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SINGLE AND TWO STAGE DIFFUSION PROCESS BY DIFFERENT CHEMICAL COMBINATIONS FOR TREATMENT OF RUBBER WOOD

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Treatment of rubber wood by diffusion process using sodium pentachlorophenate in combination with either zinc sulphate or copper sulphate was found to be very effective for the preservation of both fungal and insect attack. Zinc sulphate or copper sulphate can be considered as a substitute for borax, boric acid combination against insect attack in the preservative treatment of rubber wood. It was found that single stage diffusion process after two consecutive dippings in sodium pentachlorophenate and in either zinc sulphate or copper sulphate is equally effective as two stage diffusion process, first with sodium pentachlorophenate and then with either zinc sulphate or copper sulphate.

Key words : *Hevea brasiliensis*, Sapstain fungus, Insect borer, Wood preservation, Diffusion process, Rubber wood.

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INTRODUCTION

The rubber tree, *Hevea brasiliensis* (Willd. Ex. Adr. de Juss.) Muell. Arg., yields valuable timber after its exploitation for latex. In 1993-94, it was estimated that 1.235 m^3 of rubber wood was available in India (Joseph and George, 1994). After felling, rubber wood undergoes degradation by different fungi viz., *Botryodiplodia theobromae* Pat, *Aspergillus* sp., *Penicillium* sp. (Ali *et al.*, 1980), *Trichoderma* sp. (Hong, 1981), *Fusarium* sp. (Jose et al., 1989) and by different borer beetles *Heterobostrychus aequalis, Sinoxylon conigerum , S. anale, Minthea rugicollis, Platipus latifinins, P. solidus, Xyleborus similis* (Mathew, 1987). Deterioration of wood by these organisms can be prevented, if the wood is properly treated. Diffusion treament is one of the methods for the preservation of rubber wood (Indian Standard, IS 401).

Diffusion treatment of rubber wood planks with borax, boric acid and sodium pertachlorophenate mixture was reported to be effective agaist both fungi and insect borers (Gnanaharan and Mathew, 1982). Earlier studies have shown that diffusion treatment with copper sulphate was effective agaist borer beetles (Jose *et al.*, 1989). Copper sulphate and zinc sulphate were also tested with sodium pentachlorophenate and good preservative qualities were reported (Richardson, 1978). Hence, a study was undertaken with different combinations of sodium pentachlorophenate with either zinc sulphate or copper sulphate to compare single stage and two stage diffusion processes.

MATERIALS AND METHODS

The study was conducted under laboratory conditions. The treatments were done by diffusion process as suggested by Tisseverasinghe (1969) and the Kerala Forest Research Institute (1984). Fresh rubber wood planks of 30 x 4 x 2.5 cm were used for the treatments. For each diffusion , 30 litres of the preservative solution was taken in a plastic trough having a diameter of 64 cm and 60 litres capacity. There were nine treatments in total including the untreated control (Table 1). The treatments included four different combinations of chemicals and two methods ie., single stage diffusion process and two stage diffusion process. In the single stage diffusion process two consecutive dippings in the preservative solution were done one after the other, each lasting for 40 min. followed by diffusion by wrapping in polythene sheet for 30 days. In the two stage diffusion process, first the rubber wood planks were dipped in one set of preservative (A) for 40 min. and then kept for diffusion under wrapping in polythene sheet for 30 days. The polythene sheet was then removed and the planks were again dipped in the other set of solution (B) for 40 min. and then kept for the second diffusion stage by wrapping again in polythene sheet for 30 days. After diffusion, in both methods, the treated planks were stacked one above the other for air drying. This was continued for two months and observations were recorded for fungal and insect attack. Final observations were recorded after 3 years. The intensity of infection was assessed as per the ratings for the fungal and insect borer attack (Jose *et al.*, 1989). Later the ratings were converted to per cent infection index (Horsfall and Heuberger, 1942).

