EFFECT OF COMPOUND FERTILISER AND SOIL MOUNDING ON NATURAL STAND BAMBOOS OF *GIGANTOCHLOA SCORTECHINII* IN PENINSULAR MALAYSIA

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Received August 2001

AZMY, H. M. & HALL, J. B. 2002. Effect of compound fertiliser and soil mounding on natural stand bamboos of *Gigantochloa scortechinii* in Peninsular Malaysia. *Gigantochloa scortechinii* is one of the most important commercial species available in Malaysia. It is found growing profusely in the forest immediately after logging has taken place. This species is widely distributed throughout Peninsular Malaysia. The raw material is extracted from the forest by the local people in a haphazard way without proper management and the resources tend to decline. Due to this reason, the resources need to be managed and a proper silvicultural management regime be introduced in managing the natural stand bamboos in the ex-logging areas. In addition, the quantity and quality of the culms need to be sustained for future supply. Owing to the importance of the study, and since there has been no silvicultural study done on the mounding of natural stand bamboos in the forests, a trial was conducted to see the effect of compound fertiliser and soil mounding on the growth of *G. scortechinii* at Nami, Kedah, in Peninsular Malaysia. Treatments such as fertiliser application at rates of 0, 2, 4, 6 and 8 kg per clump and soil mounding levels of 0, 10, 20 and 40 cm above the ground were carried out twice and once respectively during the one year study period. Significant effects were only noted due to mounding at three months after treatment and none after a year.

Key words: *Gigantochloa scortechinii* - systematic management - fertiliser application - soil mounding - ex-logging areas

AZMY, H. M. & HALL, J. B. 2002. Kesan baja sebatian dan timbunan tanah ke atas buluh dirian asli *Gigantochloa scortechinii* di Semenanjung Malaysia. Salah satu spesies buluh yang penting di Malaysia ialah *Gigantochloa scortechinii*. Di Semenanjung Malaysia, spesies ini tumbuh dengan cepat sekali setelah sesuatu kawasan hutan dibalak. Sumber keluaran batang buluh mula berkurangan dari semasa ke semasa

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akibat dieksploitasi secara sembarangan dan tidak teratur. Oleh itu satu sistem pengurusan bersama silvikultur yang teratur perlu diadakan bagi menangani masalah ini. Tambahan lagi, pemuliharaan batang buluh secara berkekalan perlu dilakukan untuk meningkatkan lagi kualiti dan kuantiti sumber pada masa akan datang. Memandangkan masih belum ada kajian khas silvikultur mengenai timbunan tanah bagi buluh dirian asli, satu kajian dijalankan untuk melihat kesan baja sebatian dan timbunan tanah ke atas pertumbuhan *G. scortechinii* di Nami, Kedah, Semenanjung Malaysia. Pembajaan pada kadar 0, 2, 4, 6 dan 8 kg bagi setiap rumpun dilakukan dua kali sepanjang setahun kajian dijalankan sementara timbunan tanah setinggi 0, 10, 20 dan 40 cm atas paras tanah dilakukan sekali. Kesan yang signifikan hanya didapati dalam kajian timbunan tanah tiga bulan selepas rawatan dan tiada kesan selepas setahun.

Introduction

There are 59 species of bamboo found in Peninsular Malaysia, of which 34 are indigenous and 25 are exotic. The genera found in the country are *Bambusa, Dendrocalamus, Dinochloa, Gigantochloa, Racemobambos, Schizostachyum, Thyrsostachys, Chusqua, Phyllostachys* and *Yushania* (Wong 1995).

Malaysian bamboos grow profusely in ex-logging areas throughout the country (Azmy 1991a), on hill slopes, riverbanks and flat land. The vegetation can be pure stand or mixed with other tree species in the forest (Ng & Md. Noor 1980). Most of the bamboos in Peninsular Malaysia are distributed in forest compartments. The total estimated area of bamboo by forest compartments is 421 722 ha, accounting for 6.9% of the total forested land in the peninsular (Lockman *et al.* 1994).

