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MORPHOLOGICAL CHARACTERIZATION OF *Fusarium oxysporum*-ONE OF THE NEW JUTE PATHOGENS

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ABSTRACT

Fusarium oxysporum, a soil-borne pathogen, is increasingly recognized as a significant threat to jute (*Corchorus* spp.) production in Bangladesh. This study aims to provide a comprehensive morphological characterization of this new jute pathogen. Detailed microscopic analyses were conducted to elucidate the morphological features of *F. oxysporum* isolates collected from diseased jute plants in various regions. Key morphological traits, including mycelial structure, and conidial morphology, were documented. The findings revealed distinct morphological clues that can help the rapid identification of *F. oxysporum* affecting the jute. The results of this study provide insight on the morphology of *F.* oxysporum and lay the foundation for the development of targeted disease management strategies in jute.

Key words: *Fusarium oxysporum*, jute, fusarium wilt, macroconidia, microconidia, chlamydospores

Introduction

Jute (*Corchorus* spp.), often referred to as the "golden fiber," is an essential natural fiber crop primarily grown in tropical regions, especially in South Asia. Jute fibers are widely used for making ropes, bags, textiles, and various other products, contributing significantly to the economy of jute-producing countries (Islam, 2014). The sustainable production of jute is critical, not only for economic reasons but also for environmental sustainability, given its biodegradable and renewable nature (Roy *et al*., 2011). However, the cultivation of jute faces several challenges, with diseases being one of the most significant threats. Among the diseases, fusarium wilt, caused by *Fusarium oxysporum*, has emerged as a notable problem (Wali *et al*., 2019; Booth, 1971). *Fusarium oxysporum* is a well-known soil-borne pathogen with a broad host range, causing vascular wilt diseases in many economically important crops (Agrios, 2005). The pathogen invades the vascular system of plants, leading to symptoms such as yellowing, stunting, and wilting, which can result in substantial yield losses (Nelson *et al*., 1983). In recent years, *F. oxysporum* has been identified as a pathogen of jute, raising concerns among jute farmers and researchers alike. Given the pathogen's notorious reputation and the economic importance of jute, understanding the morphological characteristics of *F. oxysporum* isolates from jute is crucial for developing effective disease management strategies (Leslie and Summerell, 2006). Morphological characterization is a fundamental step in pathogen identification, providing essential information for distinguishing *F. oxysporum* from other *Fusarium* species and related pathogens (Tewari and Skoropad, 1977). *Fusarium oxysporum* is characterized by its production of various types of spores, including macroconidia, microconidia and chlamydospores. These spores differ in their shape, size, and formation patterns, which are key features used in the identification and classification of the pathogen (Booth, 1971). Macroconidia are typically sickle-shaped and multi-septate, microconidia are usually single-celled and formed in false heads, and chlamydospores are thick-walled resting spores that help the pathogen survive under adverse conditions (Nelson *et al*., 1983). Previous studies have highlighted the importance of detailed morphological studies in understanding the diversity and pathogenicity of *Fusarium* species (Leslie and Summerell, 2006). By comparing the morphological traits of *F. oxysporum* isolates from jute with those from other hosts, researchers can

identify unique markers that facilitate rapid and accurate identification (Tewari and Skoropad, 1977). This, in turn, aids in the development of targeted disease management strategies, including breeding for resistant varieties and implementing effective crop rotation practices (Agrios, 2005). The primary objective of this study is to provide a comprehensive morphological characterization of *F. oxysporum* isolates obtained from diseased jute plants. By documenting and analyzing key morphological features such as mycelial structure, and conidial morphology, we aim to enhance the understanding of this pathogen's biology and its impact on jute cultivation. The findings of this study will contribute to the broader knowledge of fusarium wilt in jute and support the development of effective management strategies to mitigate the impact of the disease on jute production.

Materials and Methods

Sample Collection: Diseased jute plants exhibiting symptoms of fusarium wilt, such as yellowing, stunting, and vascular discoloration, were collected from various jute growing regions such as Dhaka, Manikgonj, Kishorgonj, Rangpur, Faridpur and Monirampur (Jashore). These regions were selected based on reports of high incidence of fusarium wilt in jute, ensuring a diverse range of isolates. Plants/plant parts were carefully collected and transported to the laboratory in sterile bags to prevent contamination.

