



Research Article

Morphological Identification of Fungi Associated with the Incidence of Groundnut Leaf Spots in Lafia

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ABSTRACT

Fungal leaf spots pose a serious threat to groundnut (*Arachis hypogaea* L.) production, resulting in significant yield losses annually. This study was carried out to evaluate the incidence and identify the fungi associated with leaf spots of groundnuts in Lafia, Nasarawa State, Nigeria. Incidence of groundnut leaf spots was evaluated in four randomly selected farms in four cardinal locations in Lafia, using a 4 m × 4 m quadrat, and the data were analysed using ANOVA at the 5% level of significance. Fungi from infected groundnut leaves were isolated on PDA and morphologically identified. The highest incidence of leaf spots was recorded in Lafia East (54.47%), followed by Lafia North (49.72%), Lafia South (26.32%), and Lafia West (22.86%) (P<0.05). A total of 17 species were identified, comprising *Trichoderma* sp. 1 (n=23), *Trichoderma harzianum* (n=9), *Trichoderma* sp. 2 (n=3), *Trichoderma* sp. 3 (n=1), *Fusarium incarnatum* (n=5), *Fusarium* sp. 1 (n=1), *Fusarium chlamydosporum* (n=1), *Fusarium* sp. 2 (n=1), *Aspergillus terreus* (n=7), *Aspergillus niger* (n=3), *Curvularia lunata* (n=10), *Colletotrichum* sp. (n=2), *Mucor* sp. (n=4), *Clonostachys rosea* (n=3), *Aureobasidium pullulans* (n=7), *Penicillium oxalicum* (n=3), and *Lecanicillium lecanii* (n=4). These findings imply that leaf spots of groundnuts may be the product of a pathogen complex rather than a single entity; however, pathogenicity tests are required to establish the etiology of the disease, as the next critical step towards selecting appropriate disease management approaches to improve crop health and enhance groundnut yield of groundnuts in the study area.

Keywords: Disease incidence; Fungal species; Groundnuts; Lafia; Leaf spots

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.), also known as peanut, is an important leguminous oilseed crop widely cultivated in tropical and subtropical regions for its edible seeds and oil (Chilwal *et al.*, 2025). The crop is believed to have originated in South America, particularly in the region of present-day Bolivia and northwestern Argentina, where its wild ancestors still exist (Bertioli *et al.*, 2020; de Blas *et al.*, 2025). From its center of origin, groundnut spread to Africa, Asia, and other parts of the world through colonial trade routes and has since become a globally important crop (Umer *et al.*, 2025).

Nutritionally, groundnut is rich in oil and protein, making it a critical food resource in both developing and developed countries. Groundnut seeds contain approximately 45–50% oil and 25–30% protein, along with essential amino acids such as lysine, arginine, and methionine (Ododo *et al.*, 2026).

According to Audu *et al.* (2017), groundnut production covers over 4,000 ha, with smallholder farmers achieving a net farm income of ₦ 14,355 per hectare and a cost-benefit ratio of 1.81, demonstrating the crop's economic viability despite input constraints. Groundnut contributes meaningfully to rural livelihoods in Lafia, serving both as a key source of household income and a means to improve food security in the region. Therefore, understanding how disease affects yields in this environment can directly inform regional disease management as a means to improve food security in the region.

The incidence and severity of early and late leaf spot, rust, *Alternaria* blight, and powdery mildew have shown a marked increase in groundnut fields across Nigeria in recent years (Ajeigbe *et al.*, 2020). Studies in northern Nigeria have reported average disease severity reaching up to 45 % at peak infection stages, notably impacting pod and haulm yields (Sheriff and Turaki, 2023; Kumar *et al.*, 2022). Therefore, this study was aimed at evaluating the incidence of leaf spots, and identifying foliar fungi associated with infected groundnut leaves in Lafia, Nasarawa State. The findings are expected to inform policymaking by providing empirical evidence on disease prevalence, which could be useful in the development of evidence-based policies for crop protection and groundnut yield improvement.

MATERIALS AND METHODS

Study Area

Lafia is the capital of Nasarawa State, located on Latitude 8° 29' 17.99" N, and Longitude 8° 30' 59.99"

E, in the Southern Guinea Savannah Region of North-Central Nigeria (Mshelmbula *et al.*, 2023). The State has a total of 13 Local Government Areas on a total land mass of 27,117km². Agriculture is the mainstay of the inhabitants, and cash crops such as tomato, pepper, maize, groundnuts, etc. are the major cultivated crops in the study area (Kwon-Ndung *et al.*, 2016).

Sample Collection and Evaluation of Disease Incidence

A total of 16 farms, comprising four farms each were randomly selected from four cardinal locations (Lafia North, Lafia South, Lafia East and Lafia West) in Lafia. Within the selected farms, four infected plants were collected within four randomly placed (4 m × 4 m) quadrats, making a total of 64 plants. The samples were kept in sterile transparent polyethene bags, labeled accordingly, and transported to the Plant Science and Biotechnology Laboratory, Federal University of Lafia, Nasarawa State, for further analysis.

The percentage incidence was calculated from each quadrat using the formula:

$$\frac{\text{Number of infected plants per quadrat}}{\text{Total number of plants present within the quadrat}} \times 100$$

Isolation of Fungi from Diseased Groundnut Leaves

The modified method of Nakei *et al.* (2024) was adopted. The infected leaf tissues were cut to sizes of about 2 cm², rinsed in tap water to remove debris, and surface-sterilized by immersing in 1% Sodium Hypochlorite (NaOCl) solution for 1 min. Thereafter, the tissues were rinsed three times in sterile distilled water, and plated on sterile PDA at the rate of four tissues per plate, and three replicates per sampled location. Inoculated plates were incubated at room temperature and monitored daily for the emergence of fungal growth for a duration of seven days. Fungal growths were sub-cultured on freshly prepared PDA plates and incubated for a period of three days, to obtain pure cultures.

Identification of Fungal Isolates

The fungal isolates were identified morphologically based on colony morphology, shape and configuration of conidia, conidiophore and conidiogenous cells, hyphal septation, and branching pattern (Terna *et al.*, 2024).

Experimental Design and Data Analysis

Treatments were laid out in a Completely Randomized Design (CRD) with three replicates. Data obtained was subjected to Analysis of Variance (ANOVA) at 5% level of probability, using the Minitab Statistical Software, Version 19. The means were

separated using Tukey's Honestly Significant Difference Test.

RESULTS

Figure 1 presents the incidence of leaf spots of groundnuts in Lafia. The highest incidence was recorded in Lafia East (54.47%), followed by Lafia North (49.72%), Lafia South (26.32%), and Lafia West (22.86%). The differences in incidence of leaf spots of groundnuts among the surveyed locations were significant ($P < 0.05$), based on Tukey's HSD.

Results of morphological identification of fungi associated with diseased leaves of groundnuts in Lafia are presented in Table 1 and plates 1-17. On the basis of morphological characteristics such as colony colour, texture, elevation, margins, pigmentation, diameter, hyphal structure, type and structure of conidiophore, in addition to shape and texture of conidia, the fungal isolates were identified as *Trichoderma* sp. 1 (22 isolates), *Trichoderma harzianum* (9 isolates), *Trichoderma* sp. 2 (3 isolates), *Trichoderma* sp. 3 (1 isolate), *Fusarium incarnatum* (5 isolates), *Fusarium* sp. 1 (1 isolate), *Fusarium chlamydosporum* (1 isolate), *Fusarium* sp. 2 (1 isolate), *Aspergillus terreus* (7 isolates), *Aspergillus niger* (3 isolates), *Curvularia lunata* (11 isolates), *Colletotrichum* sp. (2 isolates), *Mucor* sp. (4 isolates), *Clonostachys rosea* (3 isolates), *Aureobasidium*

pullulans (7 isolates), *Penicillium oxalicum* (3 isolates), and *Lecanicillium lecanii* (4 isolates). A total of 87 fungal isolates were recovered from groundnut leaves in the sampled locations.

Table 2 presents the occurrence of the different fungal species associated with diseased groundnut leaves in Lafia. Of the isolated fungi, *Trichoderma* sp. 1 was the most occurring (25.29%), followed by *Curvularia lunata* (12.64%), *Trichoderma harzianum* (10.35%), both *Aspergillus terreus* and *Aureobasidium pullulans* (8.05% each), *Fusarium incarnatum* (5.75%), both *Mucor* sp. and *Lecanicillium lecanii* (4.60% each), *Trichoderma* sp. 2, *Aspergillus niger*, *Clonostachys rosea*, and *Penicillium oxalicum*, with 3.45% occurrence each, while *Trichoderma* sp. 3, *Fusarium* sp. 1, *Fusarium chlamydosporum*, and *Fusarium* sp. 2 had the least occurrence of 1.15% each.

