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NATURAL DURABILITY OF PALMYRAH AND NIBONG PALM STEMS

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บทคัดย่อ

การทดลองหาความทนทานตามธรรมชาติของไม้ตาล และไม้หลาวชะโอน โดยทำแปลงทดลองให้เพรียงทำลายในทะเลเทียบกับชุดไม้ตัวอย่างที่อาบน้ำยาซีซีเอ เข้มข้น 3% ตรวจผลทุก 3 เดือน เป็นระยะเวลา 21 เดือน และทำแปลงทดลองบนบกแบบไม้เหลี่ยมเล็กในสภาพดินฟ้าอากาศธรรมชาติ เทียบกับไม้สักและไม้ยาง รวม 2 แปลงคือ ที่จังหวัดลำปาง กับจังหวัดประจวบคีรีขันธ์ ตรวจผลทุก 6 เดือน เป็นระยะเวลา 24 เดือน ผลปรากฏว่า การทดลองเพรียงนั้น ไม้ตาลและหลาวชะโอนที่ไม่อาบน้ำยาเสียหายหนักภายใน 9 เดือน ส่วนที่อาบน้ำยาปรากฏว่า ทนทานกว่าไม้อาบประมาณเท่าตัว ส่วนการทดลองบนบกในสภาพดินฟ้าอากาศธรรมชาตินั้น ปรากฏว่า ไม้ตาลและหลาวชะโอนทนทานเทียบได้กับไม้สักทั้ง 2 แปลง และกล่าวได้ว่าอาจเกิดความเสียหายได้เท่า ๆ กันทั้งสาเหตุจากเชื้อราและปลวก

ABSTRACT

Field tests on the resistance against marine borers and open field graveyard of nibong and palmyrah were undertaken during July 1988 to November 1990. Marine trials were conducted by exposing the untreated and 3% CCA treated panels to the seawater for a period of 21 months. Inspections were made every 3 months. The graveyard tests were made at 2 sites representing northern and southern part of the country. Teak and yang *(Dipterocarpus alatus)* were used as reference species. Inspections were made every 6 months.

Results of marine trials indicate that the untreated panels of nibong and palmyrah palms sustained heavy attack after nine months. Of the graveyard tests for the duration of 2 years so far, results show that the durability of nibong and palmyrah is comparable with teak at both sites. There is no apparent difference between decay and termite susceptibility of both species.

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INTRODUCTION

There are several species of palmwoods in Thailand. This study was conducted only on 2 species : Palmyrah *(Borassus sp.)* and Nibong *(Oncosperma sp.)* and is a sub project of a three year research project entitled "Properties and Processing Techniques of *Oncosperma sp.* and *Borassus sp.* Palm Stems" sponsored by IDRC, Canada.

The palmyrah palm grows mainly in the central part of Thailand. Utilization of its trunk has been scarce until recently it has noticeably increased as a result of the nationwide logging ban recently enforced by the government. The nibong palm is found in mangrove and low land rain forests mainly along the southern part of the country. It is traditionally used in the round forms mostly for structures in sea water because of its high resistance to marine borers.

This paper deals with the natural durability of both palms, by means of accelerated graveyard and marine borer tests which had been conducted during July 1988 to November 1990.

MATERIALS AND METHODS

Marine Trial

400 panels cut to the size of 19×76×460mm were prepared from the hard part of 5 mature palmyrah stems. They were divided into 10 groups of 40 panels of which 20 were to be untreated and 20 treated with CCA wood preservative. With appropriate markings, each group represented specimens from 5 trees, height levels in tree, and sidematched untreated/treated panels. Each group was arranged in ladderlike manner with double ropes by means of a drilled hole at each end of the panel. Spacing between panels was 50mm apart. All 10 groups were fastened to a 4×4m steel cage equipped with floats and anchored to the sea bed. One group was to be picked up at random for inspection.

For nibong palm the same number and pattern of arrangement as above was applied. Most of the stems available were not mature and rather small in diameter, therefore 15 stems were required to make 8 identical groups and another 5 to make 2 groups with respect to tree number and height levels in tree. Also every panel was not squareshaped but a segment sawn from a cylindrical stem with the bark intact. The surface area was approximately equal to that of palmyrah panel.

