UNIVERSITI PUTRA MALAYSIA

SOME SELECTED PROPERTIES OF TWO MALAYSIAN BAMBOO SPECIES IN RELATION TO AGE, HEIGHT, SITE AND SEASONAL VARIATIONS

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By

ABD. LATIF MOHMOD

Dissertation Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy in the Faculty of Forestry, Universiti Pertanian Malaysia.

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Dedicated to loving memory of my late parents,

Mohmod bin Kamat and Satiah bte Jalal;

and

to all our bamboo friends

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Abstract of dissertation submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the Degree of Doctor of Philosophy.

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February 1996

Chairman : Associate Prof. Mohd. Zin Jusoh

Faculty : Forestry

Bamboo is widely found in Peninsular Malaysia but little research has been conducted on its importance and suitability for industrial use. A study was initiated to determine the variation and correlations of anatomical, chemical, physical, mechanical and machining properties of two bamboo species, namely *Bambusa vulgaris* Schrad `Buluh minyak' and *Gigantochloa scortechinii* Gamble `Buluh semantan' in relation to age, height, site and season.

The anatomical properties differed significantly with species, are generally stable with site, had no significant relationship with age from one to four years old and decreased with culm height. *B. vulgaris* fibres (1.9 - 2.4 mm) were shorter than those of *G. scortechinii* (2.7 - 5.6 mm). The average fibre sheath percentage and cell wall thickness of both bamboo species ranged from 32 to 49% and 2 to 13 µm, respectively. Based on the Runkle ratio, older culms of both bamboo species appeared to be potential

pulping materials. The anatomical structures correlated positively with density, mechanical properties, recovery rate and product quality but are inversely correlated with moisture content and dimensional shrinkages.

Age and culm height showed greater impact on the chemical compositions (particularly the carbohydrate content) of the two bamboo species than site and harvesting month. The high cellulose (and relatively low ash) contents of both bamboo species are favourable for pulping.

The initial moisture content of bamboo at each site decreased with age and height and was relatively higher in the wetter than the drier period. Age and height had more significant impact on density, shrinkage and strength of bamboo than site. The density and mechanical properties increased with age and culm height while shrinkage behaved conversely. The strength values suggest that age and height (intrinsic factors) were more significant than site and other external factors. Bamboo should be harvested and processed at a minimum age of two years with ideal usage made of the basal and middle portions.

Both bamboo species exhibited properties that were influenced more by their age and height of the culms than by site. Thus they can be planted at and harvested from any location for manufacturing.

Abstrak disertasi yang dikemukakan kepada Senat Universiti Pertanian Malaysia bagi memenuhi syarat untuk memperolehi Ijazah Doktor Falsafah.

SIFAT-SIFAT TERPILIH DUA JENIS BULUH MALAYSIA DAN PERHUBUNGANNYA DENGAN VARIASI UMUR, KETINGGIAN BATANG, LOKASI DAN MUSIM TEBANGAN

Oleh

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Februari 1996

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Buluh boleh dijumpai dengan mudahnya di kebanyakan kawasan di Semenanjung Malaysia. Namun demikian, kerja-kerja penyelidikan yang dijalankan kurang memberikan tumpuan terhadap kepentingannya sebagai bahan asas perindustrian. Memandangkan kepada banyaknya buluh yang hidup meliar di negara ini, satu kajian asas dijalankan bagi menilai kepelbagaian dan perkaitan antara sifat-sifat anatomi, kimia, fizikal, mekanikal dan pemerosesan di dalam dua jenis buluh utama iaitu *Bambusa vulgaris* Schrad (Buluh minyak) dan *Gigantochloa scortechinii* Gamble (Buluh semantan) dan hubungannya dengan umur, ketinggian batang, lokasi dan bulan tebangan.

Sifat-sifat anatomi buluh berbeza mengikut spesies tetapi didapati agak stabil terhadap perubahan lokasi. Sifat-sifat anatomi juga tidak dipengaruhi nyata oleh umur dan ketinggian batang. Gentian *B. vulgaris* juga didapati lebih pendek (julatara 1.9 - 2.4 mm) berbanding *G. scortechinii* (2.7 - 5.6 mm). Peratusan kelopak

gentian dan ketebalan dinding sel kedua-dua jenis buluh pula adalah di dalam julat purata antara 32 - 49% dan 2 - 13 µm. Berdasarkan kepada nilai nisbah Runkle, batang-batang buluh yang lebih tua adalah lebih berpotensi untuk digunakan sebagai bahan pulpa. Struktur anatomi juga didapati berhubung positif dengan ketumpatan, kekuatan, kadar pulangan dan mutu barangan tetapi berhubung negatif dengan kandungan lembapan dan pengecutan buluh.

Kesan umur dan ketinggian batang terhadap kandungan kimia buluh (terutama kandungan karbohidrat) didapati lebih nyata berbanding pengaruh lokasi dan bulan tebangan. Peratusan selulosa yang tinggi bersertaan dengan nilai kandungan abu yang agak rendah membayangkan potensi kedua-dua jenis buluh ini untuk digunakan sebagai bahan pulpa dan kertas.

Kandungan lembapan menurun mengikut peningkatan umur dan ketinggian batang; tetapi peratusannya lebih tinggi pada musim hujan berbanding musim kering di setiap lokasi. Kesan umur dan ketinggian batang terhadap ketumpatan, pengecutan dan kekuatan buluh pula adalah lebih nyata berbanding pengaruh lokasi. Nilai ketumpatan dan kekuatan buluh meningkat mengikut umur dan ketinggian batangnya sementara nilai pengecutan bercorak sebaliknya. Perbezaan kecil antara nilai kekuatan buluh-buluh dari setiap lokasi menunjukkan bahawa pengaruh faktor dalaman seperti umur dan ketinggian batang adalah lebih ketara berbanding faktor luaran. Penuaian buluh untuk pembuatan pula adalah dicadangkan supaya dilakukan selepas mencapai umur dua tahun dan dengan penggunaan ideal dari bahagian pangkal ke tengah batang bagi menjamin kadar pulangan dan mutu barangan yang lebih baik.