EFFECTS OF INTERCROPPING AND FERTILIZATION ON SHOOT PRODUCTIVITY OF *GIGANTOCHLOA LIGULATA*

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Bamboo shoots are a delicacy in China, Japan, Taiwan and South-East Asian countries. China and Thailand export millions of dollars worth of bamboo shoots annually. Malaysia, on the other hand, imports most of its bamboo shoots for local consumption although certain species such as *Dendrocalamus asper* and *Gigantochloa ligulata* produce high quality shoots. Bamboo shoots are often sold fresh or as processed products, namely, tinned, dried or preserved as pickles. Bamboo shoots of *G. ligulata* (locally known as 'buluh tumpat') are widely consumed in the northern states of Perlis and Kedah. Most of the shoots are harvested from wild stands and sold fresh. In this study, we established experimental plots of *G. ligulata* to assess its growth and the rate of shoot production. With the recent high demand of bamboo shoots locally, plantations should be established to overcome the shortage of shoot from this species. By introducing this species to other areas, and with proper planting techniques and conditions, it is hoped that the growth of *G. ligulata* will be promoted and its shoot production increased.

The experiment was carried out in the Agriculture Department, Serdang, Selangor. The area experiences an annual rainfall of 2800 mm, mean temperature of 27 °C and relative humidity of 80%. Branch cuttings of *G. ligulata* obtained from Mata Ayer Forest Reserve, Perlis were used as planting materials. A split-plot factorial design consisting of two planting techniques and four fertilizer applications was adopted in this experiment. The two planting techniques were open planting with a density of 400 clumps per ha and intercropping between rows of 10-year-old oil palms where light intensity and bamboo planting density were 60% and 200 clumps per ha respectively.

The treatments for fertilizer applications were control, 1 kg organic fertilizer (dry chicken dung), 200 g compound (slow-release) fertilizer (10:7:7:5 ratio of N:P:K_2O:MgO) and a combination of organic and slow-release fertilizers (1 kg:200 g). The experiment was conducted with three replicates comprising 10 experimental units (bamboo clumps) for each treatment. A total of 240 clumps were observed in this experiment and parameters recorded were percentage of survival, mean number of shoots and mean fresh weight of bamboo shoots produced per clump. Normally bamboo shoots that reached the height of 30 cm were harvested and their fresh weight determined. The collection of data started 20 months after field planting and was continued for one year.

Results of this experiment indicated that open-planting technique produced higher (95.7%) survival rate of *G. ligulata* compared with intercropping (90.2%) (Table 1). The satisfactory survival performance under the intercropping technique suggests that *G. ligulata* can be intercropped with 60% light intensity condition although bamboo is a light-demanding species. The identified areas can be planted with *G. ligulata* to maximize land usage and productivity.

Our results also showed that number of shoots and their fresh weights were significantly different

Table 1 Percentage of survival and effects of planting techniques and fertilizer application on mean number and mean weight of shoots of *Gigantochloa ligulata*

Treatment	% of survival	Mean number of shoots	Mean weight of shoots (g)
Open planting	95.7	12.35	983.3
Control	94.2	10.27	633.2
Organic	98.2	13.40	1214.6
Compound	94.0	11.60	836.6
Organic + compound	96.3	14.13	1247.0
Intercropping	90.2	9.23	789.2
Control	88.4	6.80	508.5
Organic	93.6	10.80	975.3
Compound	87.8	7.60	671.8
Organic + compound	91.2	11.73	1001.3

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($p < 0.05$) in the experiments involving planting technique and fertilizer applications (Table 2).

Duncan's multiple range test (DMRT) was used to determine the effectiveness of each fertilizer treatment and also its application in both planting techniques (Table 2). Mean number of shoots and fresh weights produced were significantly different between open and intercropping planting techniques. In the open planting technique, the number of shoots and fresh weight produced were 12.4 and 983.3 g respectively compared with 9.2 shoots and 789.2 g respectively in the intercropping treatment.

The best treatment in this study was the combination of organic and compound fertilizers. This treatment produced 12.6 number of shoots with mean fresh weight of 1124.5 g. Application of only organic fertilizer did not produce any significant difference ($p > 0.05$) in number of shoots and fresh weight. This indicated that application of organic fertilizer was crucial for bamboo growth and shoot production.

Open planting technique applied with organic fertilizer can produce high number of shoots and fresh weight of *G. ligulata*. Results in Table 1 showed that when applied with organic and combination of organic and compound fertilizers, open planting technique produced 13.40 and 14.13 mean number of shoots respectively and 1214.6 and 1247 g of mean shoots weight respectively compared with intercropping. Using organic fertilizer alone is cheaper compared with the combination of organic and slow-release fertilizers. This would contribute to reduce the management cost of *G. ligulata* planted for shoot production. However, application of only organic matter is inadequate (Fugeng & Maoyi 1985). For this 20-month observation period, the organic fertilizer was essential to bamboo growth which can be considered as establishment stage for bamboo plantations. Hence, more nutrients are needed as the bamboo clumps mature especially for long-term production. This can only be done by applying mixed compound with organic fertilizer. Therefore, application of compound and organic fertilizers is recommended to further enhance the growth and yield of bamboo plantation.

In conclusion, the trial conducted showed that *G. ligulata* stands could be established by intercropping with 60% light intensity conditions, and applying a mixture of organic and compound fertilizers. However, it was found that growth performance was better when using open-planting technique, which received more light compared with intercropping technique. The organic fertilizer applied during this establishment stage is crucial for the growth of bamboo stands. However, the application of organic or mixed organic compound fertilizer is found to be adequate for optimum shoot production of *G. ligulata*.

Table 2 Effects of planting techniques and fertilizer application on number and weight of shoot of *G. ligulata*

Treatment	Mean values*	
	Number of shoots	Weight of shoots
Planting technique		
Open	12.35a	983.3a
Intercropping	9.23b	789.2b
Fertilizer application		
Control	8.53a	571.0a
Organic	12.47b	1095.2b
Compound (slow release)	9.60a	754.3c
Organic + compound	12.57b	1124.5b

* Values with the same letter are not significantly different at $p = 0.05$

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