

53. Association of Marine Fungi on Timber Panels Treated with Preservatives

S. Raghu-kumar, L.N. Santhakumaran, and D. Chandramohan

Seven wood species (18 samples), untreated and treated with preservatives (copper-chrome-arsenate, copper-chrome-borate, creosote: fuel oil) were examined for fungal colonization following submergence in the Mandovi estuary for periods up to 36 months. All samples, except one, had fungi. *Periconia prolifica* was the most common, while *Halosphaeria quadricornuta* was generally observed on untreated panels. Preliminary experiments with the fungi *Cirrenalia* sp., *Clavariopsis bulbosa*, and *Arthrobotrys* sp. on their tolerances to copper-chrome-arsenate indicated that these species could best tolerate the preservative at 20 ppt salinity, which is also the optimum salinity for their growth. Growth was observed up to 0.05% copper-chrome arsenate concentration in these fungi.

INTRODUCTION

The degradation of wood in the marine environment by fungi has not been studied in sufficient detail in tropical countries. Only a few fungi have been reported from untreated wood in Indian waters (Becker and Kohlmeyer 1958, Jones 1968, Kohlmeyer et al. 1967, Raghu-kumar 1973). The occurrence of fungi on wood treated with preservatives and the effect of wood preservatives on marine fungi have not been investigated in this country, although similar studies were conducted elsewhere (Irvine and Jones 1975, Leightley 1980). Such studies are important because fungi not only degrade wood themselves but also assist wood-boring organisms in destroying wood submerged in the sea (Kohlmeyer and Kohlmeyer 1979). This paper presents the results of preliminary investigations on the occurrence of marine fungi in timber treated with various preservatives, and the effect of one of these, copper-chrome-acetate, on fungal growth.

MATERIALS AND METHODS

Timber panels from various species of wood (table 1) treated with differ-

ent concentrations of three preservatives—copper-chrome-arsenate (CCA), copper-chrome-borate (CCB), and creosote: fuel oil mixture—were immersed in the Mandovi estuary at the Betim jetty (15°30'N, 73°55' E). The details of the preservatives used, their concentrations, and durations of submergence are given in table 1. After submergence, the panels were immediately examined for fungi, and also after four to eight weeks incubation in moist chambers (Kohlmeyer and Kohlmeyer 1979). The fungi found were cultured and maintained on Meyers medium (Kohlmeyer and Kohlmeyer 1979).

For the study of the effect of CCA on growth, a stock solution was prepared according to Irvine and Jones (1975) and aliquots were added to 15 ml of medium in Petri dishes to yield final CCA concentrations of 0.5, 0.2, 0.1, 0.05, and 0.0125%. The medium used for the CCA tolerance experiments was the same used for isolation and maintenance of cultures. Five different salinities (0, 10, 20, 30, 40 ppt) were used for the experiments, each with the six concentrations of CCA. The following three fungi were used in the study: (1) *Cirrenalia* sp. isolated from drift wood from Bingaram Island, Lakshadweep, in the Arabian Sea; (2) *Clavariopsis bulbosa* isolated from CCA-treated panels of *Anogeissus latifolia*, and (3) *Arthrobotrys* sp. isolated from CCB-treated panels of *Mangifera indica*. Agar plugs (0.5 m) of one-week old cultures were used. Growth was measured as colony diameter and sporulation recorded after microscopic observations.

RESULTS

The data obtained on fungal colonization of timber treated with preservatives are presented in table 1. Fungi were found in 11 of the 13 samples examined. Six of the seven wood species showed colonization. Those that were not infested were: *Lagerostroemia microcarpa* wood treated with the creosote: fuel oil mixture at 320 kg/m³ and kept for 21 months, and one of three CCB-treated *M. indica* wood samples. Although *L. microcarpa* did not have any fungi, *A. latifolia*, also treated with the creosote: fuel oil mixture at 320 kg/m³ but submerged for 36 months, had fungal growth.

The most common species found on the treated panels was *Periconia prolifica*. Other species were: *Cirrenalia*, *Torpedospora radiata*, *Leptosphaeria*, and *Arthrobotrys*. Only one treated panel supported growth of *Halosphaeria quadricornuta*, while it was found on three untreated panels.

