A holistic assessment of the use of teak at a landscape level in Luang Phrabang, Lao PDR

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Preface

This study was conducted at the Departments of Forest Soils and Soil Sciences, Swedish University of Agricultural Science (SLU), National Agriculture and Forestry Research Institute (NAFRI), Lao PDR and National Institute for Soils and Fertilizers (NISF), Vietnam. The study is a part of a project called: Sustainable Land Use Practices for the Uplands of Vietnam and Laos: Science and Local Knowledge for Food Security (LUSLOF).

My supervisors were Professor Mats Olsson, Department of Forest Soils; Professor Ingvar Nilsson, Dr. Minh Ha Fagerström, Department of Soil Sciences, SLU, and Dr. Nguyen Cong Vinh, at the National Institute for Soils and Fertilizer (NISF) Vietnam. MSc. La Nguyen and MSc. Nguyen Due Phuong gave much support during my Minor Field Study (MFS) as well as in the data analyses of this thesis work.

This report was made using data, which were gathered during the field work in 2005 by the author, as well as data from the field work carried out by the whole LUSLOF Lao team since 2003. Data on the effects of pruning and thinning on teak growth were gathered in four experimental sites in four villages from 2002 to 2004. All data presented in this thesis are published with the kind permission of the LUSLOF project through Dr. Minh Ha Fagerstrom, the LUSLOF coordinator and the LUSLOF-Lao project team.

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Abstract

Teak (*Tectonia grandis*) plantation establishment in Lao PDR started in 1942, and has strongly increased since 1980. The total area of teak plantations in the Luang Phrabang province is estimated at 5 587 hectares. Pak Ou district is one of the most important areas with teak plantations in the Luang Phrabang province. An attempt was made by the Teak Research Station in Luang Phrabang to test effects of technologies such as thinning and pruning on teak growth during a 2-3-year period during 2002-2004. This thesis work aims at evaluating the effects of these forestry practices from both bio-physical and socio-economic aspects.

A literature survey was made to compile information about nutrient element demand, nutrient cycles and problems related to insects and fungi in teak plantations. Pruning and thinning and their effects on teak growth were monitored and analysed. The socio-economic aspects, such as the role of teak forestry in the farmers' household economy and the market flow of teak, were also studied.

The socio-economic data collection was carried out in four villages in the Pak Ou district. The village headmen and owners of teak in the experimental plots provided the history and general information about the villages relevant for this study. The bio-physical data, i.e. the tree growth variables diameter at breast height (DBH), commercial tree height and total (top) tree height were analyzed with ANOVA assuming pseudoreplication to compare mean annual increments of teak growth between different treatments at the four sites Lathahea, Had Soa , Pak Check , and Houay Leuang .

The results show that thinning and pruning increased teak growth. Pruning was applied at 50%, 60% and 70% combined with thinning at 25%, and control plots were left untreated. Thinning was applied at 25% and 50% and according to farmers' practice, in combination with pruning to 60% of total height, and control plots were left untreated. The results suggested that pruning should be applied at a rate between 50 and 60%, and that thinning should be applied at 25 to 50%.

Teak played an important role for the farmers, because they got a high income when selling the timber to local and outside traders. Teak accounted for 27, 15 and 14 % of the total household income for the wealthy, middle and poor groups, respectively. The market channel of teak production for most growers went via local and outside traders, and teak growers could not access the wood processing units directly. It was estimated that 99 % of the teak logs in a village were bought by outside traders and only 1 % by a local trader. The export was estimated at about 95 % of the teak wood produced. The remaining 5% of teak logs were used locally as teak residues obtained after pre-processing in the Wood Processing Units.

In order to have a positive effect on farmers' living standard, teak may need to be produced more efficiently to be marketable. The income from teak was ranked as the second one of importance for the inhabitants of the Pak Check, Houay Leuang, Lathahae and Had Soa villages.

Key words: Teak, growth rate, effect, thinning, pruning, ANOVA, Laos, Luang Phrabang.

1. Introduction

1.1 General information about Lao PDR

Lao PDR occupies a relatively large area of 236,800 km^2, and is predominantly a mountainous and land-locked country. It shares borders with China in the north, Myanmar in the northwest, Thailand in the west, Cambodia in the south and Vietnam in the East. In Lao PDR water for hydropower and timber are the principal natural resources. Approximately 3% of the area is used for agriculture with rice as the main crop. Fallow land in slash-and-burn systems may account for another 6-10% of the total land area. Lao PDR has a small population of approximately 5.1 million people (Pravongviengkham, 2002). About 83% of the population is rural and 66% of the people depend on subsistence agriculture (Roder, 2001). The population is ethnically diverse with more than 60 ethnic groups (Stuart-Fox, 1986). Based primarily on ethnic, linguistic, and geographical characteristics, ethnic groups have been divided into three broad categories: Lao Loum (Lao of the lowlands), Lao Theung (Lao of the mountain slopes), Lao Soung (Lao of the mountain summits). All major ethnic groups of the country depend to some degree on upland agriculture in proportion to their total numbers. Lao Theung and Lao Soung farmers are more likely to live in hilly areas. Although, all ethnic groups are engaged in slash-and-burn agriculture, it is very common to hear that it is “the ethnic minorities” (groups other than Lao Loum) or the “ethnics” that live from slash-and-burn agriculture and destroy the forest areas. Lao PDR, is poor by Asian standards with a per capita GDP estimated at 390 USD per year in 2002 (Pravongviengkham, 2002). Especially the mountainous areas are marginalized and have a high incidence of poverty, low per capita income, predominantly within the agricultural and rural sectors and scarce availability of social and economic infrastructure.

Forestry is an important sector in Lao PDR. Forests covered 70% of the area of the country in the 1940's and decreased to 47% in 1989 (Sodarak, 2000). The deforestation was mainly caused by shifting cultivation, which included clearing of forest areas by slash and burn. The shifting cultivation in the uplands of Lao PDR was a well adapted and sustainable farming system for centuries but has lately become a major problem, caused by overuse of forest land due to an increase of the population. The fallow periods have been shortened, leading to an increase in weed abundance, soil degradation, and lower crop yields (see e.g. McAllister et al., 2000).

The government of Lao PDR has recognized the agriculture and forestry sectors as the backbone of the national economy. Therefore the organization of the protection and maintenance of forests including reforestation is a major concern. The government policy is to allocate land to farmers and to forest protection (Souvanthong et al., 1995). In connection with the forestry policy in Lao PDR, teak has been introduced since 1942, and the teak area has increased markedly since 1980. It is estimated at 8 000 ha in the whole country of which about 2000 ha consist of stands older than 30 years (Southitham *et al.*, 2001).

This MSc thesis is part of an assessment of the sustainability of teak forestry at a landscape scale. Sustainability means maintained and secure productivity, protection of the environment as well as maintained social values. The thesis is a part of the project named ‘Sustainable Land Use Practices for the Uplands of Vietnam and Laos: Science and Local Knowledge for Food Security (LUSLOF). The LUSLOF project aims at the development of sustainable land use at selected study sites in Vietnam and Lao PDR (Hoang Fagerstrom et al. 2004). The project is carried out by an international team from the Swedish University of Agricultural Sciences (SLU), National Agriculture and Forestry Research Institute (NAFRI) Lao PDR, National Institute for Soils and Fertilizers (NISF), Vietnam and World Agroforestry Centre (ICRAF). It is funded by the Rockefeller Foundation (RF).

The field work of this MSc thesis was carried out 2002 – 2005, as a part of the LUSLOF fieldwork in Lao PDR.

1.2 KBS Approach

A Knowledge Based System (KBS) approach has been tested, whereby local and scientific knowledge were combined to develop land use options, at Dong Cao catchment, Luong Son district in the Hoa Binh province, Vietnam and in Pak Check and other villages in the Pak Ou district in Luang Phrabang province, Lao PDR (Hoang Fagerstrom et al., 2004). When searching options other than the short – fallow crop rotation in the upper part of the landscape, a combination of Participatory Landscape Analysis (PaLA), Local Ecological Knowledge (LEK), Participatory Household Economy Analysis (PHEA) and modelling was regarded as suitable. People in the lower part of the landscape have made efforts to find several useful innovations. Therefore it was important to investigate how much the lowland options could compensate for the loss from not planting upland rice in the upper parts of the landscape, and instead concentrate on teak plantations (LUSLOF project report, 2003).

2. Background with Literature Review and Objectives

2.1. Teak and environment

Teak (*Tectonia grandis*) has its natural distribution in limited regions of South and Southeast Asia (Tanaka *et al.*, 1998). In Lao PDR teak is found in the north-western part of the country along the northern border to Thailand and Myanmar. It is one of the valuable tree species in tropical regions of the world (Kaosa-ard, 1999). The area used for plantations varies greatly between different countries. It comprised 159,000 ha in Thailand (Varmola, 2002), 700,000 ha in Indonesia (Tanaka, 1998), 139,000 ha in Myanmar (Varmola, 2002) and 40,000 ha in Costa Rica (Cordero, 2002). More than 90 percent of the 1990 total area of teak plantation in the world was located in Asia. The total area of teak plantation in the world increased to 1.7 million ha in 1980 and 2.2 million ha in 1990 (FAO, 1995).

Luang Phrabang is a mountainous province located in the Northern part of Lao PDR, where teak has been planted more than in other provinces, by both the state and the farmers. So far, the total teak area of Luang Phrabang is about 5,587 ha of which 89 % belongs to the farmers (Southitham, 2001). It is planted on hill slopes and along roads, rivers and footpaths. It is also planted near paddy fields and in home gardens (LUSLOF fieldwork report, 2003).

An increasing proportion of teak coming from plantation forests may circumvent some environmental controversies but sometimes attract others. Teak is a pioneer species and as such is generally susceptible to competition from other plant species. Cleaning undergrowth and debris may assist teak growth in the short-term, but almost inevitably at the cost of long-term site degradation (Kaosa ard, 1981). A Minor Field Study (MFS) was carried out in Luang Prabang in early 2005 to study soil characteristics under teak. (Keonakhone, 2005).

The existing teak plantations in the Luang Phrabang province seem to have a positive impact on the environment. Luang Phrabang has presently a low forest cover. Therefore, more forest cover than shifting cultivation areas would be a good sign of improvement of the environment. Planting more teak in areas, where there is a lot of shifting cultivation practiced would enhance the value of the area presently covered by fallows.

2.2. Soil-plant interactions with respect to Teak

The species and its general site requirements

Teak was previously believed to belong to the family Verbenaceae but recently scientists have questioned this classification based on the use of modern DNA-technique. Probably teak will be placed in the family of Labiatae within short (Teaknet, 2005).

Teak grows when the monthly minimum temperature is above 13 °C and monthly maximum temperature is below 40 °C. Optimal rainfall for teak ranges between 1 250 and 3 750 mm per year. For the production of good-quality timber the species requires a dry season of at least four months with less than 60 mm precipitation per month (Kaosa-ard, 1981). Teak has proved to grow well in day temperatures ranging from 27 to 36°C and night temperatures ranging from 22 to 31°C. In order to determine whether a site is good or bad for teak plantations, Tanaka et al. (1998) claim one should consider the following factors: 1) climate, 2) edaphic factors such as geology, topography and soil and 3) Factors on a plant community level such as light, moisture conditions etc. In order to identify sites that fulfil the requirements for good teak growth in accordance with the stated three factors, one can use either of two methods. The first method is the establishment of a trial plantation, which is time consuming but normally gives an easily interpreted result. The second is the so-called plant indicator method where one uses species such as *Lagerstroemia calcylata, Xylia dolabriformis* or Bambuseae spp., all of which have similar site requirements as teak but have a much more rapid growth (Tanaka et al., 1998).

According to Kaosa-ard (1981), teak can grow on a variety of soils. However, the quality of the biomass depends on the soil depth, structure, porosity, drainage and moisture-holding capacity. Teak develops best on deep, well-drained and fertile soils, especially on volcanic substrata and on alluvial soils formed from various parent materials. The optimal soil pH for teak is between 6.5 and 7.5. The calcium content of the soil is also an important factor. Calcium deficiency may result in stunted growth (Tewari, 1992).

Plant nutrition and fluxes of organic matter and organic carbon

Cleaning of undergrowth and debris (litter raking) may stimulate teak growth in the short term, but will almost inevitably cause a long-term site degradation. In practice the “cleaning” exposes the soil to wind and water. Litter raking and excessive burning, may particularly exacerbate erosion and leaching problems in such teak plantations that have a wide tree spacing and are prone to leaf drip Kaosa-ard (1981).

Kumar et al. (1998), found that intercropping of teak with *Leucaena sp.* in India affected the soil properties. Soil organic C in the topsoil layer (0–30 cm) varied across the southwest monsoon, inter monsoon and northeast monsoon periods. The total N content of the soil increased with increasing relative proportion of *Leucaena* and available P levels were highest in teak-*Leucaena* plots, while available K levels were highest in the teak-*Leucaena* mixture and in pure *Leucaena* plots. For teak it has been previously reported that wide seasonal variations occur in fine root biomass indicating a significant accumulation and disappearance pattern of fine root biomass. Soil organic C increases after the onset of the southwest monsoon and may continue until the dry summer when soil moisture availability limits fine root growth (Srivasthava et al., 1986).

Kraenzel et al. (2001), studied the C storage of harvest-age teak plantations in Panama. The biomass and C concentration of the teak tissues were obtained by weighting the different tissue types by the proportion of the total tree biomass, and assuming that the C concentration of the dry biomass was 49.5%. The mean C storage in the tree roots, with root sizes varying between coarse roots (>5mm diameter) and fine roots (<5 mm diameter) was 15.7 t/ha, while the mean C stock in above ground standing biomass was 104.5 t/ha. The mean total tree C storage at the plantation level was 120.2 t/ha. The dry mass of litter which accumulated during the dry season in the teak plantations was 7.9 t/ha, with a C content of 3.4 t/ha.

