A preliminary result of soil improvement trial on teak in Khon Kaen, Thailand

Wilawan Wichiennopparat[1)*], Mayuree Wanpinit[1)], Suchart Nimpila[2)]

[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
* *Corresponding author; e-mail: wilawanbwcc@yahoo.com*

Abstract

A study on soil improvement for planting teak (*Tectona grandis*) was carried out at Northeastern Forest Seed Center, Ban Had District, Khon Kaen Province, Thailand. The experimental design was randomized complete block with 3 replications. The trees were planted at 2 m x 4 m spacing. Five different soil improvement methods (treatments) were applied, including 1) Control (no treatment) 2) Application of dolomite (400 kg/rai) 3) Application of dolomite (400 kg/rai) and organic fertilizer (1 kg/tree) 4) Application of dolomite (400 kg/rai) and chemical fertilizer (100 g/tree x 2 times) and 5) Application of mixed fertilizer (dolomite + organic fertilizer + chemical fertilizer at (100 g /tree x 2 times). Height of the trees was recorded. The composite soil samples in each subplot prior to application of soil improvement materials were collected and analyzed for some chemical and physical properties. The surface soil moisture in each subplot was measured using theta probe type ML2x. The preliminary results showed that there was no significant difference in height growth of teak at 15 months after planting. There were no significant differences in almost all studied soil properties except for soil pH and organic matter.

Keywords: teak, *Tectona grandis*, soil improvement, tree growth, soil property

Introduction

Thailand is one of the countries known as teak natural stands. Natural teak distribution lies mainly in the northern and the western part of Thailand. Although teak can grow over a wide range of edaphic conditions, the quality and distribution of natural teak is related to the nature of underlying rock which reflects its soil conditions. The physical and chemical properties of soil such as texture, depth, porosity and drainage are deciding factors in determining the growth quality of teak. Teak requires deep, moist, fertile and well drained sandy loam soils (Kadambi 1951; Kaikini 1956). Teak prefers basic to acidic soils and can grow well in soils where pH values ranges between 6.5 and 7.5. However some studies showed that teak could also grow well even in acid soils (Puri 1951; Pande and Sharma 1986; Banerjee et al. 1986). Several soil characteristics including soil moisture, cation exchange capacity, base saturation, phosphorus and calcium content in soils were also found to be association to teak growth (Beumea and Beckman 1956; Kotwal 1959; Yadav and Sharma 1967; Jungsuksuntigool and Wichiennopparat 1994).

Due to continuous high demand on teak and short supply of teak from natural stands, teak plantation is an important source for constant supply for teak. However the areas with favorable site and soil conditions for teak growth are limited. The Japan International Research Center for Agricultural Sciences (JIRCAS) and the Royal Forest Department (RFD) have established a collaborative project entitled “Development of Techniques for Nurturing Beneficial Indigenous Tree Species and Integrated Management of Agriculture and Forestry in Northeast Thailand, Tropical Monsoon Regions”. This study is under one of the two subprojects aiming to find appropriate soil improvement techniques to promote better teak growth in the Northeastern of Thailand where the soils are generally acidic and sandy with less fertility compared to other parts of the country. The know−how and techniques gained from this study would be further extended to the farmers in the regions.

Materials and Methods

The study site was located at the Northeastern Forest Tree Seed Center, Ban Nonesomboon, Tambon Nonesomboon, Ban Had District, Khon Kaen Province in

Fig. 1. Location of the study site

the northeastern part of Thailand (Fig. 1).

The experimental design was randomized complete block design with 3 replicates (blocks). Five treatments (soil improvement methods) including A) Control (no treatment) B) Application of dolomite (400 kg/rai) C) Application of dolomite (400 kg/rai) and organic fertilizer (1 kg/tree) D) Application of dolomite (400 kg/rai) and chemical fertilizer (100 g/tree x 2 times) and E) Application of mixed fertilizer (dolomite + organic fertilizer + chemical fertilizer at (100 g/tree x 2 times) were randomly assigned to each subplot. Each subplot was surrounded by buffer. The size of the subplot was 18 m x 28 m. The seedlings were planted with 2 m x 4 m spacing.