Gigantochloa scortechinii is one of the most important commercial species available in Malaysia (Azmy 1991b). Its culm is used mostly for producing items such as chopsticks, skewers, joss-sticks, joss papers, baskets, blinds and handicraft items (Azmy 1989, Wong 1989). In addition, it is also utilised for making high value-added products such as lamination panels, which have an important role in the local timber industry. The introduction of products such as panels from bamboo will help in the supply of wall panelling and parquet flooring for Malaysian houses.

Gigantochloa scortechinii is extracted from ex-logging areas in a haphazard way without proper systematic management. This has caused the resource to decline to a rate that warrants a proper silvicultural management regime be introduced. Steps must be taken to ensure that the quantity and quality of the culms are sustained for future supply.

Compound fertiliser has been found to increase bamboo yield (Azmy 2000). Fertiliser application is very important for the management of bamboo stands (Fu *et al.* 1988). Fertiliser is best applied during the periods of shoot bud differentiation and leaf renewal (Pushparajah 1982, Qiou & Fu 1985). The most important nutrient for bamboo is nitrogen (N) followed by phosphorus (P) and potassium (K). The application of 50 kg N ha^{-1} is recommended for best growth of *Phyllostachys pubescens* and the best proportion for mixed compound fertiliser of N:P:K is to 2:2:1 (Qiou & Fu 1985). The fact is, the rate of application of NPK to bamboo stands should depend on the soil condition.

In China, application of NPK fertiliser at 150–225 kg ha^{-1} to stands of *P. pubescens* increased the annual bamboo yield to as much as 10% ha^{-1} (Shi *et al.* 1985). Studies showed that NPK fertiliser should be applied three times annually and application was best after rain or after hoeing out weeds (Tang *et al.* 1987, Zhao & Liu 1987, Chen 1988, Chu & Xu 1988, Guo 1988). In India, the application of fertiliser to *Bambusa arundinacea* and *Dendrocalamus strictus* showed significant increase in bamboo yields (Kinhal 1985, Lakshmana 1990). In Peninsular Malaysia, preliminary application of NPK fertiliser at Nami, Kedah showed that for every 2 kg of NPK fertiliser applied to each natural stand clump of *G. scortechinii*, regardless of its culm density, a 30% increase in shoot sprout can be expected (Azmy *et al.* 1997). In managing bamboo forests in India, mounding the soil level of clumps with earth is generally regarded as a means of promoting culm production (Chaturvedi 1988).

In the effort to sustain the natural stand bamboo culms as an important resource, and since there has been no such study conducted before, a trial study was carried out to see the effect of compound fertiliser and soil mounding on the growth of *G. scortechinii* at Nami, Kedah, Peninsular Malaysia.

Materials and methods

The study was carried out at Chebar Forest Reserve, Nami, Kedah (6° 05' N, 100° 50' E), about 55 km east of Alor Setar (Figure 1). The 0.5 ha-experiment plot involved four replicates which consisted of 20 treatments per replicate. Each of the 20 clumps within the replicate received a different combination of mounding level and fertiliser (NPK 15:15:15) application (Figure 2). The replicates were chosen by dividing the clump areas within the 0.5 ha randomly regardless of the number of live culms available per clump in the experimental area. The spacings of the clumps were between 0.5–2.0 m. The duration of the study was one year (July 1991–August 1992). There were two applications of fertiliser at the rates of 0, 2, 4, 6 and 8 kg ha^{-1}. The first was on the onset of the rainy season (2 July 1991) and the second prior to the dry season (December 1991) (Figure 3) (Anonymous 1992). Soil mounding at 0, 10, 20 and 40 cm above ground was done once during the year. Fertilisers were broadcasted around the clumps and covered by mounding the soil according to the assigned mounding height. The factorial treatment combinations for each replicate are shown in Table1.

Parameters such as number of shoots, diameter at breast height (dbh) and height were initially measured in July 1991. Subsequent monitoring was conducted in October 1991 and August 1992. Basal area was determined from dbh.

