J. Bamboo and Rattan, Vol. 3, No. 4, pp. 309–317 (2004)

Also available online - www.vsppub.com

Application of organic fertilisers on natural stand bamboos for sustainable management in peninsular Malaysia

H. M. AZMY [1,*], W. RAZAK [2], W. S. HASHIM [3] and O. SULAIMAN [4]

[1] *Faculty of Forestry, University Putra Malaysia, Serdang, 48300 Selangor D.E., Malaysia*
[2] *School of International Tropical Forest , University Malaysia Sabah, Lock Bag 2073, 88999 Kota Kinabalu, Sabah, Malaysia*
[3] *Forest Research Institute Malaysia, 52109 Kepong, Kuala Lumpur, Malaysia*
[4] *Universiti Sains Malaysia, Minden, Pulau Pinang, Malaysia*

Abstract—This paper highlights research on the influence of three organic fertilisers (chicken dung, palm oil mill effluent and peat materials specially made for fertilisers) on the number of new shoots, the diameter at breast height, the height of the culms and the number of culms. Especially the number of new shoots and the diameter at breast height are positively influenced, which is promising for commercial purposes.

Key words: Natural stand bamboos; organic fertilisers; growth bamboo.

INTRODUCTION

Bamboo, being a multipurpose plant, has been found to be growing profusely in the ex-logging areas in the forest compartments [1]. There are many species found in the forest, either mixed or mostly dominated by a single species. Most of the bamboo areas in the forest are dominated by commercial species such as *Gigantochloa scortechinii, Dendrocalamus pendulus* and some *Schizostacyum brachycladum* (green) [2]. Natural stand bamboo is distributed throughout the whole country in Peninsular Malaysia. According to Lock *et al*. [3], forest compartments which comprise bamboo areas cover 413 000 hectares within the whole country. The main bamboo products in Malaysia are bamboo baskets, toothpicks, joss-sticks, chopsticks, joss papers, bamboo blinds, cage-making and handicrafts [4–7].

The Malaysian Government has identified bamboo as one of the important non-timber resources in the country; it ranks second next to rattan. At present, there

*To whom correspondence should be addressed. E-mail: azmymohamed@putra.upm.edu.my

has been no study on the application of organic fertiliser on natural stand bamboo. The Forest Research Institute Malaysia (FRIM) decided that it is imperative to have a study on the application of organic fertilisers on natural stand bamboos in the country based on the demand for resources.

METHODOLOGY

To study the effect of organic fertilisers on the growth of natural stand bamboos, a trial plot of 1 hectare was demarcated at Nami, Kedah, Northern Peninsular of