In an evaluation of a site quality index for teak plantations in Thailand (Sakurai et al., 2002) average values of soil chemical data in the surface and subsurface layers, indicated that the growth of teak would be better than Eucalyptus and several other native tree species on acidic and less fertile soils with a hard surface layer. Among four exchangeable cations, only Mg seemed to promote the tree growth. The C and N contents did not seem to yield a positive effect on growth. C and N did not accumulate in these soils. One reason could be that teak leaves are big in size and do not always stay on the ground when shedding. One should notice that the statement that teak grows better on acidic and nutrient poor soil is in conflict with Kaosa ard (1981).

In connection to the C and N behaviour described above it could be mentioned that Roder (2001), who studied rice-fallow systems found a downward trend for total N and organic C over the entire cropping and fallow period, possibly indicating substantial losses of C and N to the atmosphere, biomass uptake combined with harvest of N and/or soil losses. On an average, losses over a period of 3 years represented 20% of the total soil organic C and 8% of the N content in soil (in a 1 m deep profile). While the loss in the initial year occurred largely in the top soil layer, it was more significant at greater soil depths during the following years. There was a higher level of organic C in the deeper layers and the trends were similar for all sites with total C losses over 49 t ha^{-1}.

Morphology and phenology

According to a study in Tiripati, India, the teak species comprises at least two different phenotypes. The differences between the phenotypes are found in their leaf length/breadth ratio and they are called broad-leaved (BL) and narrow-leaved (NL) phenotypes (Rajendrudu, Naidu and Malikarjuna 1977). The same phenotypes also occur in Lao PDR (Syanuvong *pers. comm*. 2005).

According to a study performed in India made on three different localities (Priya & Baht, 1998) a mature tree shows the annual phenological sequence displayed in Table 1.

Table 1: ***Phenology of teak in India (Priya & Baht, 1998)***

Month	Phenomena
December-January	Leaf Fall
February	Leafless
March-April	Leaf emergence
May	Full foliage
June	Full foliage + flowering
July	Full foliage + flowering + fruit set
August-October	Full foliage
November	Beginning of leaf fall

According to Syanuvong pers. comm.. (2005), the flowering occurs in July throughout August and the trees normally start flowering at the age of ten years. However, in Lao PDR some trees flower and bear fruit already at the age of three to five years but then the seeds are often of poor quality. According to Kadambi (1972), teak in Uttar Pradesh, starts to produce seeds as early as at four years. However, the seed viability at that age is only 4 percent. This should be compared with seeds from 23-year-old trees, which have a viability of 18 percent.

Effects of insects and other pests
According to Kim (2004), there are at least two different insect larvae in Luang Phrabang province which attack teak trees, one that eats the leaves (*Hyblaea puera*) and one that eats the cambium, (*Psilogramma spp*.) Both larvae have a negative impact on tree growth and quality. Rats as well as termites (Isoptera) can attack the roots, thus decreasing the tree's ability to get nutrients and water and eventually this will kill the tree. Also wind and frost can cause damage to the trees; the former in windy regions and especially in trees with poorly developed roots, the latter affects young shoots at high altitudes where the temperature is low during winter. Other pests of teak seedlings are some orthoptroriods, aphids, mites, thrips, coccids, bark beetles, leaf beetles, ants and snails.

Mycorrhiza
According to Rajan et al. (1998), the Arbuscular Mycorrhizal (AM) fungi form a ubiquitos group of soil fungi colonizing the roots of plants belonging to more than 90% of the plant families. Teak plants grown in the presence of AM increase in plant growth variables such as plant height, stem girth, leaf area and total dry weight, compared to those grown in soils that are not inoculated with AM fungus. The mycorrhizal inoculation increases the phosphorus content of the teak plant. The enhancement in growth and nutritional status is also related to the percent root colonization in soil apart from several other soil and environmental factors.

2.3. Socio-economic aspects of Teak

2.3.1 Teak in the household economy
The final survey of the LUSLOF project in Laos was carried out in January, 2005. The objective of this survey was to investigate constraints and possibilities of scaling up improved management of teak through studies of the teak market, household economy and relationships between trees and soil in teak plantations. In this survey, the household economy was studied in the four villages Pak Check, Houay Leuang, Lathahae and Had Soa in the Pak Ou district. Based on wealth ranking and data collected from interviews, the middle group of households with respect to wealth accounted for 49%, 81%, 90% and 63% of the income in the four villages. The income per capita of those people was 369, 268, 353 and 249 USD per year (LUSLOF fieldwork report 5, 2005). The middle income in the studied villages was lower than the GDP reported for Laos (390 USD per capita per year) in 2002 (Pravongviengkham, 2002).

Among the four studied villages Pak Check was the oldest one, which was established already in 1753 (McAllister et. al., 2000). According to the village leader teak had been present on their land for about three generations. Farmers in the village used teak for house construction, sale and barter. For these reasons the Pak Check village was chosen for the analysis of the role of teak in the household economy

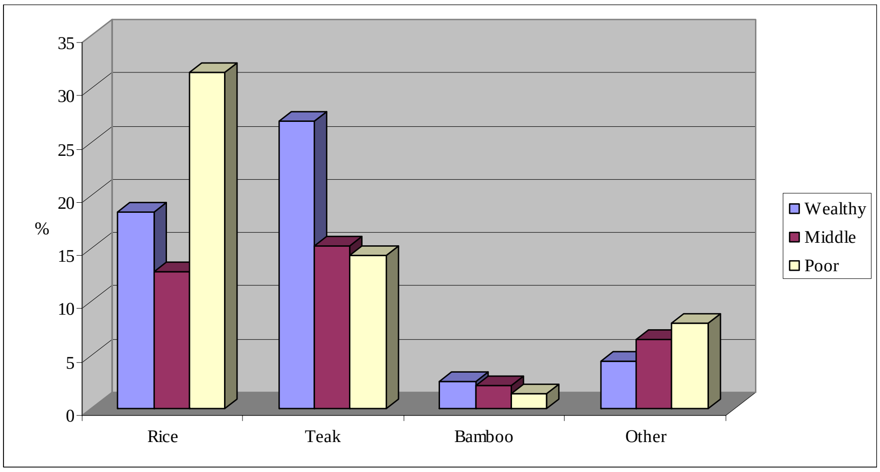
Table 2: Income from rice, teak, bamboo and other plants as a percentage of total income from farm production in Pak Check village.
(These data come from interviews of 24 farmers in Pak Check in 2005, LUSLOF fieldwork report 5, 2005)

	Percentage (%)				Total (%)
Group	**Rice**	**Teak**	**Bamboo**	**Other**	
Wealthy	**35**	**52**	**5**	**8**	**100**
Middle	**33**	**45**	**5**	**17**	**100**
Poor	**57**	**26**	**3**	**14**	**100**

Table 2 shows that teak took the second position in the poor group (26 %) with respect to total income from farm production. This was not the case in the wealthy and middle groups where teak took the first position and accounted for 52 and 45%, respectively.. It seemed to be in the poor group, that farmers used most of their land to grow rice and other crops for home consumption.

Rice also accounted for an important part of the total household income of the poor group as it made up 32 % (Figure 1). This was higher than the income from teak (14%). The ranking of income sources was different in the wealthy and middle groups. The income from rice in these groups accounted for 18% and 13%, respectively of the total household economy. The income from teak was higher and accounted for 27% and 15%, respectively.

Figure 1: Production of rice, teak, bamboo and other plants as a percentage of the total household income (Luslof fieldwork report 5



Market channels of teak

Teak was sold to local and national markets. We assumed that the character of the market flow may have an impact on the farmers' income from selling teak. Therefore a study was done by the LUSLOF team concerning the teak market flow. The flow chart (Figure 2) shows that products from most of the teak growers were sold via local and outside traders, because the teak growers could not access wood processing units directly. It was is estimated that 99 % of the teak logs in a village were bought by outside traders and only 1 % of the teak logs were bought by a local trader.

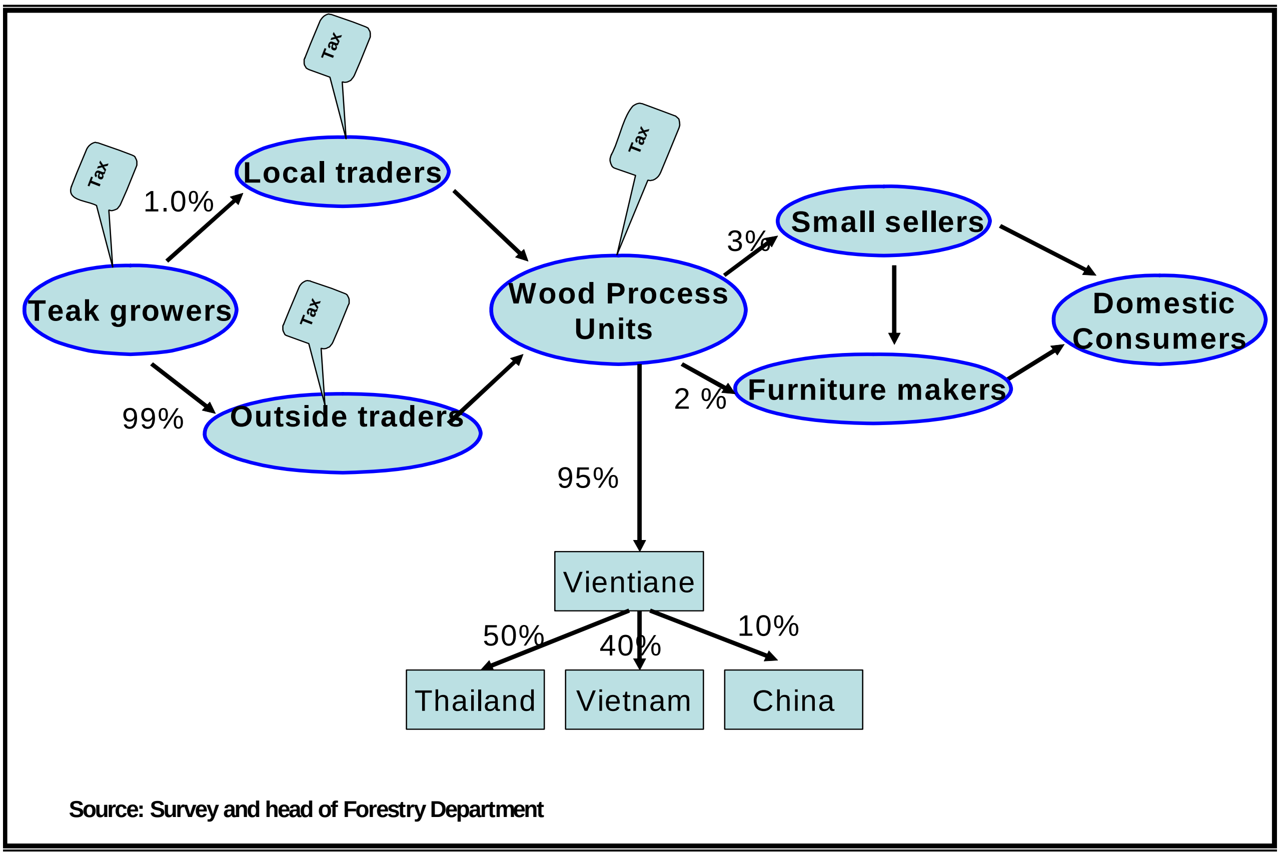


Figure 2: Marketing channel of teak logs in Luang Phrabang province, Lao, PDR (LUSLOF fieldwork report 5, 2005)

The export was estimated at about 95 % of the teak wood produced. Five percent of the teak logs were used locally as teak residues obtained after pre-processing in the wood processing units. Of these 5%, 3 % (in absolute numbers) were sold to small sellers and 2 % were used for making furniture in Luang Phrabang.

According to Syanuvong pers. comm.. (2005), about 50 % of the *square* teak logs were exported to Thailand, 40 % to Vietnam and 10 % to China. The change of the teak log price from producers to traders and then to Wood Processing Units (WPU) was large. The income of the teak growers was lower than the economic potential of teak products because farmers could not access the WPU and sell their products directly. The major problem was that the teak growers had not enough resources in terms of labour, equipment and means of transportation to first harvest teak, and then transport the logs to a WPU. Therefore, marketing of teak in the Luang Phrabang province was made by floating on rivers and depended on the demand of the WPU and the export market (LUSLOF fieldwork report 5, 2005).

Southitham (2001), found that there were two steps associated with the purchasing of teak in Luang Phrabang. Firstly, buying teak from plantations was handled by a buyer and a teak owner (a farmer); secondly, round wood and square logs were produced, then sold to wood processing units and factories. A price based on standing teak has been practised in Luang Phrabang, but the price of teak can be negotiated between owner and buyer. For example, a standing teak tree with a dimension of 90 cm circumference (or about 28.7 cm in diameter) at breast height has the price of 90,000 Kip (USD 9.4) per tree, and if the circumference is 100 cm (or about 32 cm in diameter) at breast height its price is 100, 000 Kip (USD 10.5) per tree. The price of round logs with an average diameter greater than 25 cm for example, is about 1,700,000 Kip or about USD 180 per cubic meter. The price of square logs differs depending on the diameter. For example, the price of square logs with a diameter of less than 15 cm is about 1,500,000 Kip (USD 158) and if the diameter is greater than 15 cm the price is about 2,000,000 Kip (USD 210).

Better techniques that can improve the quality of the teak wood products may bring a better income to the local farmers.

