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Natural Durability of Ten Heartwood Species and Effectiveness of BFCA on *Trametes cingulata*

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မြန်မာသစ် (၁၀) မျိုးတို့သစ်ဆွေးမှိုး *Trametes cingulata* အပေါ် သဘာဝအလျောက် ခုခံနိုင်အားနှင့် သစ်ကြာရှည်ခံဆေးရည် (BFCA)၏ အကျိုးသက်ရောက်မှုကို့ လေ့လာခြင်း

ဦးဝင်းကြည် (၂) B.Sc. (For.), (Rgn.), M.S (SUNY) အကြီးတန်းသုတေသနမှူး
နှင့်
ဒေါ်ဝေဝေသန်း (B.Sc.) (Zoo.), (Mdy.) ဒု-သုတေသနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

ရွေးချယ်ထားသော သစ်(၁၀) မျိုးတို့၏ ½ x ½ x ၁ လက်မအရွယ် သစ်နမူနာတုံးများကို ကြိုတင် ပြင်ဆင်ထားသော သစ်ဆွေးမှိုး (Trametes cingulata) ပါရှိသော စမ်းသပ်ဖန်ပြွန်ထဲတွင် ထားရှိပါသည်။ ကျွန်းသစ်ကို နှိုင်းယှဉ်ရန် ထည့်သွင်းခဲ့ပါသည်။ (၁၆)ပတ် ကုန်ဆုံးပြီးနောက် ၄င်းသစ်ဆွေးမှိုကြောင့် အလေးချိန် လျော့ရာတွင် အများဆုံးမှ အနည်းဆုံးရှိသော သစ်မျိုးအစီအစဉ်မှာ-ကညင်၊ တောင်သရက်၊ ခူသန်၊ ရုံး၊ မျောက်ငိုး၊ လယ်စ၊ ဇောင်းပလေး၊ ယမနေ၊ အင်၊ ကျွန်း နှင့် ချဉ်ယုတ် တို့ဖြစ်ကြပါသည်။ ကညင် နှင့် တောင်သရက်သစ်တို့ကို (BFCA) (၅)၁၀၀ (၁၀) (၁၅) (၂၀) (၂၅) ရာခိုင်နှုန်း ဆေးရည်စိမ်၍ အလားတူ စမ်းသပ်မှုပြုခဲ့ရာ သစ်ဆွေးမှိုး စားခြင်းမှ ထိရောက်စွာ ကာကွယ်နိုင်ကြောင်း တွေ့ ရှိရပါသည်။

Natural Durability of Ten Heartwood Effectiveness of BFCA on *Trametes cingulata*

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Abstract

½ x ½ x 1 inch-size specimens of ten selected species of wood were infested with a white-rot fungus, *Trametes cingulata,* in culture tubes. Kyun was included as a standard. A decreasing order of oven-dried weight looses of species at the end of the exposure period (16- weeks) was Kanyin, Taung-thayet, Kuthan, Yon, Myaukngo, Leza,Zaungbale, Yemane, In, Kyun and Chinyok. Excellent performance of 5,10,15,20 and 25 percent BFCA treated Kanyin and Taung-thayet was found when tested with the decay-fungus.

Contents

1. Introduction

Growing tendency of Forest Department personnel to publicize the use of lesser-known species of wood has led wood product researchers acquire better knowledge of such species and investigate techniques to improve the quality of the products. Failure to last long when exposed to weather is the major draw-back of wood other than a few durable species. Termites and wood-decay fungi are mainly responsible for the deterioration of wood.

This paper initiates the study of a number of wood-destroying fungi in the locality and their activities on many timber species. The first happened to be selected fungus was *Trametes cingulata,* a white-rot fungus. The severity of attack of this fungus on ten selected species of wood was determined. Performance of BFCA treated wood was also studied in this paper.

2. Literature Review

White rots are more commonly associated with hardwoods and brown rots with softwoods (Ref.1). This is the reason why a white rot fungus was chosen as an agent for wood deterioration in this project. Laboratory decay tests of In and Kanyin using three brown and three white rot fungus indicated both white and brown rot fungi attacked the specimens though a considerable differences in weight loss were observed (Ref.2). Variation in weight loss due to different fungi was also found when In, Kanyin and Tanug-thayet wood specimens were exposed to soft rot (*Chaetomium globosum),*white rot (*Coriolus versicolor*) brown rot *(Coniophora puteana),* and unsteriled soil (Ref.3). Soil burial test showed the most drastic weight loss among the others.

