Growth Performance of Teak (*Tectona grandis* Linn f.) and Padauk (*Pterocarpus macrocarpus* Kurz) Used in the Enrichment Planting for the Restoration of Degraded Tropical Forests in Myanmar

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Abstract: Enrichment planting has been used as one of the promising restoration techniques to accelerate the natural restoration process of secondary forests or logged-over forests in Myanmar. The objectives of this study were to examine the growth performances of two commercial species such as Teak (*Tectona grandis* Linn f.) and Padauk (*Pterocarpus macrocarpus* Kurz) in response to different canopy opening treatments and to examine the suitability of these species in enrichment planting activities for the restoration of degraded tropical forests in Myanmar. In this study, split plot design was applied, and three levels of canopy openings were experimented. The survival rate and height growth of two species were measured four times with 6 month interval. The root collar diameter (RCD) was also measured in the last assessment. Although the survival rate of seedlings was not significantly different among the three treatments (p>0.05), as well as between two species (p>0.05) for all consecutive measurements, height (p<0.05) and RCD were significantly different (p<0.001) among the treatments. *T. grandis* seedlings thrived best under complete canopy opening (i.e., 5 m width canopy opening with strip-clear cutting) while *P. macrocarpus* seedlings grew under partial canopy opening (without felling of marketable tree species). Because this study is concerned with only for young stage of seedlings, continuous assessment and follow-up tending activities are needed to verify the species suitability and optimum width of canopy opening for enrichment planting activities in restoration of degraded forests of Myanmar.

Keywords: canopy opening, enrichment planting, partial cutting, site suitability, survival rate

Introduction

Enrichment planting has been commonly used for restoration of previously logged forests and for increasing timber volume and the economic value of secondary forests (Lamprecht, 1989; Aders et al., 1995; Montagnini et al., 1997). The general principle of enrichment planting is to improve the light environment around the planted seedlings by removing overtopping trees, and to reduce competition from the surrounding undergrowth (Augspurger, 1984; Appanah and Weinland, 1993). Canopy openings are critical for regeneration of many canopy tree species (Hartshorn, 1978; Denslow, 1980).

In addition to conventional forest plantations, Forest Department of Myanmar has been implementing enrichment planting activities using valuable tree species such as Teak (*Tectona grandis* Linn f.) and Padauk (*Pterocarpus macrocarpus* Kurz) for 15 years to restore the logged-over and degraded forests of Myanmar (Kyaw, 2000; Forest Department, 2006). However, little is known about the optimum width of canopy opening to achieve the best growth performance of these species (Kyaw, 2000; Oo et al., 2006). Likewise, information regarding the enrichment planting activities in the degraded forests of tropical countries is also scarce. In order to fulfill this gap, two tropical tree species (i.e. *T. grandis* and *P. macrocarpus*) were used in this study due to their economic importance and popularity in restoration of degraded forests in Myanmar. Three widths of canopy opening treatments were applied, and it was hypothesized that these are optimum widths to achieve the best growth performances of the tested species. *T. grandis* that belongs to the family Verbenaceae can
be found within mean annual rainfall of 900-3500 mm and mean annual temperature of 25-32°C with an elevation lower than 1000 m (Troup, 1921; Hundle and Ko, 1987; Lampecht, 1989; Gyi and Tint, 1998). *P. macrocarpus* that belonging to family Papilionaceae occurs from undulating to hilly regions ranging from 100 to 800 m altitude with 1000 to 2000 mm rainfall per year and mean annual temperature of 23-27°C (DFSC, 2000; Aung, 2001).

This enrichment planting experiment is one of the ASEAN-Korea Environmental Cooperation Project (AKECOP) regional research activities in Myanmar, which was established in 2003-2005. AKECOP (2005) and Oo et al. (2006) carried out the assessment on this experiment in 2004 and 2005, respectively. Thus, this study is the follow up activity for the assessment on survival rate, height and root collar diameter (RCD) growth of these two species from January 2007 to July 2008. The key objectives of this study were to assess the survival percentage, height and RCD growth of seedlings in response to different treatments (i.e., widths of canopy openings), and to examine the suitability of *T. grandis* and *P. macrocarpus* in enrichment planting activities. Hence, the results of this study would substantially contribute to the enrichment planting activities for restoration of degraded tropical forests in Myanmar.

Materials and Methods

1. Study site

Enrichment planting experimental plots are located at the Compartment 18 of the Ngalaik Reserved Forest in Pyinmana Township (latitude 19° 56' N and longitude 95° 56' E) (Figure 1). This experiment covered an area of 18 ha. The area received mean annual rainfall of 1,329 mm and mean annual temperature of 23.9°C. According to FAO (1988) classification system, the soil of the study areas is classified as Xanthic Ferralsols (yellow brown forest soils). Soil texture ranges from silt loam to clay loam with a soil pH of approximately 6, which is slightly acidic for *T. grandis*, since it usually occurs on soil with a pH range of 6.5-7.5 (Pritchett and Ohn, 1981).

2. Planting materials

*T. grandis* and *P. macrocarpus* seedlings were used as planting materials for enrichment planting experiment. The seedlings were six-month-old at the time of planting in June 2004 with an average height of about 20 cm (AKECOP, 2005; Oo et al., 2006). A total of 1800 seedlings (900 each for *T. grandis* and *P. macrocarpus*) were used: 600 seedlings per plot (replicate), and 300 plants per treatment for each species.

![Figure 1. Map of Myanmar showing location of the study site.](image)

![Figure 2. Layout of experimental plots of the enrichment planting.](image)

3. Experimental design

Split plot experimental design was applied to test the growth performance of two abovementioned species. This design is specifically suited for a two-factor experiment wherein levels of one of the factors require large plot size for execution and also show large differences in their effects (Jayaraman, 2000). An east-west direction was used to increase the time period in which the plants would receive sunlight (Lampecht, 1989). Three replications were implemented in three blocks. Each replicate consisted of three main plots (experimental unit) to which three different canopy openings as treatments were assigned. Each main plot was then divided into two subplots (observatory unit), in which two species were incorporated. There were altogether 18 subplots: each