East as food grains. The grains have great aptitude, versatility and potential benefits in human diet, feed for poultry, swine, fish, as well as livestock [1]. The crop has been reported for its good nutritional values which includes a superior protein quality among cereals and this crop has been rated the sixth most important cereal in the world [2]. Asides from its food value, millet grains have been reported for its therapeutic effects such as; high antioxidant activity, maintenance of normal muscle function, control of diabetes and inflammations [3].

Millets are distributed in about 10 genera and 20 species in all [4], and the varieties that are mostly cultivated worldwide according to the production capacity are; Pearl millet (*Pennisetum glaucumI),* Foxtail (*Setaria italica*), Proso (*Panicum miliaceum*) and Finger millet (*Eleusine coracana*) [5]. Millets have distinctive attributes with their adaptability to adverse agroecological conditions and have been reported to survive where other cereals fail, because this crop is highly resistant to drought, well adapted to poor soils and has low vulnerability to diseases and insect pests. These attributes has encouraged its cultivation and makes millet a key crop during food insecure periods in the West African drylands, since it represents a fast and reliable food source [1], moreso, the crop has an excellent long-term seed storage attributes which is a relevant feature in food insecure areas [2].

Despite millet being an ancient food and important grain,

research on this crop with its food value is still in its infancy and its potential vastly untapped [1] thus, this cereal crop has been labelled an underutilized crop. The history of pathogenic organisms associated with the cultivations of this rich cereal has been found as a major limitation to the optimal productions of yield of millet. Most of the agricultural plants have been reported to have at least one *Fusarium* associated disease [6], the fungi genus *Fusarium* has been reported for various pathogenic infections caused on cereals. *Fusarium* infections such as *Fusarium*-ear blight has been reported as a destructive disease in various cereal-growing regions,that has led to significant yield and quality losses for farmers and to contamination of cereal grains with mycotoxins [7]. The diseases caused by *Fusarium* species have been re-emerging in many cereal-growing regions worldwide [8] and this is because of the pathogenicity and high prevalence of these species [9]. There are also past reports of pathogenicity of *Fusarium* species to millet plants [10].

In view of this, biological control strategies ought to be given attention most especially on pathogenic *Fusarium* species of millet. Several efforts have been made in the control of plant diseases, the most successful is the chemical method which is a conventional method of control but has an inherent toxicity that can endanger health and the environment [11]. The negative effects of the chemical fungicides on human health led to a resurgence of interest in botanicals [12]. Botanicals have advantages over broad-spectrum conventional pesticides because of their minimal costs and fewer ecological side effects. They affect only target pest and closely related organisms, effective in very small quantities, decompose quickly and they also provide the residue free food and a safe environment to live [11,12]. Therefore, development of biologically based management strategies for the control of soilborne pathogen in place of synthetic pesticides has become an acceptable method of control [13]. The biocontrol potentials of extracts of *Jatropha curcas* and *Mangifera indica* was investigated on the *Fusarium* pathogens of millet in this study. Extracts of the two plant species had earlier been reported for their efficacy against some phyto-pathogens of economic importance [14, 15, 16,17]. Furthermore, they are readily accessible and safe to use like other botanicals [18]. This study therefore evaluates the antagonistic effects of the extracts of *J. curcas* and *M. indica* against the pathogenic *Fusarium* species of millet seedlings with a view to determine the best effective plant extract for field application.

MATERIALS AND METHODS

Source of millet varieties and plant extracts

This study was carried out in year 2012; the seeds of Pear millet *(Pennisetum glaucum)* were obtained from National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan Oyo state, Nigeria. The extracts of *Mangifera indica* var. julie (leaf methanol extraction) and *Jatropha curcas* (root back methanol extraction) were obtained from Dr. O.O. Aiyelaagbe (Organic unit) Chemistry Department, University of Ibadan, Nigeria.

Isolation and identification of *Fusarium* species

Soil samples were collected from various cereal growing farm sites across the five ecological zones in Southwestern Nigeria. Isolation of *Fusarium* species from the soil samples was carried out by soil plate method according to the procedure of Warcup [19] using the selective media; Peptone Pentachloronitrobenzene Agar (PPA). The isolated Fusarium species were grown on Spezieller Nährstoffarmer Agar (SNA) medium for identification purpose. The microscopic identification was carried out using electronic microscope (Olympus CHBS laboratory microscope) while the taxonomic classification were aided by *Fusarium* identification manuals described by Leslie and Summerell [6] and Fuskey *Fusarium* Interactive key reported by Seifert [9].

