

# PROPAGATING NATIVE TREES TO RESTORE DEGRADED FOREST ECOSYSTEMS IN NORTHERN THAILAND

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## ABSTRACT

Producing a wide range of native forest tree species to restore forest ecosystems for conservation of biodiversity is beset with nursery scheduling problems. Different species produce seeds at different times of the year and they have different growth rates, yet all seedlings must reach a plantable size at the same time of the year. A research programme was begun in 1997, to formulate production schedules for various forest tree species indigenous to northern Thailand and to determine optimum propagation methods. Basic data were collected on performance in the nursery from seed collection to planting out. In this short report, we present detailed results for four tree species suitable for forest restoration plantings (*Bischofia javanica*, *Castanopsis tribuloides*, *Ficus semicordata* and *Dalbergia rimosa*) and a summary production schedule for 35 species. Of these, 12, 22 and 1 species respectively reached plantable sizes by the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> planting season after seed collection. The amount of nursery time required ranged from 6 to 25 months.

**Key words:** seedling production or propagation, forest restoration, tropical tree nursery methods, Thailand

## INTRODUCTION

Deforestation is one of the most serious environmental problems in Thailand today, causing rural poverty, watershed degradation and loss of biodiversity. In the past, efforts to solve the problem usually meant establishing single-species plantations, which are of little value for wildlife conservation and watershed protection. Recently, however, the idea of restoring original forest ecosystems has rapidly gained ground. Some senior Royal Forest Department officials are actively promoting "enrichment planting", using a wide range of native tree species and a random planting pattern (CHATWIROON, 1997).

In 1993 a nation-wide project, involving the government, NGO's and the private sector, was launched to replant 8,273 km<sup>2</sup> of deforested land, to celebrate His Majesty King Bhumibol Adulyadej's Golden Jubilee. The project stipulates use of a wide range of native forest tree species. Consequently, tree-planting programs, using mixtures of several native

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forest tree species, have become very popular in Thailand. However, the results of such tree-planting programs are often disappointing. Their success depends on selecting suitable tree species and on the size and the quality of the trees planted. In the past, most tree nurseries grew very few, mostly commercially valuable species such as teak (*Tectona grandis* L. f. (Verbenaceae)) and *Eucalyptus* spp. (Myrtaceae). Now, to satisfy the growing interest in restoring forest ecosystems for wildlife conservation, there is an urgent need to propagate a much wider range of native forest trees in nurseries.

Growing a wider range of tree species, however, is beset with scheduling problems. Different tree species produce seeds at different times of the year and their seedlings grow at different rates, yet they must all reach a plantable size (40-60 cm tall) at the same time of the year, i.e. the beginning of the rainy season, May-June, in northern Thailand. The vast majority of the approximately 1,200 tree species indigenous to northern Thailand have never been propagated in nurseries. Lack of information about how to grow them has limited their use in forest restoration programmes.

In 1997, staff at the Forest Restoration Research Unit (FORRU) began collecting data on the performance of a wide range of native trees in the nursery. FORRU is a joint initiative between Chiang Mai University and the Headquarters of Doi Suthep-Pui National Park (under the Royal Forest Department). Its aim is to develop suitable techniques to restore forest ecosystems for wildlife habitat in conservation areas in northern Thailand (FOREST RESTORATION RESEARCH UNIT, 1998). This preliminary report presents the results of four species, which were part of larger experiments to propagate a wide range of native forest tree species. The objective was to prepare production schedules to raise trees to a plantable size from seed and to determine optimum propagation methods.

## METHODS

Seeds of *Bischofia javanica*, *Castanopsis tribuloides*, *Ficus semicordata* and *Dalbergia rimosa* were collected and sown in baskets in a germination medium of forest soil and coconut husk mixed in the ratio 1:1. All seedlings were pricked out of the germination trays when they had the first pair of leaves and transplanted into black plastic bags 2.5 inches in diameter by 9 inches in depth. The potting mix consisted of forest soil, peanut husk and coconut husk mixed in the ratio of 2:1:1. Seedlings were shaded inside the nursery under a plastic roof (approximately 20% full sunlight), for about 2 weeks. During this time, they were given nitrogen fertiliser (45-0-0) every 2 days. Approximately 20 g of fertiliser was mixed with 10 litres of water and applied to the seedlings using a watering can. After two weeks, the seedlings were moved out of the nursery and placed under black shade netting (approximately 50% of full sunlight).

Fifteen seedlings of each species were randomly selected for monitoring of health and measurement of relative growth rate (RGR) of height and root collar diameter. These measurements were repeated every 45 days. Ten granules of Osmocote slow-release fertiliser (15-15-15) were applied to selected species every 3 months. Weeds, pests and diseases were controlled, as necessary for each species. Growth rate measurements ceased when the seedlings were ready for planting out, i.e. when they had grown at least 40-60 cm tall (30 cm

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for the fastest-growing species) and appeared healthy and vigorous. Seedlings were hardened off in full sunlight for 4 weeks in May and dispatched for planting in June each year.

