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Fungal Isolation and Characterization from some Ornamental Plants in Baze University Abuja, Nigeria

***Mairami, F.M. and Ahmad Bello**
Department of Biological Sciences,
Baze University Abuja, Nigeria.

Email: fatima.mairami@bazeuniversity.edu.ng

Abstract
A research was carried out to isolate and characterize the fungal community present on some ornamental plants grown in Baze University Abuja Nigeria. Leaf samples showing diseased symptoms were collected from four different ornamental plants in the area (Indian shot, Canna indica; Plantain lily, Hosta undulata; Elephant ear, Caladium sp; and Song of India, Pleomelere flexa. The diseased portions were cut to form an aliquot. Serial dilutions were carried out and the samples were inoculated on Potato Dextrose Agar and incubated at 27 ^{o}C for 5 days. Fungal colonies formed were counted and sub-cultured. Data obtained for occurrence was analyzed in frequency and percentages while for enumeration using Analysis of Variance (ANOVA) with Duncan's New Multiple Range Test was used to separate significant means at 5% level. The result obtained revealed the presence of ten fungal species represented by eight genera associated with the plants: Aspergillus niger, Aspergillus parasiticus, Mucor racemosus, M. mucedo, Saccharomyces cerevisiae, Fusarium oxysporum, Rhizopus stolonifer, Alternaria alternata, Pythium aphanidermatum and Penicillium chrysogenum. Aspergillus niger is the most predominant species. Elephant ear has the highest fungal loads. Four of the fungal species: A. alternata, Aspergillus parasiticus, Pythium aphanidermatum and Fusarium oxysporum are potential pathogens while the remaining six species are saprophytes. This implies that the plants are at risk of losing their aesthetic values as such proper attention need to be given to these plants.

Keywords: Abuja, Fungi, Isolation, Ornamental plants.

INTRODUCTION
Ornamental plants are plants grown largely for their artistic (Kaushal *et al*., 2023) or aesthetic values due to pleasant traits such as shape, bark, leaves, flowers, fruit, or any combination (Jain, 2002). These type of plants are associated with home gardens, landscape designs, recreational parks, indoor plants, cut flowers specimen display (Albuquerque and Alves, 2016). Although all forms of plants are used as ornamental, with aesthetic values assigned on some special features such as flowers, leaves, foliage texture, color, fruits, and scents of the plants (Gullino and Garibaldi, 2007) yet they specifically include all plants used for decorative purposes, with floral sales ranging from $40-60 billion (Lecomte *et al*., 2016). There is increase in the commercial floriculture worldwide (Gullino and Garibaldi, 2007). Ornamental plants are of high economic values (Andrew, 2018) used in traditional medicine, seeds used for making jewelry and leaves used to make paper. They also provide a lot of positive vibes in religious events. The better production of these flowering plants increases the economic status and its commercial values in a whole world (Arti and Kaur, 2023).

**Author for Correspondence*

However, despite the significant importance placed by humans on ornamental plants and the roles played by ornamental plants to enhance the glory of the entire world, fungal infection causes the diseases in these plants reducing their aesthetic values and damage~~d~~ the crops ~~leading to the~~ losses in ~~their~~ production (Arti and Kaur, 2023). Different varieties of ornamental plants often host many plant fungal pathogens and saprotrophs, causing severe damages (Trkulja *et al*., 2018). These fungal species threatened their prospects by affecting their aesthetic qualities.

The occurrence of plant disease is a result of a complex interaction of a susceptible host plant, the presence of a pathogenic causal organism, and the environment. The diseases result in huge economic loss to farmers and some diseases are devastating in nature like wilt in carnation and gladiolus. Moreover, disease ~~d~~ infected plants or flowers are restricted to export and not accepted in domestic market (Singh *et al*., 2012).

These fungal species usually cause several symptoms such as flower malformation, growth abnormalities, yellowing of leaves, elongation and etiolation of internodes, witches' broom, stunting, little leaf, and virescence (Khan *et al*., 2016). Others include: detectable change in color, shape or function of the plant as it responds to the pathogen (Isleib, 2012). Some fungal pathogens cause leaf spotting and falling into their incubating plants and arguably the most harmful and widespread are caused by species of the genus Alternaria (Matić *et al*., 2020) which is the most common fungal species found in ornamental plants. Not only the pathogenic fungi, the saprotrophic ones also deteriorate the aesthetic values of leaves. Therefore, the aim of this study is isolation and identification of fungal community present on the ornamental plants within Baze University, Abuja, Nigeria.

MATERIALS AND METHODS

Sample Collection

A total of 400 leaf samples showing symptoms of diseased conditions such as appearance of spots and lesions on leaf were collected from four most common ornamental plants existing in Baze University, Abuja, Nigeria. The samples were collected in sterile polythene bags ad labeled accordingly. The plants sampled were: Indian shot (*Canna indica*), Plantain lily (*Hosta undulata*), Elephant ear (*Caladium sp*), and Song of India (*Pleomelere flexa*). The samples were authenticated at the Herbarium of the Department of Biological Sciences. The samples were transported to the Biology Laboratory, Baze University, Abuja for mycological analyses.

