

ABSTRACT

Reforestation with indigenous tree species can play an important role in the restoration of unproductive degraded forestland resulting from shifting cultivation in Sarawak. To evaluate the mortality and growth of tree species planted in six different sites reforestation since 1984, demographic data from 100 plantation yield plots were analyzed and compared in this study. The seven species included in this study were *Acacia mangium*, *Shorea macrophylla*, *Dryobalanops aromatica*, *S. parvifolia*, *S. pinanga*, *S. splendida* and *Scaphium macropodum*.

Tree mortality and growth of *A. mangium* were size dependent in this study. The smallest size-class (<5 cm dbh) had a significantly higher mortality rate for this species. Growth rate was observed to decrease with tree size. The overall nonlinear relationship between growth and tree size showed a negative exponential distribution. The highest mean annual volume increment for the species was 21.15 m³ha⁻¹yr⁻¹ for 6 year-old plots in Sampadi. In terms of growth, Sampadi and Labang showed significantly higher ($P < 0.05$) dbh increment than the other four sites (Sabal, Niah, Bakas and Sawai).

Some indigenous tree species showed an encouraging growth rate. *Dryobalanops aromatica* had the highest dbh growth rate of 0.93 cm yr⁻¹, followed by *S. macrophylla*, *S. splendida*, *S. pinanga*, and *S. parvifolia* with growth rates of 0.88, 0.72, 0.67 and 0.66 cm yr⁻¹ respectively. *Scaphium macropodum* had the lowest diameter growth of 0.49 cm yr⁻¹. The mortality rate for most indigenous species was high (from 15 – 40%) during the first three years after planting.

In the second part of this study, the performances of two of the above indigenous tree species (*Dryobalanops aromatica* and *Shorea parvifolia*) planted under different planting methods of establishment were analysed for mortality and growth. The seedlings were planted at two sites in two different planting hole sizes (12 x 18 cm and 20 x 30 cm), and four soil treatments (control, mulching, nutrient addition, and mulching + nutrient addition) using a randomized complete block design with two replicate blocks in each site. ANOVA indicated that survival of the two species did not significantly differ whereas collar diameter (10 cm above ground level) was significantly different between species, sites, as well as among planting techniques. Mulching may have suppressed weeds, reducing below ground competition and therefore enhancing the growth of the seedlings. Nutrient addition also increased growth of the two dipterocarp seedlings. The highest diameter and height growth was observed in the combination of mulching and nutrient treatments. Leaf numbers were significantly higher following nutrient treatments on the two dipterocarps seedlings particularly for *S. parvifolia*.

The results from the plantation yield plot analysis and the field experiment on methods of establishment provide detailed information on performances of several important plantation species currently being used in Sarawak. This provides a preliminary baseline for further studies of reforestation and forest plantation design and management in Sarawak. Data and information from the study provide inputs for the continued development of the reforestation and forest plantation programme in Sarawak.

ABSTRAK

KAJIAN MENGENAI POKOK TEMPATAN DAN EKSOTIK DI SARAWAK

Penanaman semula *hutan* dengan pokok tempatan dapat memainkan peranan penting dalam pemulihan *hutan* yang tidak produktif akibat daripada aktiviti pertanian pindah di Sarawak. Data *demografi* daripada 100 plot hasil *ladang hutan* telah digunakan untuk menilai kadar kematian *dan* pertumbuhan pokok yang telah di *tanam* di *enam* kawasan penanaman semula di Sarawak dari tahun 1984. Tujuh jenis pokok yang dikaji ialah *Acacia mangium*, *Shorea macrophylla*, *Dryobalanops aromatica*, *S. parvifolia*, *S. pinanga*, *S. splendida* *dan* *Scaphium macropodum*.

Kajian menunjukkan bahawa kadar kematian *dan* pertumbuhan *A. mangium* bergantung kepada saiz pokok. Pokok yang *kecil* bersaiz <5 sentimeter diameter (dbh) mempunyai kadar kematian lebih tinggi. Kadar pertumbuhan adalah berkurangan mengikut saiz pokok. Kaitan tak linear keseluruhan diantara pertumbuhan *dan* saiz pokok menunjukkan pertaburan eksponen yang *negatif*. Purata kenaikan isipadu tahunan (MAI) yang tertinggi *bagi* *A. mangium* adalah $21.15 \text{ m}^3\text{ha}^{-1}$ setahun *pada* umur 6 tahun di Sampadi. Kadar pertumbuhan pokok *A. mangium* adalah lebih tinggi ($P < 0.05$) di Sampadi *dan* Labang berbanding dengan *empat* kawasan lain iaitu, Sabal, Niah, Bakas *dan* Sawai.

Kajian *juga* menunjukkan bahawa kadar pertumbuhan pokok tempatan adalah memuaskan. *Dryobalanops aromatica* mempunyai kadar pertumbuhan yang paling tinggi, 0.93 sentimeter setahun, diikuti oleh *S. macrophylla*, *S. splendida*, *S. pinanga*, *dan* *S. parvifolia* masing-masing mempunyai kadar pertumbuhan 0.88, 0.72, 0.67 and 0.66 sentimeter setahun. *Scaphium macropodum* mempunyai kadar pertumbuhan yang paling *rendah* 0.49 sentimeter setahun. Kadar kematian pula adalah tinggi (antara 15 hingga 40%) dalam masa tiga tahun pertama selepas ditanam.

Bahagian kedua kajian *ini*, menganalisis pencapaian dua daripada pokok tempatan yang di *tanam* menggunakan kaedah penanaman yang berbeza. Eksperimen *ini* mengandungi dua spesies (*Dryobalanops aromatica* *dan* *Shorea parvifolia*), dua saiz *lobang* penanaman (12 x 18 sentimeter *dan* 20 x 30 *sentimeter*), *dan* *empat* jenis rawatan *tanah* (tiada rawatan-kontrol, mulching, penambahan nutrien, *dan* mulching + nutrien) yang ditanam di dua kawasan (Sampadi *dan* Balai *Ringin*) menggunakan reka bentuk blok secara rawak. *Analisis* pembolehubah menunjukkan bahawa kadar kehidupan *bagi* kedua-dua spesies tidak menunjukkan perbezaan bererti tetapi diameter *bagi* kolar (10 sm diatas *paras tanah*) menunjukkan perbezaan bererti diantara spesies, kawasan, *dan* kaedah penanaman. Mulching dapat mengurangkan pertumbuhan *rumput*, mengurangkan persaingan di bawah *tanah* *dan* meningkatkan pertumbuhan anak benih pokok. Penambahan nutrien *juga* didapati meningkatkan pertumbuhan anak benih dipterokap. Didapati bahawa kadar pertumbuhan diameter *bagi* kolar *dan* ketinggian anak pokok adalah paling tinggi *bagi* rawatan campuran mulching + nutrien. Jumlah daun *bagi* kedua anak benih dipterokap *juga* adalah lebih tinggi *pada* rawatan penambahan nutrien terutama *bagi* *S. parvifolia*.