BFCA, a mixture of compounds of sodium tetraborate, sodium flouride, arsenic pentoxide, and sodium dichromate, is a water-borne wood preservative. It was first used experimentally in a dip-diffusion treatment of timber for houses built in Port Morseby in 1955. Results with this decay and termite-susceptible timber have remained excellent over almost 30 years (Ref. 4).

Within the range of concentration tested (0.032 %-0.495 %) BFCA treated timber showed no protection against soft rot *(Chaetomium globosum)*, and in the unsterile soil. However, it was found satisfactory with the white rot and the brown rot fungi at high concentration ((Ref. 3).

A much higher concentration (30-40%) of BFCA was suggested by researchers and producers of BFCA ((Ref. 5,6,7). In this paper a concentration gradient of 5,10,15,20 and 25 percent of BFCA dry salt was used.

3. Materials and Methods

1. Natural Durability Test

½ x ½ x1 inch-size heartwood specimens of the following species were cut, sanded, oven-dried and oven-dried weights of individuals were recorded. The specimens were soaked with boiled water and kept in plastic bags for 24 hours to attain an approximate moisture content of 30-40 percent. Each specimen was placed in a culture tube containing test fungus.

Kyun	*Tectona grandis* Linn
In	*Dipterocarpus tuberculatus* Roxb
Kanyin	*Dipterocarpus alatus* Roxb
Yon	*Anogeissus acuminata* Wall
Leza	*Lagerstroemia tomentosa* Presl
Zaungbale	*Lagerstroemia villosa* Wall
Kuthan	*Hymenodictyon excelsum* Wall
Myaukngo	*Daubanga grandifolia (*Roxb) Walp.
Yemane	*Gmelina arborea* Linn
Taung-thayet	*Swintonia floribunda* Griff
Chinyok	*Garuga pinnata Roxb.*

Test fungus was isolated from decaying wood of Kokko (*Samanea saman)* and identified as *Trametes cingulata* by Dr.Pegler from Kew garden, England. It was cultured on a PDA (Potato, Dextrose and Agar) medium in a petri dish and transferred aseptically into 25 mm-size culture tubes containing the same agar medium. Culture tubes so prepared were then plugged with cotton and kept at room temperature (80-90° F). At the end of sixteen weeks incubation period, specimens were taken out and attached mycelium were carefully scraped off. Oven-dried weights of the specimens were taken again and weight loss percentages were calculated.

2. Test on the effectiveness of BFCA

BFCA used is the product of Koppers (PNG) PTY, LTD. It is a water-soluble dip diffusion wood preservative. The active constituents contained in it are as follows:-

132.8 g/kg	Boron present as boric acid and sodium tetra borate
84.2 g/kg	Fluorine present as sodium fluoride.
77.2 g/kg	Arsenic present as arsenic pentoxide
44.1 g/kg	Chromium present as sodium dichromate .

5, 10, 15, 20 and 25% BFCA solutions were prepared by serial dilution of BFCA with water.

Being susceptible to test fungus Taung-thayet and Kanyin were selected for the determination of effectiveness of BFCA. Oven- dried weights of ½ x ½ x 1 inch- size wood specimens of said species were taken. The specimens were then soaked with water to attain 30-40 percent moisture content as before and dipped separately in 5,10, 15,20 and 25% BFCA solutions for 5 minutes. Each group of BFCA treated specimens was wrapped in plastic bag for further diffusion of salt into the wood. Diffusion period was two weeks.

BFCA treated and control specimens were placed in culture tubes containing test fungus *Trametes cingulata,* as before. Oven- dried weights of the specimens were taken at the end of 8th, 12th and 16th weeks. Percentages of weight loss of individuals were calculated .

4. Results and Discussion

Using percent weight loss as a measure of severity of decay, Kanyin and Taung-thayet were found to be the most susceptible to the test fungus and Chinyok and Kyun least susceptible (Table 1).