Of the studied locations, Lafia North and Lafia West had the highest number of fungal species ($n=11$), followed by Lafia South ($n=9$), and Lafia East ($n=8$). The highest number of isolates ($n=27$) was obtained from Lafia West, followed by Lafia North ($n=25$), Lafia East ($n=18$), and Lafia South ($n=17$). Of the identified fungi, *Trichoderma* sp. 1, *Trichoderma harzianum*, *Curvularia lunata*, and *Aureobasidium pullulans* were the most widespread, as they were found on diseased groundnut leaves in all four studied locations.

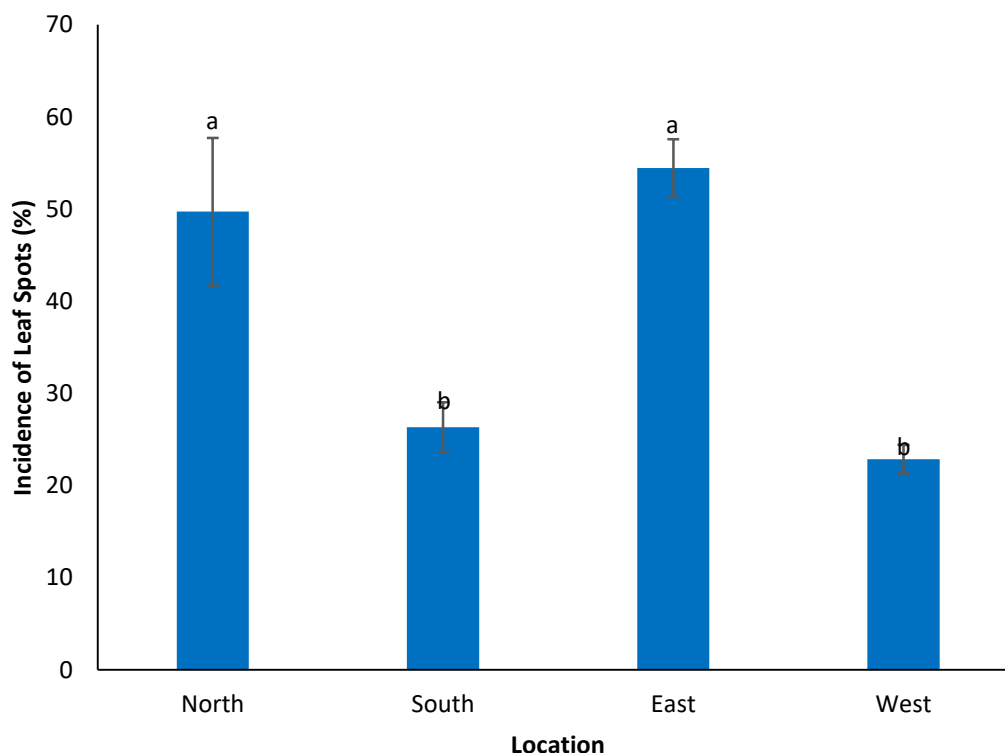


Fig. 1. Incidence of Leaf Spots of Groundnuts in Lafia

Bars with different letters are significantly different ($P < 0.05$), based on Tukey's HSD

Table 1. Morphological Identification of Fungi Associated with Diseased Leaves of Groundnuts in Lafia

Group	Macromorphology				Micromorphology			ID	No. of Isolates
	CC	TS	MCD (mm)	PG	HY	CPH	CD		
1	Deep green surrounded by gray margins	Circular, flat, faintly slimy, with filiform margins	7.80	Pale to green	Septate and highly branched	Abundant short monophialides present	Abundant endoconidia present	<i>Trichoderma</i> sp.1	23
2	Grayish green	Irregular, raised, wooly, with filiform margins	6.60	Brown	Septate, highly branched, and swollen	Abundant short monophialides present	Abundant endoconidia present	<i>Trichoderma harzianum</i> Rifai	09
3	Dull cream	Circular, powdery, flat with filiform margins	8.10	Gray to brown	Slender, sparingly branched and septate	Few slender monophialides	Globose conidia and abundant endoconidia present	<i>Trichoderma</i> sp. 2	03
4	Cream margins with green mycelia towards the center	Irregular, slightly raised, scantily wooly, with filiform margins	8.10	Brown	Septate and highly branched	Abundant short monophialides present	Abundant endoconidia present	<i>Trichoderma</i> sp. 3	01
5	Cream to beige	Irregular, raised, wooly, with filiform margins	7.05	Orange to brown	Highly septate and branched, with abundant swollen hyphae and chlamydospores	Swollen flask-shaped and cylindrical mono and poly phialides present	Conidia not found	<i>Fusarium incarnatum</i> (Desm.) Sacc.	05
6	Reddish gray	Almost circular, flat, with filiform margins	6.05	Reddish-brown	Highly septate and sparingly branched, producing chlamydospores	Long slender monophialides present	Slender, boat-shaped macroconidia present	<i>Fusarium</i> sp. 1	01
7	Pink mixed with white	Circular, raised, fluffy, with filiform margins	7.25	Reddish	Highly septate, with extensive and long branching pattern	A few slender, cylindrical and short monophialides present	Abundant endoconidia present	<i>Fusarium chlamydosporum</i> Wollenw. & Reinking	01
8	Orange margins with deep red mycelia towards the center	Circular, flat, with filiform margins	7.50	Reddish	Highly septate, with extensive and long branching pattern	Abundant slender, cylindrical and long monophialides present	Macro and microconidia present	<i>Fusarium</i> sp. 2	01
9	Grayish brown	Lobate, slightly raised, velvety, wrinkled, with irregular filiform margins	7.20	Yellow to brown	Sparingly septate and poorly branched	Conidial heads were radiate and monoseriate, bearing slender cylindrical phialides on sub-clavate vesicles	Conidia were smooth-walled, and ranged in shape from oval, globose to sub-globose	<i>Aspergillus terreus</i> Thom	07

CC = Colony colour; TS = Texture and structure; MCD = Mean colony diameter after 5 days on PDA; PG = Pigmentation; HY = Hyphae; CPH = Conidiophore; CD = Conidia

Group	Macromorphology				Micromorphology			ID	No. of Isolates
	CC	TS	MCD (mm)	PG	HY	CPH	CD		
10	Coffee brown towards the center, surrounded by grayish-brown mycelia at the margins	Powdery, almost circular, slightly raised, with filiform margins	8.00	Faint brown to yellow	Septate and sparingly branched	Conidial heads were radiate, monoseriate and biseriate, bearing slender cylindrical phialides on sub-clavate and sub-globose vesicles	Conidia were rough-walled, and mostly globose	<i>Aspergillus niger</i> van Tieghem	03
11	Grayish green	Irregular, slightly wooly, slightly raised, with entire margins. on reverse	7.05	Gray to brown	Highly septate, constricted, and sparingly branched	Conidiophores were straight, multiseptate, and scantily branched, bearing terminal conidia	Conidia were pigmented large and septate, ranging in shape from curved, obovoid to cymbiform	<i>Curvularia lunata</i> (Wakker) Boedijn	10
12	Pink mixed with white mycelia	Circular, raised, fluffy, with filiform margins	7.25	Reddish	Highly septate, highly branched, and pigmented, with clamp connections	Abundant, slender, and short to long phialides present	Conidia were short, pigmented, sickle-shaped, with single septation at the mid-point	<i>Colletotrichum</i> sp.	02
13	Orange center, surrounded by cream mycelia at the margins	Circular, raised, crateriform, fluffy, with filiform margins	7.80	Gray to pink	Highly septate and extensively branched	Sporangiophores were smooth-walled and hyaline, terminating in small oval-shaped columellae and sporangia	Small oval and mostly hyaline with a few pigmented sporangia present	<i>Mucor</i> sp.	04
14	Green mixed with gray	Irregular, slightly raised, with entire margins	6.55	Pale to dark green	Septate and highly branched	Long slender monophialides were present	Smooth-walled pear-shaped conidia present, with abundant endoconidia	<i>Clonostachys rosea</i> (Link) Schroers, Samuels, Seifert & W. Gams	03
15	Blackish brown, mixed with gray	Flat, with few aerial mycelia, surrounded by filiform margins	8.50	Blackish brown	Highly septate, constricted, swollen, and pigmented hyphae, with an extensive branching pattern	Poorly defined conidiophore	Abundant endoconidia present	<i>Aureobasidium pullulans</i> (de Bary) G. Arnaud	07
16	Green mixed with white	Slow-growing, irregular, raised, with entire margins	3.00	Faint yellow to cream	Septate hyphae with sparse branching pattern	Conidiophores were mostly terverticillate, with flask-shaped phialides	Conidia were smooth-walled, hyaline, and ellipsoidal	<i>Penicillium oxalicum</i> Currie & Thom	03
17	Cream	Circular, fast-growing, sunken in the middle, fluffy, with filiform margins	8.50	Cream to yellow	Sparingly septate hyphae with long scanty branching pattern	Long slender monophialides present	Globose and pigmented conidia present, as well as abundant endoconidia	<i>Lecanicillium lecanii</i> (Zimm.) Zare & W. Gams	04