### RESULTS AND DISCUSSION

Here, the results of the four species that typify three of the main types of production schedule (Table 1) are presented. Details for more species are summarised in Table 2.

Table 1. Three main types of production schedule.

Seed Collection	Ready for Planting	Time in Nursery (months)	Examples
Late rainy season	1 <sup>st</sup> planting season after seed collection	7-9	<i>Bischofia javanica</i>
Late rainy season	2 <sup>nd</sup> planting season after seed collection	19-21	<i>Ficus semicordata</i> <i>Castanopsis tribuloides</i>
Late dry – early rainy season	2 <sup>nd</sup> planting season after seed collection	14-16	<i>Dalbergia rimosa</i>

#### ***Bischofia javanica* Bl. (Euphorbiaceae)**

Seeds were collected from the ground beneath a parent tree on 19<sup>th</sup> October 1997 and sown on 21<sup>st</sup> October. Germination commenced after 13 days. Of 1,500 seeds sown, 1,270 germinated (a germination rate of 85%) by 30<sup>th</sup> December (70 days after sowing). However, damping off killed many seedlings, such that only 312 were suitable for pricking out and potting on 30<sup>th</sup> December. Of these 250 (80%) grew into plantable saplings. Plants received Osmocote fertiliser in January and April. No pruning was carried out. The mean annual RGR was 861% for height and 437% for root collar diameter. Potted seedlings grew to a mean height of 36.4 cm by mid-June 1998. Because this species is fast growing, it can be planted out when 30 cm or taller. Therefore, most seedlings were ready for planting at the beginning of the first planting season following seed collection, i.e. after about 8 months in the nursery. RGR was slow during the cool season and accelerated during the hot season. Several potted plants suffered from a disease that caused leaf curling, but otherwise they remained in good health.

**Recommendations for further research:** treatments to prevent damping off of germinating seedlings; treatment of leaf curling disease in larger seedlings.

#### ***Castanopsis tribuloides* (Sm.) A. DC. (Fagaceae)**

Seeds were collected from the ground beneath a parent tree on 20<sup>th</sup> November 1997 and sown on 22<sup>nd</sup> November. Of 1,500 seeds sown, 814 germinated (a germination rate of 54.3%) by 13<sup>th</sup> February 1999 (85 days after sowing). Germination was very asynchronous, with a

long taproot developing before the shoot appears. Seven hundred and two seedlings were suitable for pricking out and potting on 13<sup>th</sup> February. Of these 631 (89.9%) grew into plantable saplings. Application of Osmocote fertiliser and pruning were not considered necessary for this species and were not carried out. The mean annual RGR was 213.4% for height and 164.4% for root collar diameter. Potted seedlings grew to an average height of only 6.8 cm by May 1998 and were therefore not ready for planting. By May 14<sup>th</sup> 1999, the seedlings had grown to a mean height of 50.2 cm and were therefore ready for planting in the second planting season after seed collection (i.e. after 19 months in the nursery). RGR was fairly constant throughout the year, except for a slowing of growth during the cool season. Seedlings remained in good health throughout their growth in the nursery.

**Recommendations for further research:** although seeds are available from August to November, the experiment above was performed on seeds collected in November. Experiments should be carried out with seeds collected earlier, using fertiliser to see if it is possible to grow the trees to a plantable size by the first planting season after seed collection (i.e. after about 10 months of growth in the nursery).

***Dalbergia rimosa* Roxb. var. *rimosa* (Leguminosae, Papilionoideae)**

Seeds were collected from the parent tree on 15<sup>th</sup> May 1998 and sown on 20<sup>th</sup> May. Germination commenced after 5 days. Of 1,500 seeds sown, 591 germinated (a germination rate of 39%) by 15<sup>th</sup> June (26 days after sowing). Five hundred and sixteen seedlings were suitable for pricking out and potting on 15<sup>th</sup> June. Of these 452 (87.6%) grew into plantable saplings. Plants received Osmocote fertiliser in October, January and April. No pruning was carried out. The mean annual RGR was 173.1% for height and 160.9% for root collar diameter. Seedlings grew to a mean height of 55.2 cm by May 31<sup>st</sup> 1999. Most seedlings were therefore ready for planting at the beginning of the second planting season following seed collection (i.e. after 14 months in the nursery). Growth was mostly constant throughout the year, but slightly higher than average at the end of the rainy season. Seedlings remained in good health throughout their growth in the nursery.

**Recommendations for further research:** investigate treatments to improve germination rate.

***Ficus semicordata* B.-H. ex J.E. Sm. var. *semicordata* (Moraceae)**

Seeds were collected from the parent tree on December 15<sup>th</sup> 1997 and sown on December 16<sup>th</sup>. Germination commenced after 31 days. Of 1,500 seeds sown, 770 germinated (a germination rate of 51.3%) by 13<sup>th</sup> July 1998 (210 days after sowing). However, damping off killed many seedlings, such that only 120 were suitable for pricking out and potting on 13<sup>th</sup> July 1998. Of these 72 (60%) grew into plantable saplings. Plants received Osmocote fertiliser in January and April. No pruning was carried out. The mean annual RGR was 284.1% for height and 190.3% for root collar diameter. Potted seedlings grew to a mean height of 53.5cm by June 10<sup>th</sup> 1999 and were therefore ready for planting in the second planting season after seed collection (i.e. after 19 months in the nursery). RGR was fairly constant throughout the year, but slightly higher during the rainy season.