Analysis of samples

The mycological analyses were conducted according to the method described by Ezikanyi *et al*. (2016). A sterile blade was used to cut small section (1 g) of the sample ~~was cut~~ and blended in 9ml of sterile water (this was the aliquot). The exponential dilution was carried out to the fourth factor. Volume of 0.1ml of the third factor was aseptically transferred onto petri dishes containing sterile PDA containing chloramphenicol (30mg/l) to inhibit bacterial growth and spread by using bend glass rod and incubated at 27° C for 5 days. Distinct colonies formed were counted using colony counter and sub-cultured onto a PDA Slant and incubated again at 27°C for 5 days. Identification of fungal cultures was carried out using gross morphology such as colony growth pattern, conidial morphology and pigmentation as described by Fawole and Oso (1995) and Ibrahim and Rahma (2009). Wet mounts of the fungal colonies were prepared following standard procedures. One (1) drop of Lacto phenol cotton blue was put on a clean grease free slide, a little portion of the fungal hyphae was put on the phenol drop and covered with a cover slip. Microscopic examination of the specimens was carried out under low (X10) and high (X40) objectives of a compound microscope to confirm the types

of fungus in each colony (Barnett, 1991). The isolates were identified using standard mycological atlas (El-Ghaouth *et al*., 2009)

Statistical Analysis

Data obtained for the prevalence of fungal species on the samples were analysed using frequency and percentage tables. Fungal enumeration was analysed using Analysis of Variance with Duncan's New Multiple Range Test used to separate significant means at 5% level. SAS (2008) Version 9.0 was used for the analysis.

RESULTS

The results of identification of fungal community of the ornamental plants in Baze University is presented in Table 1. The result revealed the presence of ten (10) different fungal species represented by eight (8) different genera: *Aspergillus niger*, *Aspergillus parasiticus, Mucor racemosus, M. mucedo, Saccharomyces cerevisiae, Fusarium oxysporum, Rhizopus stolonifer, Alternaria alternata, Pythium aphanidermatum* and *Penicillium chrysogenum*.

Table 1: Macroscopic and Microscopic Characterization of Fungal Isolates from ornamental Plants

Fungal Isolate	Macroscopic Features	Microscopic Features
Aspergillus niger	Black and white cotton like structure	Thick septate hyphae with conidia borne in chains from the sterigmata
Aspergillus parasiticus	Dark green colonies	Septate hyphae with rough thick spherical conidial wall, with short conidiosphores
Mucor racemosus	Black cotton like structure	Aseptate hyphae are irregular in size and ribbon like
Mucor mucedo	Black cotton like structure	Aseptate hyphae, irregular in size and ribbon like
Saccharomyces cerevisiae	White creamy like with spot like structure	Spherical and irregular size hyphae with budding. Like structure
Fusarium oxysporum	Pink and white edge cottony growth	Oval microconidia produced on branched conidiosphore
Rhizopus stolonifera	Whitish cottony like structure	Aseptated hyphae irregular in size
Alternaria alternate	Black fluffy growth with white edges	Erect conidiophores, septate hyphae with cylindrical conidia.
Pythium aphanidermatum	White with golden black edge.	Aseptate hyphae with zoospores producing sponrangia.
Penecillium chrysogenum	Yellow colour colony with greyish black growth.	Single spores cells in chains and septate mycelium.

Table 2 showed the occurrence of each fungal species on the ornamental plants under study. The results showed that *Aspergillus niger* had the highest prevalence of 30.77% with highest occurrence of 35.29% on Elephant ear. It is followed by *Rhizopus stolonifer* with 12.82% prevalence. Elephant ear had the highest number of fungal species with 43.59% followed by the Song of India with 28.21%. Plantain lilly hosts the least (10.26%).

Table 2: Occurrence of Fungal Isolates on Ornamental Plants in Baze University Abuja

Fungal Isolate	Elephant ear	Indian shot	Plantain lily	Song of India	TOTAL
Aspergillus niger	6(35.29%)	2(28.57%)	1(25.00%)	3 (27.27%)	12(30.77%)
Aspergillus parasiticus	2(11.77%)	-	-	-	2 (5.13%)
Mucor racemosus	-	-	2(50.00%)	-	2 (5.13%)
Mucor mucedo	2(11.77%)	1(14.29%)	-	1 (9.09%)	4(10.26%)
Saccharomyces cerevisiae	1 (5.88%)	1(14.29%)	1(25.00%)	-	3 (7.69%)
Fusarium oxysporum	2(11.77%)	2(28.57%)	-	-	4(10.26%)
Rhizopus stolonifera	3(17.64%)	1(14.29%)	-	1 (9.09%)	5 (12.82%)
Alternaria alternate	-	-	-	2 (18.18%)	2 (5.13%)
Pythium aphanidermatum	-	-	-	3 (27.27%)	3 (7.69%)
Penecillium chrysogenum	1(5.88%)	-	-	1 (9.09%)	2 (5.13%)
TOTAL	17(43.59%)	7(17.95%)	4(10.26%)	11(28.21%)	39 (100%)

The result of fungal enumeration on the ornamental plants is presented in Table 3. The result revealed significant difference (P≤0.05) in the fungal loads on different species of ornamental plants. The result indicated that *A. niger* had the highest fungal load on Song of India while *Mucor* species and *F. oxysporum* had the highest loads on Elephant ear. However, *R. stolonifer* had highest load on Indian shot.