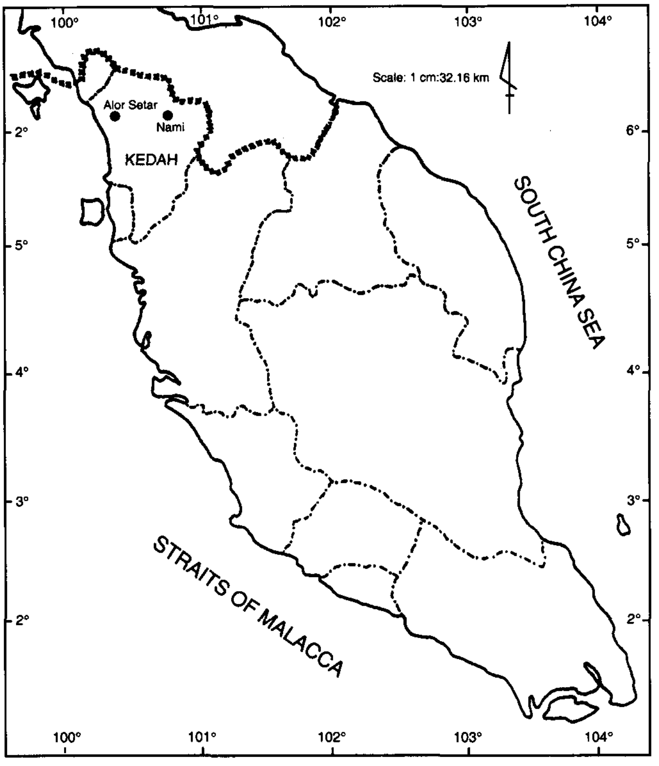

Figure 1 Location map of study

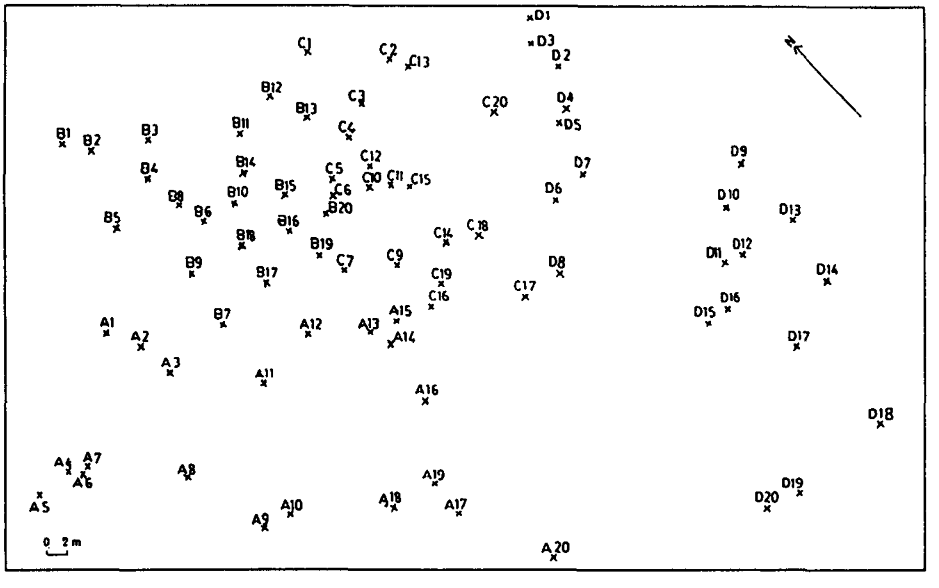

Figure 2 Compound fertiliser and soil mounding map with four replicates (A, B, C, D)

