Journal of Tropical Forest Science 6(3): 293 - 301

SOME MECHANICAL AND ABRASIVE PROPERTIES OF PINANG SALAK (*ARECA CATECHU*) STEMS

Ahmad Shakri Mat Seman, Ashaari Hj. Amin, Hilmi Md. Tahir & Said Ahmad

Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur, Malaysia

Received July 1992

AHMAD SHAKRI MAT SEMAN, ASHAARI HJ. AMIN, HILMI MD. TAHIR & SAID AHMAD. 1994. Some mechanical and abrasive properties of pinang salak (*Areca catechu*) stems. The mechanical and abrasive properties of pinang salak (*Areca catechu*) stems were tested in accordance to the standards B.S. 373 (1957) and ASTM D 1037 - 72a (1977) respectively. Results from both tests showed the superiority of pinang salak when compared to other palms such as coconut, oil palm and some rattan species. Pinang salak is also comparable to kempas in terms of its strength and abrasive resistance.

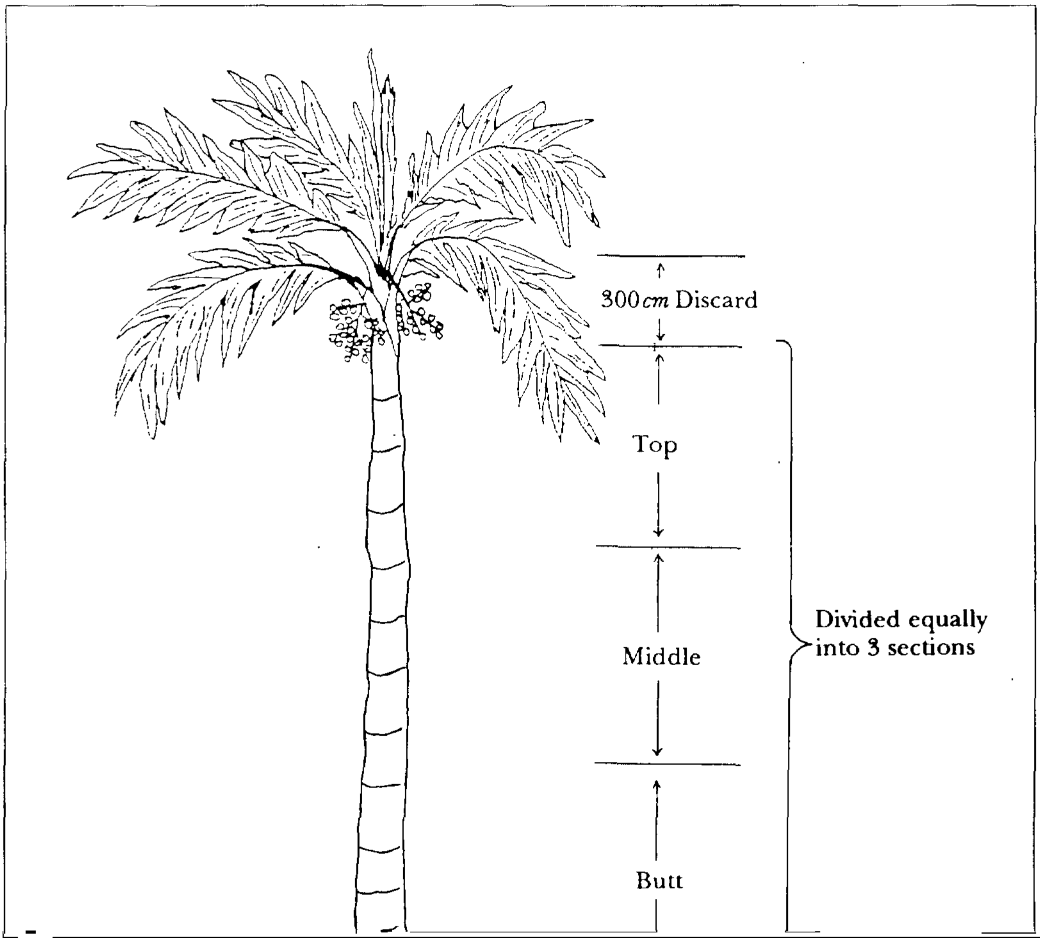
Key words: *Areca catachu* - mechanical strength - abrasive properties