The soil pits were dug at the study area prior to site preparation to investigate the under lied soil conditions. The experimental area was ploughed by using farm tractor. Soil improvement materials were applied accordingly as described earlier. Teak seedlings were prepared by using tissue culture technique. The clone number used was 38. The seedlings were planted in August 2009. The composite soil samples in each subplot were collected at 3 depth levels (0−15, 15−30 and 30−50 cm) prior to application of soil improvement materials and were, then, analyzed for some chemical and physical properties. Total height of all trees was recorded at 1, 6, 12 and 15 months old. Growth and soil data were analyzed by using the statistical package GENSTAT. The surface soil moisture in each subplot was measured using theta probe type ML2x.

Results

1. Soil conditions

We dug three pits for clarifying under lied soil property in spite of the small area of experimental site since there was apparent difference in vegetation under the plantations. (Fig. 2). The results of the range of some soil characteristics from the three soil profiles were given in Table 1. The physical and chemical properties of soil at each pit did not differ except the content of exchangeable cations and soil texture of the B_2 horizon.

The results of the analysis of composite soil samples collected at the depth of 0−15, 15−30 and 30−50 cm showed that most of chemical and physical soil properties under different treatments prior to planting were not significantly different except for soil organic matter content in the upper two layers, but the difference was not in big amount because the organic matter content of all the samples were low (less than 1%). The analyzed values of all study soil characteristics generally fell in the similar range of those found in the soil profiles shown in Table 1. The soils also contained low available phosphorus (0.6 to 4.6 ppm). The soil texture of almost all samples was sandy and small portions were sandy clay loam.

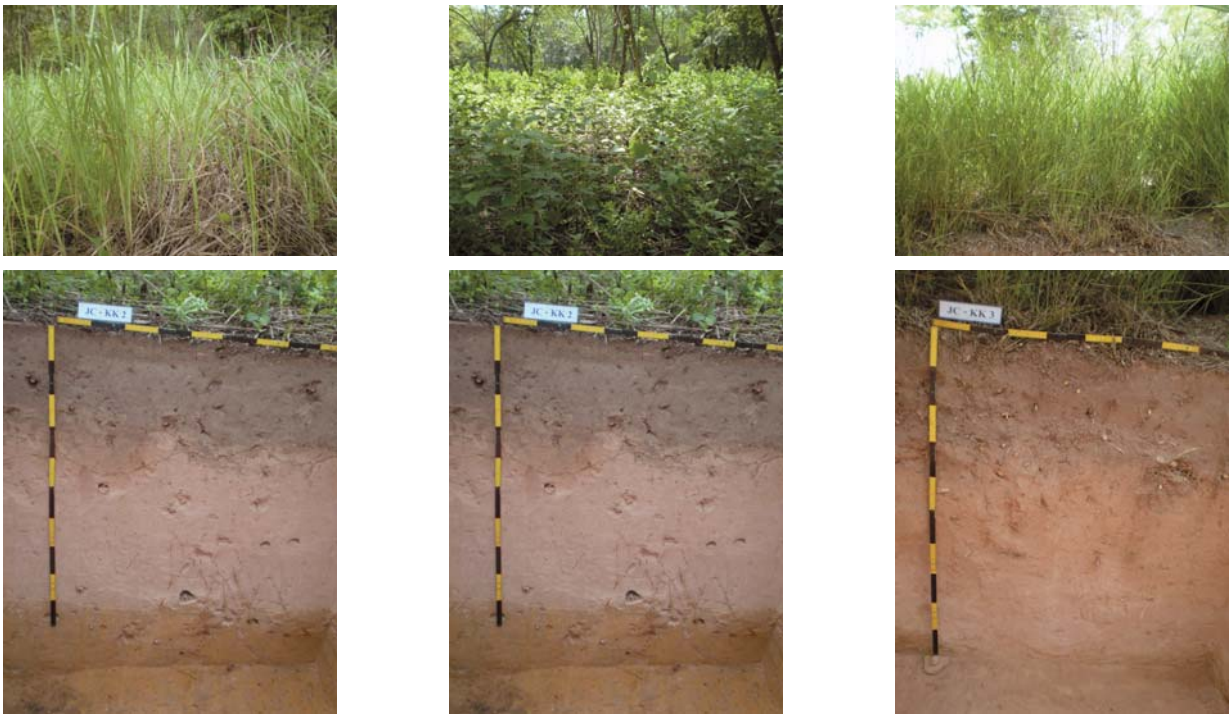
The surface soil moisture distribution monitored under different timing representing rather dry, moderately moist and wetter condition were shown in Fig. 3. Despite the wetter soil moisture found in one corner of the study plot, it showed no significant effect on teak growth at this stage.