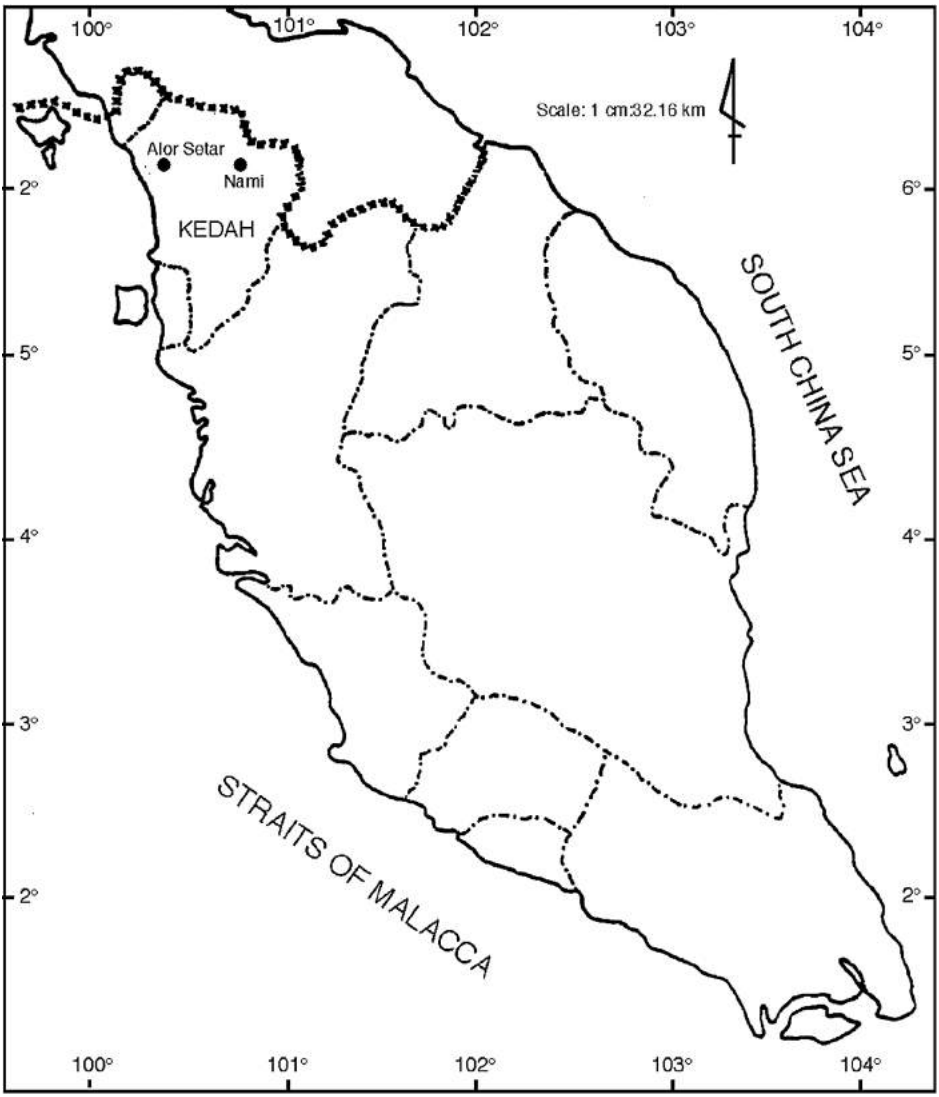

Figure 1. Location map of study.

Malaysia. The area, which is in Chebar Forest Reserve, consists of large tracts of the most important and commercial bamboo, *Gigantochloa scortechinii* (Buluh semantan). The trial plot is located at 6°05′N, 100°50′E (Fig. 1). The multiple use of this species, especially in the cottage industry, has been exploited in this area for the production of chopsticks, toothpicks, sataysticks, joss-sticks and paper.

A split-plot design was adopted for this experiment. The experimental area was divided into 4 replicates, each subdivided into 3 plots. A different organic fertiliser type was assigned at random to each of the 3 plots in each block. Every plot was further subdivided into 4 subplots. Subplots are defined by aggregations of a given number of clumps. In this case, each subplot contained 8 clumps, making a total of 32 clumps for 4 subplots. For each replicate, there were 96 clumps and for the whole experimental plot 384 clump samples were used altogether. Within each plot, a different rate of application was assigned at random to each of the 4 subplots. The three different fertiliser types are chicken dung, palm oil mill effluent (POME)

Table 1.
Chemical composition of organic fertilisers

Fertiliser	Total C (%)	Total P (%)	Total N (%)	Dry phosphate H_2O (%)
POME	12.0	0.8	2.9	4.5
Chicken dung	9.9	4.5	3.5	7.5
Peat Gro	8.0	2.5	2.6	6.1

