

Two-year results of a clonal test of teak (*Tectona grandis* L.f.) in the Northeast of Thailand

Suwan Tangmitcharoen^{1)*}, Suchat Nimpila²⁾, Jeerasak Phuangjumpee³⁾, Prasit Piananurak¹⁾

¹⁾ Forestry Research and Development Bureau, Royal Forest Department, 61 Phaholyothin, Chatuchak, Bangkok 10900, Thailand

²⁾ Northeastern Forest Tree Seed Center, Forestry Research and Development Bureau, Khon Kaen 40000, Thailand

³⁾ Plantation Extension Center No.9 (Udon Thani), Royal Forest Department, Udon Thani 41000, Thailand

* Corresponding author; e-mail: suwantang@hotmail.com

Abstract

Clonal test had been conducted at Udon Thani and Khon Kaen provinces to determine difference of tree performances among clones at different sites and to produce improved genetic materials of teak for planting in the Northeast region. The experiment was undertaken with randomized completely block design (RCBD) with four replications. One replication contained three ramets of each clone planted in row. Fifty clones were selected based on previous field trial studies and shooting ability of the seedlings. Total seedlings of 600 seedlings/sites (50 clones x 3 tree plot x 4 replications) were planted.

The preliminary results on survival rate, height (H) and diameter at root collar (D0) had been conducted when the seedlings reached three months, one year and two years. At two years, survival rate of the seedlings in Udon Thani and Khon Kaen was 68% and 70% respectively. In general, it was likely that the growth rate in terms of H (1.17 m) and D0 (2.99 cm) was relatively poor at both sites. However, H & D0 in Udon Thani (1.30 m, 3.05 cm) was slightly higher than those in Khon Kaen (1.02 m, 2.93 cm). In terms of clone performances, statistical analysis showed that there was no significant difference in H & D0 of seedlings among clones on the two sites. There was no interaction effect between site and clone on H & D0.

Keywords: *Tectona grandis*, clonal test, clone, Northeast Thailand

Introduction

A number of research projects regarding teak improvement program had been conducted in Thailand since 1965 when the teak improvement program had been initiated. The first seed orchard in Thailand was established in 1965 at Maegar seed orchard, Phayao province. In 1966, the provenance test of 30 provenances was established in Lampang province. It was found that at eight years old, Ngao provenance (S88) from Lampang province showed the best performance in terms of height.

As for clonal test, major field trials had been conducted in 2000. In order to reselect teak plus trees and select suitable clones to be planted various sites, four sets of 100 clones test were planted in three sites *i.e.* Songkhla, Kanchanaburi, Kamphaeng Phet. The first set of clonal rooted cutting seedlings was planted in 2000. Results of the first evaluation when the trees were 5 year old showed that sites significantly affected to both total height and DBH. The results showed that within site clones significantly affected DBH in all sites. In other words, The DBH among

clones was significantly different in all sites. While significantly affected height only in Kamphaeng Phet site. There were interaction effects between clone and site on both total height and DBH. In brief, the results indicated that selection of suitable clones for plantation site properties must be taken into consideration.

There was no information of clonal test in spite of recent emerging private teak plantation forestry by farmers in Northeast Thailand, so far. The objectives of this study were to determine difference of tree performances among clones at different sites in NE and to produce improved genetic materials of teak for planting in the NE areas.

Materials and methods

Experimental Plots at two sites (51.25 ha each) were determined as follow:- I. Tambon Noonsomboon, Banhaed Sub-district, Khon Kean Province (nearby Northeast Forest Seed Center), and II. Tambon Dutung, Muang District, Udon Thani (nearby Plantation Extension Center no.9). Top 49 clones were selected based on previous clonal test