Isolation and Cultivation: In the laboratory, small segments (approximately 1 cm^2) of infected plant parts were excised from the root and stem of each diseased plant. The tissue segments were surface-sterilized by immersing them in 70% ethanol for 1 minute, followed by 1% sodium hypochlorite solution for 3 minutes, and finally rinsed in sterile distilled water three times. The sterilized tissue segments were then placed on potato dextrose agar (PDA) plates supplemented with 50 ppm Autostin 50WDG and 50 ppm Streptomycin sulphateand incubated at 25°C for 5-7 days. Emerging fungal colonies were sub-cultured onto fresh PDA plates to obtain pure cultures. Sub-culturing was repeated until pure isolates of *Fusarium oxysporum* were obtained, characterized by their typical colony morphology. These pure cultures were maintained on dry filter paper at -20°C for further studies.

Morphological analysis

Mycelial growth and colony characteristics: The morphological characteristics of *F. oxysporum* isolates were examined on PDA. Three replicate cultures of each isolate were incubated at 25 °C. After 7 days, the growth rate and colony morphology, including color, texture, and zonation, were documented. Colony diameter was measured and growth rate was calculated as the total growth divided by seven.

Microscopic examination of spores: To examine spore morphology, small mycelial blocks from the edge of actively growing cultures were placed on sterile slides in a drop of calcofluor white stain. Cover slips were carefully placed over the blocks, and the preparations were observed under ultraviolet light in a fluorescent microscope.

Results and Discussion

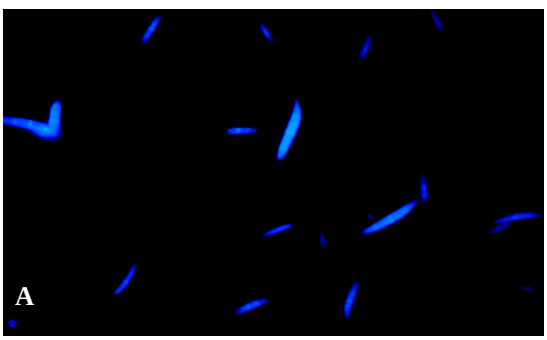
Isolation and Cultivation: A total of 23 *Fusarium oxysporum* isolates pure cultures were collected from fusarium wilt affected jute plants (Table 1).

Mycelial Growth and Colony Characteristics: The mycelium color, texture, border, and pigmentation of each isolate varied (Table 1 and Fig. 2). A range of colony colors, including white, reddish white, salmon white, Light pinkish white, white with pinkish center, pinkish white, white with light pink center, whitish pink, reddish pink, and pinkish red, were seen in the cultures of the various isolates. The bulk of isolates had cottony or flat with cottony mycelium, although other isolates had flat, velvety, and thread-like mycelium. In most isolates, the margin appearance was normal; in few isolates, it was irregular, and in others, it was slightly irregular. These findings concurred with those of Nath *et al*. (2017), who found that the colony development pattern, size, and texture of *F. oxysporum* isolates varied greatly. Burgess *et al*. (1989) also came to the conclusion that colony morphology of *F.oxysporum* was too varied.

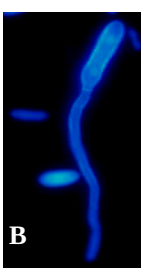
Table 1. Detailed description of colony formation on PDA medium by the *Fusarium oxysporum* isolates