Tolerance to CCA: In the absence of CCA, all three fungi showed optimum growth at 20 ppt. *Cirrenalia* tolerated up to 0.05% at 20 and 30 ppt but only 0.0125% at all other salinities (figure 1). However, even at 20 ppt, conidiation was suppressed at 0.05%, while at other salinities it did not sporulate even at 0.0125%. *C. bulbosa* grew at 0.05% CCA in 10, 20, 30,

Table 1. Fungi isolated from preservative-treated and untreated woods.

Sr. N.	Wood Species	Preservative + dosage/m ³	Submergence (months)	Fungi Isolated	Percent Destruction by Wood borers
1.	<i>Anogeissus latifolia</i>	CCA : 16 kg	21	<i>Halosphaeria quadricornuta</i>	25
2.	<i>A. latifolia</i>	CCA : 32 kg	21	<i>Clavariopsis bulbosa</i> <i>Periconia prolifica</i> <i>Clavariopsis bulbosa</i>	30 70 60
3.	<i>A. latifolia</i>	creosote: fuel oil-160 kg	36	<i>Cirrenalia</i> sp.	60
4.	<i>A. latifolia</i>	creosote: fuel oil-320 kg	36	<i>Leptosphaeria</i> sp. <i>Periconia prolifica</i>	80
5.	<i>Acrocarpus fraxinifolius</i>	creosote: fuel oil-160 kg	21	<i>Cirrenalia</i> sp. <i>Leptosphaeria</i> sp. <i>Periconia prolifica</i>	80 80 80
6.	<i>Carapa molluscensis</i>	CCA: 13 kg	7	<i>Periconia prolifica</i>	80
7.	<i>C. molluscensis</i>	untreated	7	<i>Halosphaeria quadricornuta</i> <i>Periconia prolifica</i>	80
8.	<i>Acacia auriculiformis</i>	untreated	6	unidentified sp. <i>Halosphaeria quadricornuta</i> <i>Humicola allopallonnella</i> (?)	80
9.	<i>Hevea brasiliensis</i>	untreated	6	<i>Periconia prolifica</i> <i>Halosphaeria quadricornuta</i> <i>Humicola allopallonnella</i> (?)	80
10.	<i>Lagerstroemia microcarpa</i>	creosote: fuel oil-320 kg	21	none	50
11.	<i>Mangifera indica</i>	CCB: 26 kg	21	<i>Torpedospora radiata</i>	5
12.	<i>M. indica</i>	CCB: 29 kg	21	<i>Arthrobotrys</i> sp.	5
13.	<i>M. indica</i>	CCB: 29 kg	21	none	5

CCA = copper-chrome-arsenate, CCB = copper-chrome-borate.

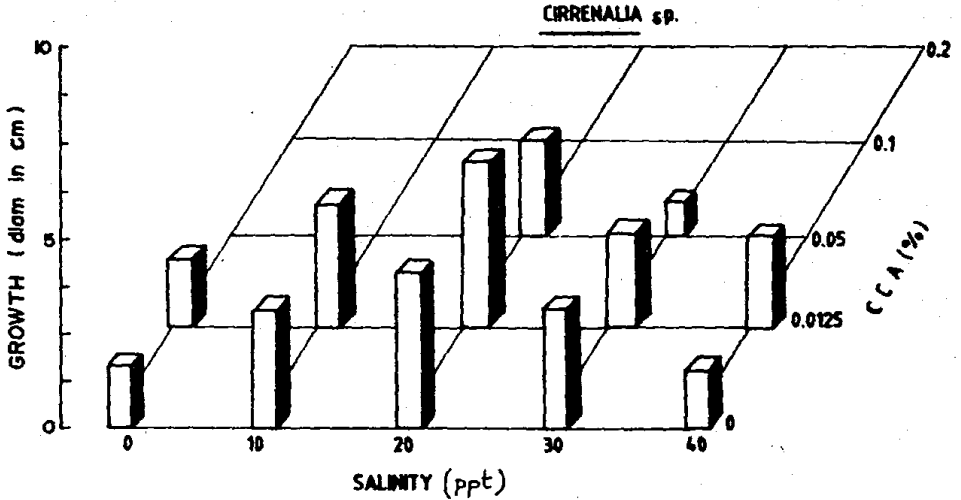


Figure 1. Growth of *Cirrenalia* sp. at different copper-chrome-acetate concentrations and salinities.

and 40 ppt salinities, but maximum growth was at 20 ppt (figure 2). This species did not sporulate at all. *Arthrotrys* tolerated CCA up to 0.05% at 10 and 20 ppt but not at other salinities (figure 3). This species, however, did not sporulate even at the lowest CCA concentration of 0.0125% at 10 and 20 ppt.