Inoculums quantification and multiplication

The mycelial growth of seven day old cultures were flooded with 5ml sterile distilled water and gently brushed with glass rod into sterile conical flasks. The solution was sieved with double folded sterile cheese cloth to allow the passage of fungal spores only. The spore suspension were then counted using haematocytometer and adjusted with sterile distilled water to 3.1 x 10^5 spores/ ml for each *Fusarium* species.

Biocontrol of the pathogenic *Fusarium* species

Fusarium anthophilum, F. verticillioides, F. oxysporum and *F. scirpi* were shown as the most virulent pathogens on millet varieties from the twenty two *Fusarium* species isolated [20]. These pathogenic *Fusarium* species were subjected to biological control using the extracts of *M. indica* and *J. curcas.*

Preparation of plant extracts

One gram of the concentrated extracts was dissolved in solvent comprising of 20ml of methanol and 80ml of sterile distilled water. The initial 20ml methanol added readily dissolved the concentrated extracts and as well sterilized the extracts against possible pathogens present. The extracts were then diluted into the concentrations; 0.15, 0.30 and 0.45 mg/ml.

In vitro control of *Fusarium* species

The inhibitory effect of the extracts of *M. indica* and *J. curcas* were evaluated on *Fusarium anthophilum, F. verticillioides, F. oxysporum* and *F. scirpi*. 5mm diameter cork borer was used to pick the fungi from the advancing edge of six days old actively growing [21]. This were inoculated at the centre of petri plates containing solidified 9ml PDA + 1ml extract, while controls were prepared with 9ml PDA + 1ml sterile distilled water. The cultures were replicated three times and all cultures incubated at room temperature. The radial growth of the Fungi mycelia were consistently recorded at two days intervals for six days and percentage mycelia inhibition was calculated according to the method of Odebode [22].

Percentage mycelia inhibition, $R = \frac{R_1 - R_2}{R_1} \times 100$

Where R1 is the value of radial growth of pathogen on control plates

R2 is the value of radial growth of pathogen in treatment plate.

In vivo control of pathogenic *Fusarium* species

Seed sterilization: This was carried out according to the

method described by Anderegg and Guthrie [23] and Daniels [24]. The seeds of millet varieties were treated with 5% Sodium hypochlorite solution for three minutes then rinsed in three exchanges of sterile distilled water and air dried in laminar flow for 2 hours.

Screenhouse experiment: Sandy-loam soil collected from the experimental farm of the Department of Botany, University of Ibadan were sterilized using an electric soil sterilizer.

The pots filled with sterilized soils were set up in the screen house in a completely randomized design (CRD). Inoculation with 10ml spore suspension (3.1x 10^5 spores/ml) per pot of each *Fusarium* sp. were carried out 24 hours prior planting and the application of extracts (10ml per pot) in the respective concentrations of 15, 30 and 45mg/ml levels. The control experiments observed were; positive control (plant extracts + millet), neutral control (millet alone) and negative control (pathogen + millet). Thinning of the millet seedling into one stand per pot was carried out after emergence while watering and weeding were carried out as appropriate. Data were obtained on plant height (cm), stem girth (mm^2), leaf number, leaf area (cm^2), disease incidence (%) and disease severity (%).

Disease Assessment, data collection and statistical analysis

Disease incidence rating: The percentage incidence of infected millet seedlings was estimated as described by Michel *et al*. [25]:

% Disease incidence = n / N x 100

Where n = number of plant showing diseased symptoms with at least one leaf diseased.

N = Total number of sample used.

Scoring of Disease Severity: This was carried out according to disease severity rating described by Soonthornpoct *et al.* [26].

0 = apparently healthy root or mesocotyl or crown tissue

1 = < 25% of tissue with disease rot symptoms

2 = 25–49% of tissue rotted

3 = 50–74%, of the tissue rotted

4 = 75% or greater of the roots rotted

5 = wilted or dead seedlings/completely rotted mesocotyl or crown tissue

Statistical Analysis: The Data collected were subjected to Analysis of Variance with General Linear Model procedure using Statistical Analysis System software version 9.1 SAS [27]. Differences among mean of the treatments were separated with New Duncan Multiple Range Test at 5% level of probability [28].