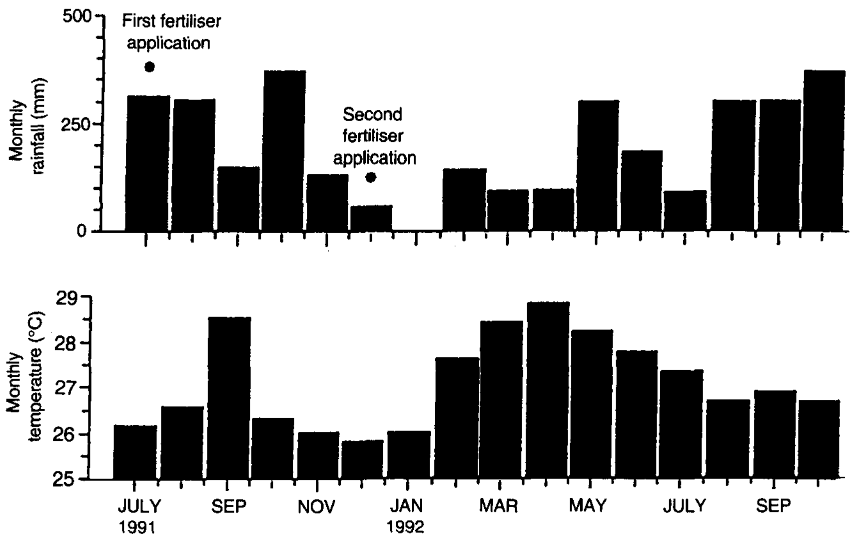

Figure 3 Climatic pattern at Nami, Kedah, throughout the experiment

Table 1 Factorial treatments of different mounding height and rate of fertiliser

Treatment	Soil mounding (cm)	NPK level per application (kg)
T1 (Control)	0	0
T2	10	0
T3	20	0
T4	40	0
T5	0	2
T6	10	2
T7	20	2
T8	40	2
T9	0	4
T10	10	4
T11	20	4
T12	40	4
T13	0	6
T14	10	6
T15	20	6
T16	40	6
T17	0	8
T18	10	8
T19	20	8
T20	40	8

Number of shoots

Only shoots with height of 30 cm or less above the ground were counted.

Number of culms

All culms were counted at each assessment in July 1991, October 1991 and August 1992. Establishment data obtained in July 1991 were compared with the numbers of culms available in October 1991 and August 1992. Diseased and malformed culms of three years and below were noted and removed.

Diameter of culm

All standing culms 120 cm and above in height were enumerated for dbh. However, culms with less than 3-cm dbh were excluded because they were not considered as commercial culms.

Height of culm

The height was determined by measuring the distance of each culm from the ground to the tip of the culm top that started to droop.

Data summarisation and statistical procedure

The number of culms which were recruited to each clump was counted and totalled to reveal the change between assessment occasions. The data collected, including incremental data, were observed to be normal and not skewed after all the parameters had been tested. The total data, and not incremental data, were used because both of them showed the same trend in significance. Data were observed using normal standard deviation distribution.

Data were analysed with the SAS (Statistical Analysis System) Package. Significant treatment effects were determined with Duncan's multiple range test (DMRT).

Results and discussion

Table 2 shows the mean number of culms, basal area and height for *G. scortechinii* bamboo stands at varying rates of fertiliser applications and soil mounding obtained in October 1991 and August 1992.

Number of shoots

The number of shoots was only available for August 1992 as there was no sprouting in October 1991. Due to this reason, no comparison could be made on the pattern of sprouting. There was no significant response for the number of shoots in August 1992 (Table 2) for all the treatments, either for the mounding levels or for the fertiliser applications. There was no interaction between mounding levels and fertiliser applications.

T7 (2 kg NPK, 20 cm mounding) showed the highest number of shoots in August 1992 (Figure 4).

Table 2 Mean number of culms, shoot, basal area and height (October 1991 and August 1992) for *Gigantochloa scortechinii* bamboo stands based on the rate of application of fertiliser (NPK 15:15:15) and soil mounding level at Nami, Kedah

