CULM COMPOSITION AND ABOVE-GROUND BIOMASS OF *GIGANTOCHLOA SCORTECHINII* IN A NATURAL STAND AND A THREE-YEAR-OLD PLANTATION

Abd. Razak Othman

Forest Research Institute Malaysia (FRIM), Kepong, 52109 Kuala Lumpur, Malaysia

Received December 1992

ABD. RAZAK, O. 1994. Culm composition and above-ground biomass of *Gigantochloa scortechinii* in a natural stand and a three-year-old plantation. Culm composition and above-ground biomass of a 3-year-old *Gigantochloa scortechinii* plantation were determined and compared with those of the same species found in a natural stand. In the plantation, 400 clumps per ha (with the average of 25.6 culms per clump) were observed consisting of 33.6, 42.2 and 24.2% of one-, two- and three-year-old culms after planting respectively compared with 422 clumps per ha (with average 19 culms per clump) in the natural stand. The above-ground biomass of *G. scortechinii* in plantation and natural stand was 36.2 t ha^{-1} and 71.9 t ha^{-1} respectively. The apparent dry matter density of *G. scortechinii* was found to be within 0.54 - 0.55 kg m^{-3}. In the natural stand, only 4.7% of the culms were categorised as suitable to be harvested while none were suitable in the 3-year-old plantation, which could be due to its immaturity.

Key words: *G. scortechinii* - natural stand - plantation - culm composition - biomass - dry matter density

ABD. RAZAK, O. 1994. Komposisi kulma dan biojisim di atas paras tanah untuk *Gigantochloa scortechinii* yang tumbuh liar dan yang ditanam pada umur tiga tahun. Komposisi kulma dan biojisim di atas paras tanah tanaman *Gigantochloa scortechini* berumur tiga tahun dan tumbuhan liar spesies ini telah ditentukan dan dibanding. Terdapat 400 rumpun per ha (dengan purata 25.6 kulma per rumpun) terdiri daripada 33.6, 42.2 dan 24.2% kulma berumur satu, dua dan tiga tahun di kawasan yang ditanam berbanding dengan 422 rumpun per ha (dengan purata 19 kulma per rumpun) untuk tumbuhan liar. Biojisim di atas paras tanah adalah 36.2 t ha^{-1} untuk *G. scortechinii* yang ditanam dan 71.9 t ha^{-1} yang tumbuh liar. Ketumpatan jisim kering ketara *G. scortechinii* adalah di dalam lingkungan 0.54-0.55 kg m^{-3}. Hanya 4.7% kulma dikategorikan sesuai untuk tuaian pada tumbuhan yang liar dan tiada pada yang ditanam di peringkat umur tiga tahun, mungkin disebabkan oleh ketidakmatangan.

Introduction

Peninsular Malaysia has 50 bamboo species which can be grouped into 10 genera, namely *Bambusa, Chusquea, Dendrocalamus, Dinochloa, Gigantochloa, Phyllostachys, Racemobamboos, Schizostachyum, Thyrostachys* and *Yushania.* Only 25 species are

indigenous and mostly grow wild on marginal lands, logged-over forest areas, hillsides and along the banks of river and streams. The rest are planted for ornamental and research purposes and also cultivated in village homesteads.

The most prominent and widely distributed bamboo species extracted for local industries is *Gigantochloa scortechinii.* It accounts for about 70% of bamboo resources consumed in the bamboo industries which are mainly concentrated on producing vegetable basket, poultry cages, incense sticks, chopsticks, barbeque sticks, blinds and handicrafts (Abd. Latif & Abd. Razak 1994) .

Many of the problems faced by the bamboo industrialists are related to the natural characteristics of the bamboo itself. This is closely associated with the fact that Malaysian bamboos, particularly *G. scortechinii,* grow in clumps, are wild and practically unmanaged. In addition, lack of management of the natural stands, proper harvesting techniques and exploitation have resulted in low supply of the good quality raw materials for manufacture.

In view of some of these problems, research on the planting and management of the natural stands has been initiated. In this paper, culm composition and above-ground biomass of the planted and wild stands of *G. scortechinii* investigated are discussed.

Materials and methods

This study was conducted in the natural plots at the Ulu Selangor Forest Reserve and in a three-year-old plantation at FRIM in Kepong. The sites are flat and the average soil pH at 0 to 30 cm soil depth was 4.6 in the bamboo plantation and 4.3 in the natural plots. Both sites had the same soil series (Rengam series) consisting of course sandy clay soil. The climate of these areas is humid where the relative humidity is 80%. The mean annual rainfall and temperature are about 2800 mm and 27 °C respectively.