CC = Colony colour; TS = Texture and structure; MCD = Mean colony diameter after 5 days on PDA; PG = Pigmentation; HY = Hyphae; CPH = Conidiophore; CD = Conidia

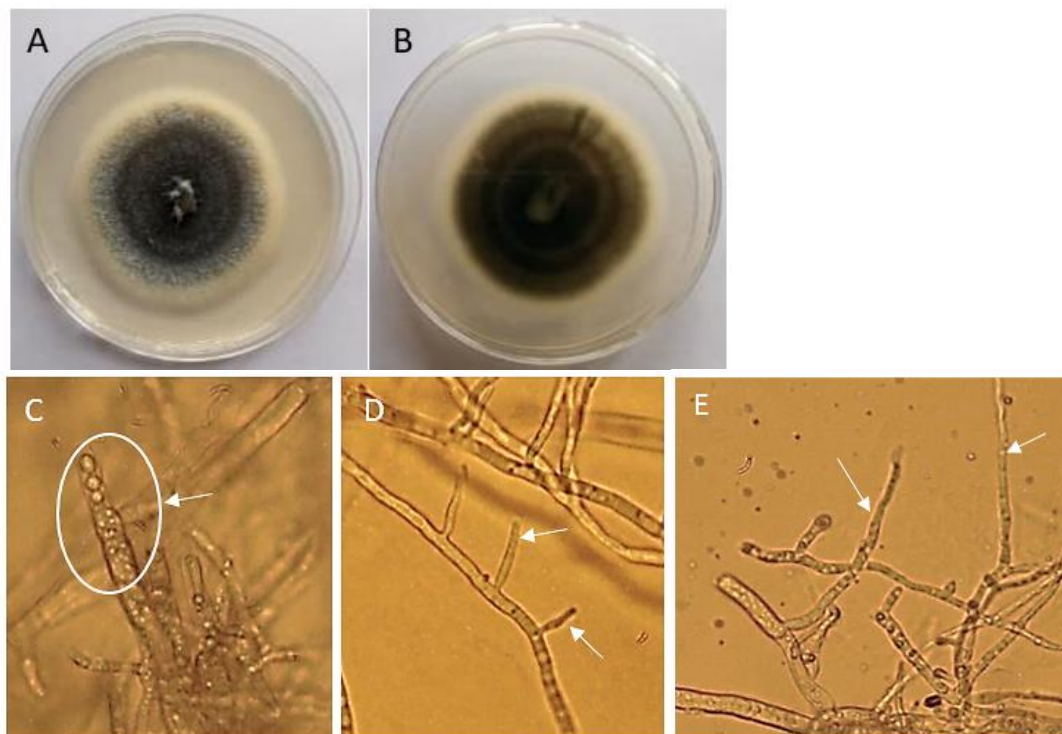


Plate 1. Morphological characteristics of *Trichoderma* sp.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Endoconidia; D). Phialides; E). Extensive hyphal branching (x40).

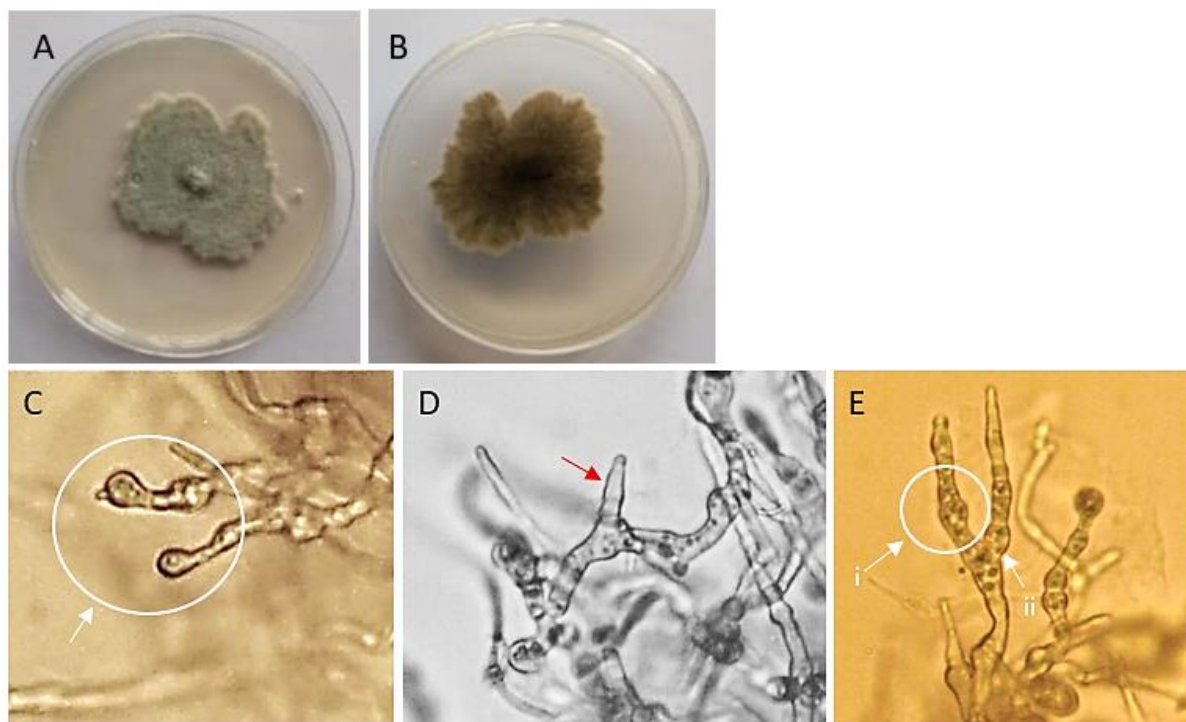


Plate 2. Morphological characteristics of *Trichoderma harzianum*.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Swollen hyphae; D). Short phialide; E). Endoconidia; Eii) Hyphal branching (x40).

