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Sapstain and mould of pine timber: Field screening of pine species and preventative chemicals

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Freshly cut and sawn timber of *Pinus elliottii*, *P. patula* and *P. taeda* was dipped in one concentration of Stopstain (a boric acid based chemical) and several concentrations of Antiblue (active ingredient sodium pentachlorophenate) following a standard ten-minute immersion time and stacked in the open at Martin Sawmill, Chimanimani during the wet season. The timber was assessed for stain and mould development four or five weeks later. *P. elliottii* was most susceptible to stain and mould fungi, *P. taeda* moderately so and *P. patula* least. Antiblue in the range 2.5–4.0 per cent concentration was the better of the chemicals, providing adequate control of causal fungi on the three pine species. The recommended rate of 5.0 per cent Stopstain gave results slightly better than the control. A similar experiment had been conducted during the wet season at Chisengu Sawmill, Chimanimani, using Antiblue and *P. elliottii* timber. A concentration of 2.0 per cent provided 91 per cent control and 3.0 per cent gave complete control against stain and mould fungi. The results indicate the need to vary concentrations of preservative chemicals depending on weather conditions, in particular rainfall amount and distribution. Broad interim recommendations to minimise stain and mould development on pine timber in Zimbabwe are provided.

Losses incurred by the Zimbabwe timber industry due to customer prejudice against stained and moulded pine timber are substantial (Masuka, 1991). These led to the initiation of a major project in 1989 to search for prophylactic and palliative solutions to the problem. Laboratory and field experiments were set up to determine the efficacy of two widely used chemicals, Antiblue and Biocide T.T. (an ammonium-based chemical), in the control of sapstain and mould fungi. The results of those investigations, and causative fungi, are reported elsewhere (Masuka 1991, 1992).

Antisapstain chemicals were traditionally formulated for the prevention of stain and mould development in air-dried timber following sawing. Development of causal fungi is inhibited by low moisture contents, of magnitudes of 25 per cent and below. The period of air-drying timber varies with the season. However, in Zimbabwe a period of up to five weeks is considered adequate.

Emphasis worldwide is being placed on finding less toxic and environmentally safer

chemicals than sodium chlorophenoxide-based preventatives. Hayward *et al.* (1983) reported earlier findings that in one experiment only 16 of the 300 chemicals tested had some potential, illuminating the difficulty of this task. Under local conditions, Biocide T.T., a less toxic chemical, proved expensive and less efficacious than Antiblue (Masuka, 1992).

Antiblue is widely used by the timber industry in Zimbabwe, but cases of severe staining following treatment during the rainy season are not uncommon. This might be due to leaching of chemicals by rain, high fungal propagule load and favourable conditions for fungal development during that period.

Variation in the susceptibility of logs of *Pinus elliottii*, *P. patula* and *P. taeda* to stain and mould fungi has been demonstrated in the field (Masuka and Kariwo, 1992) and elsewhere in timber after sawing (Lambeth, *et al.*, 1989). There is no local information on the differential susceptibility of sawn timber of the major pine species to stain and mould

fungi. Such information would be useful, as less susceptible species should be felled during the peak of the rainy season to minimize the risk of timber disfigurement.

Several designs and a number of assessments have been used to determine field optima of concentrations of antisapstain chemicals (see Momoh and Uluyide, 1967; Roth *et al.*, 1974; Lewis *et al.*, 1985). Artificial covering of stacks (Roth *et al.*, 1974) distorts the results under natural conditions (Lewis *et al.*, 1985). The schedules and methods followed should, therefore, reflect commercial practice.

The present study sought to determine differential susceptibility of three major pine species to stain and mould fungi following treatment with various concentrations of Antiblue and to evaluate the efficacy of Stopstain, a newly released antisapstain formulation.

Materials and Methods

Experiment 1

Pieces of freshly cut and sawn *P. elliotii* timber (1,2 m x 19 mm x 76 mm) were dipped in an Antiblue-water suspension, in a 210 l tank, at four concentrations (Table 1). The timber was allowed to drain for 15–30 minutes before being stacked. There were 16 timber pieces per treatment replicated twice. Each treatment was bordered by two untreated pieces of the same size resulting in a stack size of 26 x 26 pieces. Untreated spacers of the same species were used. Timber dipped in higher concentrations was at the bottom of the stack to prevent leaching of chemical onto that treated with lower concentrations.