AHMAD SHAKRI MAT SEMAN, ASHAARI HJ. AMIN, HILMI MD. TAHIR & SAID AHMAD. 1994. Beberapa ciri mekanikal dan lelas batang-batang pinang salak (*Areca catechu*). Ciri mekanikal dan lelas batang-batang pinang salak (*Areca catechu*) masing- [illegible]

Keputusan kedua-dua ujian menunjukkan kelebihan pinang salak berbanding

Material and methods

Seven pinang salak stems were obtained from the vacinity of the Forest Research Institute Malaysia. The stems were first cut at 300 *cm* above the ground and a second cut was made at 300*m* from the first fruit bunch down (Figure 1). Each stem was then cut into three equal sections and identified as butt, middle and top sections. A 250*cm* subsection from the bottom of each section was taken for mechanical properties. The remaining part of each section was sawn into boards which were air-dried.



Physical and mechanical tests

Boards used for physical and mechanical tests were prepared following the International Standard ISO 3129 - 1975 (E) (Anonymous 1975). Each section was sawn into boards in the direction of two mutually perpendicular diameters (Figure 2). Outer and inner sticks of 40 *mm* thick were obtained from these

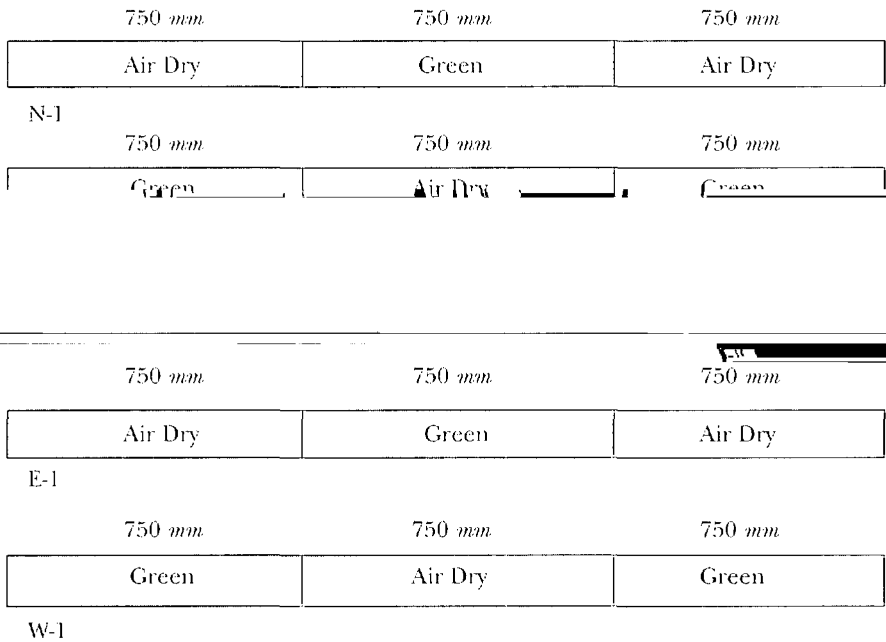


Figure 3. The allocation of boards for green and air dry parts

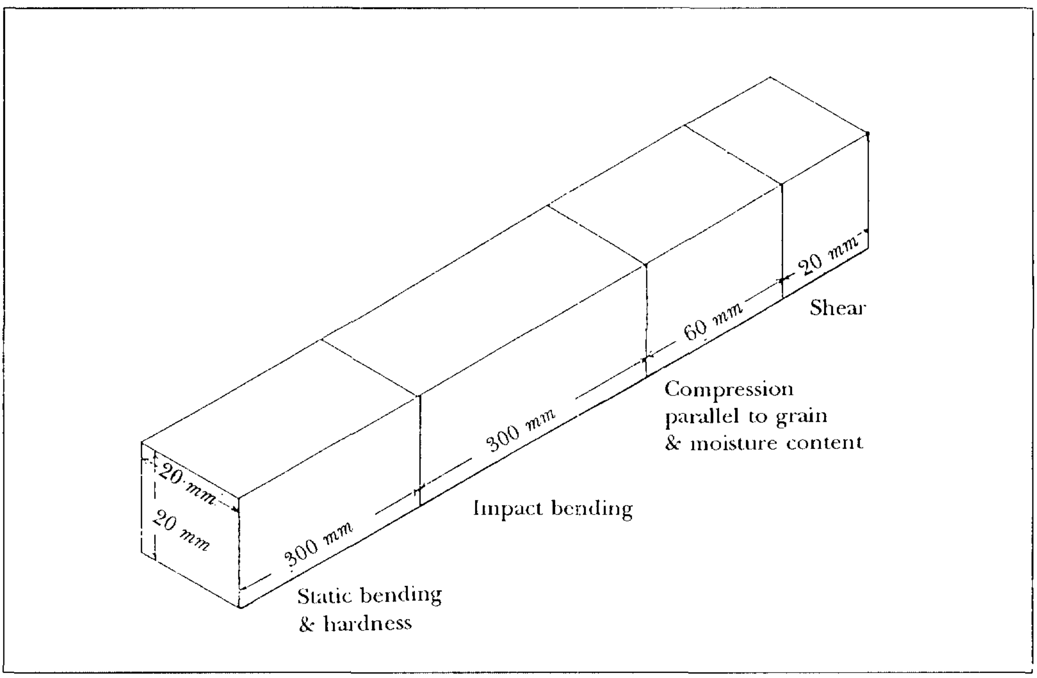
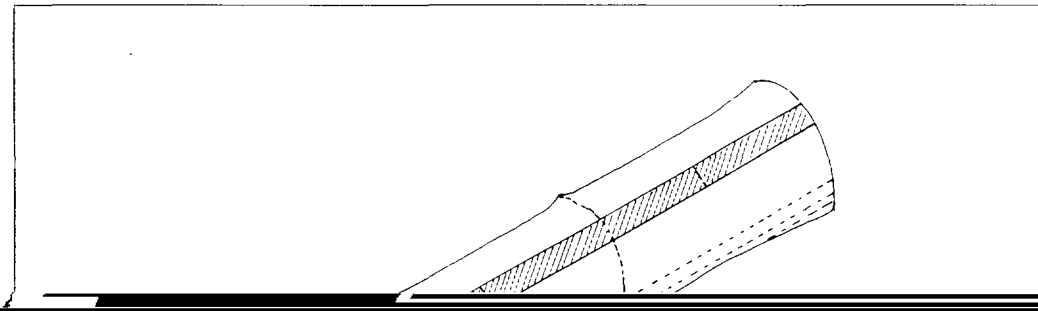


Figure 4. The allocation of specimen for each test

Abrasion test

Each section that was allocated for the abrasion testing was sawn into boards in the direction of two mutually perpendicular diameters. Outer sticks of about dried. Test samples of dimensions 25 × 10 × 75 *mm* were prepared from these air dried sticks. The faces of the sticks towards the bark and pith of the stem were called outer and inner faces respectively. For each section and face, the test specimens were taken at random and were glued sideways to form a larger size specimen of dimensions 50 × 10 × 75 *mm.*