Table 1. Mean (oven- dried) weight losses of the wood specimens infested by *Trametes cingulata* after 16th weeks .

Species	Mean Weight loss (%)	Std : Deviation
Chinyok	2.96	1.01
Kyun	4.17	1.53
In	6.89	5.14
Yemane	7.32	1.87
Zaungbale	9.03	5.53
Leza	10.68	7.88
Myaukngo	14.8	1.82
Yon	17.7	5.86
Kuthan	27.43	6.45
Taung-thayet	34.73	11.35
Kanyin	36.73	6.93

Owing to the variation in weight losses of individuals, the consecutive species shown above were not different statistically except the difference between Yon and Kuthan. A statistical analysis t-test, was made in order to establish a list of durability groups. Significant differences were found between successive groups at 95 percent confident interval (Table .2)

Table 2 . Durability groups of species tested with *Trametes cingulata* .

	Group	Intermediates
1.	Chinyok, Kyun	In
2.	Yemane, Zaungbale	Leza, Myaukngo
3.	Yon	
4.	Kuthan	Taung-thayet
5.	Kanyin	

It should be remember that different results may be obtained with different test fungi. However, the results obtained found to agree with our general concept of durability that Kyun, a reputably durable species, ranked in the first group while Kanyin, a not durable species, listed in the last group. Therefore it can be concluded that the groups of species in between the first and the last one should follow the natural pattern of decay resistance.

Percent weight losses of BFCA treated and control specimens of Taung-thayet and Kanyin are shown detail in Appendix (2). To compare the effectiveness of BFCA at various levels of concentration rearrangement of the table was made as follows:

Table 3. Mean weight losses of Taung-thayet tested with *Trametes cingulata* at various levels of concentration of BFCA.

Concentration of BFCA (%)	No. of samples	Mean Weight Loss (%)	Standard deviation
0	12	11.33	7.15
5	9	2.59	5.52
10	12	1.25	1.04
15	12	1.11	0.28
20	12	1.16	0.51
25	12	1.37	0.20

Table 4. Mean weight losses of Kanyin tested with *Trametes cingulata* at various levels of concentration of BFCA.

Concentration of BFCA (%)	No. of samples	Mean Weight Loss (%)	Standard deviation
0	12	31.72	14.01
5	12	0.12	0.17
10	12	0.60	0.28
15	9	0.36	0.36
20	10	1.19	0.59
25	12	1.37	0.39

At every levels of concentration of BFCA tested there is a significant difference between the weight losses of treated and control specimens of both Taung-thayet and Kanyin at 95 % confident interval.

There is no significant difference between weight losses of Taung-thayet specimens at different levels of concentration of BFCA.

However, Kanyin treated with 5% BFCA was found to be superior to those treated with higher concentrations of BFCA except 15 %. Reason for better performance of Kanyin specimens treated with 5% BFCA solution is not known.

Despite the lower durability of Kanyin to the test fungus BFCA treated Kanyin was found to be better than treated Taung-thayet at low concentrations of BFCA (5, 10 and 15%). In fact, BFCA treated Kanyin and Taung-thayet perform better than any untreated timber species including Kyun.

To compare the losses of weight of wood specimens at different intervals rearrangement of tables were made as follows:

Table 5. Mean weight losses of Taung - thayet at different intervals.

Intervals (weeks)	No. of samples	Mean Weight loss(%)	Standard deviation	Remark
8	4	6.76	2.7	Control
12	4	9.78	5.5	
16	4	17.44	8.3	
8	20	1.14	0.89	Treated
12	17	1.00	0.39	
16	20	2.10	3.58	

Table 6. Mean weight losses of Kanyin at different intervals.

Interval (weeks)	No. of samples	Mean Weight loss(%)	Standard deviation	Remark
8	4	15.75	5.2	Control
12	4	35.66	4.5	
16	4	43.75	10.9	
8	20	0.53	0.47	Treated
12	15	0.76	0.53	
16	20	0.90	0.74	

No significant differences in weight loss was found between BFCA treated specimens of both species at intervals of 8th, 12th and 16th weeks (Table 5. and 6).