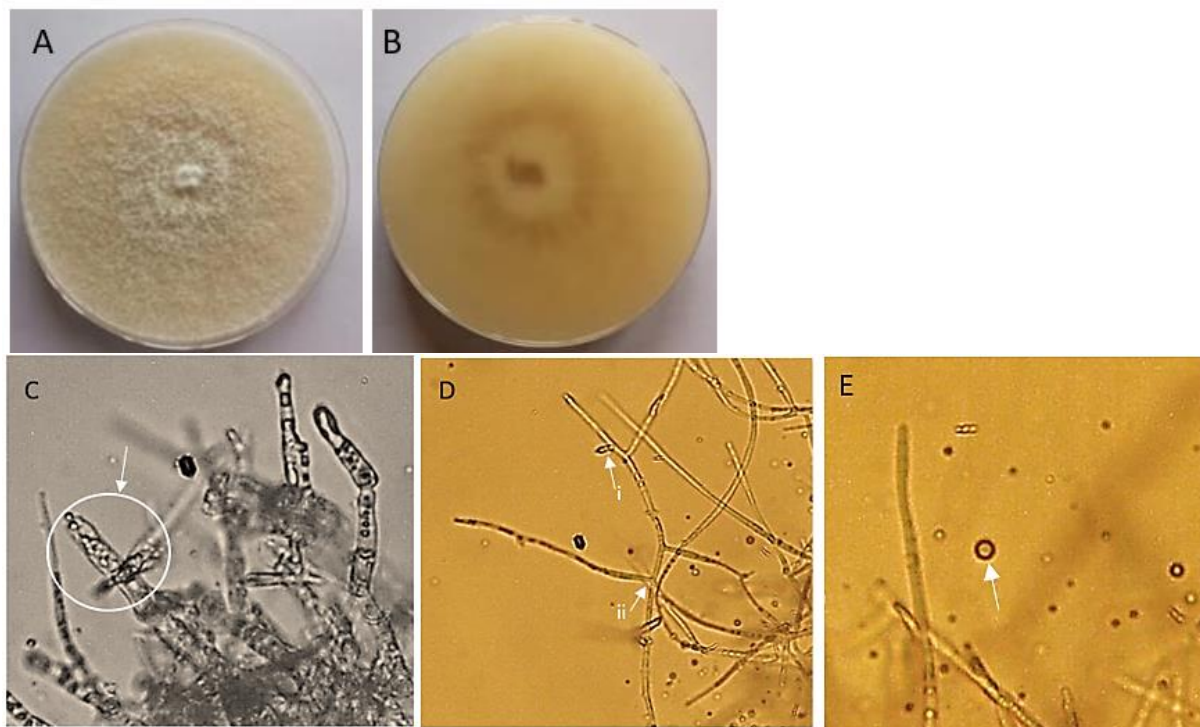


Plate 3. Morphological characteristics of *Trichoderma* sp.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Endoconidia; Di). Short phialide; Dii). Hyphal branching; E). Oval conidium (×40).

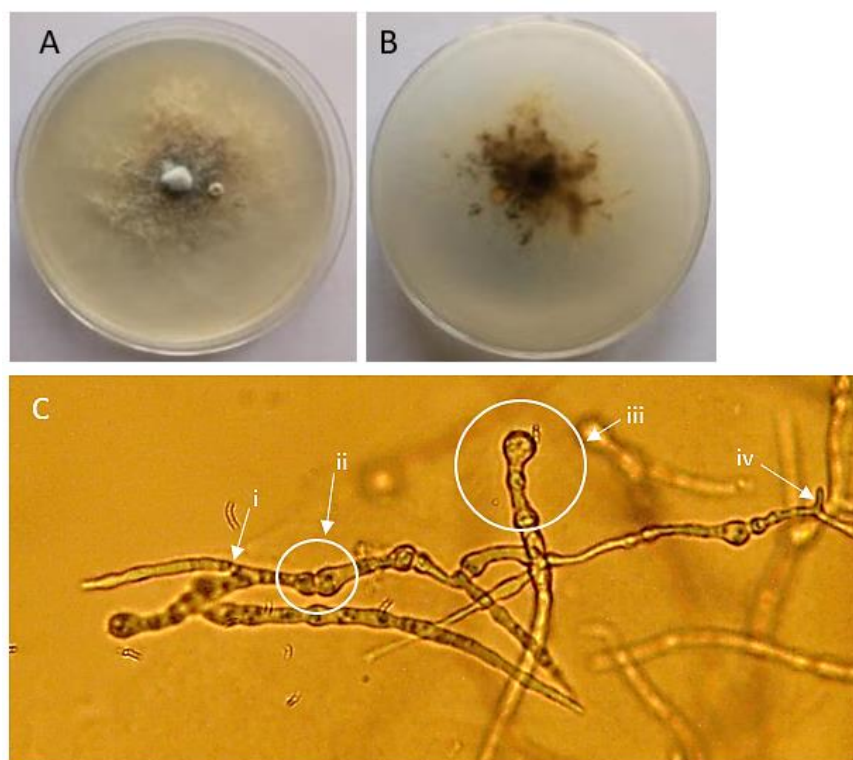


Plate 4. Morphological characteristics of *Trichoderma* sp.

A). Colony appearance on PDA; B). Pigmentation on reverse; Ci). Hyphal branching; Cii). Endoconidia; Ciii). Swollen hyphae; Civ). Short phialide (×40).

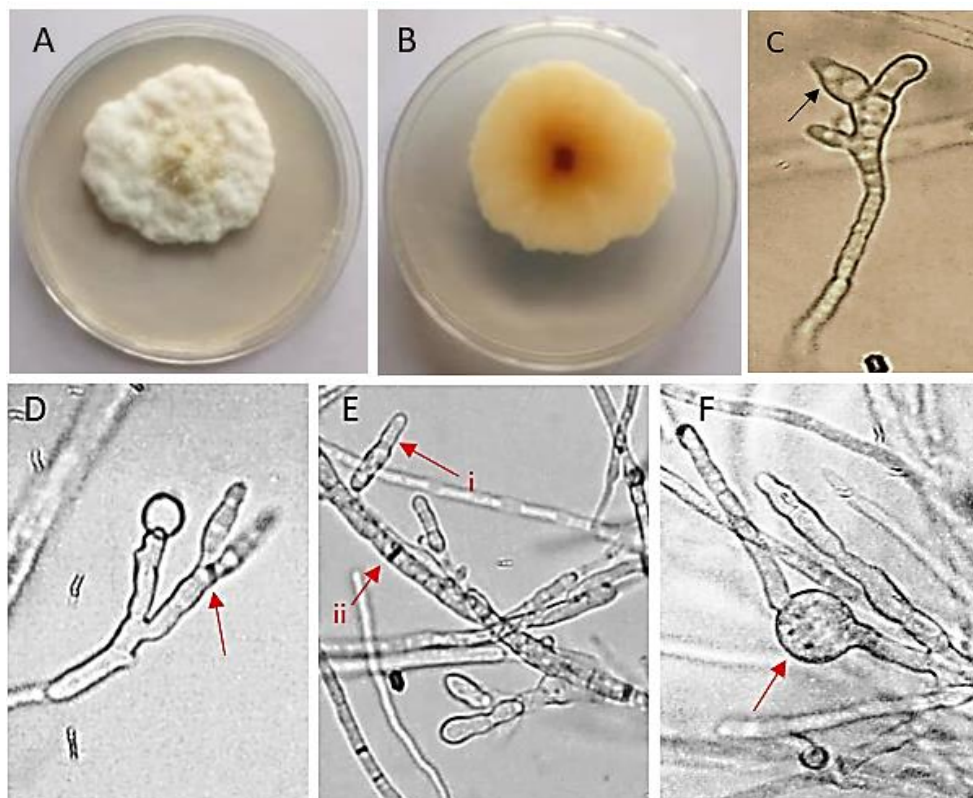


Plate 5. Morphological characteristics of *Fusarium incarnatum*.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Flask-shaped monophialide; D). Polyphialides; E). Cylindrical monophialide; Eii). Septate hyphae; F). Intercalary chlamydospore (×40).

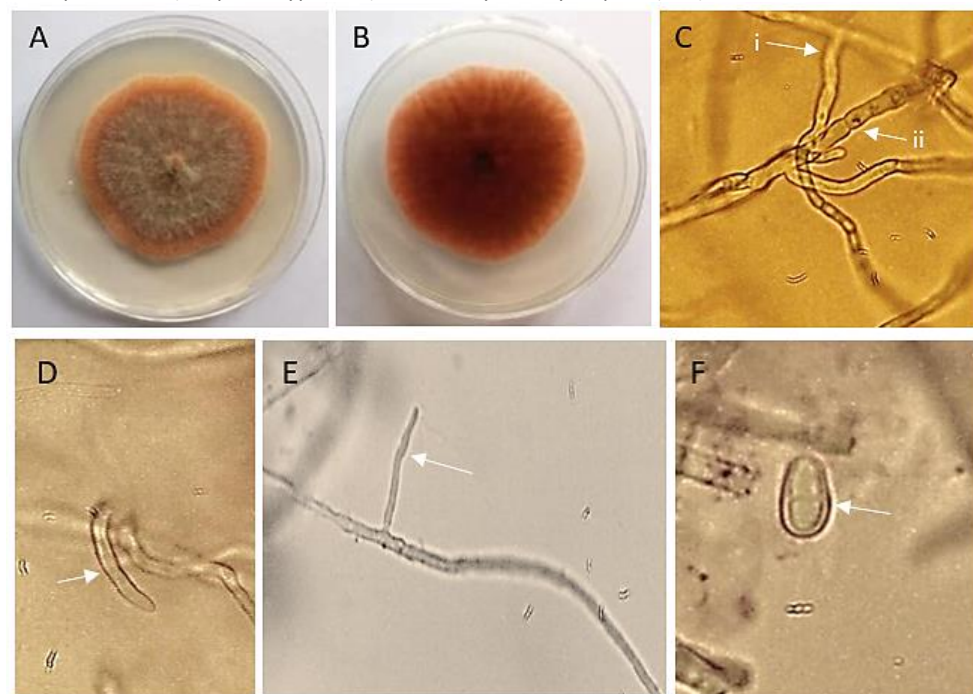


Plate 6. Morphological characteristics of *Fusarium* sp.