Stacks were assessed for stain and mould after five weeks. Stain and mould intensity was rated: 1 = slight; 2 = moderate; and 3 = severe.

Experiment 2

Sawn timber (2,4 m x 76 mm x 25 mm) of *P. elliotii*, *P. patula* and *P. taeda* was dipped for 10 seconds in various concentrations of antisapstain-water suspensions — one concentration of Stopstain and up to four

concentrations of Antiblue (Table 2). Two 210 l tanks, one for each chemical, were used. Timber was allowed to drain for 15–30 minutes before stacking. There were 64 timber pieces per treatment for each species and chemical. Each treatment was bordered by four untreated timber pieces. Spacers used were of the same species and treated with the same chemical concentration as treatment pieces. Each treatment was stacked separately.

Assessment for stain and mould fungi incidence and intensity was conducted after four weeks. Stain and mould intensity were rated as in Experiment 1.

Results

Experiment 1

The incidence of stain and mould in *P. elliotii* following treatment with various concentrations of Antiblue is shown in Table 1. A concentration of 2,0 per cent provided 91 per cent control. The highest concentration tested 3,0 per cent resulted in complete control of causal fungi. Temperature and rainfall data for Chisengu during the experimental period are given in Fig. 1.

Table 1: Intensity of stain and mould in *P. elliotii* timber treated with various concentrations of Antiblue

Concentration of Antiblue (%)	Per cent of timber with stain and mould in each intensity category		
	1+	2	3
0	0	37.5	62.5
1.5	46.9	3.1	0
2.0	12.5	0	0
3.0	0	0	0

+ stain and mould intensity ranking: 1 = slight; 2 = moderate; 3 = severe.

Experiment 2

Untreated timber of all three species was severely stained. *P. patula* was least susceptible to stain and mould fungi following treatment with Antiblue. *P. taeda* was moderately susceptible (Table 2). There

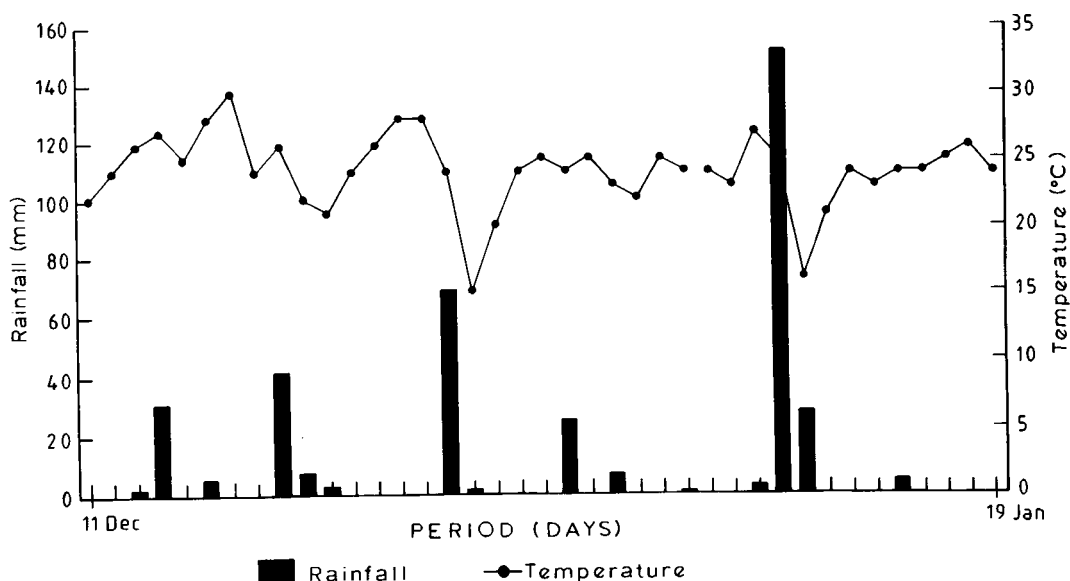


Fig. 1. Temperature and rainfall data for Chisengu between 11 Dec. and 19 Jan., 1988

Table 2: Intensity of stain and mould in timber of three *Pinus* spp. treated with various concentrations of Antiblue

