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First Report of Canker disease on Indian sandalwood (*Santalum album* Linn.) in India

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ABSTRACT

During the disease survey of sandalwood plantations, many sandalwood plants were found dying in the Anchipura area, Channapattana Taluk of Karnataka, A detail observation showed that dying plants were grown under canopy of a Banian tree, where water logging condition was prevalent. It was also observed that collar region of the dead plants showed canker-like structure caused by the pathogen *Fusarium oxysporum* which lead to death of plants. The pathogenicity was confirmed by spraying fungal spore suspension on healthy young twigs. This forms the first report of canker problem on Indian sandalwood plantations in India.

Key Words: *Canker disease, Fusarium oxysporum, Santalum album,* India.

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INTRODUCTION

Indian sandalwood (*Santalum album* Linn.) has gained importance world over for its scented heartwood and essential oil, which is used in perfume, medicine, incense material, carving and other handicrafts of curious interest. A range of pathogens attack sandalwood plants especially in seedling and plantation stage. Many of the fungal pathogens are carried through seeds into forest nurseries and become established in seedlings. Apart from the seed borne pathogens, soil borne fungal pathogens have also shown to be devastating by attacking seedlings in nurseries (Nayar *et al.* 1980). Damping off and vascular wilt are the most serious and major diseases recorded in sandalwood seedlings caused by fungus, *Fusarium oxysporum*. High incidence of disease was recorded in Karnataka and Tamil Nadu destroying the entire nursery stock in damp seasons. Off late, canker problem has been reported in sandalwood in Western Australia (Treena *et al.*2006) by *Lasiodiplodia* sp. with some growth on stem of the seedlings. Canker and anthracnose generally refer to many different plant diseases of such broadly similar symptoms as the appearance of small areas of dead tissue, which grow slowly, often over years; cankers that can kill branches of trees by choking them off. Some are of only minor consequence, but few are ultimately lethal to plants and therefore of major economic importance. Their causes include such a wide range of organisms as fungi, bacteria, mycoplasma or viruses. Diseases in sandalwood nurseries and their management need detail work to protect the seedlings which are of great demand. During the disease survey of sandalwood plantations, in the Anchipura area, Channapattana Taluk of Karnataka, it was found that many sandalwood plants were dying and examination showed canker- like structure in the collar region of the dead plants. Hence detail investigations on the problem were made and finding is reported in the present paper.

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MATERIAL AND METHODS

Collection of Material: During the disease survey of sandalwood plantations, in the Anchipura area, Channapattana Taluk of Karnataka, it was found that many sandalwood plants were dying, which were gr-

-own under canopy of a Banian tree, where water logging conditions were prevalent. The dead trees were removed carefully along with the roots and observations were made. Samples were also brought to the laboratory for the investigation.

Isolation, preservation and identification of causal organisms

Fungus associated with diseased part (swollen portion) was isolated by standard tissue method by Agar plate technique of Muskett and Malone (1941), Groves and Skolko (1944). Infected tubers were thoroughly washed, surface-sterilized for 5 minutes in 5% (v/v) sodium hypochlorite solution, and rinsed three times with sterile distilled water. Then the tubers were sliced using a sterile knife, and incubated using Potato Dextrose Agar (PDA) medium. Further single spore cultures were established by serial dilution of a conidial suspension in water with 1% Tween 20 (Sigma), dispersing a drop of 10^{-6} and 10^{-8} dilutions on PDA and selecting germinated macro conidia under the microscope, after 24h incubation at 25°C. Macroscopic characteristics were observed after 7 days of incubation at 25°C in PDA. Microscopic characteristics of isolate were observed from cultures using the keys of Barnett and Hunter (1972) and Alexopoulas and Mims (1979).

Pathogenicity of isolate

Healthy sandalwood seedlings were surface-sterilized with 70% ethanol, and five wounds were made on each plant using sterilized needle. The wounded seedlings were exposed to the isolate by spraying fungal suspension obtained from diseased part and were placed on sterilized moistened filter paper in Petri-plates and incubated at 25 ± 1°C for 6-7 days. Three replicates were made for each treatment. Symptoms were observed up to 7 days. Morphological characters of the re-isolated fungus were compared with the tested isolate Tewari and Dath (1984).