A). Colony appearance on PDA; B). Pigmentation on reverse; Ci). Long hyphal branching; Cii). Hyphal septation; D). Macroconidium; E). Long slender monophialide; F). Detached chlamydospore (×40).

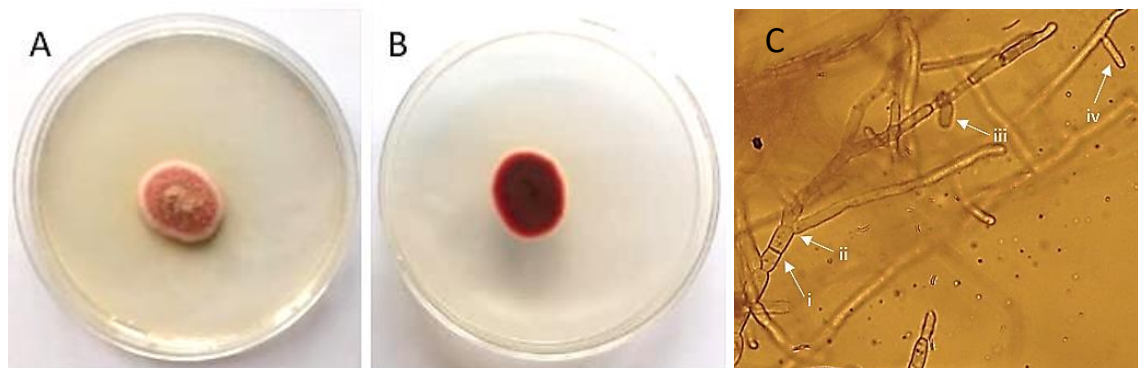


Plate 7. Morphological characteristics of *Fusarium chlamydosporum*.

A). Colony appearance on PDA; B). Pigmentation on reverse; Ci). Hyphal septation; Cii). Long hyphal branching; Ciii). Microconidium; Civ). Monophialide (x40).

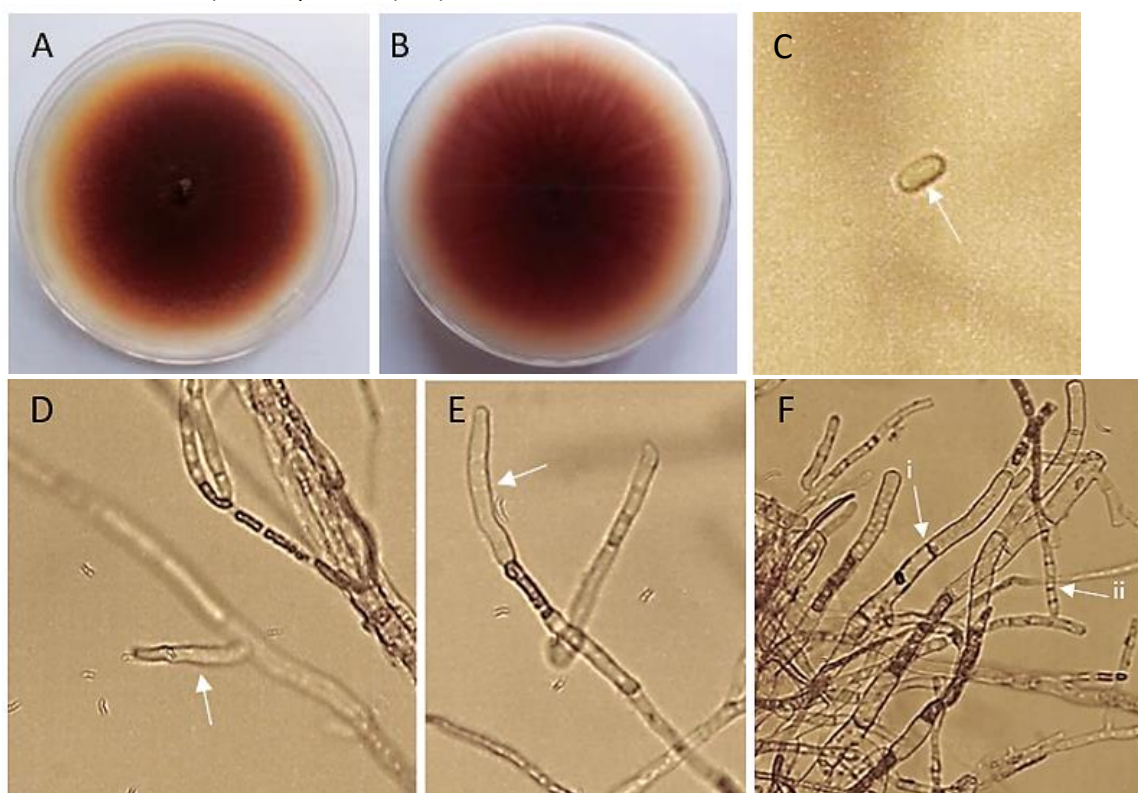


Plate 8. Morphological characteristics of *Fusarium* sp.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Microconidium; D). Monophialide; E). Undetached macroconidium; Fi). Septate hyphae; Fii). Hyphal branching (x40).

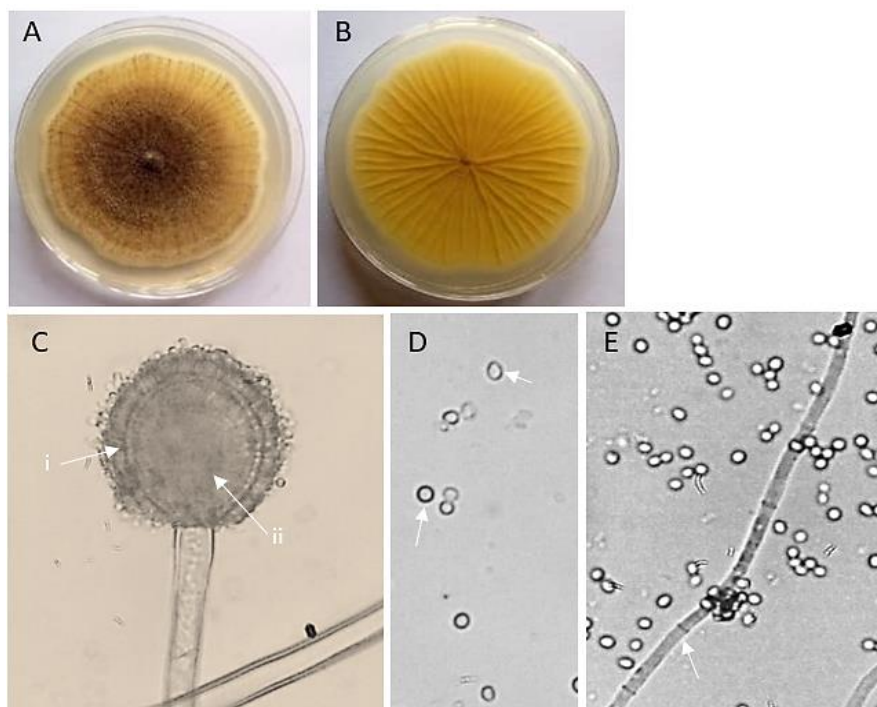


Plate 9. Morphological characteristics of *Aspergillus terreus*.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Monoseriate phialides; Cii). Subclavate vesicle; D). Conidia; E). Septate hyphae (x40).