RESULTS

The in vitro treatments of extracts at different concentration were highly significant (p<0.001) against the organisms while the replicates were not significantly (p>0.05) different from one another. The plant extracts resulted to a highly significant increase in the number of leaves, plant height and leaf area at day 7 in comparison to stem girths and leaf area that showed highly significant increase at day 14 of the screenhouse experiment. The various concentration of the extracts produced a highly significant (p>0.001) effect on the growth characters with exception of leaf area. Moreso, the pathogenicity of the *Fusarium* species significantly (p<0.05) affect the stem girth and leaf area (Table 1).

In the in vitro study, *J. curcas* significantly (p<0.05) inhibited mycelia spread of the pathogens compared to *M. indica* that showed no significant (p<0.05) difference from the control. Whereas, the two extracts significantly controlled the pathogens on millet plants in the screenhouse experiment. Similar result was also obtained when treated with extracts only. However, the treatments of *Fusarium* pathogens only produced negative effects on the plants' growth (Table 2). The efficacy of the plant extracts increases with concentration but the most significant (p<0.05) mycelia inhibition were achieved at 0.45 mg/ml *in vitro*. This concentration (0.45 mg/ml) was also the most effective against the pathogens at day 7 in vivo. The extract concentrations; 0.15 mg/ml and 0.30 mg/ml produced significant (p<0.05) result at day 14 with 0.30 mg/ml having more significant effect (Table 3).

Highly significant (p<0.001) = **, Significant (p<0.05) = *, ns = not significant, WAP = Week After Planting. Each value is the mean of three replicates. Values with the same alphabet are not significantly (p<0.05) different from one another across the column according to Duncan's Multiple Range Test. Each value is the mean of three replicates. Values with the same alphabet are not significantly (p<0.05) different from one another across the column according to Duncan's Multiple Range Test.

F. scirpi was the mostly inhibited by the plant extracts at day 2, 4 and 6 of data collection. This was followed by *F. oxysporum* which showed significant (p<0.05) inhibition in vitro, compared with *F. anthophilum* and *F. verticillioides* that were not significantly (p>0.05) different. The pathogen treatments recorded no significant (p>0.05) difference on the number of leaves, plant height and stem girth at day 7, and also on the plant height, stem girth and leaf area at day 14 of in vivo experiment. However, the result obtained from the leaf area at day7 and number of leaves at day 14 placed *F. anthophilum* as the most pathogenic organism, followed by *F. verticillioides* (Table 4). No significant (p>0.05) difference was observed on the mycelia inhibition on the replicated treatments (Table 5). Positive and highly significant (p<0.001) correlation were observed on the mycelia inhibition at day 2, day 4 and day 6. The extracts and replicates were insignificant (p>0.05) and negatively correlated with mycelial growth. Whereas, the pathogens and extract concentrations produced significant (p<0.05) and negative correlation with mycelia growths while the *Fusarium* species were highly significantly (p<0.001) correlated at day 6 (Table 6). Each value is the mean of three replicates. Values with the same alphabet are not significantly (p<0.05) different from one another across the column according to Duncan's Multiple Range Test. Each value is the mean of three replicates. Values with the same alphabet are not significantly (p<0.05) different from one another across the column according to Duncan's Multiple Range Test.

Disease incidence caused by *Fusarium* spp. were significantly

Table 1: Effect of plant extracts, concentrations levels and replicates on the control of Fusarium pathogens of millet.

	In vitro				*In vivo*								
		Mycelia inhibition				**Number of leaves**		**Plant height**		**Stem girth**		**Leaf area**	
Source	**Df**	Day 2	Day 4	Day 6	**Df**	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14
Extracts	2	0.69**	3.14**	1.97**	3	6.79**	0.19ns	906.83**	78.20ns	75.88ns	0.78**	7.70**	450.80**
Concentration	2	1.31**	1.87**	1.83**	2	93.51**	70.65**	6621.80**	6998.36**	58.32ns	3.42**	2.41ns	57.71ns
Organisms	3	0.87**	1.48**	7.73**	4	0.38ns	0.85ns	47.68ns	23.56ns	26.95ns	0.47**	3.20*	21.91ns
Replicates	2	0.001ns	0.00ns	0.02ns	2	0.07ns	3.15*	20.14ns	155.63*	74.59ns	0.40**	1.81ns	165.92*

Table 2: Antagonistic effect of plant extracts against Fusarium pathogen of millet.