Rate of deterioration of control specimens of Taung-thayet was relatively slow during the exposure period of 8th through 16th week. Therefore no significant difference was observed between the weight losses of specimens of consecutive intervals (Table 5.)

However, rate of deterioration of control specimens of Kanyin was so rapid during that period that a significant difference in weight loss was observed between the specimens at 8th and 12th week intervals (table 6).

These findings suggest the use of a maximum of 8 week exposure period in evaluating the effectiveness of any wood preservative using either Taung-thayet or Kanyin with the same fungus in order to save time.

While deterioration rate of untreated Kanyin was relatively consistent (Table 1 and Table 6), erratic results were obtained for the control specimens of Taung-thayet (Table 1 and Table 5). Therefore, a number of replications would be necessary in order to produce reliable information and a minimum of 16 week exposure period should be used in the upcoming studies in natural durability of timber species.

5. Conclusion

A fair idea of natural durability of some common hard-wood species was gained from this initial decay study. However, further decay tests both in the laboratory and in the field (stake test) are necessary to complete the knowledge of durability of lesser-known species.

Characteristics of common wood destroying fungi other than *Trametes cingulata* should also be studied. As a matter of fact soft rot is very common in the tropics.

Comparative study of the effectiveness of wood preservatives and their compatibility to the wood used should also be made. Findings in this paper recommend the use of low durable woods such as Taung-thayet and Kanyin after rendering proper preservative treatment.

Appendix (I)

Percent weight losses of wood specimens after 16 week exposure to *Trametes cingulata*.

No.	O.D Weight (g)		Wt. loss %
	Initial	Final	
	Kanyin		
1.	3.17	2.00	36.91
2.	3.00	1.51	49.67
3.	3.07	1.82	40.72
4.	3.00	1.94	35.33
5.	3.13	2.03	35.19
6.	3.09	1.95	36.89
7.	3.19	2.40	24.76
8.	3.05	2.00	34.43
	Mean		36.73
	Taung – thayet		
1.	3.30	2.46	25.45
2.	3.28	1.62	50.61
3.	3.32	1.96	40.96
4.	3.38	1.95	42.31
5.	3.23	2.41	25.39
6.	3.42	2.61	23.68
	Mean		34.73

No.	O.D Weight (g)		Wt. loss %
	Initial	Final	
	Kuthan		
1.	2.33	1.77	24.03
2.	2.34	1.84	21.37
3.	2.23	1.77	20.63
4.	2.30	1.62	29.57
5.	2.36	1.76	25.42
6.	2.29	1.71	25.33
7.	2.29	1.72	24.89
8.	2.19	1.33	39.27
9.	2.23	1.42	36.32
	Mean		27.43
	Yon		
1.	3.32	2.85	14.16
2.	3.41	2.83	17.01
3.	3.64	2.62	28.02
4.	3.47	2.77	20.17
5.	3.58	2.98	16.76
6.	3.75	2.80	25.33
7.	3.64	3.31	9.07
8.	3.89	3.12	19.79
9.	3.53	2.99	15.30
10.	3.52	3.12	11.36
	Mean		17.7

No.	O.D Weight (g)		Wt. loss %
	Initial	Final	
	Myaukngo		
1.	2.50	2.17	13.2
2.	2.10	1.76	16.19
3.	2.30	1.94	15.65
4.	2.34	2.00	14.53
5.	2.31	2.06	10.82
6.	2.16	1.80	16.67
7.	2.31	1.95	15.58
8.	2.10	1.75	16.67
9.	2.29	1.95	14.85
10.	2.39	2.06	13.81
	Mean		14.8
	Leza		
1.	2.59	2.30	11.20
2.	2.85	2.31	18.95
3.	2.57	2.33	9.34
4.	2.68	2.45	9.33
5.	2.78	2.64	5.04
6.	2.54	1.80	29.13
7.	2.64	2.50	5.30
8.	2.43	2.21	9.05
9.	2.55	2.49	2.35
10.	2.25	2.09	7.11
	Mean		10.68

