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Macro-proliferation of *Gigantochloa ligulata* seedlings for mass production of planting stock and its field performance

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Abstract—Bamboos are most suitable for afforestation. Ex-logging areas in Malaysian forest compartments can be planted with commercial Malaysian bamboos. Bamboo planting materials need to be available for afforestation purposes. Mass production of this material is relevant and a method which can be used is by macro-proliferation. There is no work done on the macro-proliferation of Malaysian bamboo seedlings. This paper reports the macro-proliferation method for *Gigantochloa ligulata* (buluh tumpat), one of the commercial species. The work was done at FRIM's nursery and specimens for the field performance for the units used were planted at Bukit Saga, Southern Johore.

Key words: Malaysia; cottage industries; depletion; micro propagation; macro-proliferation.

INTRODUCTION

In Malaysia, the bamboos are distributed on hill slopes, river banks, logged-over areas and on flat land. The vegetation can be of pure stand or mixed with other tree species in the forest [1]. There are 50 species of bamboo found in Malaysia, of which 25 are indigenous and 25 exotic.

At present, propagation of bamboos is mainly done by using the branches, culm portions and rhizome offsets of the plant [2].

Vegetative propagation of *Dendrocalamus strictus* was done using macro-proliferation by Kumar *et al.* [3] in India. Bamboo seedlings possess inherent proliferating capacity and produce offsets. The young seedlings can be utilized for vegetative multiplication. According to Kumar *et al.* [3], it was found that the mother stock of seedlings can be multiplied four to six times depending on fertiliser application in a

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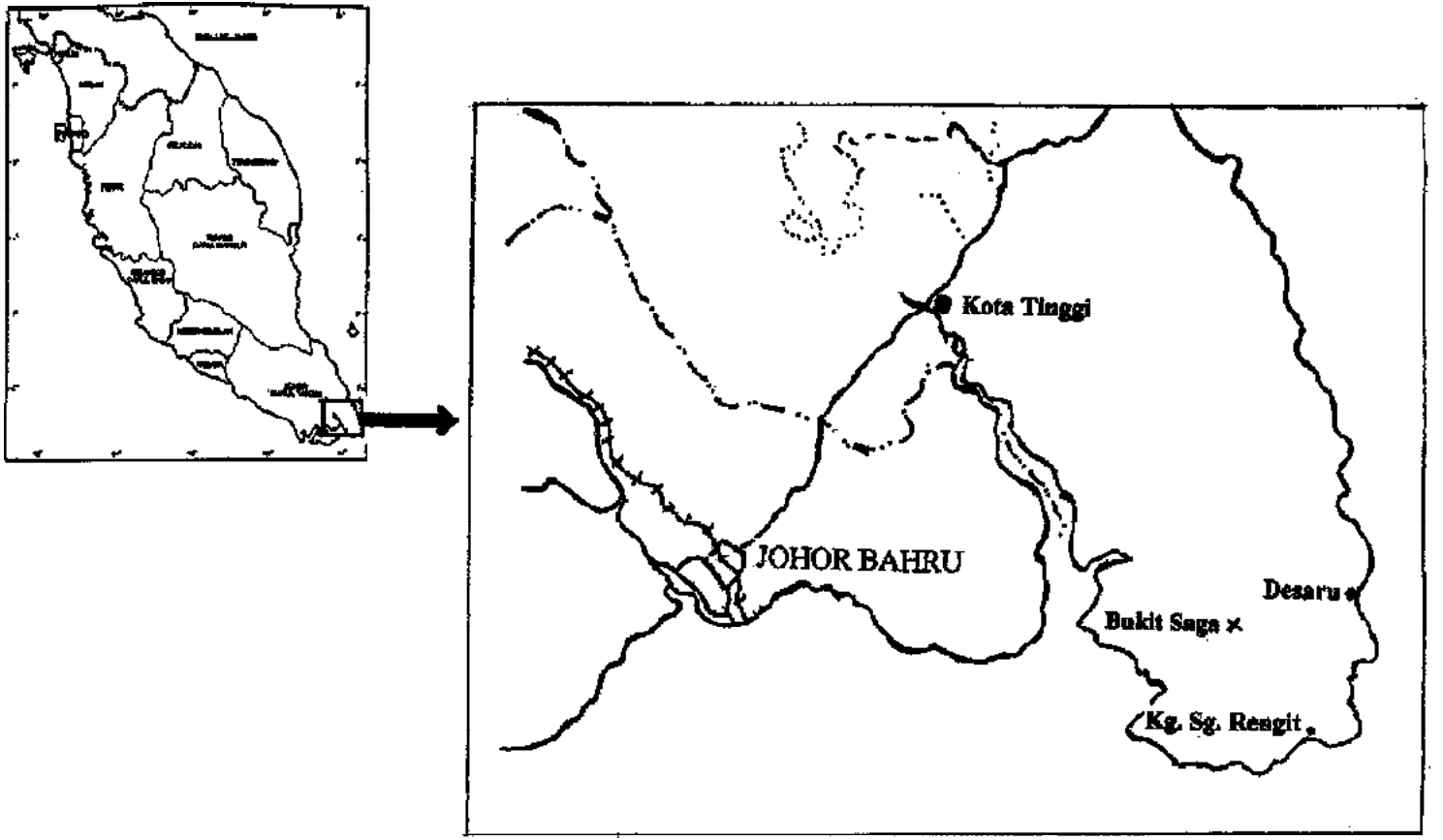