2.4. Teak management

Plantation management

According to Kaosa-ard (1986), initial planting density is generally between 1 200 and 1 600 plants per hectare. The spacing and number of trees, as well as timing and intensity of the thinning strongly affect the pattern of growth and the yield of the plantation. If thinning is practised late during the stand development, the growth rate declines or ceases, whereas if the stand is thinned too early or too heavily, the trees have a greater tendency to produce side branches and epicormic shoots. This also reduces the potential yield of the plantation since growth is diverted from the main stem, which should be free from defects such as those caused by side branches and epicormic shoots. The timing of the first thinning is often determined by the height of the trees and is commonly carried out when the trees reach 9.0 to 9.5 meters. The second thinning may be carried out when the trees reach 17 to 18 meters. Since teak has a very good coppicing ability the next tree generation will come by coppice and the original root system can support up to four teak generations before a completely new tree has to be planted.

According to Southitham (2001), teak plantation management regimes vary between and within countries, mainly according to site-specific conditions and prevailing markets. Typically, however, it is recommended that initial stocking rates should be in the range of 1 000 to 2 000 stems per hectare to allow for early mortality rates and to provide an opportunity for selecting the better individuals during thinning operations. Partially depending on the intensity of planting, an initial thinning should be considered as soon as the branches of a tree start to make contact with those of surrounding trees; this may occur when the plantation is four to five years old and the intensity of tree removals may be as high as 50 percent of the initial stocking. A second thinning may follow at about the age 10 to 15 years, and a final thinning at around 15 to 20 years. Again depending on market requirements and other factors, an ideal final stocking is likely to be around 200 to 300 stems per hectare, or approximately some 300 m^3 of wood. Management practices may vary significantly, however, depending on whether teak is grown on short or long rotations.

Productivity of teak

The productivity of teak plantations has been studied across a broad range of countries through permanent sample plots. The earliest yield table for teak was constructed by von Wulfing (1932) for plantations on Java, Indonesia. Laurie and Ram (1939) constructed a yield table for teak plantations distributed over present-day India, Myanmar and Bangladesh. More recently, yield tables have been developed using data from permanent and temporary sample plots for plantations of teak established outside its natural range, including provisional yield tables for Trinidad and Tobago (Miller, 1969), Côte d'Ivoire (Maitre, 1983), Nigeria (Abayomi, 1984) and Sri Lanka (Phillips, 1995).

The densities of teak plantations (Spacing, thinning and pruning)
According to Kaosa-ard (1986), initial spacing of teak plantation varies from 1.8 x 1.8 m to 4 x 4 m depending on many factors such as site quality, cost of establishment, thinning regime, small wood utilization, planting system etc. However, site quality seems to be the priority factor determining the size of spacing in teak planting programs. The result of 12 year-old spacing trials, with spacing of 2 x 2, 3 x 3, 4 x 4 and 6 x 6 m in Thailand clearly demonstrated how the effects of initial spacing on growth, stem quality and weed control in teak plantations vary with different site conditions. Under dry site conditions, where the initial growth rate of the plantation was poor (The height growth was <1.00 metre per year), the close spacing 2 x 2 metre was most suitable. These plantations´ were thinned about 10 times until the age of 60, which left between 100 and 150 trees/ha. Final felling was conducted at an age of 80 and the average yield was about 170 m^3 per hectare.

According to Hansen et al. (1997), teak trees can be harvested at an age of twenty years but the quality will improve if one lets them grow until they are 30-40 years old. After 40 years the heartwood is believed to rot but that is an observation which is not supported by any known scientific study. In Luang Phrabang province, the average age for teak harvest is 21 years. Probably this is due to the fact that the minimum diameter required by sawmills is 20 cm at breast height.

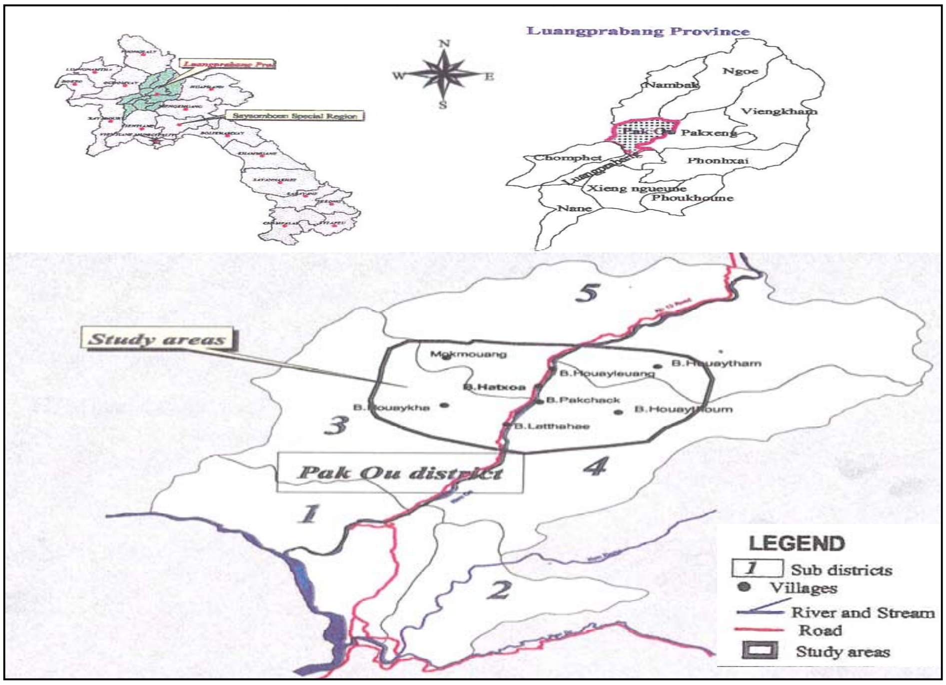
Objectives:

The overall objective was to assess the sustainability of teak plantations at a landscape scale, using a Knowledge Base System (KBS) approach.

The specific objectives of the study were:
1.) To review and understand the teak – soil interactions (see above).
2.) To analyze the effects of pruning and thinning on growth of teak
3.) To analyse the potential improvement of farmer income due to the use of pruning and thinning techniques i.e. the KBS approach.

3. Materials and methods

3.1. Study sites
The four villages in the Pak Ou district, Luang Phrabang province, which were studied with respect to their household economy were also selected for studying the growth effects on teak by thinning and pruning. The province has a total area of more than 2 million hectares. Most of the land (about 85%) is mountainous. The altitude varies from 250 to 1600 m above sea level. The total population of the Luang Phrabang province was 412100 people in 2000 with an annul growth rate of 3%. People who live in the province belong to the ethnic groups Lao Loum (lowland; 38.7%), Lao Theung (highland; 45.1%) and Lao Seung (midland; 16.2 %). About 16 000 people lived in the city of Luang Phrabang in the year 2000. More than 60% of the population are still shifting cultivators (Pradichit, 2002).



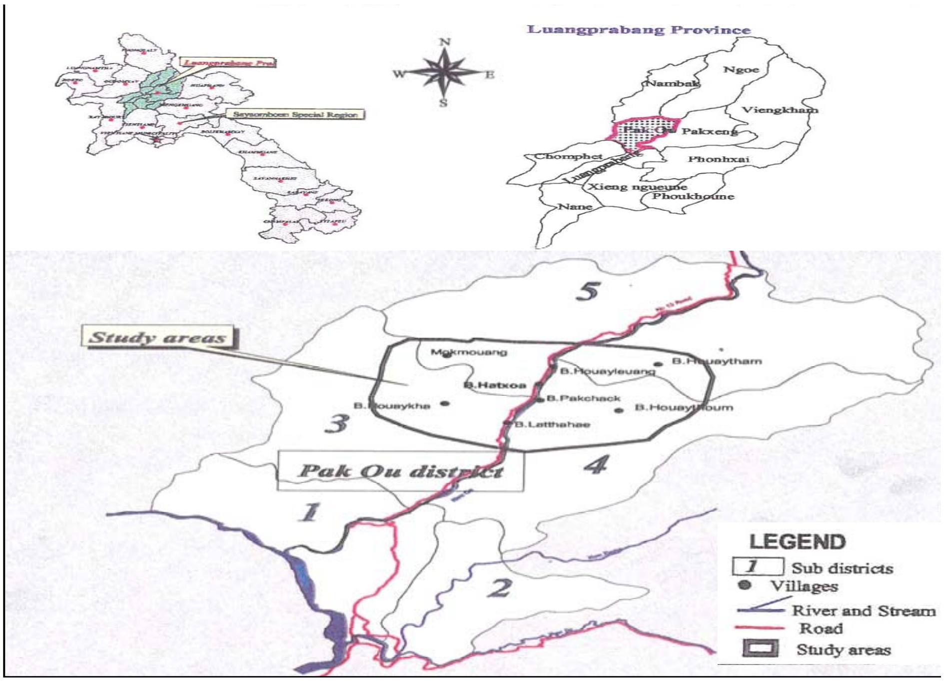


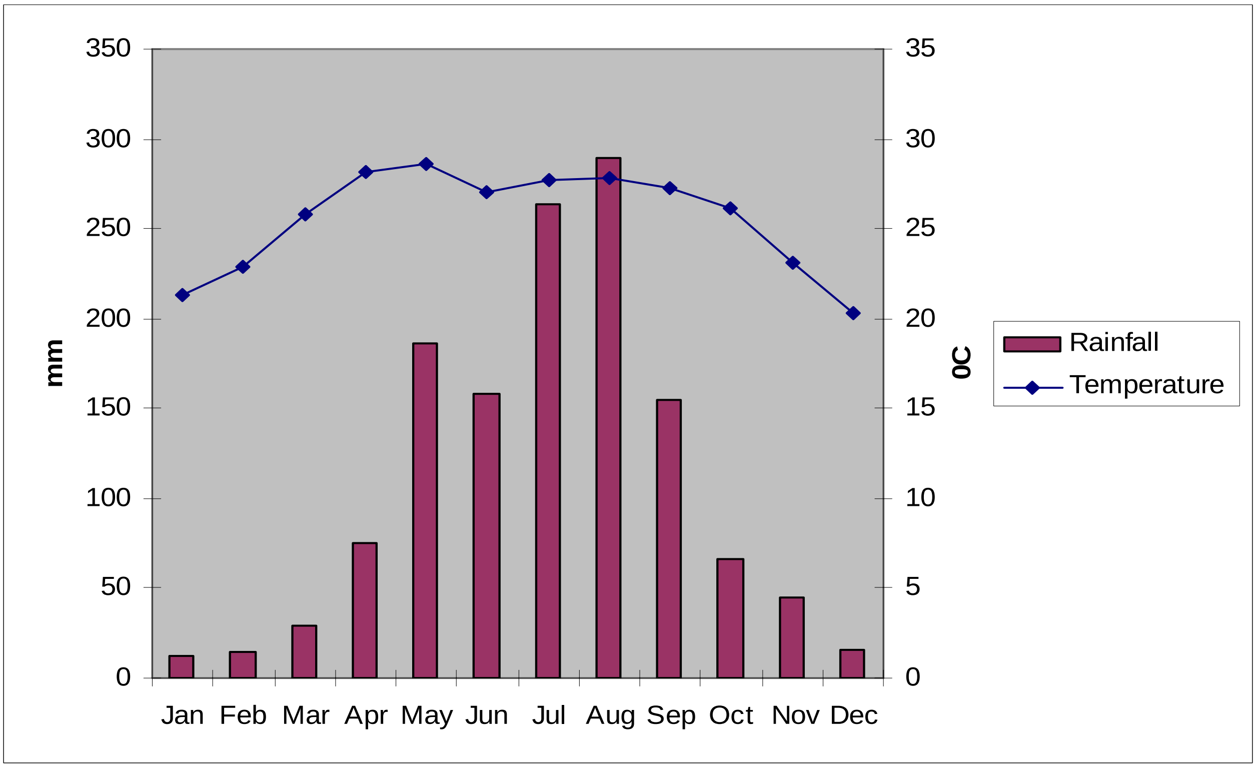
Figure 3: Location of study sites in Pak Ou district, Luang Phrabang, Lao PDR (IUARP, 2000)

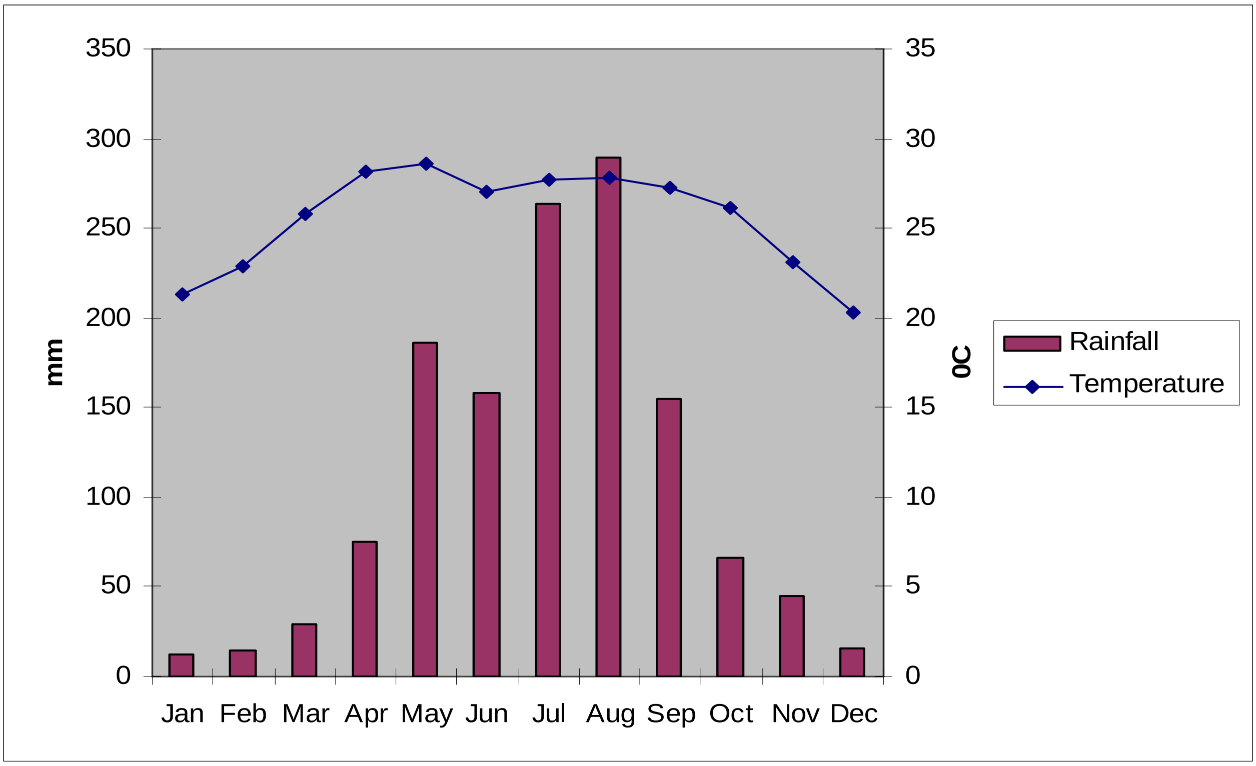
The Pak Ou district has an area of approximately 196,000 hectares and a population of 21 615 people divided into 3 663 families. It contains 75 villages and its main road of transportation is the 30 kilometre long 13-north road, which runs along the Nam Ou River. Pak Ou is a rural area with the Pak Ou town, consisting of the two villages Somsanuk and Hadnga, as the most densely populated area. The four target villages belong to the IUARP project area.
The order of the villages from North to South is Houay Leuang, Had Soa, Pak Check and Lathahae. They are situated at altitudes varying between 250 and 300 m above sea level.