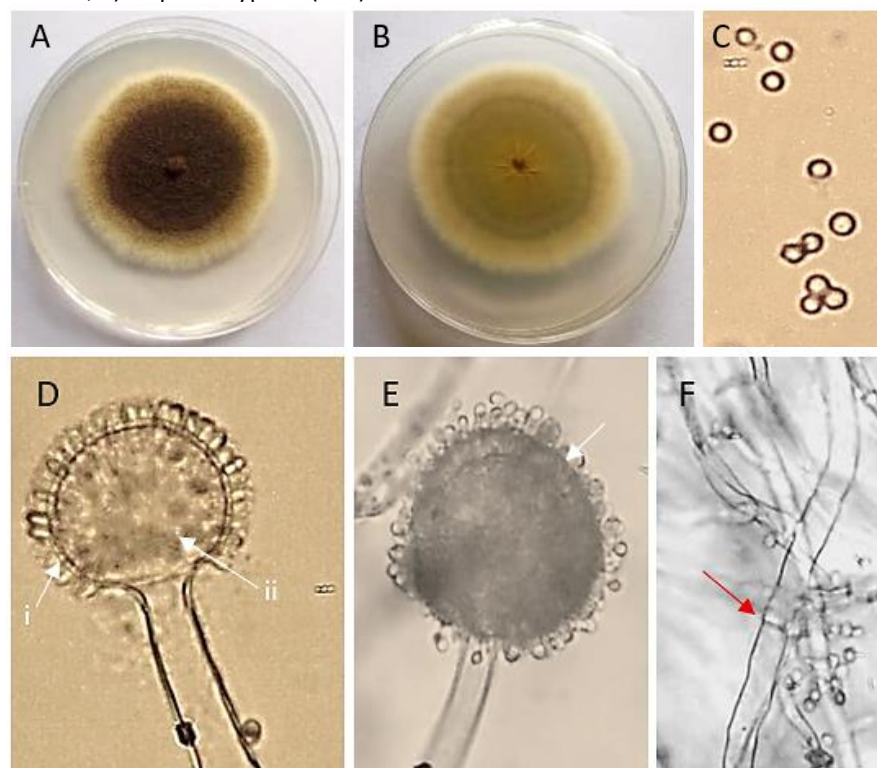
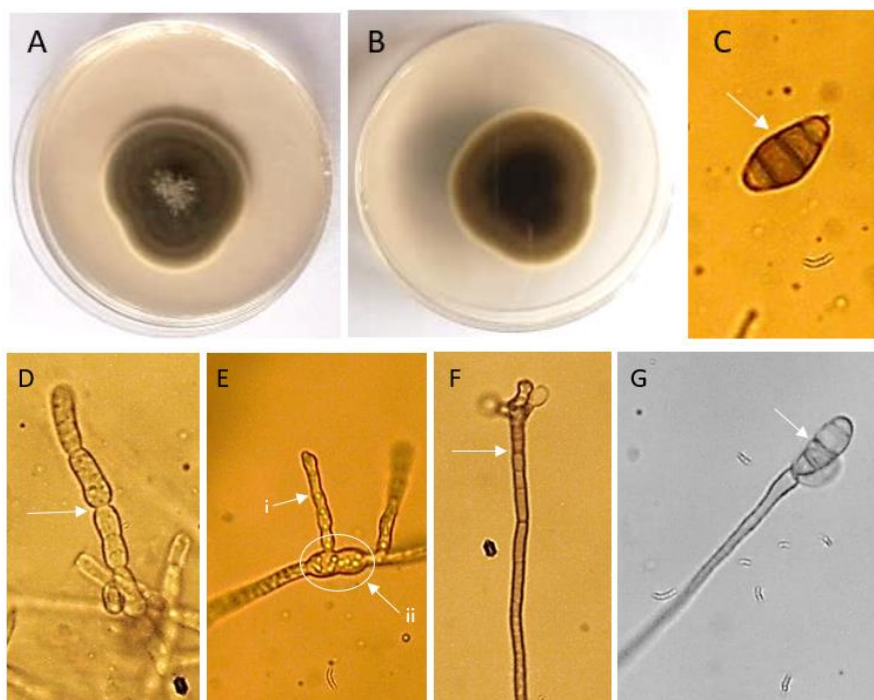


Plate 10. Morphological characteristics of *Aspergillus niger*.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Conidia; Di). Monoseriate phialides; Dii). Subglobose vesicle; E). Biseriate phialides; F). Septate hyphae (x40).



late 11. Morphological characteristics of *Curvularia lunata*.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Pigmented and segmented conidium; D). Constricted hyphae; E). Hyphal branching; Eii). Endoconidia; F). Septate conidiophore; G). Terminal conidium (x40).

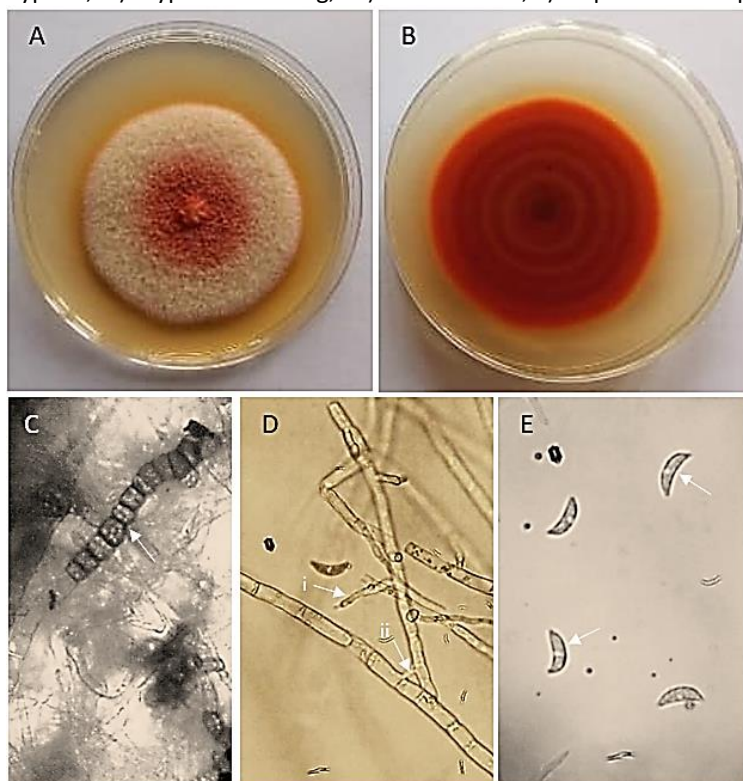


Plate 12. Morphological characteristics of *Colletotrichum* sp.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Constricted and pigmented hyphae; D). Slender and cylindrical phialide; Dii). Clamp connection; E). Conidia (x40).

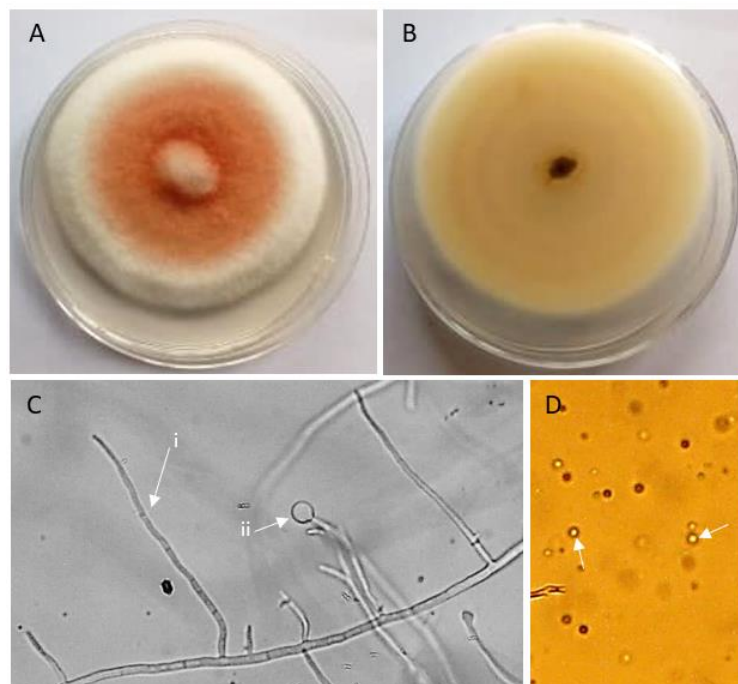


Plate 13. Morphological characteristics of *Mucor* sp.

A). Colony appearance on PDA; B). Pigmentation on reverse; Ci). Septate hyphal branch; Cii). Sporangium; D). Sporangiospores (×40).