Figure 1. Location map of study at Bukit Saga, Johore, Southern Peninsular Malaysia.

period of eight months. The macro-proliferation of *Gigantochloa ligulata* seedlings is reported in this paper. This is an important commercial species [4].

MATERIALS AND METHODS

In December 1990, thirty *Gigantochloa ligulata* glumed seeds were obtained from Kg. Perik, Kuala Nerang, Kedah (Fig. 1, map; Fig. 2, photo, and Fig. 3, flow-chart). They were sown in the Forest Research Institute Malaysia's nursery. The seedlings, with average height of 3 cm, were planted in polybags of 18 cm × 20 cm with a soil mixture of 3 parts of ordinary soil and one part of sand in January 1991 (Figs 4 and 5). Eight months later in August 1991, the seedling in each polybag consisted of four young plants and they were taken out and cut into 4 parts (Fig. 6). Each young plant was again planted in the same polybag size with the same media. This was considered as the first cutting of the young plants for separation purposes (Fig. 3).

A month later (September 1991), 3 types of organic fertilisers were used. Humus, chicken and goat fertilizers were applied at a rate of each 0, 2, 4 and 6 grams. There was a randomised design of 3 × 4 with twelve treatments for each replicate. Thus, there were 10 replicates for a total of 120 polybags for the whole experiment.

In January 1996, after two and a half years without any treatment in the nursery, the seedlings reached an average height of 30 cm in the polybags. The plants were planted on a hectare area at Bukit Saga's site owned by Lembaga Kemajuan Johor Tenggara (KEJORA) for plantation establishment. It is 10 km from Sg. Rengit, South-east of Johore (Fig. 1, location map). A spacing of 6 m × 6 m was applied with a planting hole of 0.75 m × 0.75 m × 0.5 m making 16 lines (rows) for the

Figure 2. Flowered clumps of *G. ligulata* where seeds were taken for the experiment.

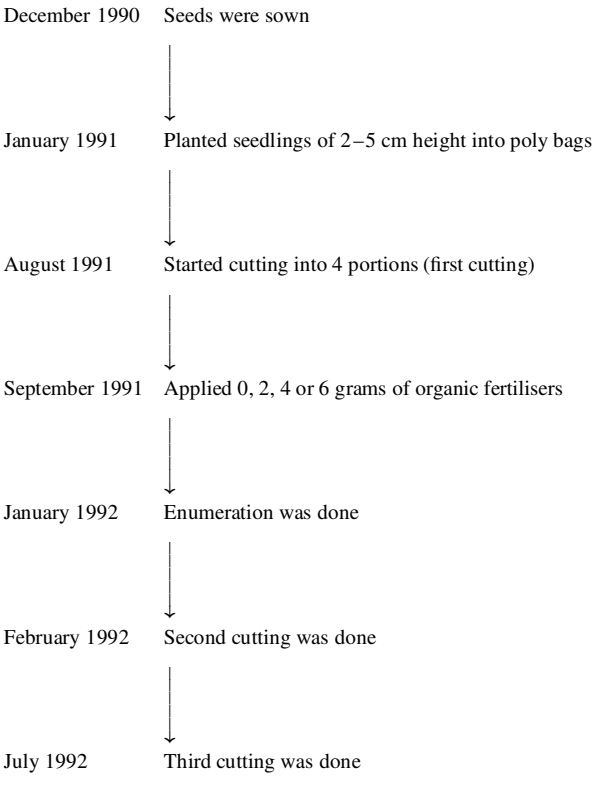

Figure 3. Flow-chart of the stages of the experiment at FRIM's nursery.