Concentration of antiblue (%)	Per cent of timber with stain and mould in each intensity category								
	<i>P. elliottii</i>			<i>P. patula</i>			<i>P. taeda</i>		
	1+	2	3	1	2	3	1	2	3
0	0	0	100	44	25	29	0	5	95
2.0	47	50	3	8	0	0	42	2	0
2.5	91	3	0	—*	—	—	48	0	0
3.0	98	2	0	—	—	—	33	0	0
3.5	94	6	0	—	—	—	25	0	0
4.0	89	0	0	—	—	—	33	0	0

* stain and mould intensity ranking: 1 = slight; 2 = moderate; 3 = severe; and * not assessed.

was only 5,0 per cent moderate stain in *P. patula* following treatment with 2,0 per cent Antiblue, the only concentration tested on the species, compared to 100 per cent in both *P. elliottii* and *P. taeda* (Table 2). However,

there was no severely stained timber (intensity ranking 3) in *P. taeda* at that concentration unlike in *P. elliottii*. The incidence of stain and mould at a concentration of 3,0 per cent Antiblue was 23

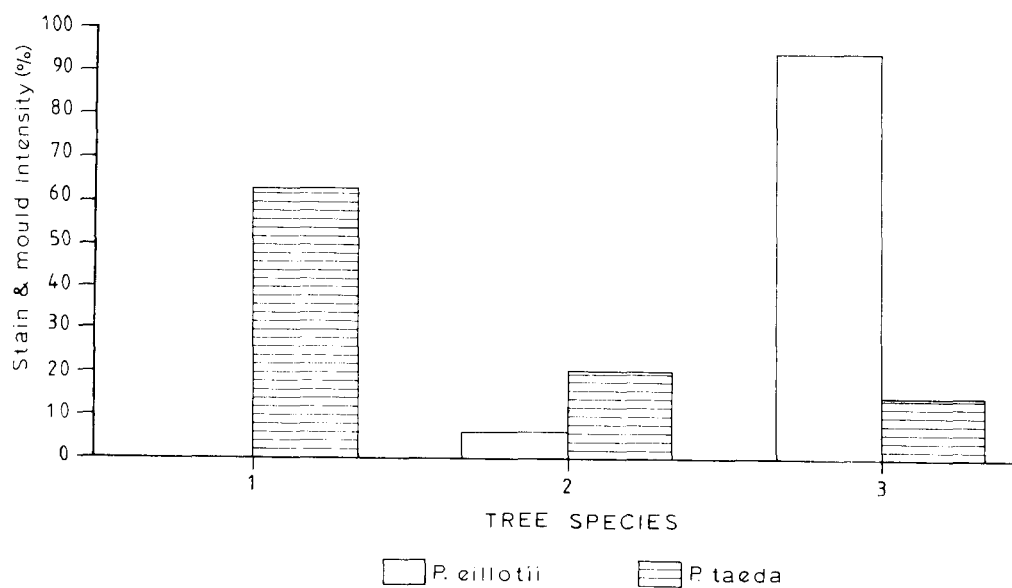


Fig. 2 Stain and mould intensity in *P. elliotii* and *P. taeda* following treatment with 5 per cent Stopstain