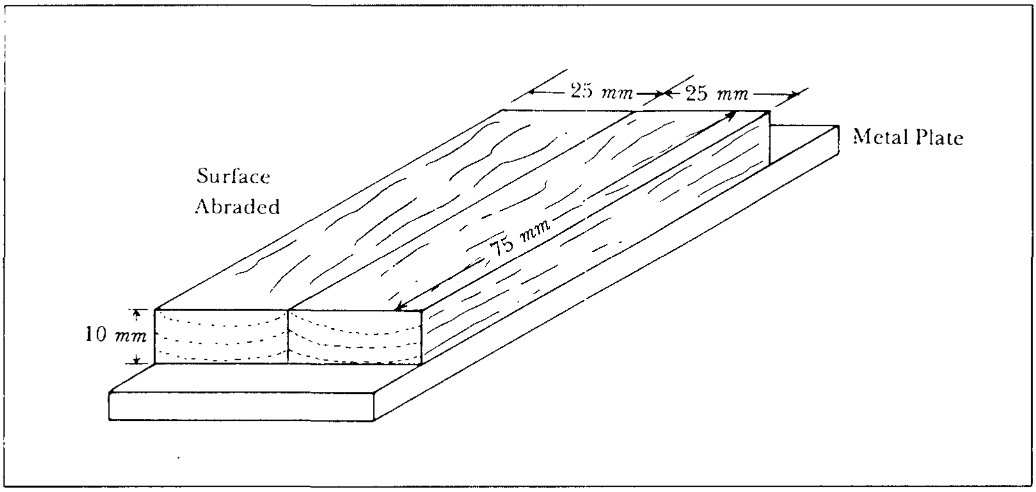


Figure 6. Sample holder with test specimen attached

Results and discussion

Most of the boards obtained from pinang salak stems twisted and collapsed after air drying. Moisture content of the boards was reduced to about 17% in four months. Only samples from the butt section were suitable for mechanical testing. The results of the mechanical test are given in Table 2.

Table 2. Mechanical properties: outer part of butt section (*Areca catechu*)

Condition	Moisture content (%)	Specific gravity ($g\ mm^{-3}$)	Modulus of rupture ($N\ mm^{-2}$)	Modulus of elasticity ($N\ mm^{-2}$)	Impact bending (mm)	Compression parallel to grain ($N\ mm^{-2}$)	Side hardness (N)	Shear parallel to grain ($N\ mm^{-2}$)
Green	92.67	0.637	98.79	14,369.70	1,070.00	39.85	4,720.27	5.92
	± 23.20	± 0.09	± 26.79	± 1963.63	± 246.90	± 10.12	± 1,849.40	± 2.24
Air dry	17.14	0.695	126.16	13,163.77	1,391.92	47.04	6,332.12	-
	± 0.64	± 0.15	± 15.11	± 3,877.47	± 330.40	± 16.90	± 3,815.01	-

Pinang salak generally has better strength properties compared to three other palms as shown in Table 3. It has higher MOE, MOR, compression parallel to the grain and side hardness than coconut, oil palm and manau cane. The outer portion of the butt section is comparable to the timbers of strength group 'A'. This could be due to the concentration of vascular bundles in the outer section and maturity at the butt section.

The results from the abrasion tests are given in Figure 7. It was found that the weight losses of the inner and outer faces of the boards for each butt and middle sections were different.

Table 3. The mechanical properties of pinang salak compared to some palm species and kempas (*Koompassia malaccensis*)

Species	Density (*kg m*$^{-3}$)	MOE (*MPa*)	MOR (*MPa*)	Compression parallel to grain (*MPa*)	Hardness (N)	Shear (*MPa*)
Pinang salak (*Areca catechu*)						
Green	637	14,370	99.0	39.9	4720	5.92
air-dry	695	13,164	126.0	47.0	6332	-
Coconut * (*Cocos nucifera*)	870	6,480	40.5	46.1	4230	7.20
Oil palm** (*Elaeis guineensis*)	584	5,505	32.9	17.8	2450	2.10
Manau cane*** (*Calamus manan*)	750	3,700	58.6	27.1	4397	1.72
Kempas (*Koompassia malaccensis*)						
Green	710	16,600	100.0	54.7	6590	10.00
air-dry	740	18,600	122.0	65.6	7610	12.40

Sources: * Tamolang *et al.* 1958, ** Killmann & Lim 1985, *** Abd. Latif *et al.* 1987.

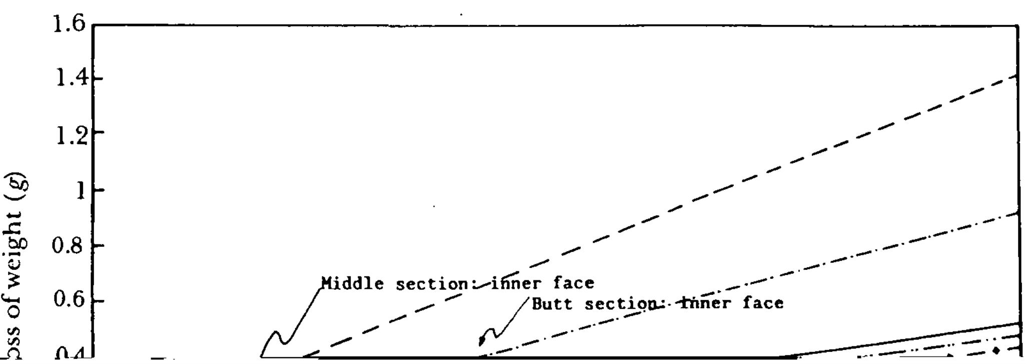


Table 4. Abrasion properties of pinang salak, manau cane and kempas

Species	Density (kgm^{-3})	Surfaces abraded	Loss in weight after abrasion (g)
Kempas*			
[illegible]	[illegible]	[illegible]	[illegible]
Manau**			
(*Calamus manan*)	750	Along the grain	0.981
Pinang salak			
(*Areca catechu*)	637		
Butt section		Outer	0.484
		Inner	0.925
Middle		Outer	0.522
		Inner	1.408