No.	O.D Weight (g)		Wt. loss %
	Initial	Final	
	Zaungbale		
1.	3.91	3.51	10.23
2.	3.88	3.47	10.57
3.	4.16	3.92	5.77
4.	4.22	3.87	8.29
5.	4.19	3.97	5.25
6.	3.90	3.59	7.95
7.	4.27	4.01	6.09
8.	4.28	4.04	5.61
9.	4.08	3.61	11.52
10.	3.92	2.85	27.30
11.	4.28	3.91	8.64
12.	3.86	3.63	5.96
13.	4.18	3.92	6.22
14.	4.00	3.56	11.00
15.	4.00	3.80	5.00
	Mean		9.03

No.	O.D Weight (g)		Wt. loss %
	Initial	Final	
	Yemane		
1.	2.61	2.43	6.90
2.	2.34	2.17	7.26
3.	2.64	2.56	3.03
4.	2.37	2.19	7.59
5.	2.60	2.41	7.31
6.	2.53	2.32	8.30
7.	2.33	2.09	10.30
8.	2.24	2.05	8.48
9.	2.30	2.12	7.83
10.	2.43	2.28	6.17
	Mean		7.32
	In		
1.	3.22	2.85	11.49
2.	3.48	3.18	8.62
3.	3.21	2.84	11.53
4.	3.28	3.23	1.52
5.	3.87	3.82	1.29
	Mean		6.89

No.	O.D Weight (g)		Wt. loss %
	Initial	Final	
	Kyun		
1.	2.43	2.34	3.70
2.	2.46	2.31	6.10
3.	2.52	2.44	3.17
4.	2.46	2.38	3.25
5.	2.59	2.50	3.47
6.	2.53	2.38	5.93
7.	2.42	2.31	4.55
8.	2.52	2.48	1.59
9.	2.60	2.45	5.77
	Mean		4.17
	Chinyok		
1.	2.62	2.50	4.58
2.	2.33	2.23	4.29
3.	2.60	2.53	2.69
4.	2.61	2.56	1.92
5.	2.80	2.74	2.14
6.	2.98	2.88	3.36
7.	2.62	2.56	2.29
8.	2.47	2.41	2.43
	Mean		2.96

Appendix (2)

Percent weight losses of BFCA - treated wood specimens exposed to *Trametes cingulata*

8 week exposure			12 week exposure			16 week exposure		
BFCA : con. %	No.	Wt. loss %	BFCA con. %	No.	Wt. loss %	BFCA con. %	No.	Wt. loss %
	Kanyin			Kanyin			Kanyin	
0	1	17.32	0	5	33.09	0	9	49.47
	2	20.92		6	37.91		10	52.88
	3	16.10		7	40.71		11	44.48
	4	8.66		8	30.92		12	28.18
	mean	15.75		mean	35.66		mean	43.75
5	13	0.0	5	17	0.0	5	21	0.0
	14	0.0		18	0.0		22	0.0
	15	0.36		19	0.36		23	0.0
	16	0.0		20	0.34		24	0.36
	mean	0.09		mean	0.18		mean	0.09
10	25	0.72	10	29	0.35	10	33	0.73
	26	0.72		30	0.64		34	0.0
	27	0.71		31	1.10		35	0.36
	28	0.74		32	0.74		36	0.36
	mean	0.73		mean	0.71		mean	0.36

8 week exposure			12 week exposure			16 week exposure		
BFCA : con. %	No.	Wt. loss %	BFCA con. %	No.	Wt. loss %	BFCA con. %	No.	Wt. loss %
	Kanyin			Kanyin			Kanyin	
15	37	0.0	15			15	45	1.11
	38	0.33					46	0.36
	39	0.0					47	0.34
	40	0.0					48	0.71
	mean	0.08					mean	0.63
20	49	0.0	20			20	57	1.83
	50	1.06					58	1.82
	51	1.06					59	1.78
	52	0.97					60	1.64
	mean	0.77					mean	1.77
25	61	0.66	25	65	1.36	25	69	1.68
	62	1.31		66	1.69		70	1.74
	63	0.70		67	1.30		71	1.31
	64	1.34		68	1.39		72	1.93
	mean	1.00		mean	1.44		mean	1.67
	Taung-thayet			Taung-thayet			Taung-thayet	
0	73	7.39	0	77	17.81	0	81	11.18
	74	6.41		78	8.74		82	9.58
	75	3.36		79	5.72		83	26.3
	76	9.89		80	6.85		84	22.70
	mean	6.76		mean	9.78		mean	17.44