Table 3: General information about the four villages.

	Houay Leuang	Had Soa	Pak Check	Lathahae.
Household	57	59	121	105
Population	319	265	638	576
Total area (ha)	791	994	2,429	1,708
Teak plantation (ha)	5	8	14	8

The climate is of the monsoon type with a mean annual rainfall of 1309 mm during 1992 – 2004, with a maximum of 1830 mm in 1998 and a minimum of 945 mm in 1997. The mean annual temperature is 25.5 ^{o}C with the annual minimum of 24.1 ^{o}C in 2004, and the annual maximum of 26.6 ^{o} C in 2003 (Pak Ou meteorological station, 2005). The wet rainy season in Lao PDR is from May to October, the cool dry season from November to February, and the hot dry season during March and April.




350
300
250
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150
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50
0
mm
35
30
25
20
15
10
5
0
0C
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Rainfall
Temperature

Figure 4: Monthly average rainfall and temperature at Pak Ou during 1992-20 04. (Source of data Pak Ou meteorological station, 2005)

3.2. Methods

3.2.1. Comments about the literature review:

The main focus of the literature review was to find relevant information related to the proposed study to be carried out. This means that similar studies conducted in Lao PDR or other relevant countries were looked for. Generally, there are a number of previous Minor Field Studies conducted in Luang Prabang on various aspects of teak management as well a number of reports from Swedish projects working in the uplands of Laos.

Literature was reviewed for specific questions related to teak such as: soil-teak interactions, site requirements, plant nutrition, teak morphology and phenology, teak management, teak productivity and effects of insects and pests as well as effects of mycorrhiza and intercropping on teak productivity.

The following websites were consulted:
www.teaknet.com. Natural distribution and densities of teak. (28 April.2005).
www.library.wur.nl/prosrom/tecona.html. The growth of teak roots. (5 May. 2005).
www.elisevier.com/locate/foreco. Forest Ecology and Management. (3 May. 2005).

3.2.2 Description and data collection of the teak experimental sites

Based on the information given in the villages, they had teak plantations which were 6-10 years old. The present study was conducted in 8-year-old teak plantations. There were four sites (site I at Lathahae, site II at Had Soa, Site III at Pak Check and site IV at Houay Leuang).

3.2.2.1. Field experiment

Field experiments were set up with 4 treatments in each village as follows:
First experiment: The effect on the growth of teak of pruning combined with constant thinning was tested at site I (Lathahae) and site II (Had Soa). The pruning and thinning were carried out in 2002, and impacts on stand development were measured during 2002 - 2004. In this and the following experiment, the percentage figures for pruning refer to the length of the stem that was pruned and the percentage figures for thinning refer to the number of removed trees in each tree row (Table 1.1 and 1.2 in Appendix 1). The area of each treatment (plot) was 0.05 ha, the total area of the four treatments was 0.2 ha at each site , and the tree spacing was 2 x 2 m. The total number of trees was 2500 per ha.

Treatments:
TP 1: Pruning 50% and thinning 25%
TP 2: Pruning 60% and thinning 25%
TP 3: Pruning 70% and thinning 25%
TP 4: Untreated

Second experiment: The effect on the growth of teak of thinning combined with constant pruning was tested at site III (Pak Check) and site IV (Houay Leuang) The thinning and pruning were carried out in 2003, and stand development measurements were done during 2003 - 2004 (Table 1.3 and 1.4 in Appendix 1). The area of each treatment (plot) was 0.04 ha, the total area of the four treatments was 0.16 ha at each site and tree spacing was 2.5 x 2.5 m. The total number of trees was 1600 per ha. In treatments TT1 and TT2 thinning was done subjectively, i.e. trees were cut depending on their size, shape or condition. Farmers' practice meant that the farmers used their knowledge and experience to improve their teak plantation. In this study the farmers removed about 10% of the teak trees. They cut the seemingly poor trees which were obviously attacked by pests and/or showed disease symptoms. They also cut trees whose stems were crooked or forked.

Treatments:

TT 1: Thinning 25% and pruning 60%
TT2: Thinning 50% and pruning 60%
TT3: Thinning according to farmers' practice and pruning 60%.
TT4: Untreated

3.2.2.2. Tree measurements

All trees in a study plot were measured with respect to the total height called TH, and the height to the first branch, called the commercial height (CH), both expressed in m. The diameter of the tree stems in cm was measured at breast height (DBH; 1.30 m above the forest floor). DBH was measured with a measuring tape, and total height and commercial height with an expandable measuring stick starting from the ground (forest floor).

The measurements were made by researchers together with the farmers who owned the teak plantations. At sites I and II measurements were done in March 2002 before the treatments were made, and thereafter once a year in March 2003 and June 2004. The data collection at sites III and IV was carried out the first time in July 2003 before treatments were made and the second time in July 2004. The latter time period included one full growing season for the trees. The data collection is detailed in Appendix 1.

3.2.2.3. Thinning and pruning

The thinning and pruning were done together with the farmers. At sites I and II thinning (25%) was made before the pruning. The control (TP4) was left untreated. At sites III and IV pruning (60% of the tree height) was done before the thinning and the control (TT4) was left untreated.

In all stands, the second thinning will be a selection thinning which will take place 7 years after the first thinning. On that occasion, trees which show disease symptoms, or are suppressed or do not have a good tree form (forked trees) will be selected for cutting (Appendix 1).

3.2.2.4. Data Analysis

The data collected during the yearly inventories were used to show the development of the stand variables diameter at breast height (DBH), commercial height (CH) and total height (TH). To compare data from different management treatments at an experimental site, average values for CH, TH and DBH were calculated for each treatment. These mean values were used to get the mean annual growth increment per unit area (m^3 per hectare) in terms of the total or commercial stem volume.

At each site, the data were analysed by one-way analysis of variance (ANOVA) assuming pseudo-replication. The measurements were made on individual trees which had been planted in rows. Sets of rows were the experimental units (pseudoreplicates) in the ANOVA analysis as there was only one plot per treatment in each experiment. Each pseudoreplicate consisted of 3 adjacent rows of trees. Three such pseudoreplicates in each plot were used for the calculations. The ANOVA analyses are presented in the Appendix.

4. Results

4.1. The impact of the pruning intensity on teak growth at site I (Lathahae) and site II (Had Soa).

The impact of the pruning intensity on the growth of teak at site I (Lathahae)

Before the treatments started in 2002, the mean diameter (DBH) (Table 4) at site I (Lathahae) varied from 8.61 to 9.56 cm. One year after pruning and 25 % thinning (in 2003), the mean increment of DBH was 2.38 cm at 50 % pruning, 2.61 cm at 60 % and 2.17 cm at 70 %.The mean increment of the untreated plot was 1.47 cm. In 2004, the measurements were made in June instead of March, i.e. just after the peak of the annual shoot growth. The increments of the pruned treatments during 2002-2004 were 4.23 cm (50%), 3.92 cm (60%) and 4.01 cm (70%). The increment of the untreated plot was 2.94 cm. In 2003-2004 the diameter growth was thus 1.9 cm (50%), 1.3 cm (60%), 1.8cm (70%) and 1.5 cm (untreated plot). For the whole period 2002-2004 the increments in TP1, TP2 and TP3 were significantly higher than in TP4 (untreated plot). Thus there seemed to be a treatment effect. By pruning small branches at different heights, the relative increment of the diameter was 47.6-77.6 % during the first year (2002-2003), and 33.3-43.9 % during 2002-2004. (two years).

Table 4: The effects of pruning on diameter growth at site I (Lathahea)

Treatment	Diameter at breast height, cm			Mean diameter increment, cm		Relative increment effect*		Basal area, m^2 per tree		
	2002 (Before treatment)	2003 (1 year)	2004 (2years)	2002-2003 (1 year)	2002-2004 (2years)	2002-2003 (1 year)	2002-2004 (2 years)	2002 (before treatment)	2003 (1 year)	2004 (2years)
TP 1 (50%)	9.51	11.89	13.74	2.38	4.23	61.9	43.9	0.007	0.010	0.014
TP 2 (60%)	8.61	11.22	12.53	2.61	3.92	77.6	33.3	0.008	0.010	0.012
TP 3 (70%)	9.56	11.73	13.57	2.17	4.01	47.6	36.4	0.009	0.010	0.014
TP 4 (untr.)	9.22	10.69	12.16	1.47	2.94			0.009	0.012	0.015
P (0.05)	0.0331	0.0209	0.0008	0.0122	0.0334			0.0755	0.0402	0.0150
LSD (0.05)	0.2812	0.3174	0.2689	0.2613	0.3687			5.243E-04	5.672E-04	6.941E-04

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The commercial height was changed by pruning (Table 5). The relative increment effect of commercial height was increased from 61.1 to 248.9% during the first year after pruning as compared to the untreated plot, and 25.4 to 137% between 2002 and2004 (two years).The increment in absolute numbers in 2003 was 1.45-3.14 m in the pruned treatments, while in the untreated plot the increment was 0.9 m. The increment during 2002-2004 was 2.17-4.10 m in the pruned treatments while the untreated plot increased by 1.73 m. During this 2-year-period all increments in the pruning treatments were significantly different from those in the untreated plot and the ranking was TP3 > TP2 > TP1 > TP4 (control). Consequently there seemed to be a treatment effect.

Table 5: The effect of pruning on commercial height of teak at site I (Lathahae)

Treatment	Commercial tree height, m			Mean height increment, m		Relative increment effect*	
	2002 (Before treatment)	2003 (1 year)	2004 (2 years)	2002-2003 (1 year)	2002–2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)
TP1 (50%)	4.26	5.71	6.43	1.45	2.17	61.1	25.4
TP2 (60%)	4.40	6.74	7.69	2.35	3.29	161.1	90.2
TP3 (70%)	5.22	8.36	9.32	3.14	4.10	248.9	137
TP4 (untr.)	4.50	5.40	6.23	0.90	1.73		
P (0.05)	0.0023	0.0000	0.0000	0.0000	0.0000		
LSD (0.05)	0.1725	0.1791	0.1802	0.0937	0.0964		

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

Table 6: The effect of pruning on total height of teak at site I (Lathahae)

Treatment	Total tree height, m			Mean height increment, m		Relative increment effect*	
	2002 (Before treatment)	2003 (1 year)	2004 (2 years)	2002-2003 (1 year)	2002- 2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)
TP 1 (50%)	9.33	10.94	12.37	1.61	3.04	23.8	11.0
TP 2 (60%)	9.28	11.57	13.11	2.29	3.83	76.2	39.8
TP 3 (70%)	10.08	12.19	13.57	2.12	3.49	63.1	27.4
TP 4 (untr.)	9.63	10.93	12.37	1.30	2.74		
P (0.05)	0.0552	0.0043	0.0018	0.0000	0.0000		
LSD (0.05)	0.6041	0.2684	0.2292	0.0877	0.1060		

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The mean height increment of the pruned trees (Table 6) was increased by 1.61 to 2.29 m in 2002-2003 (one year) and by 3.04 to 3.83 m in 2002-2004 (two years). In the untreated plot, mean height increment was increased by 1.3 m after one year and 2.74 m after two years. The relative increment effect compared to the untreated plot, was 23.8-76.2 % between 2002 and2003 (one year) and 11.0-39.8 % in 2002-2004 (two years).

In 2002-2003 the mean height increment was significantly higher in TP3 (pruning 70%) and TP2 (pruning 60%) compared to TP1 (pruning 50%) and the untreated plot. For the whole period 2002-2004 the mean height increments were all significantly different from each other and ranked as TP2 > TP3 >TP1 >TP4 (untreated plot). Consequently there seemed to be a treatment effect of the pruning.