RESULTS AND DISCUSSION

All the treatments (Table 1) were effective for the prevention of sapstain, *Botryodiplodia theobromae*, the mould, *Aspergillus* sp. and the borer beetles, *Xyleborus perforans* and *Heterobostrychus aequalis*. The growth of *Fusarium* sp. was 32.21 per cent in the two stage diffusion treatment with borax + boric acid + Na PCP and zinc sulphate. The infection due to *Penicillium* was medium on five treatments ie., 30.29 per cent in the treatment with borax + boric acid + Na PCP and zinc sulphate (single stage diffusion), 23.86 per cent in the treatment with borax + boric acid + Na PCP and copper sulphate (single stage diffusion) , 60.0 per cent in the treatment with borax + boric acid +Na PCP and zinc sulphate (two stage diffusion), 45.0 per cent in the treatment with Na PCP and copper sulphate (two stage diffusion) , 43.08 per cent in the treatment with borax + boric acid + Na PCP and copper sulphate (two stage diffusion). On rubber wood planks *Botryodiplodia theobromae, Fusarium* sp. and borer beetles were found to cause serious deterioration, since these cause deep penetration, discoloration and weight loss. Moulds such as *Aspergillus* sp., *penicillum* sp and *Trichoderma* sp. have not been found to affect the quality of rubber wood seriously as they are only superficial.

The results also showed that both the methods ie., single stage and double stage diffusion treatments were effective for rubber wood preservation. Sodium pentachlorophenate in combination with zinc sulphate as well as the copper sulphate was equally effective for protection against sapstain fungus, other moulds and infestation by insect borers.

When sodium pentachlorophenate is used in combination with either zinc sulphate or copper sulphate in both the methods ie., single stage diffusion process a precipitate of zinc pentachlorophenate or copper pentachlorophenate is formed which get fixed on the surface as well as inner layers of the treated rubber wood planks.

Table 1. **Effect of treatments on various wood degrading fungi and insect borers (Percentage infection index)**

Solutions	Treatments and concentration	*B. theobromae*	*Fusarium* sp.	*Aspergillus* sp.	*Penicillium* Sp.	*X perforans* and *H. aequalis*
A*	Na PCP 0.5%	0 (0.71)	0 (0.71)	0 (0.71%)	0 (0.71)	0 (0.71)
B	Zinc Sulphate 10%					
A*	Borax 7.5% + boric acid 5% + Na PCP 0.5%	0 (0.71)	0 (0.71)	0 (0.71)	26.67 (30.29)	0 (0.71)
B	Zinc sulphate 10%					
A*	Na PCP 0.5%	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)
B	Copper sulphate 10%					
A*	Borax 7.5% + boric acid 5% + Na PCP 0.5%	0 (0.71)	0 (0.71)	0 (0.71)	16.67 (23.86)	0 (0.71)
B	Copper sulphate 10%					
A**	Na PCP 0.5%	0 (0.71)	0 (0.71)	3.33 (6.62)	0 (0.71)	0 (0.71)
B	Zinc Sulphate 10%					
A**	Borax 7.5% + boric acid 5% + Na PCP 0.5%	0 (0.71)	28.40 (32.21)	3.33 (6.62)	73.33 (60.0)	0 (0.71)
B	Zinc Sulphate 10%					
A**	Na PCP 0.5%	0 (0.71)	0 (0.71)	0 (0.71)	50.0 (45.0)	0 (0.71)
B	Copper sulphate 10%					
A**	Borax 7.5% + boric acid 5% + Na PCP 0.5%	0 (0.71)	0 (0.71)	0 (0.71)	46.67 (43.08)	0 (0.71)
B	Copper sulphate 10%					
	Control (untreated)	88.20(74.40)	80.00 (64.43)	0 (0.71)	6.32 (14.57)	34.60 (36.01)
	SE±	2.43	2.62	N.S.	4.48	0.76
	C D (P = 0.05)	7.29	7.86		13.44	2.28

Figures in parentheses denote angular transformed values.
*Single stage diffusion after two consecutive dippings in solution A and solution B.
**First diffusion with solution A and second diffusion with solution B.

The compounds thus formed are toxic to fungi and insects. The effectiveness of sodium pentachlorophenate in comination with either zinc sulphate or copper sulphate is attributed to the toxic compounds thus formed. Richardson (1978) reported formation of toxic compounds when zinc sulphate or copper sulphate was mixed with sodium pentachlorophenate while treating rubber wood for manufacture of fibre boards. The effectiveness of sodium pentachlorophenate against fungal attack was reported earlier by Tisseverasinghe (1969) and Jose *et al* (1989). The results of the experiment indicated that zinc sulphate or copper sulphate can be considered as substitutes for borax boric acid combination against insect attack. The treatment with copper sulphate and zinc sulphate instead of the borates were more efficacious and comparable in respect of cost and hazard.

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