Sources: * Mohd Shukari Midon 1983, ** Abd. Latif *et al.* 1989.

In the case of the butt section, the weight losses for the outer and inner faces after 1000 revolutions were 0.484 g and 0.925g respectively. The losses in weight for the outer and innerfaces of the middle section were 0.522g and 1.408g respectively. Thus the outer face of the boards is more resistant to abrasion compared to the inner parts, due to its much higher proportion of vascular bundles. The vascular bundles in the outer part are matured and harder compared to those in the inner parts.

It was also observed that the boards from the butt section were more resistant against abrasion compared to the middle section. This could be due to the congestion and maturity of the vascular bundle tissues present. The wear resistance of this palm stem seems to be better than that of manau and mantang cane (Abd. Latif *et al.* 1989). The weight loss for the outer face from the butt section boards is similar to that for the radial surface of kempas (Table 4 and Figure 7).

ANANDRAJ, M. & SARAWATHY, N. 1986. Effect of systemic fungicides on fruit rot of arecanut. *Indian Phytopathology* 39(4): 607 - 609.

ANONYMOUS. 1957. *Method of Testing Small Clear Specimens of Timbers.* British Standard B.S. 373:1957.

ANONYMOUS. 1975. *Wood - Sampling Methods and General Requirements for Physical and Mechanical Tests.* International Standard (ISO) 3129.

ANONYMOUS. 1977. *Standard Methods of Evaluating the Properties of Wood-based Fibre and Particle Panel Materials.* ASTM. D 1037 - 72a.

BALASIMHA, D. 1987. Water relations, growth and other indications of plant water stress in cocoa under draught. Pp. 215 - 217 in *Proceedings of The Tenth International Cocoa Research Conference.* Dominican Republic.

BHAT, K.S. 1987. Growth and performance of cocoa (*Theobrome cacao L.*) and arecanut (*Areca catechu*) under mixed cropping system. Pp. 15 -19 in *Proceedings of The Tenth International Cocoa Research Conference.* Dominican Republic.

DUTTA, P. K. & HEDGE, R. K. 1987. Studies on two *Phytophtora* diseases (koleroga of arecanut and black pepper wilt) in Simoga District, Karnataka State. *Plant Pathology Newsletter* 5(1 - 2) : 29.

KILLMANN, W. & LIM, S. C. 1985. Anatomy and properties of oil palm stem. Pp. 18 - 42 in *Proceedings of The National Symposium on Oil Palm By-Products for Agro-based Industries.* Kuala Lumpur, Malaysia. Porim Bulletin 11.

KUMAR, P. S. & HEDGE, R.K. 1987. Studies on two *Phytophtora* diseases of plantation crops. *Plant Pathology Newsletter* 5(1- 2): 28.

MOHD SHUKARI MIDON, 1983. The abrasive resistance of rubberwood. *Malaysian Forester* 46(4): 455 - 462.

RAO, E.V.V.B. 1987. Characterization and evaluation of generic resources. Pp. 97 - 98 in *Plantation Crops.* Newsletter, IBPGR Regional Committee for South East Asia. Special Issue.

SASTRY, M. N. L. & HEDGE, R. K. 1987. Studies on *Phytopthora* species effecting plantation crops in Karnataka with special referance to koleroga of arecanut and wilt of black pepper. *Plant Pa-*

TAMOLONG, F.N., VALBUENA, R., LOMIBAO, B., ARTUZ, E.A., KALAW, C. & TOGACAN, A. 1958. Fibre dimensions of certain Philippines broad-leaved and coniferous woods, palms and woods and bamboos II. *TAPPI* 41 (10): 614 - 620.