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**Recommendations for further research:** treatments to prevent damping off of germinating seedlings.

A provisional production schedule has been compiled for 35 potential framework species, based on data collected in the FORRU nursery (Table 2). The amount of time required to grow seedlings to a plantable size ranged from 6 months for *Melia toosendan* Sieb. & Zucc. to 25 months for *Eurya acumminata* DC. var. *wallichiana* Dyer. Only 12 species reached a plantable size by the beginning of the first planting season after seed collection. Most of these species fruited in the mid- to late rainy season and exhibited rapid growth in the nursery. Twenty-two and 1 species reached plantable sizes by the 2nd and 3rd planting seasons after seed collection respectively. These species fruited at all times of the year, except June-July.

## REFERENCES

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Table 2. Production schedules for 35 potential framework species. 1 = seed sowing; 2 = pricking out; 3 = hardening; 4 = planting

Species	Family	Year 1 (months)												Year 2 (months)												Year 3 (months)					
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
<i>Acrocarpus fraxinifolius</i> Wight ex Arn.	Leguminosae (Caesalpinioideae)			1			2											3	4												
<i>Afzelia xylocarpa</i> (Kurz) Craib	Leguminosae (Caesalpinioideae)								1	2																				3	4
<i>Balakata baccata</i> (Roxb.) Ess.	Euphorbiaceae							1	2									3	4												
<i>Bischofia javanica</i> Bl.	Euphorbiaceae									1	2							3	4												
<i>Castanopsis acuminatissima</i> (Bl.) A. DC.	Fagaceae										1						2												3	4	
<i>Castanopsis tribuloides</i> (Sm.) A. DC.	Fagaceae										1						2												3	4	
<i>Cinnamomum caudatum</i> Nees	Lauraceae		1			2												3	4												
<i>Dalbergia rimosa</i> Roxb. var. <i>rimosa</i>	Leguminosae (Papilionoideae)					1	2											3	4												
<i>Diospyros glandulosa</i> Lace	Ebenaceae										1	2						3	4												
<i>Eugenia albiflora</i> Duth. ex Kurz	Myrtaceae					1				2								3	4												
<i>Eurya acumminata</i> DC. var. <i>wallichiana</i> Dyer	Theaceae					1				2																			3	4	
<i>Ficus capillipes</i> Gagnep.	Moraceae		1					2										3	4												
<i>Ficus glaberrima</i> Bl. var. <i>glaberrima</i>	Moraceae	1					2											3	4												
<i>Ficus microcarpa</i> L. f. var. <i>microcarpa</i> forma <i>microcarpa</i>	Moraceae										1									2									3	4	
<i>Ficus semicordata</i> B.-H. ex J.E. Sm. var. <i>semicordata</i>	Moraceae											1							2										3	4	
<i>Garcinia mckeaniana</i> Craib	Guttiferae						1			2																			3	4	
<i>Glochidion kerrii</i> Craib	Euphorbiaceae										1							2											3	4	

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Table 2. (Continued)

Species	Family	Year 1 (months)												Year 2 (months)												Year 3 (months)												
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J							
<i>Gmelina arborea</i> Roxb.	Verbenaceae					1	2										3	4																				
<i>Helicia nilagirica</i> Bedd.	Proteaceae							1	2								3	4																				
<i>Heynea trijuga</i> Roxb. ex Sims	Meliaceae											1				2																				3	4	
<i>Hovenia dulcis</i> Thunb.	Rhamnaceae											1				2																						
<i>Lithocarpus craibianus</i> Barn.	Fagaceae											1					2																			3	4	
<i>Lithocarpus fenestratus</i> (Roxb.) Rehd	Fagaceae											1			2																					3	4	
<i>Macaranga denticulata</i> (Bl.) M.-A.	Euphorbiaceae											1			2																							
<i>Manglietia garrettii</i> Craib	Magnoliaceae											1			2																							
<i>Melia toosendan</i> Sieb. & Zucc.	Meliaceae													1	2																							
<i>Mesua ferrea</i> L.	Guttiferae											1			2																					3	4	
<i>Michelia baillonii</i> Pierre	Magnoliaceae											1			2																							
<i>Nyssa javanica</i> (Bl.) Wang.	Nyssaceae													1	2																							
<i>Phoebe lanceolata</i> (Nees) Nees	Lauraceae											1			2																						3	4
<i>Prunus cerasoides</i> D. Don	Rosaceae					1	2																															
<i>Quercus semiserrata</i> Roxb.	Fagaceae											1	2																									
<i>Rhus rhetoides</i> Craib	Anacardiaceae														1		2																				3	4
<i>Sapindus rarak</i> DC.	Sapindaceae												1	2																							3	4
<i>Spondias axillaris</i> Roxb.	Anacardiaceae												1	2																								