In vitro				*In vivo*								
Extracts	**Mycelia inhibition**			**Extracts**	**Number of leaves**		**Plant height**		**Stem girth**		**Leaf area**	
	Day 2	**Day 4**	**Day 6**		Day 7	Day 14	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14
M. indica	2.85a	5.03a	6.71a	*M. indica* + Pathogen	3.47a	4.22a	17.21a	25.39a	0.81b	0.98a	3.04a	16.23a
J. curcas	2.58b	4.47b	6.29b	*J. curcas* + Pathogen	3.47a	4.29a	17.80a	24.97a	0.80b	1.03a	2.89a	16.38a
Control	2.77a	4.91a	6.69a	Pathogens only	2.76b	4.38a	8.60b	22.42a	0.68b	0.77b	2.20b	10.17b
				Extracts only	3.62a	4.31a	17.68a	24.44a	3.36a	1.02a	3.09a	16.83a

Table 3: Effect of extract concentration levels on against *Fusarium* pathogen of millet.

	In vitro			*In vivo*							
Concentration	**Mycelia inhibition**			**Number of leaves**		**Plant height**		**Stem girth**		**Leaf area**	
	Day 2	Day 4	Day 6	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14
0.15 mg/ml	2.85a	4.98a	6.68a	2.53b	4.85a	9.40b	29.87a	0.65a	1.02b	2.59a	13.78a
0.30 mg/ml	2.84a	4.89a	6.70a	2.68b	5.00a	9.11b	31.18a	2.52a	1.13a	2.83a	15.35a
0.45 mg/ml	2.51b	4.54b	6.30b	4.77a	3.05b	27.45a	11.86b	1.06a	0.67c	2.98a	15.59a

Table 4: Susceptibility of Fusarium species to the antagonistic effect of the plant extracts.

	In vitro			*In vivo*							
Organisms	**Mycelia inhibition**			**Number of leaves**		**Plant height**		**Stem girth**		**Leaf area**	
	Day 2	Day 4	Day 6	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14
F. anthophilum	2.82a	4.96a	7.02a	3.19a	4.11b	14.52a	23.45a	0.72a	0.87b	2.50b	14.30a
F. verticillioides	2.84a	5.01a	6.97a	3.39a	4.33ab	15.83a	24.61a	0.77a	0.88b	2.96ab	14.97a
F. oxysporum	2.81a	4.74b	6.36b	3.36a	4.31ab	16.58a	24.25a	2.33a	0.90b	3.14a	14.52a
F. scirpi	2.47b	4.50c	5.90c	3.25a	4.52a	15.92a	25.50a	2.38a	0.94b	2.95ab	16.23a
Control	-	-	-	3.44a	4.22ab	13.76a	23.42a	0.86a	1.14a	2.48b	14.51a

Table 5: Effect of replicated treatments on the extract control of *Fusarium* species.

	In vitro			*In vivo*							
	Mycelia inhibition			**Number of leaves**		**Plant height**		**Stem girth**		**Leaf area**	
Replicates	Day 2	Day 4	Day 6	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14	Day 7	Day 14
1	2.74a	4.76a	6.58a	3.30a	4.25b	15.75a	24.42ab	2.69a	0.95a	3.03a	14.68b
2	2.73a	4.81a	6.56a	3.36a	4.55a	15.55a	25.86a	0.84a	1.02a	2.78a	16.67a
3	2.73a	4.80a	6.54a	3.32a	4.10b	14.66a	22.64b	0.70a	0.86b	2.64a	13.37b

Table 6: Correlation of the extracts, concentration, organism and replicates with mycelia inhibition of *Fusarium* species.