The impact of pruning intensity on the growth of teak at site II (Had Soa)

Table 7: The effect of pruning on diameter growth of teak at site II (Had Soa)

Treatment	Diameter at breast height, cm			Mean diameter increment, cm		Relative increment effect*		Basal area, m^2 per tree		
	2002 (Before treatment)	2003 (1 year)	2004 (2years)	2002-2003 (1 year)	2002-2004 (2years)	2002-2003 (1 year)	2002-2004 (2 years)	2002 (Before treatment)	2003 (1 year)	2004 (2years)
TP 1 (50%)	11.07	13.22	15.24	2.16	4.18	16.1	41.7	0.013	0.013	0.016
TP 2 (60%)	10.18	13.92	16.27	3.75	6.10	101.6	106.8	0.011	0.011	0.015
TP 3 (70%)	9.97	13.02	15.50	3.05	5.53	64	87.5	0.010	0.010	0.013
TP 4 (untr.)	11.39	13.24	14.34	1.86	2.95			0.014	0.018	0.021
P (0.05)	0.0876	0.5119	0.0854	0.0000	0.0000			0.1152	0.0074	0.0160
LSD (0.05)	0.5463	0.6091	0.6344	0.1644	0.1789			1.451E-03	1.642E-03	1.983E-03

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

Before the treatments started in 2002, the mean diameter (DBH) (Table 7) at site II (Hadsoa) varied from 9.97 to 11.39 cm. One year after pruning and 25% thinning, the mean increment of DBH was 2.16 cm at 50% pruning, 3.75 cm at 60% and 3.05 cm at 70%.The mean diameter increment of the untreated plot was 1.86 cm. For the two-year period 2002-2004, the increments of DBH in the pruned treatments were 4.18 cm (50%), 6.10 cm (60%) and 5.53 cm (70%). The increment of DBH at the untreated plot was 2.95 cm. For the whole two-year-period 2002-2004, TP1 and TP4 (untreated plot) had a smaller DBH than TP2 and TP3. The increments of DBH of all four treatments during 2002-2004 were significantly different from each other and increased in the order TP4 (untreated plot) < TP1 < TP3 < TP2. Thus there seemed to be a treatment effect. By pruning small branches at different heights, the relative increment effect on the diameter compared to control was increased by 16.1-101.6 % after the first year (2002-2003) and by 41.7-106.8 % after two years (2002-2004).

Table 8: The effect of pruning on commercial height of teak at site II (Had Soa)

Treatment	Commercial tree height, m			Mean height increment, m		Relative increment effect*	
	2002 (Before treatment)	2003 (1 year)	2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)
TP1 (50%)	5.14	6.48	7.28	1.35	2.14	51.7	25.9
TP2 (60%)	4.84	7.88	8.81	3.04	3.97	241.6	133.5
TP3 (70%)	4.31	8.48	9.79	4.17	5.48	368.5	222.4
TP4 (untr.)	4.71	5.59	6.41	0.89	1.70		
P (0.05)	0.0399	0.0000	0.0000	0.0000	0.0000		
LSD (0.05)	0.2304	0.2731	0.2718	0.1940	0.1579		

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The commercial height was changed by pruning (Table 8). The relative increment effect in the first year (2002-2003) after pruning extended from 51.7 to 368.5% compared to the untreated plot. The mean height increment varied between 1.35 and 4.17 m in the pruned treatments while the height increment in the untreated plot was 0.89 m. The mean height increment during 2002-2004 varied between 2.14 and 5.48 m in the pruned treatments while the increment in the untreated plot was 1.70 m. For the whole period 2002-2004, all treatment increments differed significantly from each other, i.e TP4 (untreated plot) < TP1 < TP2 < TP3. Consequently there seemed to be an overall treatment effect.

Table 9: The effect of pruning on total height at site II (Had Soa)

Treatment	Total tree height, m			Mean height increment, m		Relative increment effect*	
	2002 (Before treatment)	2003 (1 year)	2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)
TP 1 (50%)	10.91	12.88	14.58	1.97	3.66	23.9	20.4
TP 2 (60%)	10.68	13.35	14.92	2.67	4.24	67.9	39.5
TP 3 (70%)	10.05	12.40	14.38	2.35	4.33	47.8	42.4
TP 4 (untr.)	10.11	11.70	13.15	1.59	3.04		
P (0.05)	0.0628	0.0049	0.0036	0.0042	0.0016		
LSD (0.05)	0.3139	0.3206	0.3340	0.2069	0.2272		

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The mean height increment of the pruned trees varied between 1.97 m (TP1) and 2.67 m (TP2) after one year (2002-2003), and between 3.66 m (TP1) and 4.33 m (TP3) after two years (2002-2004). The mean height increment of the untreated plot was 1.59 m after one year (2002-2003) and 3.04 m after two years (2002-2004). The relative increment effect compared to the untreated plot was 23.9-67.9 % in 2002-2003 (after one year), and 20.4-42.4% in 2002-2004 (after two years).

In 2004 (after two years) the total height in TP4 (untreated plot) was significantly lower than in all the pruned treatments. Consequently there seemed to be a statistically significant pruning effect (P< 0.05) after two years. This could also be shown by the mean height increments during 2002-2004. The increments of TP4 (control) and TP1 were significantly less than those of TP2 and TP3 (Table 9).

Table 10: The impact of pruning on the mean annual volume increments at sites I and II (Lathahae, Had Soa)

Treatment	Site I (Lathahae) Mean annual volume increment, $m^3 \cdot 0.05\ ha^{-1} \cdot year^{-1}$		Site II (Had Soa) Mean annual volume increment, $m^3 \cdot 0.05\ ha^{-1} \cdot year^{-1}$	
	2002-2003 (1 year)	2002-2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)
TP1 (50%)	1.0	2.4	0.6	2.6
TP2 (60%)	1.2	1.4	1.1	3.6
TP3 (70%)	1.3	2.5	0.7	2.2
TP4 (untr.)	1.8	2.5	2.1	3.6
P (0.05)	0.0653	0.0653	0.0085	0.0474
LSD (0.05)	0.0870	0.1286	0.1164	0.1666

The formula of the mean annual volume increment is:

$$\mathbf{V = \P \times (D / 2)^2 \times H \times F}$$

V – mean annual volume increment, $m^3 \cdot 0.05\ ha^{-1} \cdot year^{-1}$
¶ = 3.14
D – Diameter at breast height, m
H – Total tree height, m
F – Form factor (0.441 according to Southitham, 2001)

It is interesting to note that the untreated plots (TP4) at sites I and II tended to have a higher annual volume increment, than the treated plots. This might be due to a higher density of trees in the untreated plots. (see Appendix 2, Table 2.2).

4.2. The impact of the thinning intensity on teak growth at site III (Pak Check) and at site IV (Houay Leuang)

Table 11: The affect of thinning on diameter growth at site III (Pak Check)

Treatment	Diameter at breast height, cm		Mean diameter increment, cm	Relative increment effect*	Basal area, m^2 per tree	
	2003 (Before treatment)	2004 (1 year)	2003-2004 (1 year)	2003-2004 (1 year)	2003 (Before treatment)	2004 (1 year)
TT1 (25%)	12.53	13.99	1.46	80.2	0.016	0.017
TT2 (50%)	8.13	10.17	2.04	151.9	0.007	0.008
TT3 (Farmers pract.)	7.41	8.71	1.30	60.5	0.006	0.007
TT4 (untr.)	11.86	12.67	0.81		0.015	0.017
P (0.05)	0.0001	0.0000	0.0497		0.0000	0.0005
LSD (0.05)	0.6602	0.5216	0.3565		1.076E-03	1.833E-03

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The diameter at breast height (DBH) in 2004, one year after thinning + 60% pruning (Table 11) varied between 8.71 and 13.99 cm, and the diameter in the untreated plots was 12.67 cm. The mean DBH increment at site III (Pak Check) in 2004 was 1.46 cm in TT1 (thinning 25%), 2.04 cm in TT2 (50%) and 1.30 cm in TT3 (Farmers' practice). The mean DBH increment in TT4 (untreated plot) was 0.81 cm. The mean DBH increments were thus ranked as TT4 < TT3 < TT1 < TT2. The diameter increment of the untreated plot (TT4) was significantly less than in all the thinned treatments. Consequently there was a significant thinning effect. By reducing the number of trees at different percentage rates the relative increment effect on the diameter compared to control was 60.5-151.9 %..

Table 12: The effect of thinning on the commercial height at site III (Pak Check)

Treatment	Commercial tree height, m		Mean height increment, m	Relative increment effect*
	2003 (Before treatment)	2004 (1 year)	2003-2004 (1 year)	2003-2004 (1 year)
TT1 (25%)	6.96	8.88	1.92	4.3
TT2 (50%)	4.92	7.26	2.34	27.2
TT3 (Farmers' pract.)	3.61	6.11	2.50	35.9
TT4 (untr.)	6.53	8.37	1.84	
P (0.05)	0.0001	0.0002	0.0062	
LSD (0.05)	0.3898	0.3441	0.1507	

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The relative increment effect of the commercial height after thinning (Table 12) varied from 4.3 to 35.9% in 2003-2004 (after one year) compared to the untreated plot. The mean height increment was increased in absolute numbers by 1.92-2.50 m in the thinned treatments, while the height in the untreated plot was increased by 1.84 m.

The average increments in the untreated plot (TT4) and at 25% thinning (TT1) were significantly smaller than in the treatments TT2 (thinning 50%) and TT3 (farmers' practice). Consequently, a thinning effect was indicated.

Table 13: The effect of thinning on the total height at site III (Pak Check)

Treatment	Total tree height, m		Mean height increment, m	Relative increment effect*
	2003 (Before treatment)	2004 (1 year)	2003-2004 (1 year)	2003-2004 (1 year)
TT1 (25%)	10.35	12.53	2.18	12.9
TT2 (50%)	7.09	10.36	3.27	69.4
TT3 (Farmers' pract.)	6.02	8.71	2.69	39.4
TT4 (untr.)	9.54	11.47	1.93	
P (0.05)	0.0001	0.0002	0.0265	
LSD (0.05)	0.5407	0.4647	0.3645	

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The mean total tree height increment in the thinned treatments (Table 13) was 2.18 to 3.27 m in 2003-2004 (after one year). In the untreated plot, the mean total tree height was increased by 1.93 m. The relative increment effect among the thinned treatments varied between 12.9 and 69.4% compared to the untreated plot.

The mean total tree height increment was significantly higher in TT2 (50% thinning) and TT3 (Farmers' practice) compared to TT1 (25% thinning) and TT4 (untreated plot). There was thus a tendency of a statistically significant ($P< 0.05$) effect of thinning after one year.

The impact of thinning technique on the growth of teak at site IV (Houay Leuang)

Table 14: The affect of thinning on diameter growth at site IV (Houay Leuang)

Treatment	Diameter at breast height, cm		Mean diameter increment, m	Relative increment effect*	Basal area, m^2 per tree	
	2003 (Before treatment)	2004 (1 year)	2003-2004 (1 year)	2003-2004 (1 year)	2003 (Before treatment)	2004 (1 year)
TT1 (25%)	8.39	10.88	2.49	72.9	0.007	0.009
TT2 (50%)	9.13	12.27	3.14	118.1	0.008	0.010
TT3 (Farmers' pract.)	9.67	11.40	1.73	20.1	0.010	0.012
TT4 (untr.)	8.57	10.01	1.44		0.008	0.010
P (0.05)	0.1207	0.0189	0.0000		0.1664	0.2375
LSD (0.05)	0.5061	0.5463	0.0564		8.671E-04	1.183E-03

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The DBH in 2004, one year after thinning + 60% pruning (Table 14) varied between 10.88 and 12.27 cm in the thinned treatments, and was 10.01 cm in the untreated plot. The mean diameter increment was 2.49 cm in TT1 (25% thinning), 3.14 cm in TT2 (50%), and 1.73 cm in TT3 (Farmers' practice). The mean diameter increment in TT4 (untreated plot) was 1.44 cm. The diameter increase (increment) was ranked as TT4 < TT3 < TT1 < TT2. These treatment differences were all statistically significant from one another and indicated an effect of thinning. By thinning the relative increment effect on the diameter was 20.1-118.1%..

Table 15: The effects of thinning on commercial height at site IV (Houay Leuang)

Treatment	Commercial tree height, m		Mean height increment, m	Relative increment effect*
	2003 (Before treatment)	2004 (1 year)	2003-2004 (1 year)	2003-2004 (1 year)
TT1 (25%)	4.36	5.75	1.39	71.6
TT2 (50%)	4.68	5.99	1.31	61.7
TT3 (Farmers' pract.)	5.25	6.47	1.22	50.6
TT4 (untr.)	4.89	5.70	0.81	
P (0.05)	0.0438	0.0890	0.0006	
LSD (0.05)	0.2554	0.2849	0.0867	

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The relative increment effect on commercial height (Table 15) varied between 50.6 and 71.6% after thinning compared to the untreated plot. The increase in absolute numbers after one year was 1.22 - 1.39 m in the thinning treatments and 0.81 m in the untreated plot.

In 2004 the increase in commercial height was significantly higher in TT1 (25% thinning), TT2 (50%) and TT3 (Farmers' practices) compared to TT4 (untreated plot). Thus there seemed to be a significant effect of the thinning.

Table 16: The effects of thinning on total height at site IV (Houay Leuang)

Treatment	Total tree height, m		Mean height increment, m	Relative increment effect*
	2003 (Before treatment)	2004 (1 year)	2003-2004 (1 year)	2003-2004 (1 year)
TT1 (25%)	7.84	9.58	1.74	38.1
TT2 (50%)	8.68	9.95	1.27	0.8
TT3 (Farmers' pract.)	9.52	10.91	1.39	10.3
TT4 (untr.)	8.84	10.10	1.26	
P (0.05)	0.1559	0.3316	0.0000	
LSD (0.05)	0.6459	0.6868	0.0517	

* Relative increment effect = 100 x (treated plot – untreated plot)/untreated plot)

The mean total tree height increment of the thinned treatments (Table 16) varied between 1.27 and 1.74 m in 2003-2004. In the untreated plot, the mean total tree height increase was 1.26 m. The relative increment effect on total tree height was 0.8-38.1% compared to the control.

