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New Report of Death Terror *Pterulicium xylogenum* in Edible Bamboo of Tripura

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The presence of fungal rot disease in the edible bamboo shoot of *Melocanna baccifera* in Tripura was reported for first time. The morphological and hierarchical status were also studied in detail. *In situ* pathogenicity test was carried out according to Koch's postulate through which rot pathogen *Pterulicium xylogenum* was re-isolated.

Key words: *Pterulicium xylogenum*, edible bamboo, death-terror, new report.

Total 19 major bamboo species (Forest report of Tripura, 2002) found in Tripura are – Mrittinga (*Bambusa tulda* Roxb.), Borak (*Bambusa balcooa* Roxb.), Kanta bansh - *Bambusa bambos* (L.) Voss, Bom bansh (*Bambusa cacharensis* Majumdar), Kanak kai (*Bambusa comillensis* Alam), Tetua (*Bambusa jaintiana* Majumdar), Makal (*Bambusa nutans* Wall. ex. Munro), Paorah (*Bambusa polymorpha* Munro), Baari (*Bambusa vulgaris* Schrad. ex Wendl.), Kanta Barak (*Bambusa salarkhanii* Alam), Lanthi bansh - *Dendrocalamus strictus* (Roxb.) Nees, Pencha (*Dendrocalamus hamiltonii* Nees et Arn. ex Munro), Rupai (*Dendrocalamus longispathus* Kurz), Kanak kaich (*Thyrsostachys oliveri* Gamble), Kailai (*Gigantochloa andamanica* (Kurz) Kurz.), Kaali - *Gigantochloa rostrata* Wong (syn. *Oxytenanthera nigrociliata* Munro), Lataa bansh (*Melocalamus compactiflorus* (Kurz) Benth.), Muli - *Melocanna baccifera* (Roxb.) Kurz and Dolu bansh (*Schizostachyum dullooa* (Gamble) Majumdar).Out of these nineteen species found in the state, muli bamboo [*Melocanna baccifera* (Roxb.) Kurz] is one of the most palatable edible species. The state produces approximately 2.5 quintal of bamboo annually which is about the 12 % of total non-timber forest products (NTFP) of state (Forest report of Tripura, 2002). Recently, 2005 onwards, the production has been reduced significantly. The state is unable to satisfy the increased demand of the bamboo for consumption, household works and other uses. The reduction is due to the occurrence of an infectious rot disease in the bamboo, which changes the green bamboo to dried shoot. The *tribal* and *Bengali* community's people often use to call it as *mrityudoot* (means angel of death) or *mrityu-santraash* (means death-terror) for its characteristics as 'shoots and leaves baked in fire' and 'whitish rotten' appearance.

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MATERIAL AND METHODS

During 2007-2008 reproductive season, suburban area of Agartala were gradually devastated by that fungal attack. Even the bamboo gardens owned by the local residents were not rescued but till date no literature was reported for the same. Primarily this fungal attack was observed in the edible *Muli* bamboo shoot (*Melocanna baccifera*) of the west Tripura district and presumed to be started from the soil enriched sub-layer encircled the base of the shoot and flourished by the rain-splash. It produced a whitish powdery and later on creamish appearance around the base and epidermal layer of the shoot.

The infected edible young shoot (*karool* in local *Kokborok* language) when gradually converted to culm, pathogenicity of the fungi was re-established simultaneously from newer to older parts of the same and other bamboo stocks. Within 20-30 days of inoculation period, a complete bamboo stock became susceptible to the pathogen. Gradually, maturity and growth became slow with poor yield performance. Infection was also observed during the flowering and fruiting stage. The whole plant was approximated to die with greenish white fruit and rotten flowers. Greater extent of severity (nearly 55%) was observed in mature culms.

In contrast, 20-30% of *karool* were found to be infected or dying due to the pathogen attack. Literature was collected for the possible identity of the pathogen and was recognized as fungal pathogen-*Pterulicium xylogenum,* characteristically a member of Basidiomycetes, reported to cause culm rot disease in the bamboo (Zhishu *et al*., 1993).

The new fungi is having the following characteristics to be under the genus *Pterulicium***:** basidiocarp branched; branches acute, tough with waxy amphigenous hymenium; base of basidiocarp with an appressed patch of generative hyphae; hyphal system dimitic; generative hyphae is usually branching from the clamps; skeletal hyphae are not branched, aseptate; cystidia present; basidia clavate; spores smooth and hyaline.