Sl	Colony		
	Color	Shape	Growth rate (mm)
1	Pinkish white on the upper surface and white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- weak	10.5
2	Pinkish white on the upper surface and white to orange on the lower surface	Margin- regular hairy, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- weak to medium	8.2
3	Salmon with white on the upper surface and Salmon with white wrinkled on the lower surface	Margin- regular hairy, colony appearance- smooth with wrinkled, mycelial growth- flat with scattered cottony, sporulation- all over the colony, zonation- absent, density- medium to strong	7.5
4	white on the upper surface and white with mild pinkish on the lower surface	Margin- regular hairy, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- weak to medium	7.9
5	White with pinkish center on the upper surface and pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- weak to medium	6.9
6	White on the upper surface and pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- weak to medium	8.7
7	Reddish white on the upper surface and reddish pink on the lower surface	Margin- irregular, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- strong	6.8
8	White on the upper surface and pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- medium to strong	8.5
9	Reddish pink on the both surface	Margin- regular hairy, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- weak to medium	8.5
10	Whitish red on the upper surface and red on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- medium to strong	9.5
11	Pinkish red on the upper surface and reddish pink on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- weak to medium	9.1
12	Reddish white with orange margin on the upper surface and reddish pink on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- flat with cottony, sporulation- concentric ring, zonation- present, density- strong	7.3
13	Whitish pink on the upper surface and pinkish white on the lower surface	Margin- regular hairy, colony appearance- smooth, mycelial growth- flat, sporulation- all over the colony, zonation- absent, density- weak	8.7
15	Whitish pink on the upper surface and reddish pink on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- flat with scattered cottony, sporulation- all over the colony, zonation- present, density- medium	10.38
16	White on the upper surface and light pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- weak to medium	8
17	Light pinkish white on the upper surface and pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- weak to medium	6.88

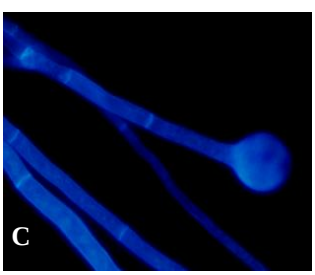
Sl	Colony		
	Color	Shape	Growth rate (mm)
18	White on the upper surface and light pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- medium	8.13
19	White on the upper surface and pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- medium to strong	9.38
20	White on the upper surface and pinkish white on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- medium to strong	9.75
22	Whitish pink on the upper surface and pink on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- velvety, sporulation- all over the colony, zonation- absent, density- medium to strong	7.1
23	White on the upper surface and white with pinkish center on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- velvety, sporulation- all over the colony, zonation- absent, density- medium to strong	7.6
24	Pinkish white with grey ring in the middle on the upper surface and pinkish white with grey ring in the middle on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- flat with velvety, sporulation- all over the colony, zonation- present, density- weak to medium	7.9
25	Whitish pink on the upper surface and whitish pink on the lower surface	Margin- regular, colony appearance- smooth, mycelial growth- cottony, sporulation- all over the colony, zonation- absent, density- medium	8.8



Macroconidia and microconidia



Conidial germination



chlamydospore

Fig. 1: Microscopic observation of *Fusarium oxysporum* islates. A, Macroconidia and microconidia. B, Conidial germination. C, Chlamydospore