RESULTS AND DISCUSSION

The collar region of the dead plants showed bulged canker-structure (Fig. 1). Almost all the plants in that patch were attacked with this problem. Probably water logging conditions under the canopy of a Banian tree would have favored the infestation resulting in death of trees (Fig. 2). Fungus associated

Fig. 1. Canker on Indian sandalwood.

Fig. 2. Dead Indian sandalwood tree due to canker formation.

from diseased portion (canker area) was isolated by standard tissue method by using PDA. Fungus was re-isolated by culturing on selective and differential media. After obtaining pure culture of isolate, microscopic characters were studied following the guidelines of Barnett and Hunter (1972) and Alexopoulas and Mims (1979) for finding out its identity. The fungus causing canker was identified as *Fusarium oxysporum* using identification keys of Barnett & Hunter (1998) and confirmed with the help of Agarkhar Research Institute, Pune.

Colony and microscopic characters

Colonies were fast growing and covered Petri plate within a week; bright white colored mat and had a cottony aerial mycelium. The color of the mat which was white in the beginning, and turned pink after 7-8 days of growth on PDA which is one of well known properties of *F. oxysporum*. Isolate produced both macro- and micro conidia from slender phialides. Macro conidia are hyaline, two- to several-celled, fusiform- to sickle-shaped, with an elongated apical cell and pedicellate basal cell. Microconidia are 1- to 2-celled, hyaline, fusiform to ovoid, straight. Hyphae are septate and hyaline. Conidiophores are short and simple (usually not branched). Macroconidia produced abundantly, slightly sickle-shaped, thin-walled. They are fusoid-subulate and pointed at both ends; 3-5 septate measuring 23-54 x 3-4.5 µm. Microconidia are abundant, non-septate, and ellipsoidal to cylindrical, 5-12 x 2.3-3.5 µm.

Pathogenicity test was conducted by spraying fungal spore suspension on healthy young plants (Koch's postulate study). Symptoms appeared in 3-4 days of inoculation. The re-isolated pathogen from the diseased tissue compared with the original ones and it confirms the findings.

Daming off and vascular wilt were the most serious disease recorded in seedlings of sandalwood plants. Though different causal organisms recorded were *Fusarium*, *Rhizoctonia*, and *Phytophthora*, *F. oxysporum* was common and more virulant and found in all infected sandalwood seedlings. The disease is systemic in sandalwood seedlings, where the entire individual or its part exhibit wilting of foilage in acropetel sucession up to the shoot. This fungus spreads rapidly in the tissues resulting in yellowing of leaves and looses the turgidity followed by withering of leaves and finally plant will die with vascular wilt (Nayar *et al.* 1980; Remadevi *et al.* 2003). Characteristic sypmtoms of vascular discolration in the outer layers of the seedlings were found and mainly translocation of water and nutrients was adversely affected. High incidence was recorded in Karnataka and Tamil Nadu during rainy season. Mortality in seedlings was recorded in all stages during their growth; pre- and post emergence rot, root rot and vascular wilt in older seedlings (Remadevi *et al.* 2003). A serious root-rot disease of sandalwood by *Fusarium moniliforme* [*Gibberella fujikuroi*] was reported in Bangladesh (Basak 1999). The typical symptom of the disease was manifested through the gradual browning of the leaves of the seedlings. Brown spots appear first on the branch and tap roots and later turned black. The leaves of infected seedlings loose their freshness and begin to die out with the stem standing erect. Seedlings-rot has been reported with the causal agent as *Fusarium* species. So far canker problem has been reported in sandalwood in Western Australia (Treena *et al.* 2006) by *Lasiodiplodia* sp. with some growth on stem of the seedlings. But there is no report of canker in India either by *Lasiodiplodia* sp. or *Fusarium* species. It forms first report of canker problem on sandalwood plants in India. Further work is essential for molecular analysis of the isolate and also for developing management practices.

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