To obtain preliminary information on the behavior of preservative treated palmwood, it was decided that preservative treated panels be added in the test. Treatment was carried out using the full-cell process with 3% CCA wood preservative. Low loading schedule was made as follows:

Initial vacuum	635 mmHg	30 minutes
Pressure	10 kg/cm^2	60 minutes

No final vacuum.

Inspections : Every 3 months one rope was brought up at random and the panels examined visually after the foulings removed. Rating for damage was as follows:

10 - no more than trace attack
9 - light attack
7 - moderate attack.
4 - heavy attack
0 - destroyed by attack

Seven inspections were made on nibong and only four on palmyrah because the latter had been carried away by heavy storm.

Field Stake Tests

Small stakes of the size 19×19×457mm were prepared from nibong and palmyrah planks taken at random from stock. Nibong stakes were, as in marine panels, containing about 50% soft part along the length because this is unavoidable. The reference species employed were stakes of the same size from yang *(Dipterocarpus alatus)* and teak *(Tectona grandis)*. Two graveyard plots were selected at different locations. One at Lampang province, another at Prachuap province, both were intended as representatives of the northern and the southern climatic conditions respectively. Stakes installed in each plot were side-matched parts taken from the respective species.

Stakes were arranged at random. Each plot consisted of 30 stakes each from nibong and from palmyrah, 20 each from yang and from teak. They were embedded one-half length into the earth, the distance between column and rows is 50×60cm respectively.

Inspections : Inspections were scheduled at 6 months interval. Each stake was pulled upward and inspected for damage either by decay or termite sources, then inserted back to the same position. So far, 4 inspections (2 years duration) were made at both sites. Grading System for decay and termite damages were as follows:

Decay Grandes

10 - sound
9 - trace of decay
7 - moderate decay
4 - heavy decay
0 - failure due to decay

Termite Grades

10 - sound
9 - trace of attack
7 - moderate attack
4 - heavy attack
0 - failure by termite attack

RESULTS AND DISCUSSIONS

Marine Trial

Conditions of the test panels : Results are presented in Table 1 and Figure 1. Scores were given as averages of 5 replicate panels from the untreated (UT) and treated (T) sets.

For natural resistance in the sea water, both kinds of palm stem have suffered heavy attack after exposing to the sea water for 9 months. Unfortunately the palmyrah test panels were ruined by heavy storm after 13 months in the sea. After 15-18 months, nibong were completely destroyed by borers. Figure 1 shows that both palms have approximately the same degree of resistance to marine borers.

For the resistance of the treated samples, the treated panels of palmyrah have shown moderate attack at the 12 months inspection before they were carried away by storm. Nibong stayed until 21 months with heavy damage. As in the untreated panels, both treated palms show almost exactly the same degree of resistance.

Data on preservative absorption expressed as dry salt retention of palmyrah and nibong are given in Appendices 1 & 1a. The retention increased with the precentage of the soft part presented in the test panel which readily absorbed more preservative than the hard part, especially toward the top of the trunk. The same applied to nibong where

Table 1. Damage ratings of untreated and treated panels of palmyrah and nibong exposed to marine borers attack.

Species	Inspection Month	Height above ground: Butt		2m		4m		6m		Average damage	
		UT	T	UT	T	UT	T	UT	T	UT	T
Palmyrah	3	10.0	10.0	9.8	10.0	9.8	10.0	9.2	10.0	9.7	10.0
	6	8.2	10.0	8.2	9.4	6.8	8.8	4.4	9.6	6.9	9.4
	9	4.0	10.0	5.2	9.4	5.0	7.5	3.0	7.7	4.3	8.6
	12	5.2	9.0	4.6	7.8	1.0	6.2	0	6.2	2.7	7.3
Nibong	3	9.0	10.0	9.8	10.0	9.2	10.0	9.8	10.0	9.4	10.0
	6	5.8	10.0	4.0	9.4	7.0	9.8	5.2	8.2	5.5	9.4
	9	4.0	9.6	4.0	7.4	4.0	9.2	4.0	6.4	4.0	8.2
	12	5.2	8.6	2.4	6.4	4.0	8.2	3.6	7.8	3.8	7.8
	15	1.6	7.8	2.0	6.2	0	8.2	0	4.0	0.9	6.6
	18	0	6.8	0	5.6	0	6.8	X	6.2	0	6.4
	21	0	5.0	0	3.2	X	4.0	X	1.3	0	3.4