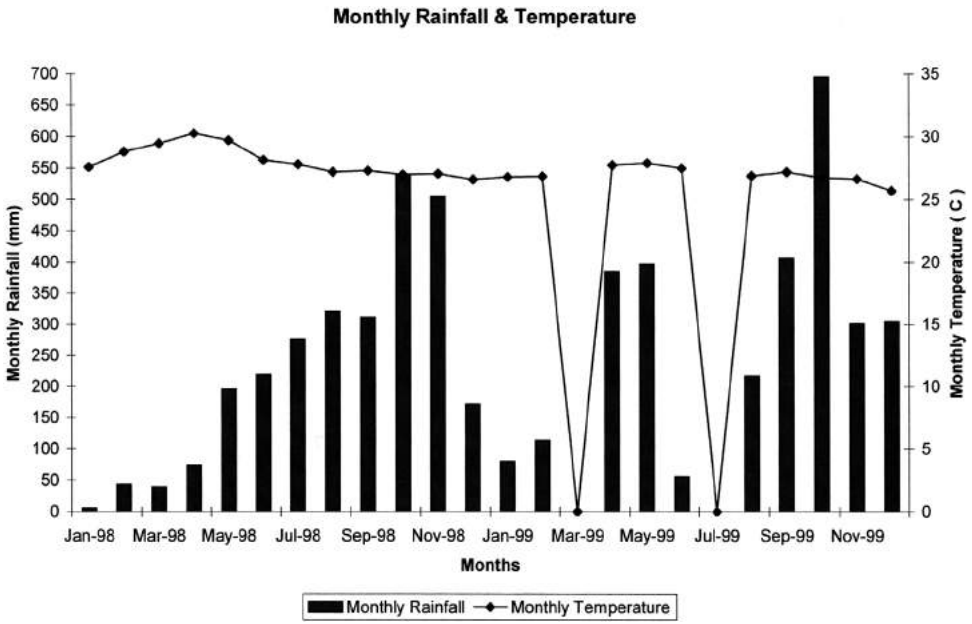

Figure 2. Climatic graph at Nami from 1998 to 1999.

and Peat Gro (peat materials specially made for fertiliser). The organic fertiliser's composition is shown in Table 1. The various rates of application for each fertilizer type are 0, 4, 8 and 12 kg applied to each clump in the subplot. The prices for each fertilizer are: Peat Gro, RM 1.25/kg; chicken dung, RM 1.00/kg; POME RM, 0.80/kg (1 RM = USD 0.26; 1 USD = RM 3.80). Felling of mature culms of 3 years and older was done after 2 years. The parameters taken were diameter breast height (DBH), height of culms and number of shoots sprouted. The monitoring was done for 2 years, from December 1997 until August 1999. The climatic data at Nami for the duration of the study are shown in Fig. 2.

RESULTS AND DISCUSSION

All results are shown in Tables 2–4: Table 2 for July 1998, Table 3 for February 1999 and Table 4 for August 1999. The maximum height of the culm was 18 m, but for most culms this was in the range of 11.0 to 14.0 m. The diameter at breast height lies within the range of 5.0 to 7.0 cm, but the largest was measured at 7.7 cm. The total number of culms available in the study plot was 4782 culms. There was an increase

Table 2.
Mean number of culms, height and DBH for *G. scortechinii* natural bamboo stands based on the application of fertiliser chicken dung, palm oil mill effluent (POME) and Peat Gro, in July 1998

	df	No. of culms	DBH (cm)	Height (m)
Rate of fertiliser (R)				
0 kg		12.7	6.8	13.8
4 kg		11.7	6.3	11.2
8 kg		11.4	6.5	11.5
12 kg		13.1	6.6	12.7
Type of fertiliser (F)				
F1		12.5	7.0	12.8
F2		11.5	6.2	12.1
F3		12.6	7.0	11.9
Corresponding analysis of variance, main factors				
Rate (R)	3	ns	ns	*
Fertiliser (F)	2	ns	ns	ns
First-order interaction				
R × F	6	ns	ns	ns
Residual: 41				
Total: 47				

* Significant at 0.05; ns, not significant; Duncan's Multiple Range test.

Table 3.
Mean number of culms, height and DBH for *G. scortechinii* natural bamboo stands based on the application of fertiliser chicken dung, palm oil mill effluent (POME) and Peat Gro, in February 1999

	df	No. of culms	DBH (cm)	Height (m)
Rate of fertiliser (R)				
0 kg		108.7	6.8	12.4
4 kg		103.8	5.9	11.5
8 kg		115.2	5.8	10.8
12 kg		123.8	6.3	12.5
Type of fertiliser (F)				
F1		112.9	6.3	12.1
F2		104.4	6.0	11.4
F3		121.1	6.2	12.0
Corresponding analysis of variance, main factors				
Rate (R)	3	ns	*	*
Fertiliser (F)	2	ns	ns	ns
First-order interaction				
R × F	6	ns	ns	ns
Residual: 41				
Total: 47				

* Significant at 0.05; ns, not significant; Duncan's Multiple Range test.

of 1911 culms after one year of plot establishment with twice an application of fertiliser. There were no new shoots sprouting during February 1999, but in August 1999 there were some shoots sprouting in some of the replicates. The shoots were tagged for future age determination purposes.

Total number of shoots

No shoots sprouted throughout the monitoring months, except in August 1999. There was no significant difference in the sprouting of shoots. As can be seen in Fig. 3, the application of 4 kg of chicken dung gave the highest number of shoots sprouted among all the replicates in terms of the net incremental increase on the number of shoots.