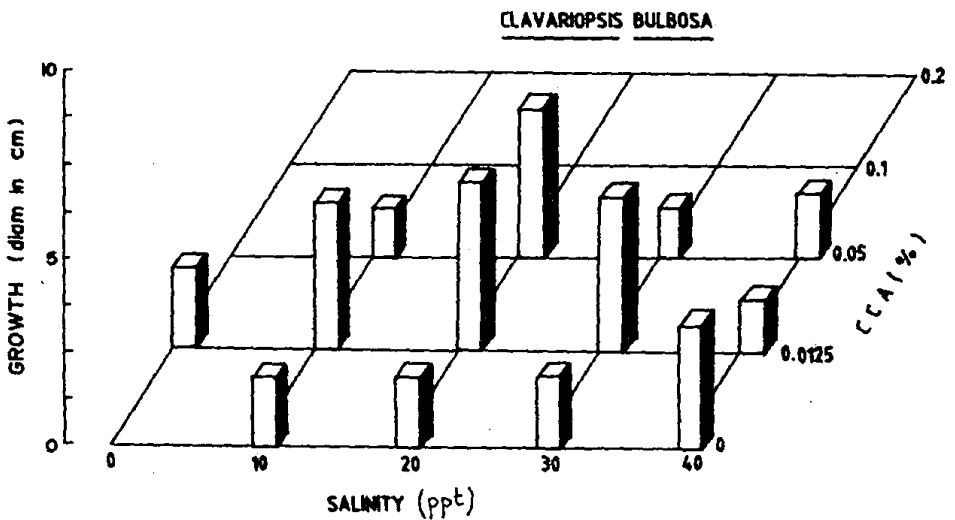


Figure 2. Growth of *Clavariopsis bulbosa* at different copper-chrome-acetate concentrations and salinities.

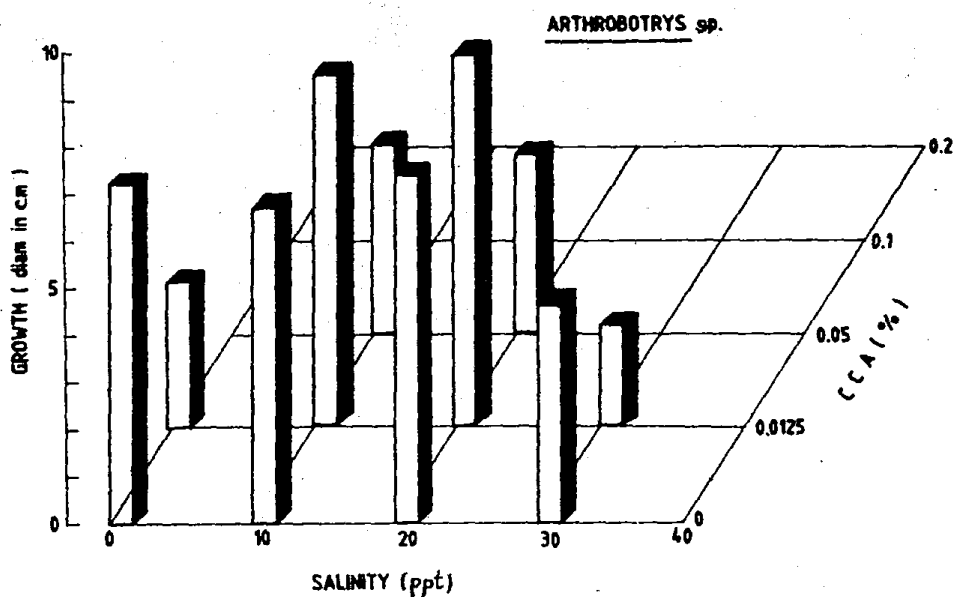


Figure 3. Growth of *Arthrobotrys* sp. at different copper-chrome-acetate concentrations and salinities.