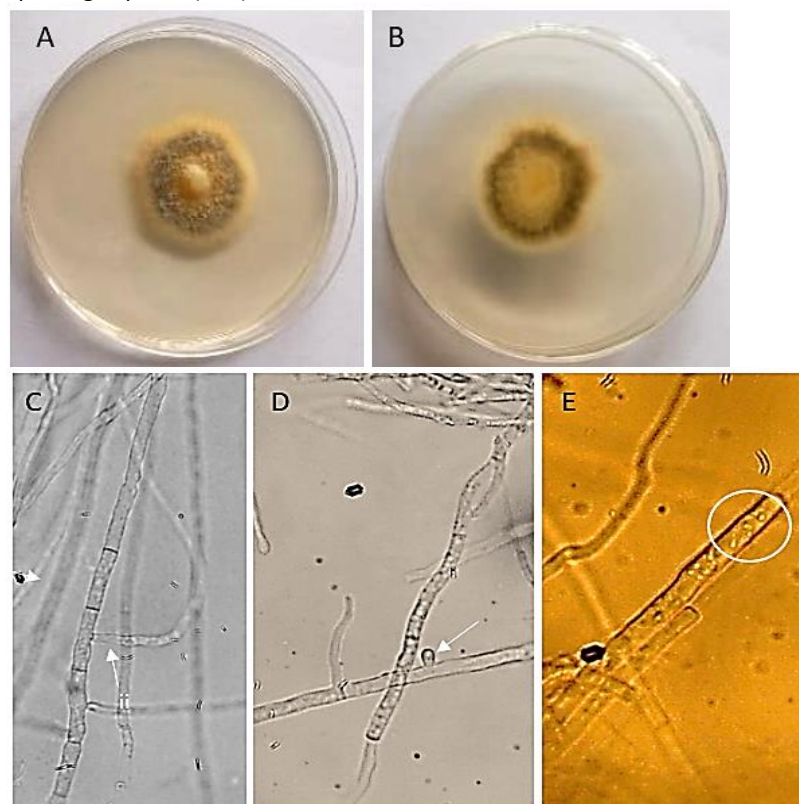


Plate 14. Morphological characteristics of *Clonostachys rosea*.

A). Colony appearance on PDA; B). Pigmentation on reverse; Ci). Septate hyphae; Cii). Hyphal branching; D). Bean shaped conidium; E). Endoconidia (×40).

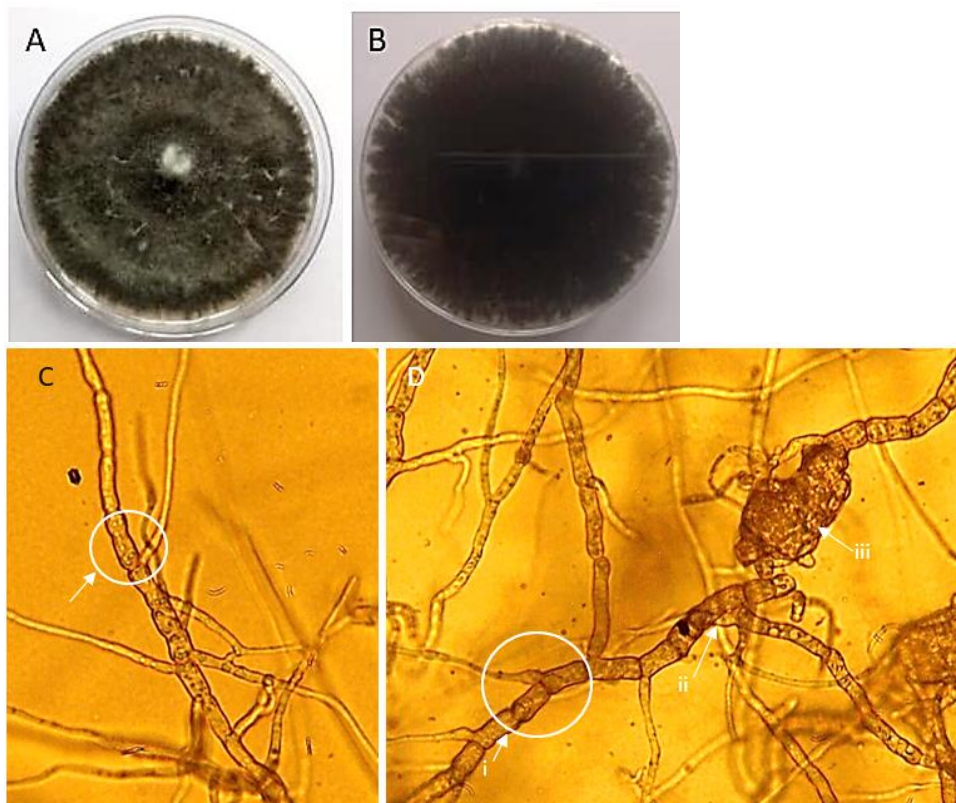


Plate 15. Morphological characteristics of *Aureobasidium pullulans*.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Endoconidia; Di). Extensive hyphal segmentation; Dii). Hyphal branching; Diii). Pigmented hyphal swelling (x40).

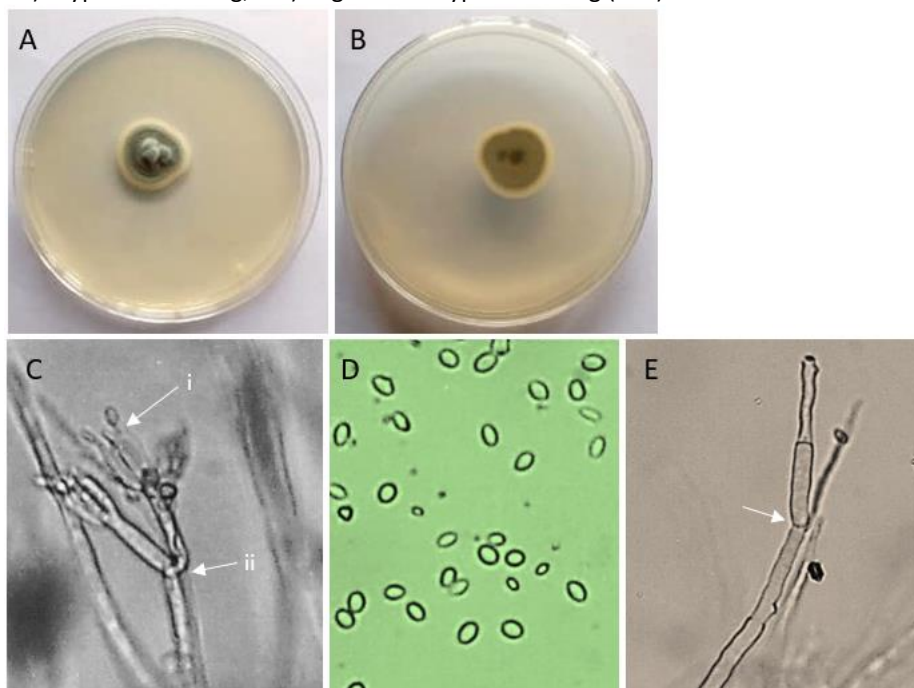


Plate 16. Morphological characteristics of *Penicillium oxalicum*.

A). Colony appearance on PDA; B). Pigmentation on reverse; Ci). Flask-shaped phialide; Cii). Terverticillate conidiophore; D). Ellipsoidal conidia; E). Hyphal branching (x40).