	October 1991			August 1992			
	Number of culms	Basal area (m^2)	Height (m)	Number of shoots	Number of culms	Basal area (m^2)	Height (m)
Rate of fertiliser (R)							
0 kg	19.000	0.0419	9.869	3.938	21.625	0.0456	9.175
2 kg	17.500	0.0400	9.956	6.687	9.875	0.0493	9.563
4 kg	16.937	0.0344	9.406	4.500	20.875	0.0425	12.419
6 kg	21.312	0.0431	9.444	6.937	25.750	0.0569	9.019
8 kg	19.937	0.0531	10.656	4.375	25.000	0.0518	9.844
Mounding height (M) (cm)							
0 cm	23.300	0.05050	9.730	6.550	27.900	0.0575	12.020
10 cm	18.250	0.03800	9.465	5.100	22.550	0.0425	8.970
20 cm	17.500	0.04300	10.320	5.800	20.600	0.0485	9.490
40 cm	16.700	0.03850	9.950	3.700	19.450	0.0485	9.535
Corresponding analysis of variance:							
Main factors : df							
Rate (R) 4	ns	ns	ns	ns	ns	ns	ns
Mounding (M) 3	**	**	**	ns	ns	ns	ns
First order interaction							
R × M 12	ns	ns	ns	ns	ns	ns	ns
Residual 60							
Total 79							

** = significant at 0.01 level, ns = not significant

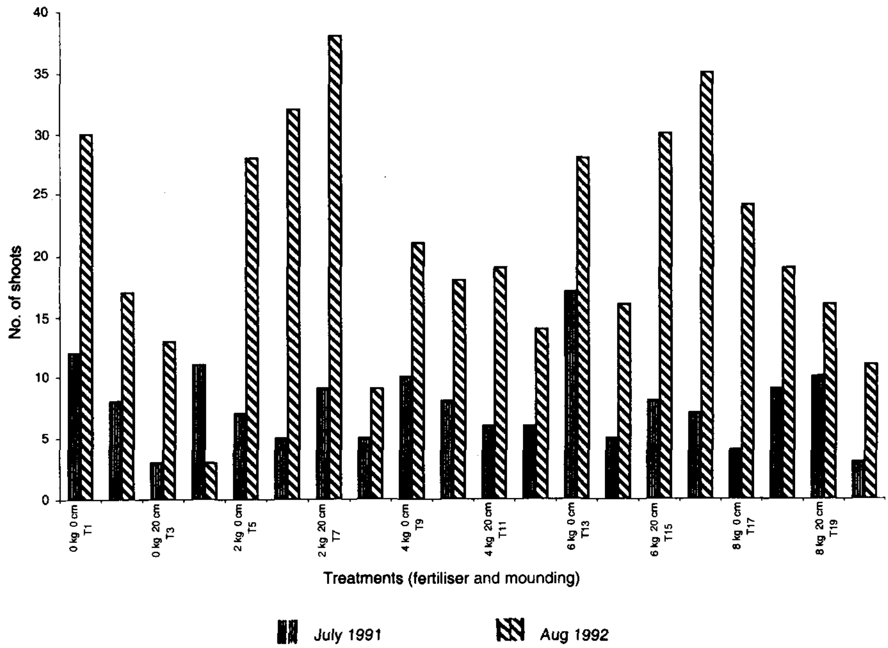

Figure 4 Number of shoots after various treatments of fertiliser applications and mounding

Number of culms

After fertilising for three months, it was found that in October 1991, there were significant differences ($p < 0.01$) in the number of culms due to mounding (Table 2). The value obtained for the 10 cm mounding level was 18.25. No significant treatment effect due to mounding was detected in August 1992 (Table 2). T13 (6 kg, 0 cm), T17 (8 kg, 0 cm) and T19 (8 kg, 20 cm) showed the greatest increases in the number of culms (Figure 5). Treatment T13 gave the highest number of culms throughout the study period but no mounding was done for this treatment. However, if both mounding and fertiliser are considered, T19 gave the highest increment in August 1992. Interestingly, the number of culms decreased in August 1992 for T16. This may be attributed to the higher number of diseased and malformed culms, which were removed, in this clump compared with the rest of the treatments.

Height of culm

No significant differences in height associated with treatments were detected in this study. T7 (2 kg, 20 cm) showed an increase in height after treatment with mounding and fertiliser (Figure 6). The rest showed little or no increase probably because the culm had nearly reached its maximum height in October 1991 before it started to droop.

Basal area

Mounding caused a significant difference in the basal area in October 1991 (Table 2). The highest increment for October 1991 and August 1992 was observed in T7 (2 kg, 20 cm) and T14 (6 kg, 10 cm) respectively (Figure 7).