The mean total tree height increments in the treatments TT4 (untreated plot)) and TT2 (50% thinning) were significantly smaller than the increments in the treatments TT3 (farmers' practice) and TT1 (25% thinning). Thus there was no clear indication of a thinning effect.

Table 17: The impact of thinning on teak growth of mean annual volume increment at site III (Pak Check) and site IV (Houay Leuang)

Treatment	Site III (Pak Check) Mean annual volume increment, $m^3 \cdot 0.04\ ha^{-1} \cdot year^{-1}$	Site IV (Houay Leuang) Mean annual volume increment, $m^3 \cdot 0.04\ ha^{-1} \cdot year^{-1}$
	2004	2004
TT1 (25%)	0.7	0.7
TT2 (50%)	0.5	0.5
TT3 (Farmers' pract.)	0.5	0.6
TT4 (unt.)	1.0	0.9
P (0.05)	0.3834	0.1962
LSD (0.05)	0.0988	0.0596

It is interesting to note that the untreated plots had a higher mean annual volume incrementthan the other treatments (Table 17). The mean annual volume increments were ranked as TT2 ≤ TT3 < TT1 < TT4. This might be due to the higher density of the trees in TT4 compared to the other treatments (See Appendix 2; Table 2.4).

5. Discussion and Conclusions

5.1. The effects pruning and thinning of teak on tree growth and productivity

Teak growth as affected by pruning

The expected effect of pruning may be twofold. A reduced amount of branch biomass enables more of the synthesised carbohydrates (biomass) to be allocated to stem wood instead of branch wood and thus increase stem growth. A second type of impact is lost canopy and, thereby, lower photosynthetic capacity and less synthesised carbohydrates and, hence, reduced growth. However, the latter effect might be less important because the lower part of the canopy is shadowed and its contribution to net assimilation might be low or even negative. The results indicate that the pruning seemed to have a positive effect on tree growth measured as either diameter growth, commercial height growth or total height growth. As a general conclusion it seems that the loss of inefficient branches has had a positive impact on tree growth.

Pruning at 50 – 60 % generally seemed to increase the diameter, commercial height and total height growth with desired proportions of DBH and total height. The strong CH increase was not primarily a result of increased production but rather a consequence of the fact that a longer part of the stem was cleared from branches and of the definition of CH as the branch free part of the bole. In order to increase teak production farmers should apply pruning at 60% during the first thinning (25%). In order to increase only CH pruning at 70% is to be preferred but the diameter is too small to sustain 70% of pruning (difficulties to climb the tree).

In a short-term perspective, if there is a higher density of trees, such as in the untreated plots, the annual volume increment will be higher. However, in the long-term there could be a higher annual volume increment, where management techniques are applied due to an additional increase of DBH and total height.

Teak growth as affected by (thinning)

After thinning at different intensities combined with pruning (60%) there was an increase in diameter at breast height (DBH), commercial height (CH) and total height (TH) at sites III and IV. In 2004 the DBH growth in the thinned treatments at site III ranged from 1.30 (farmer's practice) to 2.04 cm (50% thinning), and in the untreated plot (not subjected to thinning and pruning) there was an increase of 0.81 cm. The increase in DBH at site IV ranged from 1.73 (farmers' practice) to 3.14 cm (50% thinning) and in the control there was an increase by 1.44 cm. The increase in DBH and total height in some treatments was higher than that recommended for young teak stands in Luang Phrabang (Southitham, 2001). At both sites the increase in DBH at the thinning rate 50% was considerably higher than in the treatments 25% thinning, farmers' practice and control. The increase in total height in 2004 depended on the intensity of thinning and ranged from 1.93 (untreated plot) to 3.27 (50% thinning) m at site III and from 1.26 (untreated plot) to 1.74 (25% thinning) m at site IV. Southitham (2001) found that the diameter growth of teak increased by 1.50-2.01 $cm \cdot year^{-1}$, and top height increased by 1.9-2.3 m $year^{-1}$ in 5-10 years old teak plantations in the Luang Phrabang province.

In order to increase the diameter growth, farmers should apply thinning at 25% - 50% to get an increased diameter growth and height growth. Intensive thinning at 25% or 50% had a positive effect on the stem form, including the development of trees with desired proportions of DBH and total height.

In a short-term perspective, thinning may increase the diameter growth but decrease the total volumetric growth. However, in a long-term perspective, where management techniques are applied there might be a higher annual volume increment after thinning. This would be due to an increase in DBH and total height of the remaining trees..

A final remark concerning the statistics of the teak growth data

Replication is used in experiments to answer the following question: "Are the observed treatment effects due to the treatment or due to inherent differences between the experimental units" By applying each treatment level to several experimental units (replicates) an estimate of the "natural" variability of the experimental units is separated from and compared with treatment differences. True replicates should be placed randomly. If this (as in this study) is not the case the results have to be treated cautiously.

Teak growth and soil properties in the experimental plots in four sites

Continuing deforestation and shifting cultivation may result in changes in soil moisture, soil temperature, aeration and nutrient conditions. Soil degradation of these systems may cause a decline in soil fertility resulting in very low productivity. When these soils become degraded, farmers frequently abandon the fields and allow natural revegetation and self-forestation. New forest areas will be cleared for a new shifting cultivation cycle (Keonakhone, 2005).

Important soil chemical variables to consider when comparing the chemical properties of soil under teak plantations and fallow fields are for instance organic matter content, available amounts of nutrients such as N and P, exchangeable base cations (Ca^{2+}, Mg^{2+}, K^+ and Na^+), cation exchange capacity, and the contents of potentially toxic aluminium. The main finding was that the differences in analytical values between teak plantations and nearby fallow fields were generally small and nonsignificant. There was a tendency that the CEC in soils under teak was lower compared with soils under fallow (Keonakhone, 2005).

One reason for not finding any differences for instance regarding P, Ca or Mg under teak and fallow may be that all the plants growing in the fallows and in the teak plantations produce green manure from falling leaves so that these elements may be repeatedly remobilized and then taken up again by the vegetation to the same extent in plantations and fallows. This hypothesis requires that, there should be no differences in the leaching of nutrients or in nutrient exports.

5.2. The potential improvement of farmers' income due to the use of pruning and thinning techniques and changes in the market-flow

Southitham (2001) reported that there are numerous products coming from teak wood. Among these are floors, doors and indoor and outdoor furniture. In the town of Luang Phrabang one can usually see many kinds of wood products and furniture made out of teak in the small wood shops along the streets. However, Thongsavath (*pers. comm.* 2005), who is a trader, says that although he can make furniture out of teak upon request, the locals normally prefer to have their furniture made out of rosewood *(Dalbergia spp.)*. In the villages teak timber is much used for construction work. Generally, teak is a most important income source for the middle wealth group of farmers.

Farmers might increase both quantity and quality of teak wood by using scientific knowledge gained from thinning and pruning experiments. However, if teak is to be a valuable export commodity which gives a profit to the farmers, the infrastructure has to be better than today. Few teak growers have direct access to Wood Processing Units (WPU) or to the export market. Therefore, the gap in the price of teak logs between the farm gate and the WPU is quite wide. It ranges from 150.000-400.000 kip per cubic meter. Local traders and traders from outside play an important role in collecting teak logs from the villages. Ninety-nine percent of the teak logs are collected by outside traders. The price of teak logs mostly depends on the export market demand because 95 % of teak logs have been exported during the last years. If farmers could sell teak directly to the WPU, they could certainly increase their income.

6. Recommendations for further work

The government should review the forest policy to be pursued in the future for maintaining a sustainable timber production. This would include encouragement and persuasion of farmers who work with teak timber production to join the train of sustainable forest development.

In order to improve the teak growers' income, the Lao government should set up necessary policies to help farmers to improve both quality and quantity, by using management techniques such as pruning and thinning in their plantations. The farmers also need assistance in tree harvesting and transportation of teak logs. It is necessary that farmers can have an easy access to wood processing units (WPU) and the export market. Concerning the export market, the Lao government needs to find the opportunities for exporting teak wood to more profitable potential markets both within and outside the country.

Much research on teak silviculture is carried out internationally, including countries near Laos. Considering the limited economic resources and research capability in Laos there is still much scope for more systematic evaluations and research. Research in Laos should concentrate on solving concrete problems of specific local interest such as:

- Study the ecology and structure of natural teak stands and plantations to help improve their protection and use.
- Adopt or develop new improved silvicultural practices that will facilitate higher income and shorter rotations, especially practices that are relevant for poor farmers in the uplands.
- Investigate the environmental suitability of teak, especially regarding elevation (temperature), rainfall and bedrock. This activity may be linked to provenance trials for specified climatic zones.
- Survey pest and environmental stress problems affecting the performance of teak.
- Develop systems for inter-cropping teak with arable crops and with other tree species to improve overall production and sustainability.

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9. APPENDICES

Appendix 1: Measurement data of teak at four experimental sites

Table 1.1: Measurement data of teak at site I (Lathahae)

Name of owner: Thao Sieng My				Planting year: 1995					
Measurement date: March 20, 2002				Measurement date: March 19, 2003			Measurement date: March 18, 2004		
Treatment 1: TP1 Pruning 50%				Treatment 1: TP1 Pruning 50%			Treatment 1: TP1 Pruning 50%		
Tree No	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)
1	28.4	4	8	33.4	5	9	35.6	6	10.5
2	31	5	10	37.6	6	11	40	6.5	12.5
3	38.4	5	10	46.3	6	11	50.5	6.5	12
4	32.6	5	10	37.4	6	11	40.1	6.5	12
5	31.5	5	10	38.2	6	11	49	6.5	12
6	18	2	6						
7	32.2	4	9	38.2	5	10	41	5.5	11
8	26.8	4	9.5						
9	38	5	11						
10	35.6	4	10	46.7	5.5	11	50	6.5	12.5
11	29.4	5	10	40.4	5.5	11	46	6	12
12	31.6	5	11	41.4	6	12	46	7	13
13	29	5	11	48.2	6	12	51	7	13
14	39	5	10	42.5	6	11.5	55	6.5	13
15	23.4	4	9						
16	44.8	5	10	52.4	5.5	11	55.5	6.5	12
17	29	5	9						
18	30.2	5	11	36.7	6	12	46.5	7	13
19	35.4	2	7						
20	38.6	5	10	42.7	6	11.5	50	6.5	13
21	38.5	4	8						
22	37.8	5	11	46.6	6	12	52.5	7	13
23	39.8	4	10	48.2	6	11.5	47	6.5	13
24	38.9	4.5	10	42.7	6	11.5	47.5	6.5	13
25	33.4	5	11						
26	38.7	5	9	43.6	5.5	10.5	36	6	12
27	38.6	2	7						
28	25.8	5	10	30.4	6	11.5	35	6.5	13
29	25.4	5	11	30.4	6	12	41	7	13
30	20.4	3	7						
31	22.6	5	10	26.7	6	11.5	31.5	6.5	13
32	30.2	5	11	37.4	6	12	44.5	7	13.5
33	30.2	4	9						
34	32.5	5	11	37.2	6	12	42	7	13.5
35	20	4	8						
36	36.4	5	11	40.5	6	12	46.5	7	13.5
37	30.3	4	10	35.6	5.5	11.5	40.5	6.5	13
38	28.6	4	11	33.6	6	12	40	7	13.5
39	22.8	3	7						
40	20.6	4	9	25.7	5	10	33.5	6	12

41	38.6	5	11	43.7	6	12	48	7.5	13.5
42	36.8	4	9	40.6	5	10	46.5	6	12
R1 Av.	**31.66**	**4.37**	**9.58**	**39.48**	**5.78**	**11.28**	**44.42**	**6.57**	**12.62**
Av. DBH	**10.08**			**12.57**			**14.15**		
43	23.4	2	5						
44	29.4	5	9.5	33.6	5.5	11	40	6	12.5
45	29.8	5	10	34.2	6	11	37	6.5	12.5
46	32.5	5	9.5	35.4	5.5	11	44.5	6	12.5
47	21.8	3	7						
48	27.7	4	8.5	33.6	5	9.5	37	6	11
49	34.8	4	9	39.2	5	10	46.5	6	11.5
50	30.3	5	10						
51	36.7	4	10	42.4	6	11	46.1	6.5	12.5
52	28.4	4	9.5						
53	35.7	5	11	40.3	6.5	12	46	7	13.5
54	24.4	5	10						
55	20.6	5	10	27.4	6	11	37.5	6.5	12.5
56	26.7	5	9.5						
57	37.9	5	11	42.4	6.5	12	45.5	7	13.5
58	36.7	5	9	41.6	5	10	44.5	6	11.5
59	38.6	5	10	43.6	6	11	47.2	6.5	12.5
60	35.9	3	7	40.3	4.5	9	45	5.5	10.5
61	23.9	4	8	33.6	5	10	38.7	6	12
62	36.9	4	10.5	40.7	6	11	40.5	6.5	12.5
63	30.7	5	10	35.7	6	11	40.8	6.5	13
64	28.3	4.5	9	32.6	5	10	37.1	6	12
65	23.2	3	7						
66	21	2	7						
67	32.2	7	11	36.7	7	12	46	7	13
68	26.3	2.5	7						
69	32	4	10	42.4	6	11	48.4	6.5	12.5
70	25.3	4	9						
71	31.4	5	9	37.8	5.5	10.5	44.5	6.5	12
72	30.2	5	10	36.4	6	11.5	41.5	6.5	13
73	26.4	5	10	28.3	6	11.5	37.5	6.5	13
74	34.6	5	11	40.5	6.5	12	43	7	13.5
75	28.6	5	9.5	33.6	6	11	42.5	7	12
76	27	3	7						
77	26.5	4	9.5	32.4	6	11	37	6.5	12
78	26	4	9						
79	26.4	4	9.5	32.7	5.5	11	38.4	6.5	12
80	25.3	4	9.5	38.4	5.5	11	45	6.5	12
81	28.5	6	10	35.6	5.5	11	41.3	6.5	12
82	22.8	5	9						
83	32.8	5	11	42.7	6	12	48.1	7	13
84	28	4	10	32.4	5.5	11	38.7	6.5	12
85	28.2	5	10	33.4	5.5	11	46.5	6.5	12
86	22.8	3	7						
R2 Av.	**29.01**	**4.34**	**9.20**	**36.66**	**5.73**	**10.93**	**42.41**	**6.45**	**12.33**
Av. DBH	**9.24**			**11.68**			**13.51**		
87	33.4	5	10	37.8	6	11	45	6.5	12
88	36	5	11	41.8	6.5	12	48.5	7	13