Correlation	Day 2	Day 4	Day 6	Extracts	Concentration	Replicates	Organisms
Day 2							
Day 4	0.86**						
Day 6	0.72**	0.77**					
Extracts	-0.10ns	-0.11ns	-0.01ns				
Concentration	-0.44*	-0.36*	-0.21*	0.00ns			
Replicates	-0.01ns	0.00ns	0.01ns	0.00ns	0.00ns		
Organisms	-0.39*	-0.38*	-0.60**	0.00ns	0.00ns	0.00ns	

(p<0.05) antagonized by the plant extracts. All the *Fusarium* species were significantly (p<0.05) inhibited at 0.45mg/ml and no disease expression was observed (Figure 1). Furthermore, the extracts significantly (p<0.05) lowered the virulence of infections caused by *Fusarium* species at 0.15mg/ml and 0.30mg/ml. The pathogens showed total antagonism at 0.45 mg/ml concentrations except *F. anthophilum* (Figure 2).

Mild disease symptoms were observed in the untreated plants (neutral control). The extracts treated plants (Positive control) showed no significant (p<0.05) disease symptoms while the plants treated with the pathogens only (Negative control) were highly pathogenic expressing significant (p<0.05) and severe disease symptoms such as root rot and wilting (Figure 1 and Figure 2). *M. indica* treated plants only (positive control) at 0.15 mg/ml concentration showed significant (p<0.05) growth at the day 7 and day 14 of the experiment. *J. curcas* (positive control) expressed better growths in the plant height (34.13 cm) and leaf area (4.32 cm^2). Also, at 0.30 mg/ml, data obtained from plant height (36.17 cm), number of leaves (5.33) and leaf area (19.62 cm^2) showed *J. curcas* as more significant (p<0.05), whereas *M. indica* treated plants at 0.45 mg/ml led to significant (p<0.05) increase in the plant height, number of leaves and leaf area than the *J. curcas*. However, the two extracts showed significance (p<0.05) with increased in concentrations of the extracts when compared to the neutral control (millet seedling only). On the contrary, the negative control (millet and pathogens) showed significant (p<0.05) reduction in the plant height, stem girth, number of leaves and leaf area when compared to neutral and positive controls (Figure 3).

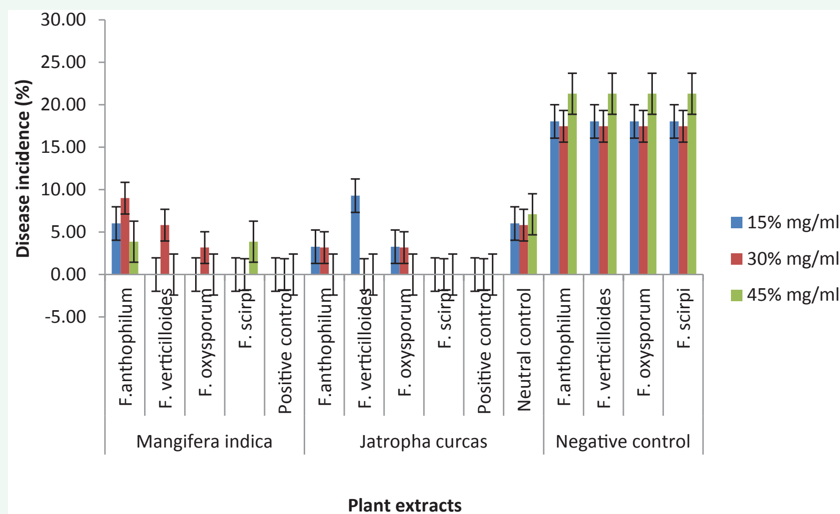

Figure 1 Percentage disease incidence of *Fusarium* spp. on millet seedling after treatment with plant extracts.