Table 3: Fungal loads (CFU/g) on Ornamental Plants in Baze University Abuja

Fungal Isolate	Elephant ear	Indian shot	Plantain lily	Song of India
Aspergillus niger	$1.2x10^{5c}$	$0.8x10^{5d}$	$1.6x10^{5b}$	$2.2x10^{5a}$
Aspergillus parasiticus	$0.6x10^{5}$	-	-	-
Mucor racemosus	-	-	$1.1x10^{5}$	-
Mucor mucedo	$1.3x10^{5a}$	$0.5x10^{5b}$	-	$1.2x10^{5a}$
Saccharomyces cerevisiae	$2.1x10^{5a}$	$1.0x10^{5b}$	$0.6x10^{5c}$	-
Fusarium oxysporum	$1.6x10^{5a}$	$0.7x10^{5b}$	-	-
Rhizopus stolonifera	$1.1x10^{5b}$	$1.3x10^{5a}$	-	$0.9x10^{5c}$
Alternaria alternate	-	-	-	$1.1x10^{5}$
Pythium aphanidermatum	-	-	-	$0.7x10^{5}$
Penecillium chrysogenum	$1.1x10^{5}$	-	-	$1.3x10^{5}$

N.B: Values across a row with same superscripts are not significantly different (P=0.05)

DISCUSSION

The presence of *Aspergillus* species, *Mucor* spp, *Penicillium* sp, *Fusarium* sp, *Alternaria* sp and *Rhizopus* sp on ornamental plants reported by this study is in agreement with the finding of Massoud and Khalil (2023) who reported similar fungal communities among host of others on ornamental plants in some Nurseries in Al–Qurayyat, Jouf region, Saudi Arabia. The present study reported that, *Aspergillus niger* had the highest occurrence. This finding agrees with that of Mailafiya *et al.* (2017) and Massoud and Khalil (2023) who individually reported *A. niger* as the most prevalent fungal species in fruits and ornamental plants respectively. Similarly, Wu *et al*. (2023) reported *Aspergillus* as the most predominant fungal species in Coastal Sediments from Guangdong, China.

Tshering and Sadruddin (2023) reported *Alternaria* sp., among the fungal species causing leaf spot diseases of ornamental plants of Sherubtse College Campus, Kanglung. Similarly, Al-healy (2023) reported *Alternaria alternata* among ornamental plants. The fungal community isolated from the ornamental plants were either saprophytes or parasites. This confirmed the finding of Wu *et al*. (2023) who reported that, saprotrophs and pathogens were the two trophic types with the highest proportions.

The present study indicated that, *Alternaria alternata*, *Aspergillus parasiticus*, *Fusarium oxysporum* and *Pythium aphanidermatum* were potential pathogens second to the saprotrophic types. This is in line with the fact that Pathogenic fungi often harm their hosts and threaten

the ecological environment (Schröter *et al*., 2019). Among the ten genera of fungi that were associated with ornamental plants, six were saprotrophs while four were parasites. Xu *et al*. (2014) and Zhang *et al*. (2015) reported Fusarium as one of the most abundant plants fungal pathogens in both coastal and deep-sea sediments, which might probably be attributed to the presence of microscopic plant fragments in the sediments as stressed by Brandão *et al*. (2021). Similarly, Chuku and Chuku (2015) reported highest prevalence of *A. niger* in *Annona muricata*. Most of the fungal organisms isolated in this study played a great vital role in saprophytic activities leading to spoilage. Chukwuka *et al*. (2010) reported *Rhizopus spp*, *A. niger*, *Fusarium spp*. and *Mucor spp*., responsible for spoilage in pawpaw. Although six of the fungal species isolated were saprophytes, yet they produced mycotoxins that are harmful to man and other organisms. For instance, Abarca *et al*. (1994) isolated Ochratoxin-A produced by strains of *Aspergillus niger*. Similarly, trichothecenes, mycotoxins most strongly associated with chronic and fatal toxic effects in animals and humans is isolated from Fusarium (Desjardins *et al*., 1993).

The presence of high fungal loads on the plants agrees with the values obtained by Zamir *et al*. (2018) from dates obtained from Dhaka, Bangladesh. These values were however higher than the values obtained by Onuorah and Orji (2015) from fruits obtained in Awka markets, Nigeria. Similarly, the values of fungal counts reported by this study conformed to the range of fungal count values reported by Tournas *et al*. (2005) in tree nuts and Ameh and Kawo (2017).

CONCLUSION

It was concluded that the ornamental plants grown in Baze University Abuja host high fungal counts. The fungal community on the plants comprised of pathogenic and saprotrophic species which all induced unfavourable symptoms on the plants thereby degrading their aesthetic values. Attention of the relevant authorities is needed towards safe-guarding the glory of these plants.

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