

OCCURRENCE OF A BLACK MILDEW IN *SANTALUM ALBUM* PLANTATION AT ANAKULAM, THIRUVANANTHAPURAM, KERALA, INDIA

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Sandal wood trees belong to the genus *Santalum* of the family Santalaceae. The genus *Santalum* comprises 25 species, distributed in Australia, Hawaii, Indonesia, New Caledonia, Vanuatu, Juan Fernández Islands, Papua New Guinea, and Indonesia, of which *Santalum album*, a small-sized tropical sandal wood tree is from the southern Western Ghats, mostly from Coorg (Kodagu) in Karnataka, extending its distribution to Andhra Pradesh, Maharashtra, Tamil Nadu and Kerala in peninsular India. The word sandal is derived from chandana (Sanskrit) and chandan (Persian). The epithet *album* refers to the 'white' of the heartwood. It is known as 'safed chandan' in Hindi, 'srigandha, gandha' in Kannada, 'sandanam' in Tamil, 'chandanam' in Telugu. The species is mostly found in dry deciduous and scrub forests. This has been an economically, medicinally and culturally important plant since ancient times and its value is equated with gold. Unfortunately, rather than being limited to its sustainable use, it is being over exploited. Hence, it has been brought under cultivation in various forestry programmes. One such programme is at the Anakulam

sub-unit. However, 100% of the plantation is being affected with a "black mildew" fungus.

Sandal spike is a major disease of the sandal wood tree, characterized by witches'-broom symptoms, showing the overcrowded littling of leaves due to the shortening of the internodes causing them to stand out stiffly from the branches, acquiring a spike-like appearance. The causal organism is mycoplasma like organism (MLO's). Further investigations revealed that a combination of pathogenic fungi (mainly *Fusarium* and *Phytophthora*) and nematodes may be responsible. Fortunately, the present plantation is free from the above diseases but is severely affected by the black mildew fungus which is reported in the present note.

Study site and raising of plantation: Anakulam sub-unit of Trivandrum Division is around 60km away from the capital city, Thiruvananthapuram, located towards the western side of Shencottai road, having an area of 7.84ha in Block V, where 5200 plants have been planted in 4.82ha in the year 2010 and 3000 plants in 3.02ha during the year 2011. For raising seedlings, seeds were collected from the Kerala Forest Research Institute, Peechi, Trichur, soaked in Gibberlic Acid (0.05%) for 16 hours, and sown in primary beds of 12x1.5 m, @ 1.5 kg/nursery bed of sand having a thickness of 4" raised to 1' height during the month of February and mulched with leaves of *Emblia officinalis* and watered as and when required. Seeds germinated after 20 days. The seedlings of 25 days were carefully transplanted to polythene bags filled with a potting medium of a mixture of soil, sand, powdered cow dung, neem cake and fungicides. *Mimosa pudica* seedlings were also planted in polythene



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bags as host plants. When the seedlings attained the age of six months, they were transferred to the field. Seedlings having an average height of 25cm or above were selected for planting. Planting work was carried out during the month of August in pits, the size of 45cm³ spaced at 3x3m. Pits were pretreated with Carbofuran (Phorate; Unitech Organics Ltd., Muzaphar Nagar, UP) and ground rock Phosphate (Rajphos; Rajasthan State Mines & Minerals Ltd.) and filled with soil. Seedlings of *Mimosa pudica* and *Emblica officinalis* were planted as host plants. As a part of maintenance, soil working, and application of chemical fertilizers substituting cow dung was carried out. Fungicides and DAP were sprayed periodically. The plantation has an average stock of 95% with an average height of 190cm and collar girth of 8.5cm.

Disease symptom and identification of pathogen:

Black mildew fungus had infected the leaves of small seedlings and up to the grown-up trees, covering both the upper and lower surfaces of the leaves, petioles, and often the soft stem. The infected leaves had turned yellow, wrinkled, twisted and defoliated. The colonies were dense, up to 2mm in diameter, spreading and covering the whole soft green portion of the plants. Colonies were mounted in situ by using the nail polish technique (Hosagoudar & Kapoor 1985). Microscopic examination of the colonies revealed that the hyphae was brown, produced superficially on the epidermis of the plant, flexuous, branched, reticulate and often formed a roughly round mycelial net, cells 11–24 x 4–7 μ m. Fin-like structures produced from either side of the hyphae are brown, unicellular, unilateral, alternate, straight to slightly curved, oblong, cylindrical, entire to sublobate, 9–15 x 4–7 μ m. These are known as appressoria. From the central lower surface of the appressoria, a thin hyphae-like bulbous projection is produced inside the epidermal cells, through which the fungus absorbs nourishment from the host plant. The fruiting body is known as ascomata or thyrlothecia. This structure is flattened with radiating cells on the upper surface. These are scattered or grouped, circular in shape, up to 154 μ m in diameter, split like star at the center of the upper portion. These thyrlothecia are embedded with a number of sac-like structures known as ascus. These asci are 5–20 in number in each ascomata and are globose, eight spored, measuring up to 35 μ m in diameter. These sac-like asci are two-layered, possess eight spores and are known as ascospores. These ascospores are oblong in shape, brown, having septum (partition) at the central portion slightly constricted, measuring 13–26 x 9–11 μ m. The wall of the ascospores is smooth. In addition to these

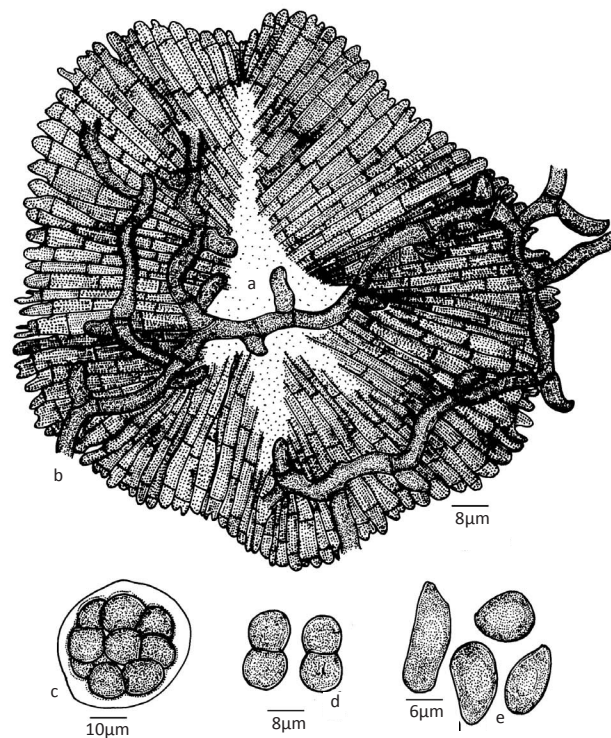


Figure 1. *Asterina congesta* (microscopic details)
a - Mycelium; b - Ascomata; c - Ascus, d - Ascospores,
e - Pycnothyriospores

ascospores, unicellular spores are also produced and are known as pycnothyriospores. These pycnothyriospores are ovate, pyriform, brown, measure 9–13 x 4–9 μ m, wall smooth.

Based on the morphology and infection pattern, the causal organism is a fungus identified as *Asterina congesta* Cooke (Fig. 1, Image 1). This fungus has been known since 1884 from Belgaum, Karnataka (Cooke 1884), then from Mysore (Hansford & Thirumalachar 1948) and is also known from Kerala (Hosagoudar 2012). Except for a few exceptions of pathogenic, most of these fungi are symbiotic biotrophs, i.e., they are well balanced with the host plants and never produce any disease symptoms. The fungus infects the sandal plant wherever it is grown in peninsular India but its drastic pathogenicity is known here for the first time. Biochemistry of the infected plants revealed reduction in the total chlorophyll, chlorophyll 'a', chlorophyll 'b', soluble sugar, starch, protein and total amino acids. There is an increase in the proline and total phenol contents. Amylase and protease enzyme activities increased in the infected leaves while peroxidase was reduced (Hosagoudar et al. 1997). It can now be recollected here the statement of Wellman (1972) who stated that "...nowhere are these black mildews being made a subject of major



Image 1. Black mildew infected twigs of *Santalum album*

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pathological study, although agriculturists who observe their crops well, know that at times these fungi are very damaging in their effects.”

Recommendation for management of the disease: Fungi causing black mildew diseases are air borne (Nayar et al. 1998), and are disseminated through ascospores or pycnothyriospores. These fungi do not infect other hosts. Hence, this species is restricted to this host species or at the most to the genus. These fungi start germinating through the spores soon after the rainy season, make their appearance in a month, and attain the maximum development of their colonies during the month of January. Spray of 1% Bavistin is recommended soon after the rainy season in the nursery plantation.

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