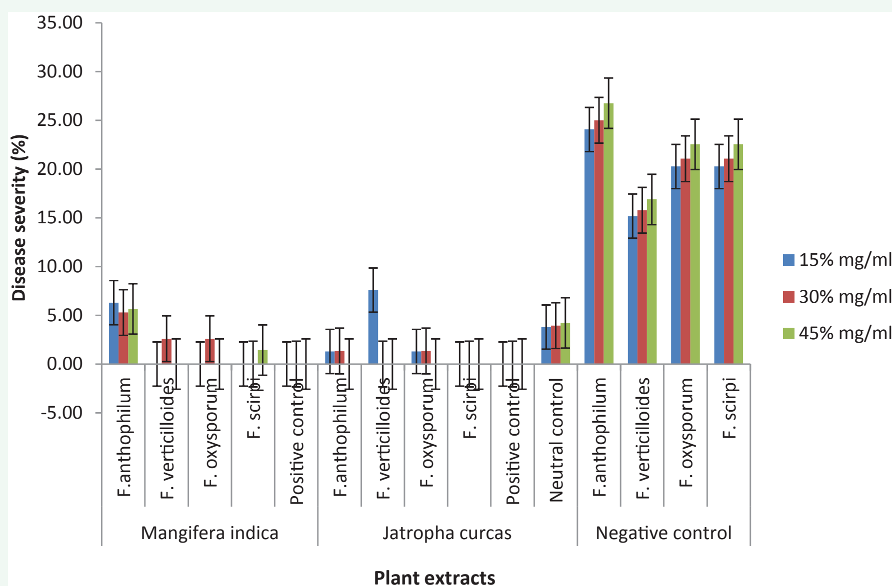

Figure 2 Percentage disease severity of *Fusarium* spp. on millet seedlings treated with plant extracts.

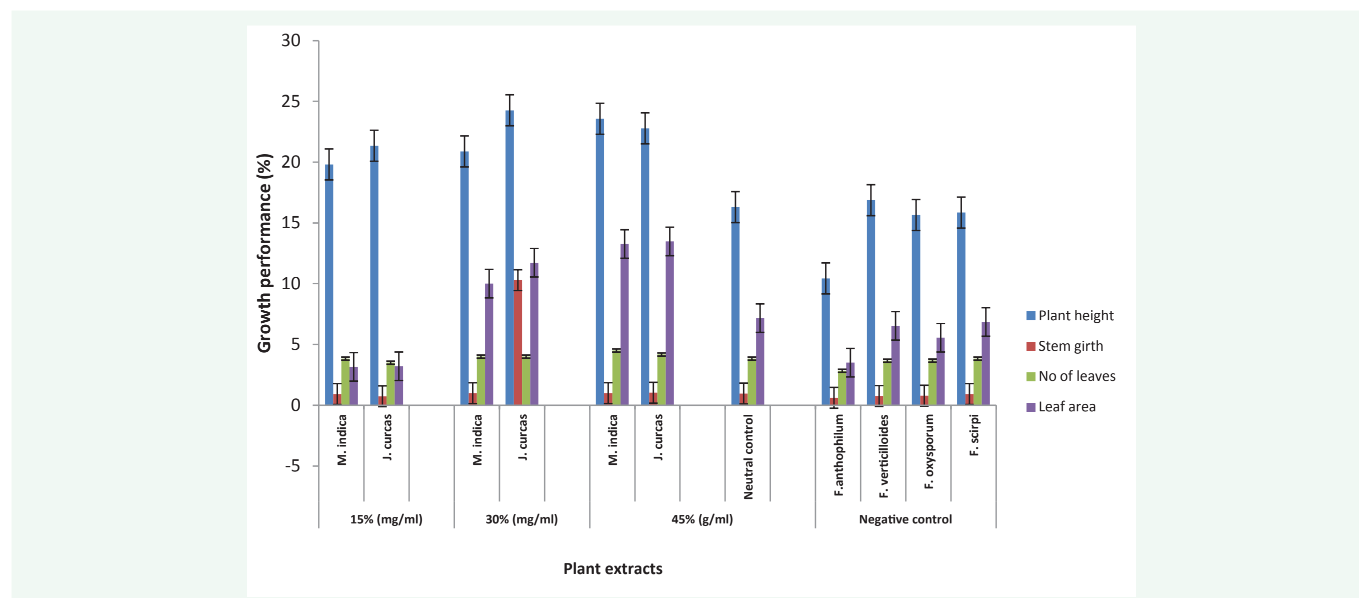

Figure 3 Effect of Plant extracts on the Percentage growth of millet seedlings.

Table 7: Correlation of the extracts, concentrations, organisms and replicates with the growth of millet seedlings at day 14 after inoculation.