Note : Grading system :

10 – no more than trace attack
9 – light attack
7 – moderate attack
4 – Heavy attack
0 – destroyed by attack
X – missing

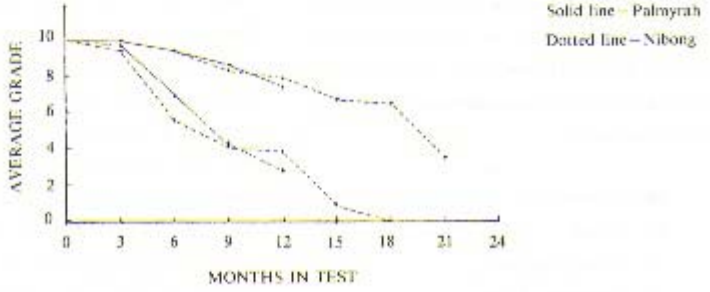

Figure 1. Curves showing resistance to marine borers of palmyrah and nibong palms. Treated panels – above pair, untreated panels/lower pair. See Table 1 for tabulated data.

Table 2. Index of Condition of Nibong and Palmyrah palms after 2 years in the test plot (Prachuap Province)

Species	Months in test	Soft Part			Hard Part		
		Decay	Termite	Average	Decay	Termite	Average
Nibong	6	8.3	9.8	9.1	9.5	10.0	9.8
n = 30	12	5.5	9.3	7.4	8.5	9.8	9.2
	18	2.7	9.1	5.9	7.4	9.7	8.6
	24	0.9	8.4	4.6	6.5	9.5	8.0
Palmyrah	6				9.6	10.0	9.8
n = 30	12		No test		8.7	9.9	9.3
	18				7.9	9.9	8.9
	24				7.0	9.4	8.2
Teak	6				9.6	10.0	9.8
n = 20	12		No test		8.6	10.0	9.3
	18				7.6	9.9	8.8
	24				7.4	9.5	8.4
Yang	6				9.2	10.0	9.6
n = 20	12		No test		6.8	9.7	8.2
	18				5.4	9.5	7.4
	24				4.1	8.6	6.4

Notes : 1. Grades 10 – sound 9 – trace 7 – moderate 4 – heavy 0 – failure

2. Index of Condition was calculated from weighted averages of each grade class sustained by individual stake.

3. Teak and yang belong to the durability groups of over 10 years and 2 – 6 years respectively, according to the graveyard tests on standard 50 × 50 mm stakes conducted by the Royal Forest Department.

Table 3. Index of Condition of Nibong and Palmyrah palms after 2 years in the test plot (Lampang Province)

Species	Months in test	Soft Part			Hard Part		
		Decay	Termite	Average	Decay	Termite	Average
Nibong	6	7.5	4.7	6.1	9.5	9.9	9.7
n = 30	12	2.5	2.0	2.2	9.4	9.7	9.6
	18	2.1	1.9	2.0	9.1	9.5	9.3
	24	0	0.1	0	3.3	4.2	3.8
Palmyrah	6				9.5	9.9	9.7
n = 30	12		No test		9.4	8.8	9.1
	18				8.8	8.3	8.6
	24				6.0	6.4	6.2
Teak	6				9.1	9.9	9.5
n = 20	12		No test		8.6	9.2	8.9
	18				8.2	8.5	8.4
	24				5.2	5.1	5.2
Yang	6				8.2	7.2	7.7
n = 20	12		No test		4.9	5.1	5.0
	18				4.8	4.5	4.6
	24				2.4	2.2	2.3