Field investigation on a 40-ha area of *G. scrotechinii* in the natural stand was carried out in March 1991 using four random sample plots of 0.1 ha (20 × 50 m) each. Two sample plots of 0.1 ha each (with planting distance of 5 × 5m) were selected in the three-year-old plantation.

All the culms in the plots were numerated according to the age (except for the natural stand), and diameter at breast height (DBH). The heights of the culms were also measured and classified into three groups of (i) less than 10 m, (ii) 10 - 15 m, and (iii) more than 15 m.

Twenty bamboo plants were randomly felled for the determination of the green weight of the culms, branches and leaves. Small samples of culms, branches and leaves were then oven dried at 103 ± 2 °C to constant weight. Conversion to total dry-weight was based on the method used for moisture content determination.

Results and discussion

Culm composition

The culm compositions of *G. scortechinii* in the 3-year-old plantation and in the natural stand are summarized in Table 1. The average number of clumps was found to be 422 clumps per hectare in the natural stand, with about 19 culms per clump, or a total of 8018 culms per ha (without knowing the age composition of the culms). In the plantation, however, there were 400 clumps per ha consisting of 25.6 culms per clump with an average total number of 10 240 culms per ha. The numbers of culms per clump according to the ages of 1, 2 and 3 years after planting were 8.6, 10.8 and 6.2 respectively.

The average DBH (measured at 1.3 m above the ground) of *G. scortechinii* in the natural stands was observed to be 6.8 cm. This was slightly bigger than the 2.1 cm, 3.3 cm and 4.6 cm of the 1-, 2- and 3-year-old culms in the plantation. With regards to height classification in the natural stands, 53.6% of the culms were less than 10 m, 41.7% in the range of 10 - 15 m while only 4.7% were above 15 m tall. Most of the culm heights of planted stand, however, were less than 10 m (87.5%) while the other 12.5% were found to be within the height range of 10 - 15m.

Table 1. Culm composition of *G. scortechinii* in a 3-year-old plantation and natural stand (per hectare basis)

Location	No. of clumps	Average no. of culms/ha	Average no. of culms/ clump	DBH (cm)	DBH range (cm)	Height (m)		
						10<	10-15	>15
Natural stand:								
	422	8 018	19	6.8	4.1-8.9	4 297	3 341	380
% of culm composition						53.6	41.7	4.7
In plantation:								
Composition by age:								
1 year after planting	400	3 440	8.6	2.1	1.0-3.4	3 440	-	-
2 years after planting		4 320	10.8	3.3	2.3-4.5	4 032	288	-
3 years after planting		2 480	6.2	4.6	2.5-6.7	1 488	992	-
Total		10 240	25.6			8 960	1 280	-
% of culm composition						87.5	12.5	-

Harvesting of bamboo culms usually depends on age, species and their specific intended usage. Bamboos are harvested preferably when they are more than three years old and of 15 m high and above. Less priority is given to bamboos with culm height of 10 - 15m while those less than 10 m high are not harvested.

Based on the sampling, only 4.7% of the culms in the natural stands were categorized as 'good' to be harvested. This very low production could be reflected in the fact that no management (control on harvesting of bamboo

culms) is being done. In the three-year-old plantation, there were yet no culms available for harvesting (based on the standing height of more than 10 m).

Above-ground biomass

The relationships between D (DBH in cm) and H (height in m), and those of culm weight , branch weight, foliage weight and total dry weight to D^2H of *G. scortechinni* are shown by the following liner regression equations (Table 2):

Table 2. Linear regression equations

Site	Equation	Correlation coefficient (r)
Natural stands:		
	$H = -0.6199 + 2.2815D$	0.9430**
	$Wc = 3483.82 + 5.1743D^2H$	0.8667**
	$Wb = 587.047 + 1.0791D^2H$	0.9065**
	$Wl = 626.463 + 0.9634D^2H$	0.8162**
	$Wt = 4697.32 + 7.2169D^2H$	0.8710**
Three-year-old plantation:		
	$H = 0.1200 + 1.9315D$	0.9373**
	$Wc = 436.932 + 16.018D^2H$	0.9777**
	$Wb = 308.169 + 2.0259D^2H$	0.8281**
	$Wl = 134.354 + 2.8702D^2H$	0.9181**
	$Wt = 879.455 + 20.9194D^2H$	0.9764**

** significant at $p < 0.01$

D - DBH (cm), H - height (m), Wc - culm weight (gm), Wb - branch weight (gm), Wl - foliage weight (gm), Wt - total dry weight (gm)