Correlation	Number of leaves	Plant height	Stem girth	Leaf area	Disease severity	Disease incidence	Organisms	Extracts	Concentration	Replicates
Number of leaves										
Plant height	0.87**									
Stem girth	0.65**	0.75**								
Leaf area	0.14*	0.25*	0.39*							
Disease severity	0.01ns	-0.14*	-0.40*	-0.57**						
Disease incidence	0.01ns	-0.08ns	-0.30*	-0.52**	0.88**					
Organisms	0.05ns	0.02ns	0.27*	0.04ns	-0.15*	-0.00ns				
Extracts	0.03ns	-0.05ns	-0.05ns	-0.08ns	0.19*	0.10ns	0.00ns			
Concentration	-0.62**	-0.66**	-0.44*	0.13*	-0.02ns	-0.00ns	0.00ns	0.00ns		
Replicates	-0.05ns	-0.07ns	-0.12*	-0.09ns	-0.09ns	-0.20*	0.00ns	0.00ns	0.00ns	

Positive and highly significant ($p<0.001$) correlation existed between days of observation and mycelial spread of the pathogen. The inhibitory effects of the extracts were insignificantly ($p<0.05$) correlated with days of observation while the organisms were significantly ($p<0.05$) inhibited (Table 6). Moreso, the *in vivo* assessment was highly significant ($p<0.001$) and positively related to the growth characters. Similarly, highly significant relationship occurred between disease incidence and disease severity. However, both were significantly and negatively related to plant height, stem girth and leaf area. The Fusarium species produced insignificant ($p<0.05$) correlation with the disease incidence and growth characters except stem girths, but were positive and significantly correlated disease severity. Except on the number of leaves which was positive, the extracts showed negatively and insignificantly ($p<0.05$) relationship with the growth characters, it also showed positive and significant relationship with disease severity. Meanwhile, the concentration of extract was negative and highly significantly ($p<0.001$) correlated with number of leaves and plant height, while stem girth and leaf area were also significantly ($p<0.05$) related. However, the replicates were significant and negatively related to disease incidence (Table 7). Highly significant ($p<0.001$) = **, Significant ($p<0.05$) = *, ns = not significant. Highly significant ($p<0.001$) = **, Significant ($p<0.05$) = *, ns = not significant.

DISCUSSION

Plant extracts had been reported safe and effective in the control of plant diseases [12,29]. The antifungal properties of extracts of *Mangifera indica* (mg/ml) and *Jatropha curcas* (mg/ml) studied in this research were effective against Fusarium species *in vitro* and *in vivo*, this result was in line with the study conducted by Ayanbimpe. [14] and Jonathan. [17] That reported the increased efficacy of the extracts with concentration in the treatment of fungal pathogens. The biocontrol potentials of *M. indica* tested against the Fusarium species confirmed the report of Nunez-Selles [30] who linked the antifungal effects of aqueous leaf extracts to the presence of mangiferin which are bioactive compounds. Moreso, Masibo and He [31] reported a wide array of other polyphenols and microelements in the leaves and stem bark extracts of the mango, all of which play a role in their

pharmaceutical potential. Furthermore, the extract of *J. curcas* showed better control of diseases caused by the four *Fusarium* species this was in accordance with the report of Silval et al. [32] in which *J. curcas* was reported for its high inhibitory effect on *F. oxysporum.* Moreso, in the report of Falade et al. [15], the extracts of *Jatropha gossypifolia* effectively controlled *Sclerotium rolfsii* (*Corticium rolfsii*) and *Fusarium oxysporum* which were isolated from tomato. However, *F. scirpi* and *F. oxysporum* were the mostly inhibited pathogens in this research compared to *F. anthophilum* and *F. verticillioides* which showed resistance to activities of the plant extracts at low concentrations, as was also evident in the report of Adejumo and Langenkämper [33]. Significant relationship existed between the pathogens and disease severity recorded; result similar to this had been reported in the work of González [34] on the high disease severity of common rust on corn, a situation attributed to the pathogen virulence, genotype and environmental conditions. Also, the effects of extracts were found to correlate with the mycelia inhibition, increased in plant growths characters and also on the antagonistic effect against diseases caused by the pathogens. *M. indica* and *J. curcas* were noticed to be good promoters of growth of millet seedlings. This was observed on plants treated with extracts only (positive control) in this study, and was found in agreement with the findings of Jogdande [16] who affirmed that shoots of mango cultivars contains naturally occurring growth promoters. Therefore the extracts of *M. indica* and *J. curcas* can serve as an alternative to the use of chemical fertilizers, pesticides and fungicides that are employed for facilitating plant growth in agriculture, horticulture and silviculture [35]. Generally, it is presumed qualitatively that *J. curcas* and *M. indica* contains some antifungal compounds which may be utilized as phytofungicide and as phytofertilizer to control the pathogenic fungi and enhance the growth of various economically important food crops.

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