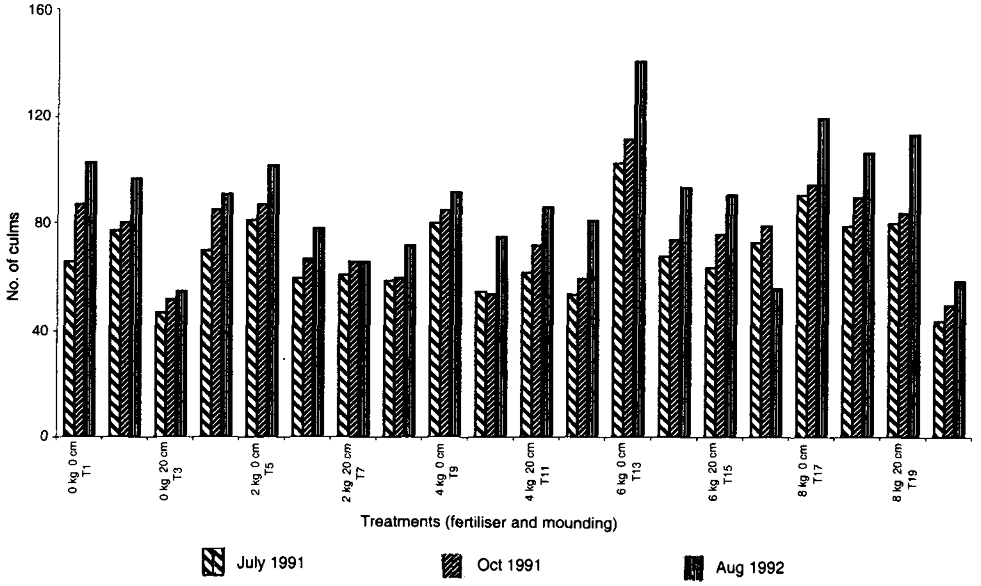

Figure 5 Number of culms after various treatments of fertiliser applications and mounding

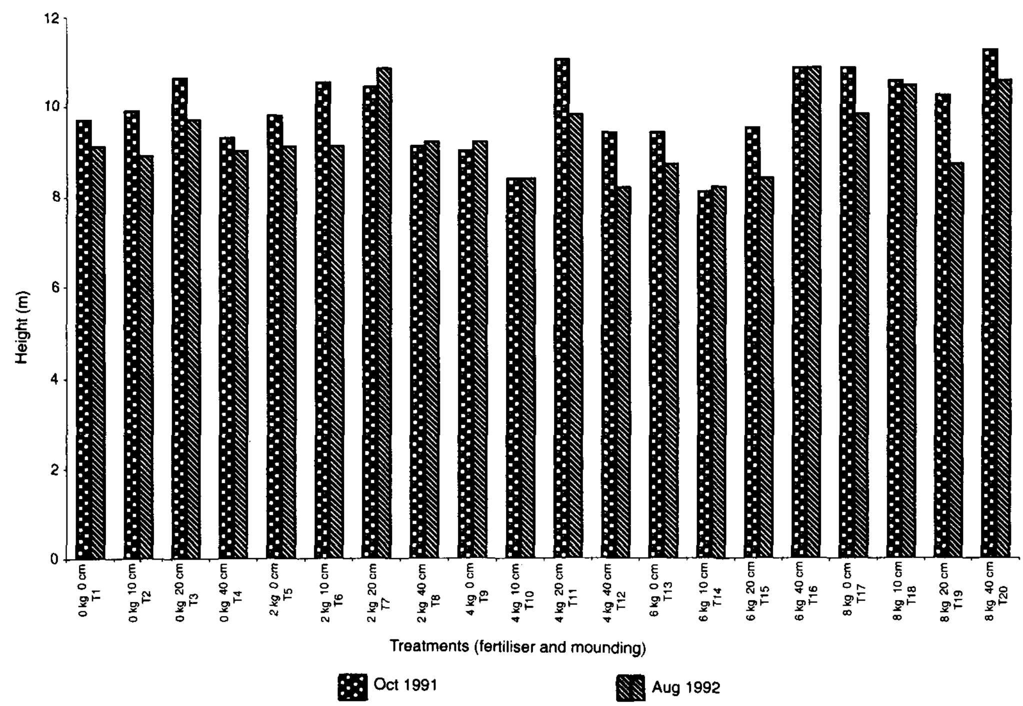

Figure 6 Height of culms after various treatments of fertiliser applications and mounding