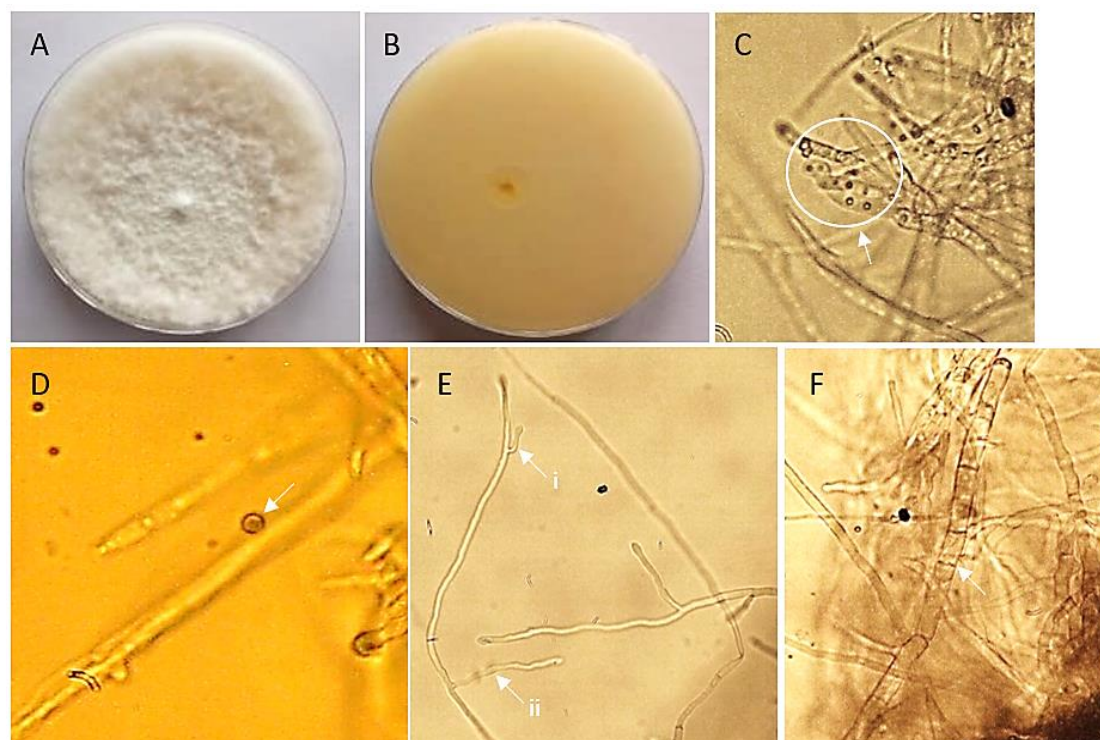


Plate 17. Morphological characteristics of *Lecanicillium lecanii*.

A). Colony appearance on PDA; B). Pigmentation on reverse; C). Endoconidia; D). Conidium; E). Phialide; F). Hyphal branching; F). Septate hyphae (×40).

Table 2. Occurrence of Fungal Species on Diseased Groundnut Leaves in Lafia

Fungal Species	Species Occurrence				Total
	Lafia North	Lafia South	Lafia East	Lafia West	
<i>Trichoderma</i> sp. 1	10(11.49%)	3(3.45%)	5(5.75%)	4(4.60%)	22(25.29%)
<i>Trichoderma harzianum</i>	1(1.15%)	2(2.30%)	3(3.45%)	3(3.45%)	9(10.35%)
<i>Trichoderma</i> sp. 2	2(2.30%)	1(1.15%)	-	-	3(3.45%)
<i>Trichoderma</i> sp. 3	1(1.15%)	-	-	-	1(1.15%)
<i>Fusarium incarnatum</i>	2(2.30%)	1(1.15%)	-	2(2.30%)	5(5.75%)
<i>Fusarium</i> sp 1	-	-	1(1.15%)	-	1(1.15%)
<i>Fusarium chlamydosporum</i>	1(1.15%)	-	-	-	1(1.15%)
<i>Fusarium</i> sp 2	-	-	-	1(1.15%)	1(1.15%)
<i>Aspergillus terreus</i>	2(2.30%)	4(4.60%)	1(1.15%)	-	7(8.05%)
<i>Aspergillus niger</i>	-	-	-	3(3.45%)	3(3.45%)
<i>Curvularia lunata</i>	2(2.30%)	1(1.15%)	5(5.75%)	3(3.45%)	11(12.64%)
<i>Colletotrichum</i> sp.	1(1.15%)	-	1(1.15%)	-	2(2.30%)
<i>Mucor</i> sp.	-	2(2.30%)	1(1.15%)	1(1.15%)	4(4.60%)
<i>Clonostachys rosea</i>	1(1.15%)	1(1.15%)	-	1(1.15%)	3(3.45%)
<i>Aureobasidium pullulans</i>	2(2.30%)	2(2.30%)	1(1.15%)	2(2.30%)	7(8.05%)
<i>Penicillium oxalicum</i>	-	-	-	3(3.45%)	3(3.45%)
<i>Lecanicillium lecanii</i>	-	-	-	4(4.60%)	4(4.60%)
Total	25(28.74%)	17(19.54%)	18(20.69%)	27(31.04%)	87(100.00%)

- = Species not found

DISCUSSION

The study revealed significant differences in the incidence of groundnut leaf spot disease among the surveyed locations in Lafia, with the highest incidence recorded in Lafia East and the lowest in Lafia West. These variations may be attributed to differences in environmental conditions, cropping practices, host susceptibility, and the amount of pathogen inoculum present in each location. Environmental factors such as temperature, humidity, and rainfall have been reported to influence the development and spread of groundnut leaf spot diseases in the Southern Guinea Savannah of Nigeria (Richard *et al.*, 2017).

Morphological characterization of diseased leaf samples showed that a diverse fungal community was associated with groundnut leaf spots in Lafia, with a total of 87 isolates belonging to 17 fungal taxa. The predominance of *Trichoderma* spp., *Curvularia lunata*, *Aspergillus terreus*, *Aureobasidium pullulans*, *Fusarium* spp., and *Lecanicillium lecanii* indicates that groundnut leaves harbour both pathogenic and saprophytic fungi. This finding is consistent with previous studies conducted in Lafia, where *Fusarium incarnatum*, *Curvularia lunata*, and *Aureobasidium pullulans* were isolated from diseased groundnut leaves and implicated in foliar disease development (Joseph *et al.*, 2025).

The occurrence of *Curvularia lunata*, *Fusarium* spp., *Aspergillus* spp., and *Penicillium* spp. in the present study also agrees with reports from other parts of Nigeria, where these fungi have frequently been associated with groundnuts and other agricultural commodities (Oyedele *et al.*, 2017). Similarly, Akharenegebe *et al.* (2022) reported the occurrence of several species of *Aspergillus*, *Fusarium*, and *Penicillium* in stored groundnuts collected from different agricultural zones of Nasarawa State, suggesting that these fungal genera are widely distributed within the state and are well adapted to local environmental conditions.

The high occurrence of *Trichoderma* species observed in this study is similar to reports from agricultural soils and plant tissues in Nigeria, where *Trichoderma* species have been commonly isolated because of their rapid growth, competitive ability, and adaptation to diverse ecological niches (Terna, 2015). Although *Trichoderma* species are widely recognized as beneficial fungi and biological control agents, their frequent recovery from diseased tissues may reflect secondary colonization of infected plant material rather than primary pathogenicity (Harman *et al.*, 2004; Natsiopoulou *et al.*, 2024). Furthermore, the

high natural abundance of native *Trichoderma* species in this study could represent a valuable indigenous resource for disease management. In vitro and subsequent field-based screening of the recovered *Trichoderma* isolates for antagonistic activity against the confirmed leaf spot pathogens could inform the development of locally adapted biocontrol formulations. This approach would offer a sustainable, environment-compatible component for integrated management strategy (Zin *et al.*, 2020).

The isolation of *Curvularia lunata* and *Fusarium* species corroborates earlier findings in Lafia and North-Central Nigeria, where these fungi were reported among the most common fungi associated with diseased groundnut tissues and other crop plants (Joseph *et al.*, 2025; Ezekiel *et al.*, 2020). The isolation of *Aureobasidium pullulans* further supports previous observations in Lafia, where the fungus was identified among the dominant fungi associated with foliar diseases of groundnut (Joseph *et al.*, 2025).

Furthermore, beyond their implication in leaf spot etiology, several fungal genera recovered in this study, notably *Aspergillus* and *Fusarium*, include species with recognized potential for the production of mycotoxins such as aflatoxins and fumonisins (Magomya *et al.*, 2023). The presence of these genera on foliar tissues raises the possibility of pod and seed contamination during later stages of crop development, an important food safety consideration for groundnut production in Nasarawa State.

CONCLUSION

This study revealed that groundnut leaf spots disease is prevalent in Lafia, with significant differences in disease incidence among the surveyed locations. Lafia East recorded the highest disease incidence, while Lafia West had the lowest. Morphological identification showed that infected groundnut leaves were associated with a vast array of fungi, comprising 17 fungal species across 10 genera, with the genus *Trichoderma* being the most prevalent. These findings suggest that leaf spots of groundnuts could be the product of a pathogen complex rather than a single entity, requiring integrated disease management strategies to improve crop health and enhance yield of groundnuts in the study area. Further studies involving molecular identification and pathogenicity tests will accurately determine the organisms responsible for the observed symptoms, and enhance evidence-based management approaches for disease management of groundnut leaf spots.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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