2. Growth

The growth performance of teak at 1, 6, 12 and 15 months old in the study area was shown in Fig. 4. It was apparent that the growth of teak in the plots with application of dolomite and chemical fertilizer (treatment D) and in the plots with application of mixed fertilizer (treatment E) were better than those in other plots although no statistically significant difference was detected at 15 months (Fig. 5). The teak in control plots also showed good height growth despite no soil improvement material was applied.

Table 1. Some soil characteristics of the soil profiles in the study area

Horizon	Depth (cm)	Organic matter (%)	pH	Avail. P (ppm)	Exchangeable Cations (ppm)				Texture
					K	Ca	Mg	Na	
A	0 – 21/35	0.72 − 0.94	4.9 − 5.5	2 − 5	51 − 59	212 − 364	47− 50	5 − 9	Sandy
B_1	21/35 − 55/100	0.07 − 0.12	4.9 − 5.8	nil − 3	8 − 20	50 − 98	10 − 40	2 − 7	Sandy
B_2	55/100 − 120+	0.04 − 0.28	4.9 − 5.1	nil − 3	12 − 94	34 − 600	15 − 307	7 − 9	Sandy/ Sandy clay loam



(a) Soil profile under *Imperata cylindrical*

(b) Soil profile under *Chromolaena odoratum*

(c) Soil profile under *Arundinaria pusilla*

Fig. 2. Soil profiles at the study site

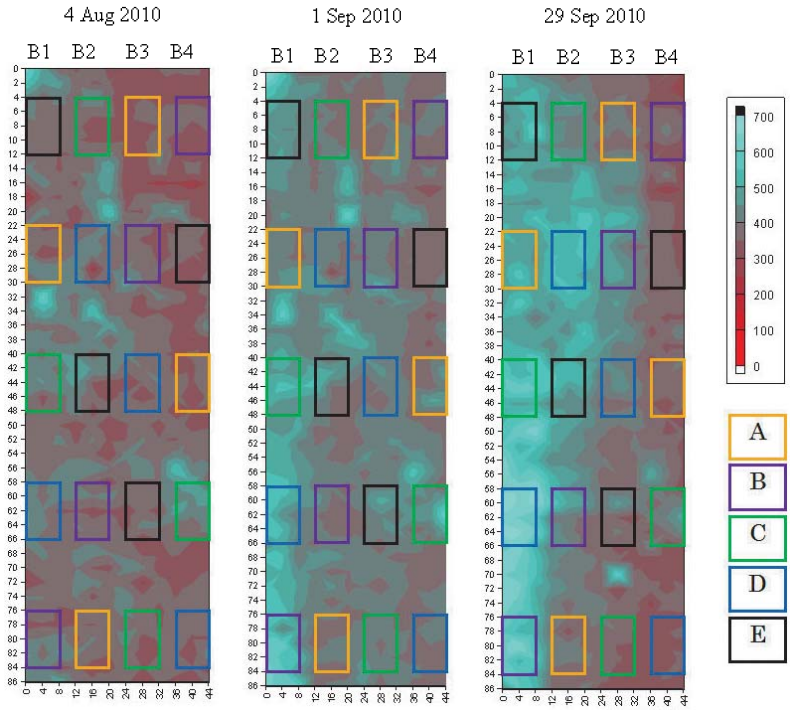


Fig. 3. Surface soil moisture distribution monitored under different timing representing rather dry, moderately moist and wetter condition