Table 3 shows the above-ground biomass of *G. scortechinni* stands estimated by the regression formulae. The above-ground biomass (total dry weight) of *G. scortechinii* in natural stand was estimated to be about 71.9 t ha^{-1} comprising 52.9 t ha^{-1} of culm, 9.8 t ha^{-1} of branch and 9.2 t ha^{-1} of foliage respectively. On the other hand, the total biomass production in the 3-year-old plantation of *G. scortechinii* was estimated at about 36.2 t ha^{-1} (about half that in the natural stands) comprising 24.8 t ha^{-1} of culm, 6.1 t ha^{-1} of branch and 5.3 t ha^{-1} of foliage (Table 3). It is interesting to note that the culms consisted of 73.6% and 68.5% of the total biomass in the natural stand and the plantation respectively. The lower culm biomass harvested in the plantation could be related to the early stage of growth establishment (such as the development of branches, leaves and rhizome-root systems) (Chaturvedi 1988).

Table 3. Above-ground biomass of *G. scortechinii*

	Natural stands	Plantation age*(year) 1	2	3	Overall
No. of culms (pcs/ha)	8018	2480	4230	3440	10 240 (T)
Average DBH (cm)	6.8	2.1	3.3	4.6	3.3 (A)
Average height (m)	13.3	3.8	6.7	9.2	6.6 (A)
Fresh weight of culms (t ha^{-1})	82.15	3.30	14.1	24.4	41.8 (T)
Fresh weight of branches (t ha^{-1})	20.00	1.00	3.9	6.5	11.4 (T)
Fresh weight of leaves (t ha^{-1})	16.90	0.7	3.1	7.4	11.2 (T)
Dry weight of culms (t ha^{-1})	52.90	1.8	8.1	14.9	24.8 (T)
Dry weight of branches (t ha^{-1})	9.80	0.6	2.1	3.4	6.1 (T)
Dry weight of leaves (t ha^{-1})	9.20	0.3	1.5	3.5	5.3 (T)
Total dry weight (t ha^{-1})	71.90	2.7	11.7	21.8	36.2 (T)
Dry matter density (kg m^{-3})	0.54				0.55 (T)

* Year after planting T: Total A: Average

The total above ground biomass divided by the average height gives the apparent density of dry matter per unit space occupied by the forest (Kira & Shidei 1967). As shown in Table 3, the dry-organic matter density of *G. scortechinii*, was about 0.54 - 0.55 kg m^{-3}, i.e. within the range of 0.52 - 0.88 kg m^{-3} in other bamboos species as reported by Suzuki and Jacalne (1986).

Conclusion

The study showed that the culm production of *Gigantochloa scortechinii* in natural stand was very low (4.7% of the total standing culms). This is due to the lack of proper management and harvesting techniques. The results also indicate that it takes more than three years for the planted bamboos to produce culms suitable for industrial purposes.

In the bamboo plantation, the total culm yield was 10 240 culms ha^{-1} compared to 8018 culms ha^{-1} of the natural stands. These initial results show that there is a tendency for bamboo plantations to produced higher yields than natural stands.

The above-ground biomass in the three-year-old plantation was almost half that of the natural stands. In the natural stand, the estimated total biomass was about 71.9 t ha^{-1} compared to only 36.2 t ha^{-1} in the three-year-old plantation. However, the dry organic matter density (0.54 - 0.55 kg m^{-3}) was about the same in both.

Acknowledgments

The author is greatful to Wan Razali Wan. Mohd., Aminuddin Mohamad and Abd. Latif Mohmod for critical comments in the preparation of this paper.

References

ABD. LATIF, M. & ABD RAZAK, O. 1994. Availability, distribution of bamboo and its industrial status in Peninsular Malaysia. Pp. 60 - 67 in *Bamboo in Asia and the Pacific. Proceedings of the Fourth International Bamboo Workshop.* Chiangmai, Thailand, 27 - 30 November, 1991. Forspa Publication 6. Food and Agriculture Organization of theUnited Nations.

CHATURVEDI, A.N. 1988. Management of bamboo forests. *Indian Forester* 114(9): 489 - 495.

KIRA, T. & SHIDEI, T. 1967. Primary production and turnover of organic matter in different forest ecosystems of western Pacific. *Japan Journal of Ecology* 17: 70 - 87.

SUZUKI, T. & JACALNE, V. D. 1986. Above-ground biomass and the growth of bamboo stands in the Philippines. *Japan Journal of Agriculture Research* 20(1): 85 - 91.