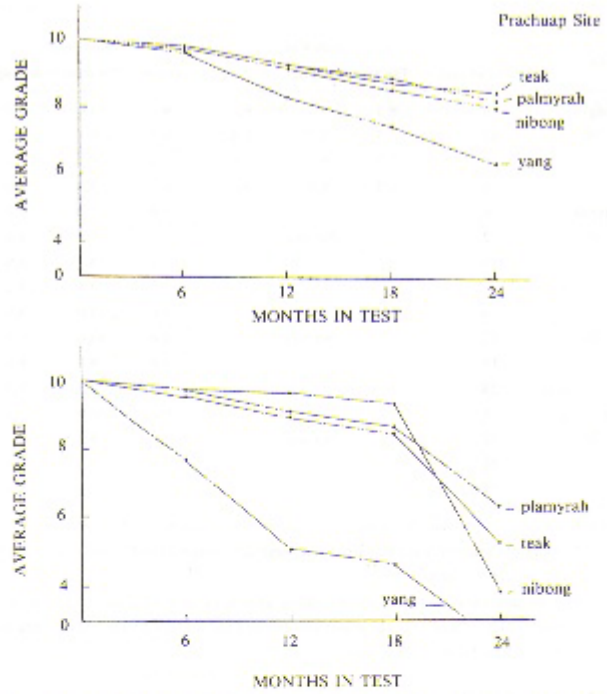

Figure 2. Curves showing conditions of test stakes of palmyrah and nibong palms, compared with those of teak and yang. Southern site (above), northern site (below).

Table 4. Climates and soil characteristics at the test sites

Test Plot	Lampang (Norhtern)	Prachuap (Southern)
Soil Type	Sandy – clay loam	Sandy
Average orgnic matter (%)	5.74	2.45
pH	6.50	6.50
Average rainfall (mm)	1064	1166
Average temperature (°C)	Max. 29.70	31.60
	Min. 21.20	22.70

less fiber depth indicates more soft part and more preservative absorption.

Boring organisms : Throughout the period of the trial which terminated at 21 months, only two kinds of borers were found as the attacking borers. They were indentified as *Martesia striata* and *Lyrodus pedicellatus*.

Fouling organisms : The following organisms were observed on the test panels removed at each inspection.

1. Encrusting sponge
2. Green mussel : *Perna viridis*
3. Acorn barnacle : *Chthamalus sp.* and *Balanus amphitrite*
4. Sea squirt : *Pyura sp.*
5. Sea anemone

Stake Test

Results of successive 6 month inspections on nibong, palmyrah, compared with teak and yang are shown in Tables 2,3. The data shown are Index of Condition calculated from the weighted averages of each grade class in which the individual stake within each species was evaluated, as recommended in ASTM D 1758-74. The data indicate that, from both sites, the conditions of nibong and palmyrah rank closely with teak. There is no observed difference between the two palms since the inspecrins had been conducted by qualitative (visual) inspection.

Both palms and teak remained in good condition for at least 18 months and began to suffer moderate damage (grade 7) some time beyond 18 months of exposure, Figure 2, at the northern plot; while at the southern plot they still retained the average grade of 8 or above until 24 months. This is obviously due to the difference in climatic conditions, the soil types and the amount of organic matters in the soil, since these factors have influence on the activities of both decay and termite. Table 4 gives detail of climates and soil characteristics at the test sites.

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APPENDIX 1. Palmyrah – Dry salt retention in kg/m³ in relation to the percentage of the soft part presented in the marine test panels

Soft part (%)		kg/m³	Soft part (%)		kg/m³
0	Mean	6.33	45 – 50	Mean	11.15
	Standard deviation	0.77		Standard deviation	0.65
	Number of tests	20.00		Number of tests	5.00
5 – 10	Mean	8.27	55 – 60	Mean	12.90
	Standard deviation	1.33		Standard deviation	–
	Number of tests	20.00		Number of tests	2.00
15 – 20	Mean	8.84	65 – 70	Mean	13.93
	Standard deviation	1.03		Standard deviation	–
	Number of tests	20.00		Number of tests	2.00
25 – 30	Mean	9.87	75 – 80	Mean	14.78
	Standard deviation	1.03		Standard deviation	–
	Number of tests	15.00		Number of tests	1.00
35 – 40	Mean	11.04	85 – 90	Mean	15.46
	Standard deviation	1.63		Standard deviation	1.55
	Number of tests	6.00		Number of tests	4.00
45 – 50	Mean	11.15	95 – 100	Mean	16.00
	Standard deviation	0.65		Standard deviation	0.98
	Number of tests	5.00		Number of tests	5.00

APPENDIX 1a. Nibong – Dry salt retention in kg/m³ in relation to peripheral fiber (hard portion) depth in the segment shaped marine test panels. See text under Materials and Methods.