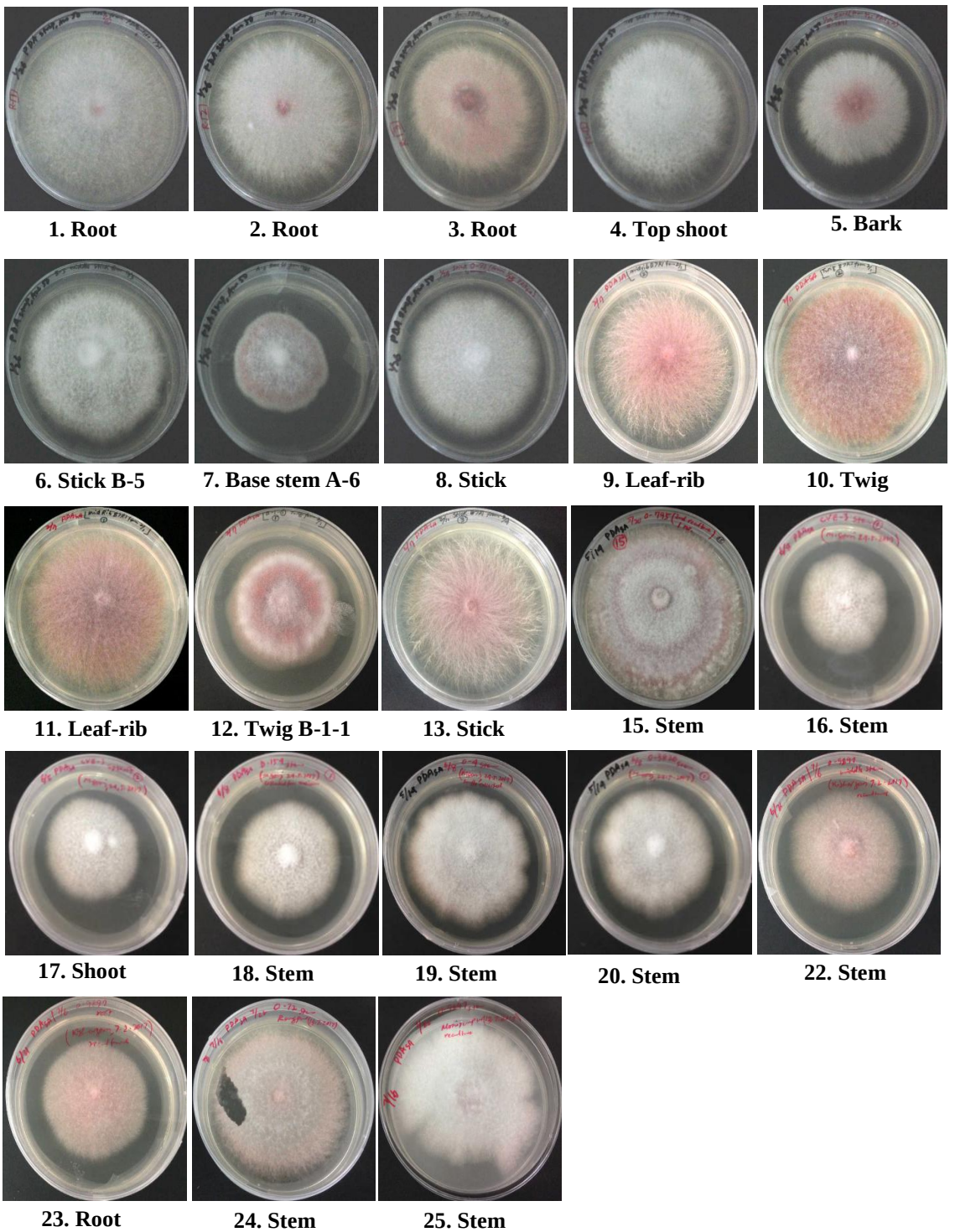


Fig. 2. Cultural characteristics of *Fusarium oxysporum* isolates on PDA medium collected from different parts of infected jute plants

Macroconidia and Microconidia: The macroconidia of *F. oxysporum* isolates were observed to be typically sickle-shaped, with 3-5 septa. The average length of the macroconidia ranged from 27 to 38 µm, while the width ranged from 3 to 5 µm (Fi. 1). These measurements are consistent with the descriptions provided by Booth (1971) and Nelson *et al.* (1983). The pointed apical cell and the foot-shaped basal cell were distinctive features observed under the microscope, confirming the identity of the pathogen (Nelson *et al*., 1983). Microconidia were abundant, oval to ellipsoid in shape, and typically non-septate. They measured 7-12 µm in length and 2-3 µm in width (Fig. 1).

Chlamydospores: Chlamydospores were globose, thick-walled, and formed singly or in pairs within the mycelium or terminally (Fig. 1). Their diameter ranged from 7 to 12 µm. The formation of chlamydospores in older cultures was observed, which is a survival mechanism for the pathogen under adverse conditions (Nelson *et al*., 1983). This trait is significant for the long-term persistence of F. oxysporum in soil, contributing to the difficulty in eradicating the pathogen from infected fields (Tewari and Skoropad, 1977).

Conclusion

The morphological characterization of *Fusarium oxysporum* isolated from jute provides crucial insights into its identification and differentiation from other *Fusarium* species. The distinctive features such as sickle-shaped macroconidia, and abundant microconidia formation are key diagnostic markers. This study enhances our understanding of the pathogen's morphology and lays the groundwork for further research into its biology and control measures. Effective disease management strategies can now be developed to mitigate the impact of this pathogen on jute cultivation.

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