89	34.4	4	11	39.4	6	12	45.7	7	13
90	31.6	5	11	36.8	6	12	43.5	7	13
91	26.8	3	8						
92	34.8	4	8	40.3	5	9	47.5	6	11
93	21.8	3	7						
94	20.3	4	9	26.3	5	10	34.5	6	11.5
95	28.8	2.7	7	32.3	4.5	9	38.2	5.5	10.5
96	30.8	3	8	36.5	5	9	43.5	5	10.5
97	29.5	4	9.5						
98	38.5	5	11.5	43.5	6	12.5	51.3	7	13.5
99	28.6	3	8						
100	36.3	4	9	40.3	5.5	10	47.5	6	11
101	27.9	4	8						
102	31.2	4	8	37.2	5	9	43.6	5.5	10
103	23.3	5	10	29.3	5.5	11	36.3	6	12
104	25.6	4	8	30.9	5	9	37.5	5.5	10.5
105	25.8	4	9	31.6	5.5	10	40.1	6.5	12
106	29.3	5	11	36.3	6	12	43.4	7	13.5
107	28.8	5.5	11	32.4	6.5	12	39.2	7	14
108	30.5	5	10	34.2	6	11	40.5	7	13
109	31.4	4	10	38.3	6	11	41.7	7	13
110	29.2	5	11	35.8	6.5	12	43	7	13.5
111	16.4	2	10						
112	28	5	10	36.3	6	11	38	6.5	12.5
113	26	4	8						
114	30.4	5	11	36.7	6	12	42.3	6.5	13
115	34.5	4	9	41.5	5.5	10	43.4	6	11.5
116	20.4	2	7						
117	23.6	3	8	26.8	4.5	9	35	5	11.5
118	28.4	4	9	34.5	5.5	10	42	6	11.5
119	25.4	4	8	31.4	5	10	38.7	5.5	11.5
120	26.4	4	9	33.2	5.5	10	42	6	11.5
121	21.7	3	7						
122	30.4	5	10	37.8	6	11	44.7	6.5	13
123	38.8	5	11	43.4	6.5	12	52.5	7	14
124	28.8	4	8	33.2	5	9	43.5	5.5	11
125	32.5	5	10	38.7	6	11	45	6.5	13
R3 Av.	**28.88**	**4.08**	**9.21**	**35.82**	**5.63**	**10.62**	**42.59**	**6.28**	**12.15**
Av. DBH	**9.20**			**11.41**			**13.56**		

Measurement date: March 20, 2002				**Measurement date: March 19, 2003**			**Measurement date: March 18, 2004**		
Treatment 2: TP2 Pruning 60%				**Treatment 2: TP2 Pruning 60%**			**Treatment 2: TP2 Pruning 60%**		
Tree No	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)
1	35.8	5	10	41.4	7	12.5	45.5	8	14
2	26.6	5	9	31.5	6	11	38.3	7	13
3	27.4	4.5	10	32.5	7	12.5	35	8	14
4	33	2	8	38.3	5.5	10	43	6.5	11.5
5	26	6	10.5	32.2	7	13	37.8	8.5	14.5
6	32	4	10	39.8	7	12.5	39.5	8	14
7	22.4	3	8	29.7	5.5	10	33.5	6.5	11.5

8	20	2	7	28.3	5	9	30.7	6	10.5
9	24.4	4	9	30.2	6	11	34.5	7	12.5
10	36	4	11	43	7	12.5	46	8	14
11	33	5	10	39.4	7	12	43.4	7.5	13.5
12	31.7	5	10	36.3	7	12	40	7.5	13.5
13	27	2	8	33.4	5.5	10	35.5	7	12
14	13.6	2	6						
15	23	2	7						
16	36.8	5	10	43.2	7	12	45	7.5	14
17	21.6	3	8	28.3	5	10	32.4	7	12
18	41	5	11	47.5	7	12.5	48.5	7.5	14
19	20	4	9	28.1	6	11	33.1	7	13
20	29.4	5	10	37.8	7	12	43	7.5	14
21	33.6	6	11	40.2	7	13	43.5	7.5	14
22	27	4	8						
23	22	5	9						
24	22.5	5	9	30.2	6	11	32.5	7	13
25	25	4	8	33.2	6	10	36	6.5	12
26	30.6	5	10	38.6	7	12	39	7.5	14
27	20.2	5	9	27.7	6	11	31.5	7	13
28	33	3	8						
29	31	4	10	38.6	7	12	38.5	7.5	14
30	26.5	5	9.5						
31	34.4	5	10	41.3	7	12	43	7.5	14
R1 Av.	**27.95**	**4.15**	**9.13**	**35.63**	**6.42**	**11.46**	**38.75**	**7.30**	**13.18**
Av. DBH	**8.90**			**11.35**			**12.34**		
32	20.4	5	9	26.2	6	10.5	30	7	12
33	20.8	4	9	25.7	6	10.5	30	7	12
34	35.6	5	11	40.3	7	12.5	44.5	8	14
35	27	5	10	32.4	7	12	36	8	13.5
36	30.6	6	11	36.2	7.5	12.5	41.5	8	14
37	20.3	5	10	25.3	7	12	30.2	8	13.5
38	29	5	11	36.2	8	13	40.5	8	14
39	19.4	4	8						
40	15	4	7						
41	32	5	11	39.3	8	13	43	8.5	14
42	17	5	9						
43	18	3	8	25.6	6	10	30	7	12
44	19.5	3	9						
45	23	4	9	26.7	6	10	30.5	8	13
46	34.8	5	11	39.3	8	13	44	8.5	14
47	18.3	3	7						
48	36.8	5	11.5	41.4	8	13	45	8.5	14
49	23.6	5	10	29.3	7	12	34.5	8	13
50	23.6	6	10.5						
51	34.8	5	10	39.6	7	12	44	8.5	14
52	46.8	5	11	51.3	8	13	55.5	8.5	14
53	32.2	5	10	38.6	7	12	43	8.5	14
R2 Av.	**26.30**	**4.64**	**9.68**	**34.59**	**7.09**	**11.94**	**38.89**	**8.00**	**13.44**
Av. DBH	**8.37**			**11.02**			**12.38**		
54	22.3	4	8						
55	30.4	5	11	37.2	8	12.5	42.5	8.5	13.5

56	27	4	9	32.4	6	11	38.1	7	12
57	28	4	9	37.8	6	11	42.5	7	12
58	37	6	11	43.4	8	12.5	47	8.5	13.5
59	33.8	6	11	40.2	8	12.5	45	8.5	13.5
60	36.2	6	11	43.2	8	12.5	47.5	8.5	13.5
61	18	4	9	25.3	6	11	30	7.5	12.5
62	16.2	2	7						
63	36	5	10	40.2	7	11.5	44.5	8.5	13.5
64	34.5	5	10	39.6	7	11.5	43	8.5	13.5
65	19.2	5	9	26.4	6	11	31.2	7	12
66	18.6	3	7						
67	28.6	6	10	33.5	7	12	38.5	8.5	13.5
68	18	3	6						
69	34.5	5	10	40.2	6.5	11.5	42	8	13
70	16.7	4	7						
71	31.3	6	10.5	38.2	7	12	40.5	8	13.5
72	18.3	3	7						
73	27.2	3	7						
74	25.2	5	10	32.4	6.5	11.5	36.5	8	13
75	26	5	10	31.5	6.5	11.5	35.8	7.5	13
76	27.4	5	10	35.6	6.5	11.5	40.5	8	13
77	29	5	10	34.6	6.5	11.5	40	8	13
78	18	2	7						
79	34	5	10	39.3	7	11.5	45	8	13
80	21.3	5	9.5	26.7	6.5	10.5	32.4	7.5	12
81	41.8	6	11	47.9	7	12	51.5	8.5	13.5
82	22.6	3	7						
83	28.4	4	10	35.6	7	11.5	42.5	8	13
84	37.6	4	8	40.2	6	9.5	46.5	6.5	11
85	20	4	8	25.8	6	9.5	32.1	6.5	11
86	23.4	4	9	28.2	6.5	10.5	36.5	7	12
87	25.9	4	8	31.4	5.5	9.5	38	6.5	11
R3 Av.	**26.84**	**4.41**	**9.03**	**35.47**	**6.72**	**11.32**	**40.38**	**7.76**	**12.72**
Av. DBH	**8.55**			**11.30**			**12.86**		

Measurement date: March 19, 2002				**Measurement date: March 19, 2003**			**Measurement date: March 18, 2004**		
Treatment 3: TP3 Pruning 70%				**Treatment 3: TP3 Pruning 70%**			**Treatment 3: TP3 Pruning 70%**		
Tree No	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)
1	33.4	6	10	38.7	8.5	12	45.5	9	13.5
2	35.6	4	9	39.3	7.5	10.5	45.7	8.5	12
3	28.5	5	9	33.8	8	11	37	8.5	13
4	25.6	4	8						
5	26.3	5	10	31.4	8.5	12	40	9	13.5
6	22.3	4	8						
7	25.8	6	10	32.3	8	11	41.5	8.5	13
8	20.3	4	9						
9	28.5	5	11	35.6	9	13	40	10	14
10	36.7	6	11	41.5	9	13	32.5	10	14
11	21.4	4	8						
12	34.5	6	11	40.3	9.5	13.5	43	10.5	14.5
13	28.4	5	10	35.7	8.5	12	46	9	13.5

14	16.3	4	7						
15	29.5	5	10	35.6	8.5	12	47.5	9	13.5
16	40.2	6	11	44.6	9	13	50	10	14.5
17	22.8	5	9						
18	25.4	4	8						
19	30.4	5	11	37.6	8.5	12.5	41	10	14
20	23.4	4	9						
21	35.4	6	11	39.6	9	13	42.5	10	14
22	36.2	5	10	41.3	8.5	12	51.5	9	13.5
23	34.5	6	11	39.6	8.5	12.5	43.4	10	14
24	27.2	5	10	32.8	8.5	12	41	9	13.5
25	30.3	6	11	36.8	8.5	12.5	40.5	10	14
26	34.5	5	10	39.2	8	12	43.1	9	13.5
27	30.4	4	9	38.2	7.5	10.5	48	8.5	12
28	27.3	5	9	35.7	7.5	10.5	41.1	8.5	12
29	32.6	6	11	40.3	7.5	12.5	42.5	10	14
30	24.3	4	8						
31	27.4	5	9	32.7	7	10.5	40	8.5	12
32	30.3	6	10	38.2	8	11.5	43.1	9	13
33	28.4	5	10	35.6	8	11.5	45	9	13
34	27.8	5	10						
35	40.2	6	11	46.7	8.5	12.5	50	9.5	13.5
36	38.2	5	11	45.9	8.5	12.5	45.5	9.5	13.5
37	30.1	4	9	37.6	7	10.5	42.1	8.5	12
38	35.4	6	10	42.3	8.5	12	45.5	9.5	13
R1 Av.	**29.63**	**5.03**	**9.71**	**38.18**	**8.27**	**11.93**	**43.38**	**9.27**	**13.34**
Av. DBH	**9.44**			**12.16**			**13.81**		
39	28.6	5	9	38.4	8	11	42.7	8.5	13
40	36.7	6	11	42.6	8.5	12.5	32	9	14
41	23.2	5	9	28.7	8	11	36.5	8.5	13
42	19.6	5	10	27.8	8	11.5	33.8	8.5	13
43	23.4	5	9	32.6	8	11	38	8.5	12.5
44	20.3	4	9						
45	19.7	5	10	28.6	8	12	34	8.5	13
46	26.4	5	11	33.4	8.5	13	50	10	14
47	32.4	6	10	39.2	8	12	52.5	9	13
48	28.8	5	9						
49	35.6	6	10	42.4	8.5	12.5	52	10	13.5
50	28.7	5	11	35.6	8.5	13	42.5	10	14
51	23.5	4	9	32.4	8	11.5	40.3	8.5	12.5
52	28.2	5	10	36.5	8	12	38.5	9	13
53	23.3	4	9						
54	27.6	5	11	33.4	9	13	47.5	10	14
55	30.4	6	12	36.7	9	14	42.5	10	15
56	33.5	6	11	40.3	10.5	13	45	10.5	14.5
57	30.6	5	10						
58	32.5	5	12	38.7	9	14	42	10	15
59	28.4	4	9	39.2	8	11	46.1	9	12.5
60	30.3	5	11	38.7	9	13	45.5	9	14.5
61	35.4	6	10						
62	32.4	5	11	38.7	8.5	13	50	10	14.5
63	33.5	5	10						