Figure 4. Three months old untreated *G. ligulata* seedlings in the nursery.

Table 1.
Parameters collected at Bukit Saga, Johore, after 3 months in the field.

No.	Parameters	Minimum	Maximum	Average
1.	No. of culms/clump	2.9	12.7	6.5
2.	Diameter-breast height (Dbh)	0.65	1.45	1.10
3.	Height	0.56	1.69	1.20
4.	No. of shoots/clump	2	5	3

whole trial plot, where each line consisted of 16 planting holes. Three months later, in April 1996, the mortality rate, number of shoots sprouted, number of culms formed from shoots, diameter of culms and the height were observed and recorded (Table 1). The diameters were measured at the middle of the standing culm, and the height, where the utmost tip of the plant start to droop. Six months old *Gigantochloa ligulata* were planted in the field at KEJORA's site, Bukit saga, Johore as shown in Fig. 7.

RESULTS AND DISCUSSION

Results

The first cutting was done in January 1992, one year after the onset of the experiment. Each polybag had four young plants, totalling up to 120 young plants obtained altogether with heights 18–20 cm tall. Each plant was separated with enough roots to help it to develop so that it could multiply and grow again for the next stage. The data taken after three months of the application of fertilisers showed that there were few young plants produced again within each polybag. Then, in February 1992, a second cutting was done and the number of plants obtained was 178.

The application of chicken dung with a rate of 4 g gave the best results in terms of average height, diameter and number of internodes. This includes the increment in the number of young plants. Goat fertiliser is seldom used nowadays in comparison to chicken fertilisers and it is an advantage for fertilisation purposes.

Data enumerated in April 1995, 3 months later after planting at Bukit Saga, Johore, showed that the mortality rate on the average was found to be 10.5%. Even though observation for a three months stage in the field is too short, it is adequate to show the performance of plant parameters, since bamboo is a fast growing species especially during the establishment stage.

The area achieved the highest rainfall on February 1995 before the monitoring month (Fig. 8).

As given in Table 1, the average number of culms per clump was found to be 6.5. The minimum was 2.9 with a maximum of 12.7 culms per clump. The average diameter was 1.1 cm with a minimum of 0.65 cm and a maximum of 1.45 cm.

Figure 5. Five months untreated glumed *G. ligulata* plants before first cutting in the nursery.