324	5n/3	115	335	n2/40	289	n4/87	38	n5/47	331	300	n1/46	n4/9	330	n5/47	119	n1/28	28c60	317	n4/19
39	273	3n/2	n1/28	91	x5	251	n4/19	343	263	n4/87	3n/7	39	n1/18	289	5n/34	273	29	n5/28	336
n1/29	4n/24	29	336	n1/18	267	3n/14	x3	271	n4/9	335	267	x5	251	5n/33	115	343	n4/38	263	245
300	302	5n/34	130	333	n2/33	3n/7	35	317	305	n1/29	5n/3	324	n3/23	35	305	3n/14	38	333	302
5n/33	119	n5/28	26c17	28c60	245	330	n3/23	n4/38	n1/46	91	333	26c17	3n/2	271	4n/24	130	n2/40	n2/33	x3
305	n1/28	251	4n/24	317	n1/18	39	n2/33	336	n1/29	273	n1/46	n5/28	130	n2/40	28c60	n3/23	289	n5/47	n4/87
28c60	35	3n/2	271	n4/38	130	300	5n/34	119	343	336	115	5n/33	4n/24	263	38	330	n1/29	26c17	271
245	263	333	x3	91	335	26c17	29	n4/9	289	305	x3	35	302	n4/9	331	245	335	39	300
302	3n/7	n1/46	38	3n/14	x5	267	n3/23	324	n4/19	251	324	3n/2	n2/33	91	343	3n/7	29	5n/3	n4/19
n2/40	331	330	n5/28	5n/3	n4/87	115	5n/33	n5/47	273	n4/38	n1/18	119	3n/14	5n/34	267	n1/28	x5	317	333

R1	R2
R3	R4

3 trees planted in line

4 replication

Fig. 1. Planting design (low-column design) of teak clonal test of 50 clones (4 replications x 3 tree plots)



Fig. 2. Examples of teak seedlings at 2 year after planting (Left); Clone no.115 of replication no.1. (Right); Seedling planted at Khon Kaen was monitored on height and diameter at root collar

studies (27 selected clones from 100 clones of clonal test planted in 2000, 22 clones from cross-controlled pollination) excluding (unselected) clones used as a control treatment. Stock plants were prepared by tissue culture. Experimental design was randomized complete block design (RCBD) with 4 replications and one replication containing 3 ramets of each clone planted in row (Fig. 1). In 2008, seedlings were planted on September, and August at Khon Kaen and Udon Thani Provinces, respectively. Monitoring growth in terms of height (H) and diameter at root collar (D0), survival rate and determine clone x site interaction. Analysis of variance (ANOVA) was used to determined variation of growth among clones.

Results

The preliminary results were monitored when the trees reached one year and two years old (Fig. 2). Survival rate, height, and diameter at root collar (D0) were measured and statistically analyzed. The major findings were as follow:-

- 1) The survival rate of the seedlings in Udon Thani (68%) was similar to those in Khon Kaen (70%).
- 2) Growth rate of one and two years old was similar. Height (H) and Diameter at root collar (D0) in Udon Thani was slightly larger than in Khon Kaen.
- 3) At one year old, average H and D0 in Udon Thani (n= 429) was 56.54 cm (SD=49.34) and 18.10 mm (SD= 9.09), respectively; And H and D0 in Khon Kaen (n = 534) was 38.30 cm (SD=21.19) and 10.66 mm (SD=0.56 mm), respectively (Fig. 3).
- 4) At two years old, average H and D0 in Udon Thani (n = 408) was 1.30 m (SD=0.87) and 3.05 cm (SD=1.34), respectively; And H and D0 in Khon Kaen (n=422) was 1.07 m (SD=0.61) and 2.93 cm (SD=1.25), respectively (Fig. 3).
- 5) Statistical analysis showed that there was no significant difference in H and D0 of seedlings among clones on the 2 sites. Besides, there was no interaction effect between site and clone on H and D0. (Tables 1 and 2).