Mean diameter breast height (DBH)

There were significant differences for both mean DBH in February and August 1999 (6.4 and 6.8, respectively), as shown in Tables 3 and 4. In both months the 12 kg rates were significantly different. There was no significant difference for DBH in July 1998 (Table 2). The DBH graphs in Fig. 4 show that the application of

Table 4.
Mean number of culms, height and DBH for *G. scortechinii* natural bamboo stands based on the application of fertiliser chicken dung, palm oil mill effluent (POME) and Peat Gro, in August 1999

	df	No. of culms	DBH (cm)	Height (m)
Rate of fertiliser (R)				
0 kg		96.3	6.6	12.6
4 kg		93.3	5.9	11.9
8 kg		120.8	5.8	10.8
12 kg		102.1	6.8	12.7
Type of fertiliser (F)				
F1		110.4	6.5	12.5
F2		92.6	5.9	11.9
F3		106.3	6.3	12.2
Corresponding analysis of variance, main factors				
Rate (R)	3	ns	*	*
Fertiliser (F)	2	ns	ns	ns
First-order interaction				
R × F	6	ns	ns	ns
Residual: 41				
Total: 47				

* Significant at 0.05; ns, not significant; Duncan's Multiple Range test.

12 kg of palm oil mill effluent (POME) gave the highest positive increment of the diameter for all the four replicates besides the control. The control gave an increase of the average DBH while no felling activity was done due to the number of culms available.

Mean height of culms

There were significant differences for the mean height for all the monitoring months with values of 12.7 (Table 2), 12.5 (Table 3) and 6.7 (Table 4), respectively. All the significant differences were at 0.05% level and with rates of 12 kg of fertilisers applied. From Fig. 1 it seems that with the application of 8 kg of Peat Gro, the average height of the culms tends to give a constant increment in the height value.

Mean number of culms

There were no significant differences in all the months monitored for the mean number of culms. One can see in Fig. 2 that the total number of culms was higher with the application of 12 kg of Peat Gro in comparison with the other fertilisers.

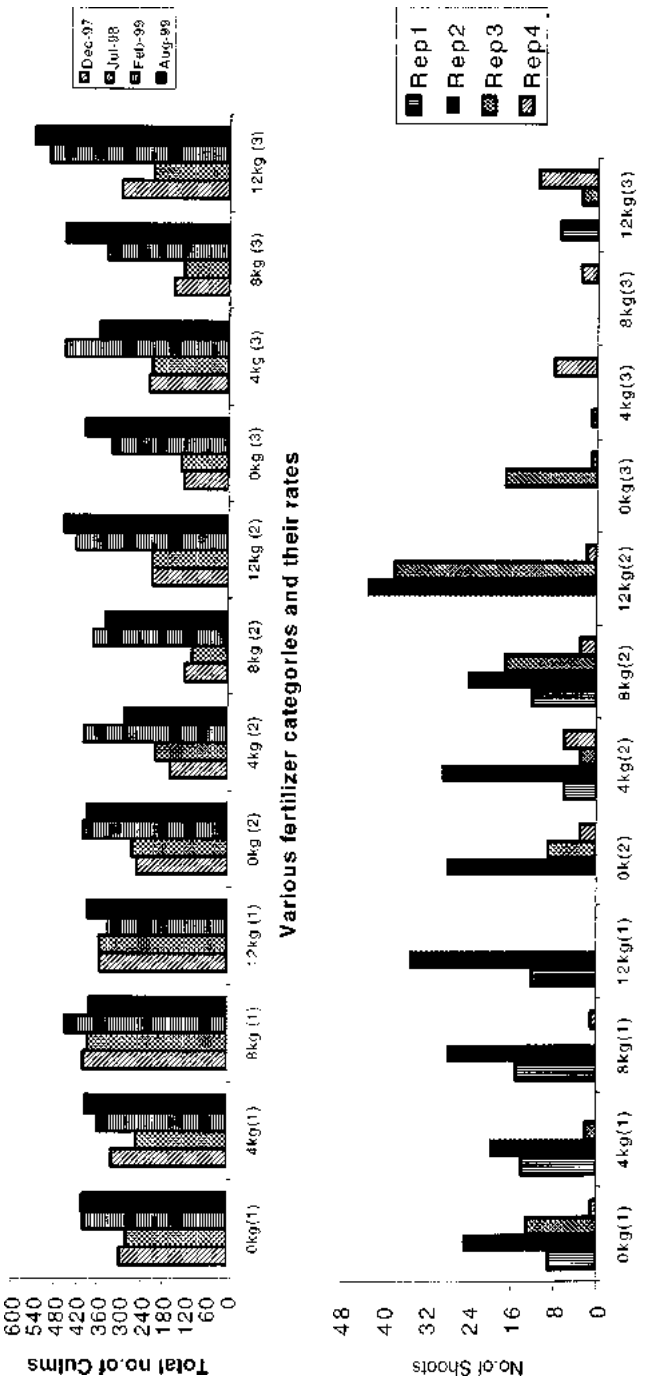

Figure 3. Total number of shoots and culms for all replicates with various fertilizer types and rates. (1) POME, (2) chicken dung, (3) Peat Gro.