Fiber depth (mm)		kg/m³
5 – 10	Mean	8.54
	Standard deviation	1.97
	Number of tests	35.00
15 – 20	Mean	6.46
	Standard deviation	1.08
	Number of tests	17.00

APPENDIX 2. Weight of 19×19×457 mm stakes installed in the graveyard (gram)

Species	Lampang (Northern)		Prachuap (Southern)	
Palmyrah	Maximum	202.5	Maximum	203.7
Borassus sp.	Minimum	144.9	Minimum	153.2
	Average	179.0	Average	182.0
	All stakes contained entirely hard part			
Nibong	Maximum	178.6	Maximum	175.0
Oncosperma sp.	Minimum	123.0	Minimum	129.0
	Average	154.0	Average	154.6
	All stakes contained approximately 50% hard part			
Teak	Maximum	128.0	Maximum	137.0
Tectona grandis	Minimum	89.9	Minimum	89.1
	Average	114.3	Average	115.7
	All stakes contained entirely heartwood			
Yang	Maximum	141.5	Maximum	136.8
Dipterocarpus	Minimum	110.6	Minimum	102.5
alatus	Average	128.0	Average	121.4
	All stakes contained entirely heartwood			

APPENDIX 3. Circumferences of palm logs used in this investigation.

Species	Tree No.	DBH (cm)	Species	Circumference (cm)	No. of Logs
Palmyrah	1	70	**Nibong**	25 – 30	16
	2	75		31 – 40	43
	3	80		41 – 50	11
	4	85		Total	70
	5	90	Maximum	46 cm Minimum	25 cm

Note : 70 nibong stems were taken at random from an assortment of 2m long butts, its circumference was measured at mid length.

APPENDIX 4. Properties of sea – water at the test site. July 199 to November 1990.

Year/Month	Temperature Range (C –)°		Salinity Range (ppt)		pH Range	
	Min	Max	Min	Max	Min	Max
1988 July	28.5	33.0	30	34	8.23	8.61
August	28.0	32.0	28	32	8.21	8.51
September	27.5	32.0	26	31	7.90	8.42
October	27.0	31.0	26	32	7.50	8.78
November	24.5	29.0	30	34	7.94	8.32
December	23.0	28.0	32	35	8.00	8.41
1989 January	26.0	27.5	32	35	8.10	8.32
February	27.0	29.0	32	34	7.95	8.18
March	27.0	32.0	30	34	8.05	8.30
April	29.0	33.5	32	34	8.19	8.59
May	29.0	31.8	30	35	7.87	8.36
June	28.5	32.0	28	34	8.02	8.39
July	28.5	30.5	26	33	8.25	8.60
August	28.5	32.4	18	30	8.22	8.46
September	28.8	34.0	26	32	8.14	8.43
October	27.0	32.0	30	34	8.01	8.38
November	26.0	30.5	31	34	8.10	8.38
December	24.0	30.0	32	34	8.12	8.48
1990 January	26.5	31.0	30	34	8.12	8.58
February	27.8	32.4	30	33	8.07	8.38
March	27.5	34.0	31	34	8.12	8.60
April	30.0	35.0	32	36	8.16	8.56
May	31.0	34.0	31	33	8.15	8.60
June	29.5	33.0	30	32	8.24	8.69
July	28.8	32.7	28	30	8.25	8.65
August	29.0	34.0	28	30	8.25	8.68
September	27.5	33.0	25	30	8.29	8.75
October	27.0	32.0	28	31	8.25	8.65
November	27.0	31.0	30	32	8.20	8.50

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