A = Control (no treatment)
B = Application of dolomite (400 kg/rai)
C = Application of dolomite (400 kg/rai) and organic fertilizer (1 kg/tree)
D = Application of dolomite (400 kg/rai) and chemical fertilizer (100 g/tree x 2 times)
E = Application of mixed fertilizer (dolomite + organic fertilizer + chemical fertilizer (100 g/tree x 2 times))

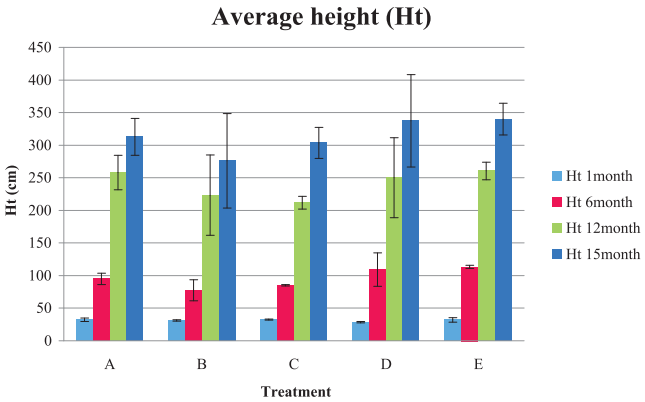


Fig. 4. Height development of teak clone no.38 under different soil improvement conditions

Fig. 5. Growth performance of teak at 15 months old in the study area

Conclusions and Discussion

The result of this study revealed that the improvement of soil quality in the Northeast of Thailand was needed to promote better teak growth, but at this early stage, there was no significant difference effect in teak growth either from the treatment applied or from the soil characteristic of each treatment. However, general conclusions and discussion could be drawn from this study as follow:−

1. The study area was one of major soils types found in northeast of Thailand. The soils were acidic and sandy with low nutrient content especially in organic matter and available phosphorus which might be limiting factors for teak growth.
2. No significant effect on fertilization with dolomite was detected at 15 months.
3. Soil moisture of the deeper layer could be another possible key factor governs teak growth so that further investigation is required.
4. From the results of the teak growth in control plots, it is likely that teak clone no. 38 may perform good growth in acidic soils with limited nutrient content.
5. Organizing systematic study on the relation between teak growth and soil property is required in various soil types to clarify the soil preference of teak in Northeast Thailand.

References

Banerjee SK, Nath S, Banerjee SP (1986) J. Indian Soc. Soil Sci. 34(2): 343-349

Beumea JGB, Beckman H (1956) Quoted from country reports on teak. Food and Agriculture Organization of United Nations (FAO), Rome

Jungsuksuntigool P, Wichiennopparat W (1994) Study on relationship between some soil properties and growth of *Tectona grandis*. *In*: Research report No. 1 (1994). Silviculture research division, Forest research office, Royal forest department, Bangkok

Kadambi K (1951) Proceed. 8th Silv. Conf. Dehra Dun

Kaikini NS (1956) Proceed. 9th Silv. Conf. Dehra Dun Part I: 58

Kotwal EK (1959) Proceed. All India teak study tour and symposium Dec. 1957 to Jan 1958: 157-158, F. R. I. Colleges, Dehra Dun

Pande PK, Shama SC (1986) Indina Forester 112(4): 328-341

Puri GS (1951) Proceed. 8th silv. Conf. Dehra Dun: 242-249

Yadav JSP, Sharma DR (1967) Proceed. XI. All India Silva. Conf. D. Dun., pp204-208