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Bamboos growth assessment related to soil suitability

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Abstract—A study on the growth and productivity of shoot and culm production of selected Malaysian bamboo species in various experimental sites was carried out. The sandy clay loam areas (Renggam series) were the best, followed by shallow lateritic soil mixed with fine sandy clay (Jitra series) as compared with lateriteic soil (Terap series), bris soil (Jambu series) and tin tailings areas. The application of organic fertilizer helped the growth performance of the bamboo species.

Key words: Bamboo; growth; shoot sprouting; culm production; soil suitability; fertilizer.

INTRODUCTION

Bamboos have become the second most important non-timber forest produce in Malaysia after rattan. This mainly is due to its availability, renewable nature, fast growth, high productivity, short maturity cycle and multiple uses. Besides culm production, bamboo is also popular for its edible shoots.

Knowledge of the growth, particularly of shoot sprouting and culm production, of the selected local bamboo species is important to assess bamboo species that can be planted commercially. Furthermore, the establishment of bamboo plantation will ensure continuous supply of quality bamboo resource for industry.

For this purpose, information on soil suitability and other silviculture management is needed for optimal production. Research from various countries shows that bamboo productivity depends on location, soil type and the nature of the bamboo species itself. Knowledge of the growth and productivity of the selected bamboos in this study will further serve to assess prospects for bamboo production in Malaysia if planted commercially under different soil types.

The main objective of this paper is to determine the good sites for bamboo growing based on soil series and texture.

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MATERIAL AND METHOD

The experiment was carried out in five sites situated in Sahom, Sungai Siput Selatan in Perak, H. S. Mata Ayer in Perlis, FELDA Mempaga, Bentong in Pahang, Field 29 in FRIM and FRIM sub-station in Setiu, Terengganu. There was not much difference in the annual rainfall, temperature and humidity of the three sites with an average of 1500 mm, 30°C and 89%, respectively. The soil classification for each site and the bamboo species used in the experiment are shown in Table 1.

The fertilizer treatments in this experiment comprised Control, Digested Solid Palm Oil Effluent (POME) and a commercial organic fertilizer, Peat-grow. Two kilograms of the organic fertilizer was applied in the first and second year after planting. Field planting was done in mid-1993 and the data collection started in January 1995, continuing until December 1996. A total of 50 clumps were used for each treatment at every site. The results included percentage of survival and mean number of culms production per clump.

Table 1.
Soil classification, bamboo species planted and fertilizer treatments

Trial plot location	Soil series/texture	Bamboo species planted	Treatment
Mata Ayer Forest Reserved, Perlis	Jitra series Shallow soil with latrite layer at 30 cm onwards mixed with fine sandy clay	*Gigantochloa ligulata* (Tumpat) *G. scortechinii* (Semantan) *Schizostachyum zollingeri* (Nipis) *Bambusa blumeana* (Duri)	Control POME Peat-grow
Kg. Sahom, Sungai Siput Selatan, Perak	Tin Tailings 70–80% sand with some clay, silt and organic	*G. ligulata* (Tumpat) *G. levis* (Beting) *Dendrocalamus asper* (Betong)	Control POME Peat-grow
Field 29, FRIM Kepong	Granitic soil mainly Renggam series deep soil with course sandy clay loam	*G. ligulata* (Tumpat) *G. levis* (Beting) *G. scortechinii* (Semantan) *S. zollingeri* (Nipis) *D. asper* (Betong) *B. vulgaris* (Aur)	Control POME Peat-grow
FELDA Mempaga 3, Bentong, Pahang	Terap series Moderately deep soil with latrite	*G. ligulata* (Tumpat) *G. levis* (Beting) *D. asper* (Betong) *S. brachycladum* (Lemang)	Control POME Peat-grow
FRIM Sub-station, Setiu, Terengganu	Bris soil — Jambu Series. Dune sand up to 50 cm pure sand with water level around 45–60 cm	*G. levis* (Beting)	Control POME Peat-grow

RESULTS AND DISCUSSION

The results showed that bamboos can be grown best in sandy clay loam areas (Field 29, FRIM) (Tables 2 and 3), followed by shallow lateritic soil mixed with fine sandy clay (Mata Ayer, Perlis) and moderately deep soil with lateritic (FELDA Mempaga 3) as compared with poor soil, such as in tin tailings and bris soil. The best fertilizer treatments for all the bamboo species planted in the different sites were bamboo sites applied with 2 kg of organic fertilizer, i.e. POME (Digested Palm Oil Effluent).

STATISTICAL ANALYSIS

Further study based on a split-split plot experimental design that was carried out on three sites situated in Kg. Sahom in Perak, FELDA Mempaga 3, in Pahang and Field 29 FRIM, Kepong as the main plot. Bamboo species consisted of *D. asper* and *G. levis* as the sub-plot and the fertilizer application as the sub-subplot with two replications. For each factor combination, 10 experimental units were randomly