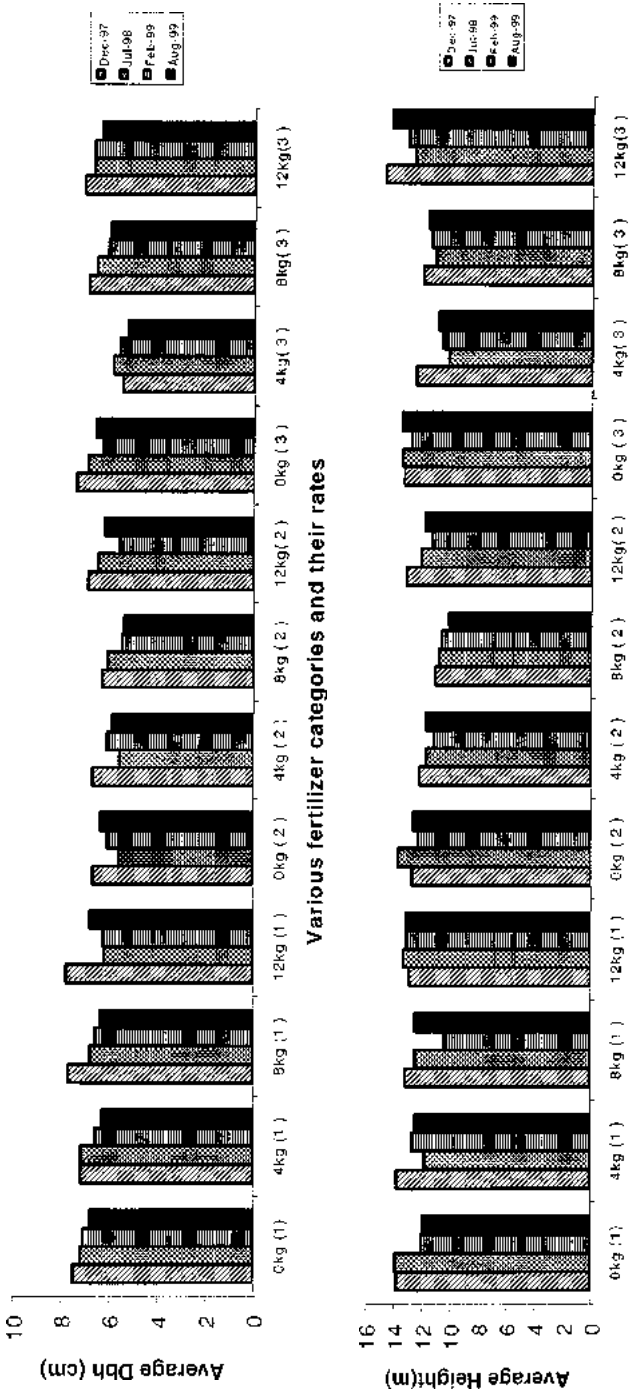

Figure 4. Average DBH and height for all replicates with various fertilizer types and rates. (1) POME, (2) chicken dung, (3) Peat Gro.

CONCLUSIONS

Based on the results, it seems that the application of 8 and 12 kg of POME and Peat Gro gave an increment in the number of shoots, DBH and height of the natural stand bamboos. The application of all the fertilisers gave an increment of 67% on the number of culms available from the study plot for initially the first year. Figure 3 shows that the number of shoots sprouted was the highest when 4 kg of chicken dung was applied.

In conclusion, this shows that the application of organic fertilisers (especially POME, Peat Gro and chicken dung) will help to increase the number of shoot's increment and the DBH of the standing culms for commercial purposes. This is a good indicator for managers to help to increase their plantation yield in terms of quality and quantity.

Acknowledgements

The author/s would like to thank the EEC commission for funding this project. In addition, we would like to thank also the Kedah Forestry Department, Malaysia and FRIM's staff for making this study possible.

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