8 week exposure			12 week exposure			16 week exposure		
BFCA : con. %	No.	Wt. loss %	BFCA con. %	No.	Wt. loss %	BFCA con. %	No.	Wt. loss %
	Taung-thayet			Taung-thayet			Taung-thayet	
5	85	0.0	5			5	93	0.73
	86	0.72					94	17.26
	87	0.98					95	1.51
	88	0.35					96	1.12
	mean	0.51					mean	5.16
10	97	0.96	10	101	0.35	10	105	1.41
	98	0.93		102	0.70		106	0.86
	99	4.38		103	0.59		107	1.43
	100	1.27		104	1.03		108	1.05
	mean	1.885		mean	0.67		mean	1.19
15	109	0.69	15	113	1.38	15	117	1.03
	110	1.37		114	0.90		118	1.32
	111	0.88		115	1.04		119	1.30
	112	0.60		116	1.42		120	1.36
	mean	0.89		mean	1.19		mean	1.25
20	121	0.27	20	125	0.86	20	129	1.20
	122	0.80		126	1.40		130	1.38
	123	1.62		127	1.23		131	1.33
	124	1.71		128	0.32		132	1.85
	mean	1.1		mean	0.95		mean	1.44
25	133	1.20	25	137	1.17	25	141	1.45
	134	1.59		138	1.40		142	1.37
	135	1.35		139	1.53		143	1.39
	136	1.11		140	1.16		144	1.74
	mean	1.31		mean	1.32		mean	1.49

Annexure 1.

A tentative classification of natural durability of timber.*

No.	Durability Classes	Weight Loss (%) **
1.	Durable to very durable	Up to 5
2.	Moderately durable to durable	5 – 10
3.	Not durable to moderately durable	10-30
4.	Perishable to not durable	over 30

* Refer to Cartwright, KSG, and Findlay, WPK (1958); Decay of timber and its prevention.
** Oven-dry weight loss percentages after 16 weeks exposure to the wood-rotting fungus.

Annexure .2

Natural durability groups of species tested with (*Trametes cingulata)*, buried in the soil for 16 weeks.

Group No.	Species	Mean weight loss (%)			
		Lab decay tests			Soil burial
		1.	2.	3.	
1.	Kyun	4.17	2.78	0.45	2.67
	Chinyok	2.96	4.38	2.52	4.11
2.	In	6.89	11.99	5.52	5.47
	Yemane	7.32	13.05	1.51	6.73
3.	Myauk-ngo	14.80	8.48	-	4.28
	Zaungbale	9.03	13.52	5.81	13.91
	Yon	17.70	17.96	-	11.04
	Leza	10.68	32.16	19.57	-
	Kuthan	27.43	-	-	21.51
4.	Taung-thayet	34.73	-	-	18.05
	Kanyin	36.73	-	-	10.95

References

1. Beesley, J. 1983. Preservative Treatment of Tropical Timbers by Diffusion Processes. Seminar on the Preservation of Tropical Timber C.S.I.R.O.
2. Findlay, W.P.K. 1985. Preservation of Timber in the Tropics. Martinus Nijhoff/

   Dr. W. Junk Publishers. The Netherlands.
3. Koppers (PNG) PTY, LTD. " Formula 7" Dip-Diffusion Wood Preservative Salts.
4. Nyunt, A. 1988. Treatability and performance of In, Kanyin and Taung-thayet. Leaflet No. 4/87-88. FRI, Yezin.
5. Panshin, A.J., and C. De Zeeuw. 1980. The Textbook of Wood Technology 4th Ed., Mc. Graw Hill, New York, 705 pp.
6. Ruddick, J.N.R. 1982. Laboratory Decay Test of Burmese In and Kanyin treated with three wood preservatives. Document No. IRG/ WP/3210.
7. Tamblyn, N,.at.el. Preservative Treatment of Tropical Building Timber by a Dip-Diffusion Process. Huon Litho Press (PNG).