Table 2.
Mean percentage of survival

Trial plot location	Fertilizer treatment	Aur *B. vulg.*	Beting *G. levis*	Betong *D. asper*	Duri *B. blum.*	Nipis *S. zoll.*	Semantan *G. scort.*	Lemang *S. brach.*	Tumpat *G. lig.*
Mata Ayer	Control				85	70	60		89
Forest	POME	—	—	—	95	85	81	—	91
Reserved,	Peat-grow				90	82	75		85
Perlis	Mean survival				90	79	72		88
Kg. Sahom,	Control		60	50					40
Sungai Siput	POME	—	85	70	—	—	—	—	75
Selatan,	Peat-grow		55	61					46
Perak	Mean survival		66.6	60.3					53.6
Field 29,	Control	85	88	83		91	81		93
FRIM	POME	95	93	96	—	98	89	—	99
Kepong	Peat-grow	87	82	89		93	83		95
	Mean survival	89	87.7	89.3		94	84.3		95.7
FELDA	Control		76	85			55	60	79
Mempaga 3,	POME	—	85	89	—	—	68	72	85
Bentong,	Peat-grow		71	81			53	63	82
Pahang	Mean survival		77.3	85			58.7	65	82
FRIM Sub-	Control		41						
station, Setiu,	POME	—	67	—	—	—	—	—	—
Terengganu	Peat-grow		30						
	Mean survival		46						

Table 3.
Mean number of culms/clump production

Trial plot location	Fertilizer treatment	Aur	Beting	Betong	Duri	Nipis	Semantan	Lemang	Tumpat
Mata Ayer	Control				7	12	10		12
Forest	POME	—	—	—	10	15	13	—	21
Reserved,	Peat-grow				8	12	9		16
Perlis	Mean no. of culm				8.3	13	10.7		16.3
Kg. Sahom,	Control		4	3					2
Sungai Siput	POME	—	10	8	—	—	—	—	7
Selatan, Perak	Peat-grow		5	4					3
	Mean no. of culm		6.3	5					4
Field 29,	Control	8	6	7		15	10		15
FRIM	POME	15	13	11	—	21	15	—	25
Kepong	Peat-grow	10	9	6		17	12		19
	Mean no. of culm	11	9.3	8		17.7	12.3		19.7
FELDA	Control		4	5			6	8	17
Mempaga 3,	POME	—	8	9	—	—	10	15	21
Bentong,	Peat-grow		5	7			8	12	18
Pahang	Mean no. of culm		5.7	7			8	11.7	18.7
FRIM Sub-	Control		1						
station, Setiu,	POME	—	5	—	—	—	—	—	—
Terengganu	Peat-grow		2						
	Mean no. of culm		2.7						

Table 4.
Analysis of variance on mean number of shoots sprouting

Source of variation	*F*-values		
	Productive shoot	Non-productive shoot	Total
Bamboo species (BSp)	1.1035ns	8.3333ns	5.4000ns
Site (Si)	32.4828**	23.5833**	59.5166**
Fertilizer treatment (FT)	23.6379**	19.0833**	45.3167**
BSp × Si	0.0689ns	1.5833ns	0.6500ns
BSp × FT	0.2241ns	0.0833ns	0.3500ns
Si × FT	0.5689ns	0.2083ns	0.5167ns
BSp × Si × FT	0.1207ns	1.2083ns	0.4000ns

ns — not significant at $P < 0.05$; ** — highly significant at $P < 0.01$.

selected to observe the shoot production. The results based on the analysis showed that the shoot production is not significantly influenced by the bamboo species, but that it critically depends on site suitability and fertilizer application (Table 4).

Table 5.
Mean total number of shoot, productive and non-productive bamboo shoots sprouting per clump per annum at trial sites aged 2.5–4.5-year-old after field planting

Bamboo species	Site	Productive shoot	Non-productive shoot	Total
G. levis	FRIM	10.8	3.7	14.5
	Mempaga	8.5	3.3	11.8
	Kg. Sahom	6.5	1.8	8.3
D. asper	FRIM	11.2	4.1	15.3
	Mempaga	8.8	3.5	12.3
	Kg. Sahom	7.2	2.8	10.0

Table 6.
Mean total number of shoot, productive and non-productive bamboo shoots sprouting per clump per annum applied with fertilizer treatments aged 2.5–4.5-year-old after field planting

Bamboo species	Fertilizer treatment	Productive shoot	Non-productive shoot	Total
G. levis	Control	6.7	2.1	8.8
	POME	9.8	3.5	13.3
	Peat-grow	9.3	3.2	12.5
D. asper	Control	7.0	2.7	9.7
	POME	10.7	4.2	14.9
	Peat-grow	9.5	3.7	13.2

SITE SUITABILITY

Results on the shoot productivity on different sites and soil texture are given in Table 5. It is observed that shoot production is highest where bamboos are planted in FRIM followed by Mempaga and Kg. Sahom trial plots. The results showed that bamboo can be grown best in sandy clay loam areas as compared with lateritic soil or poor soil such as in a tin tailings area.

Research done in China indicated that the sandy loam is the most favorable for the development of bamboo stands, followed by the light loam, clay and stone soil in sequence [1].

FERTILIZER TREATMENTS

Application of organic fertilizer enhanced shoot production compared to control. There was not much difference in shoot production between POME and Peat- grow applied. However, POME proved to give good responds on the shoot production compared to Peat-grow and control (Table 6). This could be attributed to the fact that POME are composed of higher dry matter ratio and a good source of nitrogen to other organic fertilizer [2]. Thus, POME, which is cheap and easily available, could be a potential source of organic fertilizer to be used in bamboo plantation.

The organic matter is an important element for the growth of bamboo. It helps to trap moisture and provide available N, P and K contents in soil and thus promotes growth of rhizomes and bamboo culms [3]. In addition, it improves the physical and chemical properties of the soil by increasing the humus and stabilizing the moisture content and nutrient retention.

CONCLUSION

Bamboo can be grown on good to poor soil but grows best on sandy clay loam areas. The results obtained from this study indicated that the application of organic fertilizer helped the growth performance of the bamboo species. Furthermore, POME can be used as a potential organic fertilizer in bamboo plantations.

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