DISCUSSION

Eight of ten treated wood panels had fungal growth. Although hyphae were plentiful, ascocarps or conidia were not found when examined immediately after collection but only after moist chamber incubation. The submergence period of these panels was 7 to 36 months. Thus, it appears that the treated wood did not remain immune to fungal attack. Loss of preservatives leaching through in water might have reduced their effectiveness (Irvine et al. 1972). However, more detailed studies are necessary. The reason for the absence of fungi on *L. microcarpa* treated with creosote: fuel oil might be the wood species itself. *A. latifolia* treated with creosote at the same strength had many fungi.

All samples showed heavy colonization by borers except *M. indica* treated with CCB. Interestingly, the species found commonly on the other treated panels were not found on these samples. It is possible that CCB, which was effective against borers, also prevented colonization by these fungi. However, *Arthrobotrys* sp. and *T. radiata*, not found on other treated or untreated panels, were found on *M. indica* treated with CCB. Their growth, however, was meager and they were found only after 10-week incubation in the moisture chamber. The absence of other fungi and the lack of competition probably allowed these two fungi to grow on CCB-treated panels.

Tolerance to the preservatives might be greatly influenced by the prevailing salinities of the waters. All three fungi tested tolerated CCA best at 20 ppt, which is also their optimal growth salinity. The salinities at the test sites varied from nearly freshwater during the monsoon to 35 ppt in the summer.

The minimum inhibitory concentration of CCA for growth of these fungi at 20 ppt was 0.1%, a value also found for several other marine fungi by Irvine and Jones (1968). Of the fungi tested, *C. bulbosa* showed growth stimulation at 10, 20, and 30 ppt salinities with 0.0125% CCA. A similar effect at low CCA concentrations was reported for *Chaetomium globosum*, *Phoma* sp., *Cladosporium herbarum*, and *Dendryphiella salina* (Irvine and Jones 1975). An interesting finding of the present study is that even a *Cirrenalia* species obtained from an untreated drift-wood sample from a Lakshadweep island in the Arabian Sea (400 km from the mainland) could tolerate up to 0.05% CCA, as did the other two isolates obtained from CCA-treated panels. *H. quadricornuta* is one of the most common marine fungi in Indian waters. It might be extremely sensitive to preservative treatment, judging by the fact that it was isolated from only one of eleven treated panels but from all three untreated samples.

The authors are grateful to H.N. Siddiquie, Director, and to T.S.S. Rao, Head, of the Biological Oceanography Division for various facilities and encouragement.

LITERATURE CITED

- Becker, G., and J. Kohlmeyer. 1958. Deterioration of wood by marine fungi and its special significance for fishing crafts. *J. Timber Dryers Preservers Assoc. India* 4: 1-10.
- Irvine, J., and E.B.G. Jones. 1975. The effect of a copper-chrome-arsenate preservative and its constituents on the growth of aquatic microorganisms. *J. Inst. Wood Sci.* 7: 1-5.
- Irvine, J., R.A. Eaton, and E.B.G. Jones. 1972. The effect of water of different ionic composition on the leaching of a water borne preservative from timber placed in cooling towers and in the sea. *Mater. Organ.* 7: 45-71.
- Jones, E.B.G. 1968. Marine fungi. *Curr. Sci.* 37: 378-379.
- Kohlmeyer, J., and E. Kohlmeyer, ed. 1979. *Marine Mycology. The Higher fungi*. Academic Press, New York and London.
- Kohlmeyer, J., I. Schmidt, and N.B. Nair. 1967. Eine neue *Corollospora* (Ascomycetes) aus dem Indischen Ozean und der Ostsee. *Ber. Bot. Ges.* 80: 98-102.
- Leightley, L.E. 1980. Wood decay activities of marine fungi. *Bot. Mar.* 23: 387-395.
- Raghu-kumar, S. 1973. Marine lignicolous fungi from India. *Kavaka* 1: 73-85.