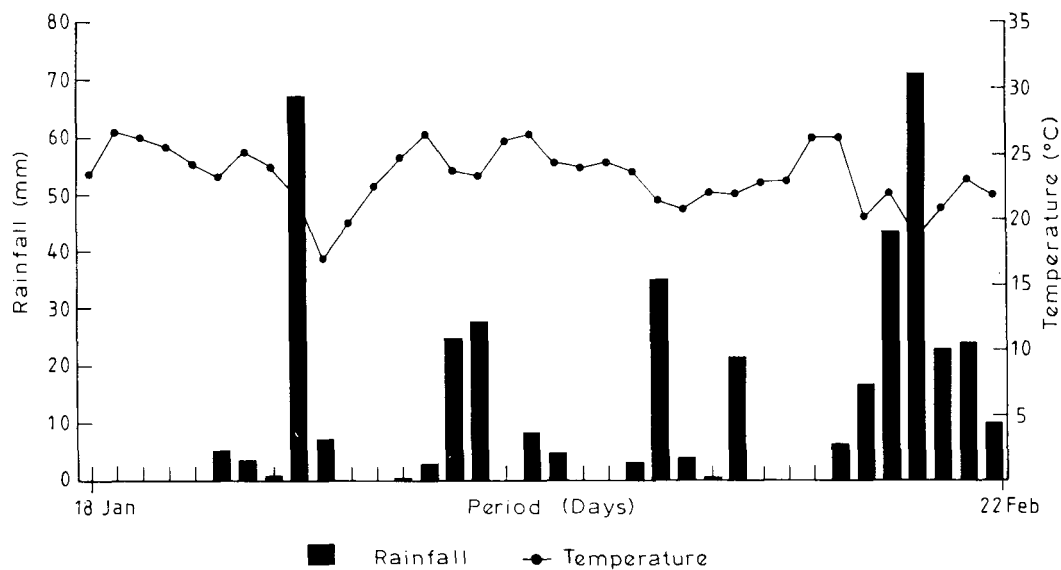


Fig. 3. Temperature and rainfall data for Martin Sawmill between 18 Jan. and 22 Feb. 1993

per cent in *P. taeda* compared to 89 per cent in *P. elliottii*. Even at the highest concentration tested, most *P. elliottii* timber had slight stain and mould. Concentrations of 3,0 per cent Antiblue and above did not seem to have a differential effect on stain and mould incidence and intensity in either *P. elliottii* or *P. taeda*.

Timber treated with Stopstain was moderately to severely stained in *P. elliottii*. In *P. taeda* 63 per cent of the logs had slight stain and mould following treatment with the same chemical concentration (Fig. 2).

Daily rainfall and temperature data for the duration of the experiment are shown in Fig. 3.

Discussion and Recommendations

The field screening results were the opposite of log screening tests for the three species. In the latter, stain and mould developed rapidly in *P. patula* logs, followed by *P. taeda* and least in *P. elliottii* (Masuka and Kariwo, 1992). A recommendation not to fell *P. patula* during the peak of the rainy season was made on that basis. However, present investigations on the susceptibility of sawn timber of the three species to stain and mould development show that *P. patula* is least susceptible. Differential susceptibility of pines to stain and mould fungi has been found elsewhere (Lambeth *et al.*, 1989). Stain and mould are of more economic significance in sawn timber than in logs. A recommendation is made to fell *P. patula* during the peak of the wet season, with a further reminder that logs be transported as quickly as possible to the sawmill. The urgency of sawing logs as soon as possible following felling is increased by the chemical activity — being only prophylactic. One suggestion would be to date-mark logs in the field upon felling so that sawmillers will know the time period that has expired before logs were delivered to the mill. Dipping timber that has stayed for too long in the field is indeed a waste of time and staff resources, as no amount of chemical will prevent the further development of stain already established.

Seasonal variation in the amount of

chemical required to inhibit stain and mould development has been reported (Holtam, 1966). In 1989 due to the dry conditions, with rainfall only 40 per cent of normal during the experimental period, a concentration of 1,5 per cent Antiblue resulted in 26 per cent stain and mould in sawn *P. elliottii* timber. In the present study the same level of protection of stain and mould was not achieved even at the highest concentration tested (4,0 per cent). This indicates the need to adjust chemical concentrations with seasons. The differential effect of localities on the incidence and severity of stain cannot be readily ascertained under present circumstances.

Laboratory studies on the efficacy of Antiblue and Biocide T.T. against stain and mould fungi (Masuka, 1991) showed that a concentration of 1,5 per cent Antiblue was effective against tested fungi. The same concentration provided less protection in the field. Laboratory studies cannot simulate field conditions where fluctuations in climatic conditions and handling practices occur. The washing away of chemicals by rains and leaching due to chemical reactions is difficult to simulate in the laboratory. Laboratory studies, however, are useful in preliminary screening trials, when an indication of the potential field efficacy of antisapstain chemicals is required.

The poor performance of Stopstain could, in part, be attributed to field screening of the chemical under dry conditions which persisted throughout the country during the past five years. Higher concentrations of the chemical could be effective but expensive.

Antiblue and similar chemicals are suspensions not solutions. Constant agitation of the dipping tank is necessary otherwise the active ingredient will sink to the bottom. The active ingredient binds as tenaciously to sawdust as it does to timber. Fluctuations in the concentration of the active ingredient following dipping of timber and accumulation of sawdust should be ascertained.

Rapid processing and use of the right chemical concentration should minimize the risk of staining and moulding. Beyond that, prevention from re-wetting should help to

provide a high quality product. Aspects that need to be addressed in future include general stack-yard hygiene, the choice and size of spacers, and the efficiency of various stacking systems. Indeed, a holistic approach to the stain and mould problem is required.

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