Thus, the specific epithet of the new fungi (under the monotypic genus *Pterulicium*) is *xylogenum* (Zhishu *et al*., 1993) further supported by the following characters**:** basidiocarp 1.82-1.94 cm high; often fasciculate, erect, once or twice branched, conical at the tip, white, drying flesh brown, white downy below, substratum with a thinner and pruinulose patch, easily separable from the substratum; generative hyphae 2.31 to 3.44 µm wide, pale yellow; apical cells usually inflated into cystidia; some cystidia encrusted by crystals, branched, septate as well with clamp-connections; basidia broadly clavate; 33-37 x 10-12 µm, 4-spored; spores ellipsoid, 5-12 x 5-7 µm, smooth, pale yellow coloured, containing several oil drops; gregarious on the leaf base and dead culms.

The preview of its hierarchical status is as follows:

Domain	:	Eukaryota
Kingdom	:	Fungi
Sub-kingdom	:	Dikarya
Phylum	:	Basidiomycota
Sub-phyllum	:	Agaricomycotina
Class	:	Basidiomycetes
Sub-class	:	Agaricomycetidae
Order	:	Agaricales
Family	:	Pterulaceae
Genus	:	*Pterulicium*
Specific epithet	:	*xylogenum* (Berk. & Broome) Corner
Botanical name	:	*Pterulicium xylogenum* (Berk. & Broome) Corner
Syn. Name	:	*Clavaria xylogena* Berk. & Broome *Pterula xylogena* (Berk. & Broome) Petch

Measurement of disease pathogenicity

Pathogenicity test was performed by the soil inoculation of the host bamboo plant in green house condition. Three-years-old six plants of *Malocana* were inoculated with 8mm mycelial discs of the fungus grown on Potato Dextrose Agar media at 20^0C for five days. Three other plants of bamboo were kept as control without inoculation.

The test (inoculated and non-inoculated) plants were covered with transparent polythene bags and kept in the same green house for about 25 days. All inoculated plants were infected with the disease and produced the similar rot symptoms with the production of mycelia (sclerotia) but there was no disease symptom in non-inoculated control

plants and remained healthy. *Pterulicium* was reisolated from infected test plants. After two months from planting, 100 ml of the leaf extracts was added singly around bamboo plants 2 days before the inoculation. The plants were artificially inoculated with *Pterulicium* spores followed by covering with a sterilized plastic bag. Control plants were sprayed with 100 µl sterilized distilled water. The following indices were recorded after 6 weeks from inoculation as described before.

$$\text{Disease incidence (\%)} = \frac{\text{No. of diseased leaves}}{\text{Total leaves}} \times 100$$

$$\text{Disease control} = 100 - \text{Disease incidence(\%)}$$

$$\text{Disease area index (DAI)} = \frac{\text{Total area of infected tissue}}{\text{Total area}}$$

$$\text{Disease development rate (DDR)} = \sum \frac{\text{Total area of infected tissue}}{\text{Time (days)}}$$

$$\text{Disease recovery index (D R I)} = \frac{\text{Total area of healthy tissue - Total area of infected tissue}}{\text{Total area of healthy tissue}}$$

Experimental design and statistical analyses

The data from repeated experiments for field trials were analyzed by the statistical analysis system MSTAT-C (Version 2.1).

RESULTS AND CONCLUSION

Rot of growing culms is potentially serious disease affecting culm production. In India, the disease has been recorded in different species of bamboos grown in Kerala state, its incidence in different localities varying from 3% to 25% during 1987-91. Young (2-4 years old) clumps of *Bambusa bambos, Dendrocalamus longispathus* and *D. strictus* were found to be the worst affected (www.inbar.int, 2010). The disease lowers the quality as well as the quantity of the culms produced (www.inbar.int, 2010).

Table 1. Result of pathogenicity test for the assessment of fungal infection in edible Muli bamboo

	Plants inoculated with *Pterulicium xylogenum*	Non-inoculated plants (Control plants)
Disease incidence (%)	85.564 ± 2.008*	2.007 ± 0.009
Disease control (%)	14.436 ± 0.106	97.093 ± 0.883
Disease area index	0.912 ± 0.005	0.002 ± 0.000
Disease development rate (cm^2/day)	1.225 ± 0.008	0.005 ± 0.000
Disease recovery index	0.231 ± 0.005	0.873 ± 0.029

* All the readings are based on ten replicates ± standard error of mean.

In the present study, disease incidence, disease area index and disease development rate is found to be higher in edible bamboo plants inoculated with *Pterulicium xylogenum* against the control plants. Reference reports are meager for its pathogenicity in any edible bamboo plant in any part of the world. So, this is reported for the first time from edible bamboo shoot and culm of *Melocanna baccifera* and also is the new report of occurrence of *Pterulicium* rot from Tripura and India as well.

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