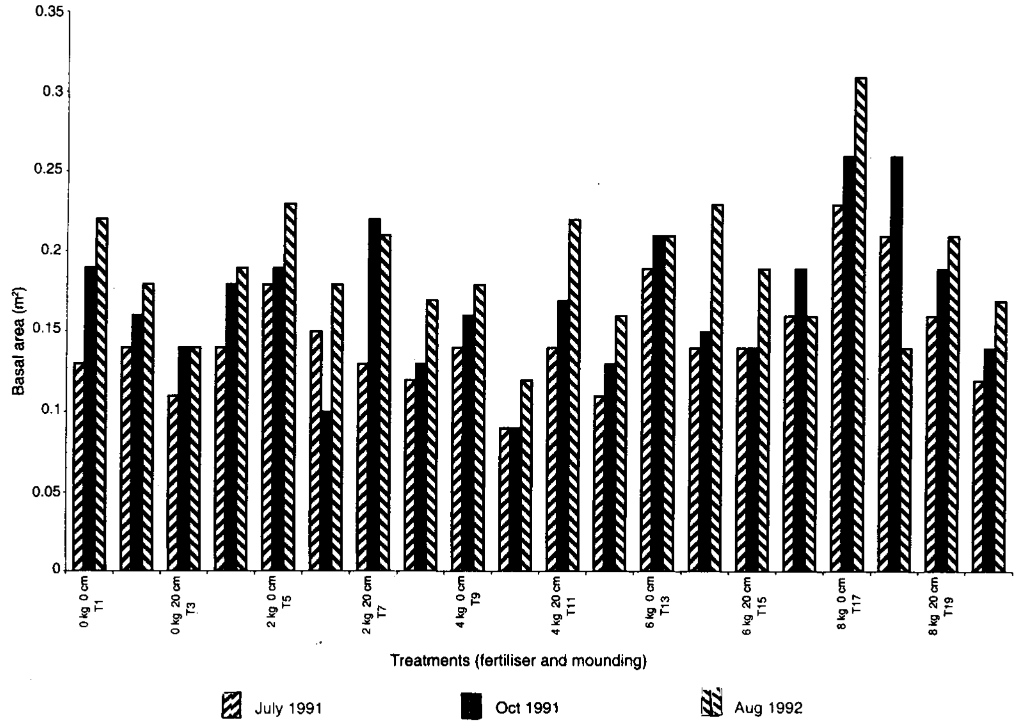

Figure 7 Basal area of culms after various treatments of fertiliser applications and mounding

Conclusions

The experiment was based on a one-year data because it is relevant to see the short-term effects of fertiliser application and soil mounding especially during the rainy season. From the results, significant effects were only observed for mounding, three months after treatment (October 1991), for number of culms, height and basal area. There was no interaction between fertiliser and mounding treatment for both October 1991 and August 1992. From the analysis, the introduction of soil mounding to the clump induced short-term effects on the number of shoots and culms, height and basal area of natural stand bamboo.

One reason why no significant differences were observed in August 1992 (after one year of study) for all the parameters could be because a longer period of study, e.g. two years, is required. Another possibility is that we have not explored higher concentrations of fertiliser. Unlike most compartments elsewhere, the soil at Nami, Kedah is quite fertile due to the biomass of the bamboo leaves that fall to the ground. Thus, further study is required to ascertain the optimum rate of fertiliser to be applied.

Acknowledgements

The authors would like to thank the Forest Research Institute Malaysia (FRIM) and the Forestry Department at Kedah for their coöperation in making the study possible.

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