INTRODUCTION

The highest rates of land use change in the world are found in the tropics. The Food and Agriculture Organization of the United Nations (FAO) estimated that during the period 1981-1990, 17 million hectares of forest were converted to other uses each year, of which about half was in the moist tropical zone (FAO, 1990). Forest biodiversity in Thailand is rapidly disappearing, mostly due to deforestation. In 1960, forest cover was 53% (Bhumibamon, 1986). It had been reduced to 25.28% by 1998 (Rojanapaiwong, 2000). In reality, remaining natural forest cover might be as low as 20% or even less (Leungaramsri and Rajesh, 1992). Between 1990 and 1995, Thailand's average rate of deforestation was approximately 2.6% (FAO, 1997) and Chiang Mai province had a deforested area of more than 6,513 km^2 in 1985 (GRID, 1988). The government realizes the importance of forests and has tried to restore them. The Forestry Policy, decided by the Council of Ministers on 3 November 1985, fixed the target forest area at not less than 40% of the country or 1.298 million km^2. Of this area, conservation forest was designated at 25% and economic forest at 15% (Budget Bureau, 1995). An appropriate goal of forest ecosystem rehabilitation is to facilitate, accelerate and direct natural succession processes so as to increase biological productivity, reduce rates of soil erosion, increase soil fertility including soil organic matter and increase biotic control over biogeochemical fluxes within the recovering ecosystem (Parrota, 1991).

According to the Budget Bureau (1995), most plantations by the Royal Forest Department (RFD) in Thailand have involved planting fast-growing monoculture

plantations of pines, teak and eucalyptus which are easier to manage than mixed species plantations (Lamb and Lawrence, 1993). The value of such plantations for diversity and conservation is low. Monoculture plantations are the quickest method to rapidly restore tree cover, but are threats to native plants and animal species (Harshorn, 1983). After realization that such plantations are of low value for wildlife conservation and watershed protection, attitudes towards reforestation changed. Planting native tree species is now recommended for reforestation projects. This change in policy could not be implemented effectively since there was a lack of knowledge about how to select, grow and plant seedlings of native tree species (Elliott *et al.*, 1996). In plantations established by the Royal Forestry Department (RFD), under National Development Plans 5-6, the average survival of planted trees during the first year was 72.1%, lower than the 80% target (Budget Bureau, 1995). There was waste in planting poor quality seedlings (World Bank, 1993), since planting stock quality is essential to reforestation success (Wightman, 1997). High quality seedlings can establish well and grow fast after out planting (Milamo and Spencer, 1985). Therefore, it is necessary to develop more efficient methods to produce and maintain trees. More cost-effective methods to produce large numbers of trees with high performance must be developed.

The new knowledge generated by my project included the effects of container type, air pruning and fertilizers on tree seedling propagation of native tree species. This project results can also produce high quality seedlings and help increase biodiversity in Thai forests by bringing about more effective implementation of forest restoration.

Hypothesis

This research tested the hypothesis that seedlings grown in root trainers, with air pruning (raised 45 cm above the ground) will be more vigorous than when raised untreated on the ground. The project also investigated whether using either osmocote or soluble fertilizer during seedling propagation results in different seedling performance in the nursery.

Objectives

The objective of this research was to determine optimum container type and size, root pruning methods and fertilizer application regimes to maximize performance of seedlings of three native tree species, grown in nurseries for restoring natural forests to deforested areas. This research focused on nursery growth, shoot per root ratio, and the cost of the various methods to balance ecological and economic considerations for developing the most effective nursery management method and methodology.

Limitations of the study

This research included 3 native species (*Artocarpus lakoocha* Roxb. (Moraceae), *Balakata baccata* (Roxb.) Ess. (Euphorbiaceae) and *Horsfieldia thorelii* Lec. (Myristicaceae)) at the Forest Restoration Research Unit (FORRU) nursery. The applicability of the results of this project to other species is unknown. This project examined performance of seedlings only in the nursery for 10 months (October 1999 to August 2000). Although it is likely that nursery performance is correlated with field performance, monitoring of seedlings after planting out would be needed to confirm

whether the effects of the treatments described here carries on after the seedlings are planted.

Study site description

Doi Suthep-Pui National Park, Chiang Mai, Thailand was established on 14 April 1981 and is under the jurisdiction of the National Parks Division of the Royal Forest Department. Doi Pui, the highest peak has an elevation of 1,685 m. The National Park covers an area of 261 km^2 (Maxwell,1988).

The Forest Restoration Research Unit (FORRU) was established in November 1994 at the headquarters of Doi Suthep-Pui National Park (18 ° 50′ N 98° 50′ E) at about 1,000 m elevation amidst primary evergreen seasonal, hardwood forest on granite bedrock. (Elliott *et al.*, 1997). The annual rainfall during October 1999 and August 2000 was about 117.37 mm and average temperature was 19.15 °C (Figure 1.).

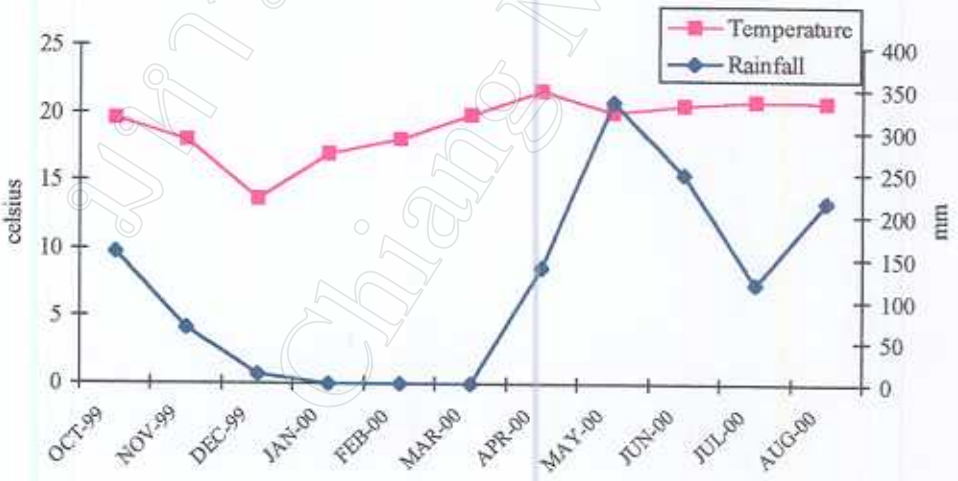

Figure 1. Average monthly temperature and rainfall at Chang Kian Station

Source: Meteorological report 1999-2000, Chang Kain Station, Faculty of Agriculture, Chiang Mai University.