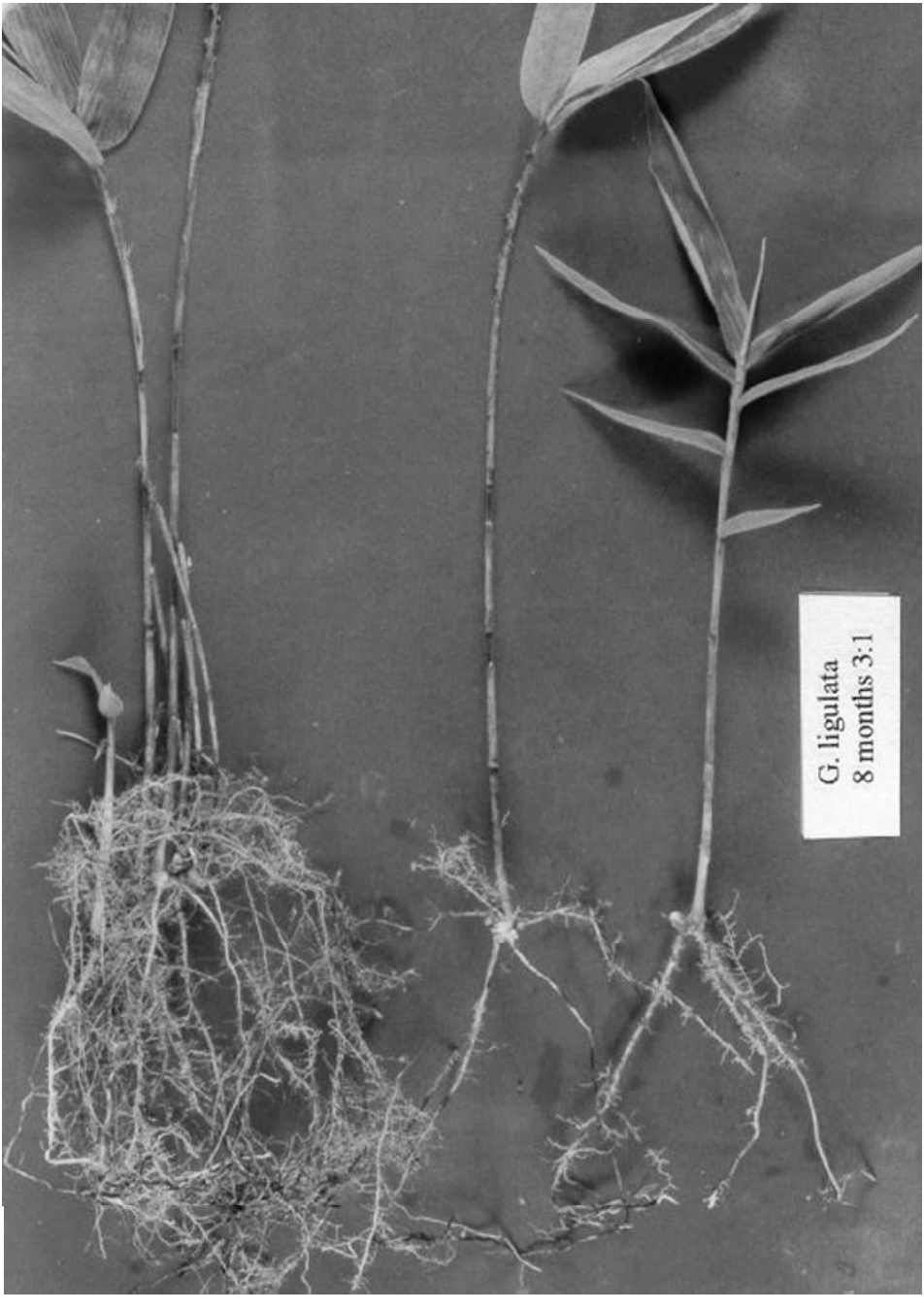

Figure 6. Portion of *G. ligulata* 8 months old young plants being cut for first cutting with their roots shown.

Figure 7. Six months old *G. ligulata* planted in the field at KEJORA's site, Bukit Saga, Johore.

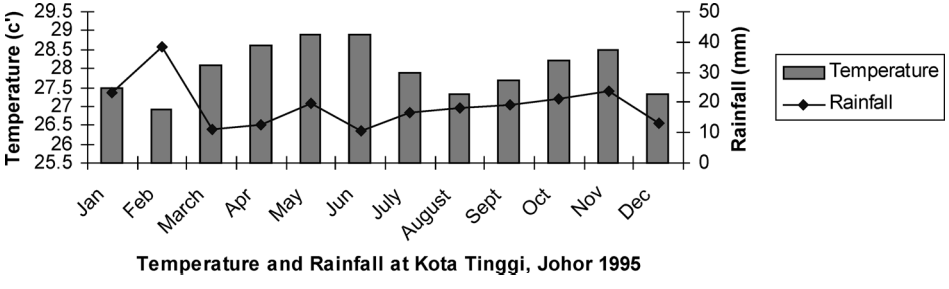

Figure 8. Climatic data at Kota Tinggi, Johor 1995.

Meanwhile, the minimum height was 0.56 m and the maximum was 1.69 m with an average of 1.20 m. Bamboo shoots for *G. ligulata* clumps at Bukit Saga were found to be 155 (total of all the shoots available in the study plot). The minimum number of shoots per clump was 1 and the maximum was 3 giving an average of 2 shoots per clump.

During the earlier stage before the first cutting was done, even though only 3 : 1 ratio of soil medium was used, the young plants tended to grow and to multiply and could therefore be divided into four portions. This is a good indication for mass propagation of all bamboo species in the nursery by using seeds for future expansion, especially for establishing a bamboo plantation. This can be improved by putting fertilisers at the beginning stage of the experiment before the first cutting. In addition, fertilisers can help to boost the growth and expansion of the young

plants vigorously by adding at constant rate every time after the cutting was done. In addition, it is recommended to apply a higher rate of organic fertilisers for better development of the root system.

Discussion

The details given are suitable for mass planting stock for future plantation purposes. Even if seeds obtained from long bamboo flowering cycle are available, it is better to use macro-proliferation technique for mass planting purposes. Other methods such as branch, culms and rhizome offsets are bulky to handle and some of their mortality rates are higher when compared with the use of seeds, especially if transplanted in the field. In addition, transportation costs using seeds can be reduced compared to other methods.

Based on these experiments, an initial 30 seeds sown can produce 266 young plants. Each seed produced 8 young plants by using the macro-proliferation method. The application of fertilisers gave an increment of 48% of young plants after 4 months stage in the nursery. Thus, this method is successful in producing mass bamboo planting materials especially for plantation purposes.

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