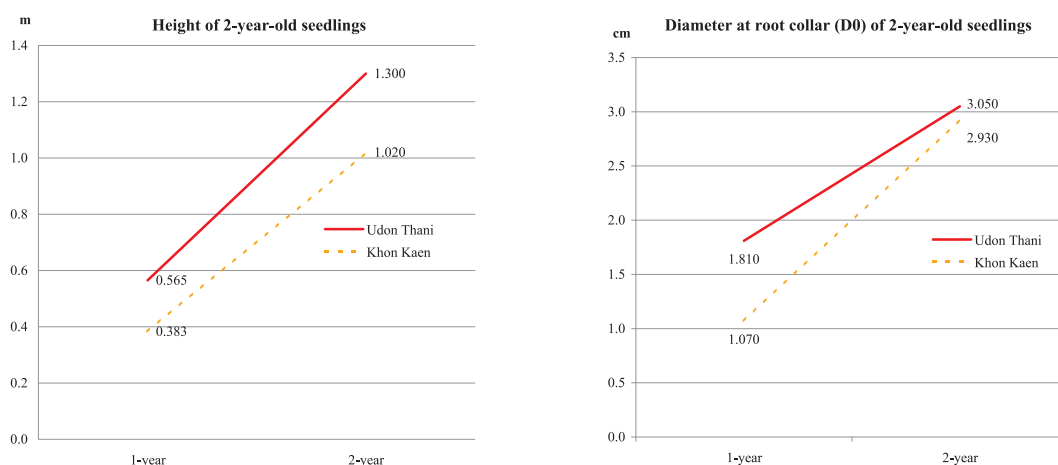


Fig. 3. Growth of two years old teak seedlings

Table 1. Statistics for Height of 2 years old seedlings at the two sites

	df	F	<i>p</i> -value	Remarks
Block	3	14.60	0.0001	Highly sig.
Site	1	16.40	0.0001	Highly sig.
Clone	50	0.91	0.6494	Non sig.
Site x Clone	48	0.81	0.8370	Non sig.
Site x Block	2	17.36	0.0001	Highly sig.

Table 2. Statistics for Diameter at root collar (D0) of 2 years old seedlings at the two sites

	df	F	<i>p</i> -value	Remarks
Block	3	13.35	0.0001	Highly sig.
Site	1	1.44	0.2309	Non sig.
Clone	50	1.10	0.3158	Non sig.
Site x Clone	48	0.90	0.6683	Non sig.
Site x Block	3	12.36	0.0001	Highly sig.

Table 3. Comparison of soil type and soil condition between the good & poor sites on growth and stem form of teak

Soil Type		Teak Preferences	Planting Site
		Sand-loam	Loam-sand
		Alluvial soils	Acidic soil (pH<6)
Soil Condition	Depth	Deep	Shallow
	pH	6.5-7.5	5.5
	Porosity	High	Low
	Drainage	Well	Poor-compacted or waterlogged soil in particular when wet)
	Moisture-holding capacity	Poor	High

Discussions

Teak grew best on deep, well-drained alluvial soils derived from limestone, schist, gneiss, shale (and some volcanic rocks, such as basalt). The optimum pH range for better growth and quality was within 6.5-7.5. Conversely, the species performed very poor, in terms of growth and stem form, on dry sandy soil, shallow soil (hard pan soil or lower water table soil), acidic soil (pH < 6.0) derived from laterite or peatbog, and on compacted or waterlogged soil (Kaosa-ard 1981; Tewari 1992).

The growth rate in terms of H and D0 of the seedlings reported in the present study was considered as low. The possible explanation for this was due to negative impact of the environmental factors in terms of soil and climate. Soil

types and soil condition of the planting site was non-preferences for teak. Soil was considered as acidic soil (pH 5.5) (Table 3). In addition, both plots faced irregular climate situations for example, drought for long period after planting. The Khon Kaen plot also experience severe flooding after planting around few weeks.

We conclude that the low rate of growth was primarily related to unsuitable condition both non-preference soil for teak and severe flooding and drought as well. We, however, founded that the tested trees could somehow adapt themselves to the sites; therefore tree performances among clones, genotypic value, determine optimum age for selection could be detected in the future (at least after 5 years old). Further monitoring shall be organized.

Acknowledgements

We would like to thank you Mr. Vitoon Luangviriyasaeng for his guidance on statistic analysis and Mr. Tosporn Vacharangkura for his support on research documents. This study was supported by a joint research project 2006-10 between RFD and JIRCAS.

References

- Kaosa-ard A (1981) Teak Its natural distribution and related factors. Nat. His. Bull. Siam. Soc. 29: 55-74
- Tewari DN (1992) A monograph on teak (*Tectona grandis* L.f.). International Book Distributors Dehra Dun India