64	35.6	6	12	41.3	9	14	39	10	15
65	30.4	5	11	38.2	9	13	42.5	10	14.5
66	34.3	6	11	42.3	8.5	13	45.8	9	14
67	37.4	6	12						
68	30.4	5	10	36.7	8	12	40	9.5	14.5
69	33.2	6	10	38.7	8	12	43.4	9.5	13.5
70	30.4	5	11	36.8	9	13	32.5	10	14.5
71	28.5	5	9	34.4	8	11	40.1	9	12.5
72	30.2	6	10	35.6	8.5	12	65.5	10	13.5
73	38.7	6	11						
R2 Av.	**29.77**	**5.23**	**10.29**	**36.59**	**8.48**	**12.37**	**42.97**	**9.39**	**13.72**
Av. DBH	**9.48**			**11.65**			**13.68**		
74	25.5	5	10	30.4	8.5	12	36	9.5	13.5
75	24.3	5	9	28.2	7.5	11	32.1	8.5	12
76	27.3	5	11	32.1	8.5	13	39.2	9	13
77	23.4	5	9	28	7.5	11	36.1	8.5	12.5
78	26.3	5	11	32.3	8.5	13	39.5	10	14
79	30.2	6	10	35.6	8	12	41	9	13
80	24.5	5	9	28.3	7	10.5	35.1	8.5	12
81	36.4	6	9						
82	34.5	5	11	39.4	9	13	44	9	13.5
83	32.4	5	9						
84	26.5	4	9	28.7	7.5	11	36.7	8.5	12.5
85	29.3	5	10	38.6	8.5	12	45.6	9.5	13.5
86	24.4	5	9	29.3	7.5	11	36	8.5	12.5
87	30.4	6	10	36.7	8	12	43	9	13.5
88	33.4	6	11	38.6	8.5	13	44.5	9	14
89	30.2	5	10	36.4	8	12	42	9	13
90	34.5	6	10	39.2	8	12	45.7	8.5	13
91	32.4	5	11	38.6	8.5	13	43.5	9	14
92	28.5	5	10	35.7	8	12	41	8.5	13
93	33.4	6	10						
94	29.5	5	11	36.5	8.5	13	42.5	10	14
95	33.2	6	10						
96	30.3	5	10						
97	28.2	6	10	35.6	8	12	41.5	9	14
98	33.4	5	11	38.8	9	13	44	9.5	14.5
99	28.5	5	9						
100	32.4	6	10						
101	28.7	5	10	35.4	8	12	42.5	9.5	13.5
102	32.4	6	11						
103	35.6	6	11	40.3	9	13	44	10.5	15
104	28.4	5	10						
105	31.3	6	11	38.2	9	13	43	10	15
106	33.2	5	11	39.4	8.5	12	44.5	9	14
107	28.5	6	10	35.6	8.5	12	39.2	9	13.5
108	31.4	5	11	37.8	9	13	42	10	14.5
109	35.6	6	11	41.3	9	13	46.5	10	14.5
110	34.2	5	11						
111	36.4	6.5	11	41.2	9	13	46	10	14.5
112	33.4	6	10						
113	28.4	5	11	33.2	8.5	12.5	44.5	10	14.5

114	30.5	6	10	36.6	8	12	40.5	9.5	13.5
115	35.4	6	11	40.3	9	13	44.6	10	14.5
116	32.4	5	11	37.2	9	13	42.6	10	14.5
R3 Av.	**30.68**	**5.41**	**10.23**	**35.73**	**8.34**	**12.28**	**41.53**	**9.30**	**13.64**
Av. DBH	**9.77**			**11.38**			**13.23**		

Measurement date: March 19, 2002				**Measurement date: March 19, 2003**			**Measurement date: March 18, 2004**		
Treatment 4: TP4 Control				**Treatment 4: TP4 Control**			**Treatment 4: TP4 Control**		
Tree No	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)	GBH (cm)	CH (m)	TH (m)
1	36	4	8	40	4.5	9	43.5	5	11
2	33.8	5	10	37.5	5.5	11	41	6	12.5
3	30.8	5	11	33.3	5.5	11.5	36.5	6	13
4	21	3	7	23	4	8.5	26.4	5	10.5
5	34.2	4.5	9	38.4	5	9.5	41.3	5.5	11
6	20.4	3	7	23.1	4	8.5	25.4	5	10
7	32.5	5.5	10	36.3	6	11	41.5	6.5	12.5
8	25.8	5	11	29.8	6	12	33.6	7	14
9	33.8	5	11.5	38.4	6	13	42.2	7	14
10	20.2	3	7	23.7	4	8	29.3	5	10
11	22.4	3	7	28.3	4	8	33.5	5	10
12	32.8	5	11	34.7	5.5	12	37.1	6	13
13	32.4	3	7	34.2	4	9	36.8	5	10.5
14	35.2	5	11	37.8	6	13	40	7	14
15	33.7	5	11	36.5	6	12	39.9	6.5	13
16	19	4	8	25.4	5	10	29.9	6	11.5
17	30.8	5	10	36.2	6	12	40.3	7	13.5
18	26.8	2	6	28.7	3.5	8	30.9	4.5	9.5
19	27.5	3	7	29.7	5	9	31.4	5.5	11
20	32.4	4	9	36.5	5	11	42.5	6	12.5
21	30.4	5	11	36.2	6	12	30	7	13.5
22	25.6	4	8	27.4	5	9.5	29.6	6	11
23	30.4	5	11	35.4	6	12	38	6.5	13
24	33	5	11	35.8	6	12	38.6	6.5	13.5
25	24.5	5	9	30.4	5.5	11	35	6.5	12.5
26	36.4	3	7	38.2	4	8.5	40.5	5	10
27	28.4	5	9.5	32.1	5.5	10.5	35.4	6.5	12
28	25.6	4	9	29.2	5	10	32.5	6	11.5
29	25.6	4	9	28.9	5	10	33.3	6	11.5
30	35.8	5	10	39.2	5.5	11	42.8	6.5	12.5
31	35	3	7	38.4	4	8.5	41.7	5	10
32	38.8	5	11	43.3	6	13	49.5	7	14
33	35.4	5	11	39.4	5.5	12	43.5	6.5	13.5
34	32.2	5	11	37	5.5	12	41.1	6.5	13.5
35	30.6	5	10	35.6	5.5	11	38.3	6.5	12.5
36	29	4	9	36.2	4.5	10	40.7	5.5	12
R1 Aver.	**29.95**	**4.28**	**9.22**	**33.73**	**5.14**	**10.53**	**37.04**	**6.00**	**12.04**
Av. DBH	**9.54**			**10.74**			**11.80**		
37	32.8	3	7	38.4	4	8.5	41.3	5	10
38	31.8	3	7	37.5	4.5	8.5	39.5	5.5	10
39	17.4	4	8	23.5	5.5	9	27.6	6	10.5
40	37.2	5	11	42.7	6	12	45.9	7	13.5
41	20.4	4	8.5	26.7	5	10	29.8	5.5	11.5

42	29.2	4	9	34.5	5	10	39.7	6	12
43	25.4	4	9	29.6	5	10	32.2	6	11.5
44	31.5	5	11	37.6	6	12	43.6	7	13.5
45	25.6	5	11	30.3	6	12	35.1	7	13.5
46	30.8	4	8	35.7	5	9	39.3	5.5	10.5
47	32.5	5	10.5	38.4	6	12	42	7	13.5
48	32.8	5	10	36.8	5.5	11	40.5	6.5	12.5
49	29.2	3	7	35.4	4	9	40.3	5	10
50	21.8	4	9	26.4	5	10.5	32	6	13
51	23.6	4	9	28.5	5	11	39.5	6	12.5
52	18.4	5	10	27.6	6	12	28.4	7	13
53	25	4	8	30.4	5	9	34	5.5	11
54	31.8	4	10	36.7	6	12	42.4	7	13
55	25.7	5	10	30.4	5.5	11	38.7	6.5	12.5
56	37.4	5	11	42.4	6	12.5	47.9	7	13.5
57	35.2	5	11	41.3	6	12.5	47	7	13.5
58	21.2	4	8	26.2	5	10	30.5	6	12
59	19.4	5	11	24.7	6	12.5	28.4	7	13.5
60	39.2	5	11	43.7	6	12.5	46.5	7	13.5
61	24.7	5	11.5	30.2	6	13	39	7	14
62	24.2	5	11	28.7	6	12	36.1	7	13.5
63	28.4	5	11	35.6	5.5	11.5	41.5	6.5	13
64	23.2	3	7	28	4.5	9	36	5	10.5
65	28.6	5	10	33.4	5.5	11	35.1	6	12
66	39.4	5	11	43.5	6	12	49	6.5	13
67	23	4	8	28.4	5	9.5	34.4	6	11
68	26.8	5	11	31.4	6	12	39.5	7	13
69	28.2	5	10	34.2	5.5	11	42	6.5	12
70	37.4	5	11	41.5	6	12	46.8	7	13
71	19	4	9	25.4	5	10	35	6	12
72	37.2	4	8	41.2	5	9	46.5	5.5	10.5
73	31.4	5	11	39.4	6	12	40.6	7	13
74	15.8	4	9	21.3	5	10	31	6	12
75	30.6	4	8	34.3	4.5	9	41.5	5	10.5
76	19	4	9	23.4	4.5	10	26.7	5.5	12
77	28.6	5	11	33.5	6	12	38.3	7	14
78	23.6	5	11	27.5	6	12	33	7	14
79	24.8	5	11	22.4	6	12	33.5	5.5	14
80	21.2	5	11	26.2	6	12	34.5	6.5	14
81	34.7	5	11	38.8	6	12	44	6.5	14
82	26	4	10	31.3	5	11	37.1	6	13
83	28.7	4	10	32.7	5	11	39	6	13
84	36.4	5	10	41.5	5.5	11	44.8	6	13
85	34.8	5	11	38.3	6	12	45	6.5	14
86	18.7	4	9	25.4	5	10	29	6	12
R2 Aver.	**27.79**	**4.46**	**9.71**	**32.86**	**5.43**	**10.93**	**38.22**	**6.27**	**12.47**
Av. DBH	**8.85**			**10.46**			**12.17**		
87	35.6	5	11	39.5	6.5	13	43.5	7	14
88	16.3	4	9	23.4	5	10	28	5.5	11
89	22.7	4	9	27.3	5	10	33	6	11.5
90	37.3	5	11	41.5	6	12.5	45	7	14
91	31.4	5	11.5	36.4	6	12.5	40	7	14

92	39.4	5	11	44.5	6	12.5	48.5	7	14
93	19.2	4.5	9	26.2	5	10	30	5.5	11
94	31.4	5	11	36.7	6	12.5	42.5	6.5	13
95	32.6	5	11	35.8	6	12.5	40.1	6.5	13
96	16.7	4.5	9	21.3	5	10	29	5.5	11
97	22.7	5	10	27.4	6	11.5	32	6.5	12.5
98	22.3	4.5	9	25.8	5.5	11	27.5	6	12
99	33.2	5	11	39.7	6	12.5	41	7	14
100	34.7	5	11	40.5	6	12.5	46.7	7	14
101	28.3	5	11	33.4	6	12.5	38.3	7	14
102	24.8	5	11	28.3	6	12	34	7	13.5
103	24.8	5	11	29.4	6	12	33	7	13.5
104	27.8	5	12	34.6	6	13	40.5	7	14
105	27	5	9.5	30.4	5.5	11	38.6	6	12
106	38	5	9.5	42.3	5.5	11	49	6	12
107	34.8	5	11	41.4	6	12	45.6	7	13
108	30	4	9	36.5	5.5	10.5	46.5	6.5	12
109	26.8	5	10	32.6	5.5	11	39	6	12
110	32	5	10	37.3	5.5	11	43	6	12
111	24.7	4	8	28.2	5	9.5	36	6	11
112	22.4	5	10.5	28.3	6	12	30.5	7	14
113	28.2	5	9	33.7	5.5	10	37.5	6.5	12
114	27	4	8	30.6	5	10	35.5	6	12
115	40.7	4	7	45.5	5	9	54	6	11
116	20.3	5	9.5	26.7	5.5	11	30.5	6	12
117	26.3	4	9	31.4	5	11	36.3	6	12
118	38.7	5	10	43.6	6	12	52	7	13.5
119	33.7	5	10	38.9	5.5	11	43	6	12
120	37.8	5	10	41.5	5.5	11	46.5	6	12
R3 Aver.	**29.11**	**4.75**	**9.96**	**34.14**	**5.63**	**11.34**	**39.30**	**6.41**	**12.60**
Av. DBH	**9.27**			**10.87**			**12.51**		

Table 1.2: Measurement data of teak at site II (Had Soa)

Table 1.2: Measurement data of Teak in experimental plots at site II (Hadsoa)									
Name of owner: Nane Seng					**Year of planting: 1996**				
Measurement date: March 18, 2002				**Measurement date: March 18, 2003**			**Measurement date: March 20, 2004**		
Treatment 1: TP1 pruning 50%				**Treatment 1: TP1, pruning 50%**			**Treatment 1: TP1 pruning 50%**		
Before pruning				**After pruning one year**			**After pruning two years**		
Tree No.	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	48.6	7	14	52.5	8	15	56	8	16
2	37.8	5	13	40	5.5	14	45.5	8	15
3	37	6	11	42	7	12	47	8	14
4	40	6	10	53	7.5	12	58.5	8	14
5	44.6	6	12	45.3	7	13.5	50.5	8.5	15
6	19.4	1	8						
7	27.6	2	8	31	2.5	8.5	35.5	4	9
8	30.2	6	12	33.2	7	13	37	8.5	14

9	39.8	9	14	42.3	9	14	47	10	15
10	49	7	12	52.2	8	13.5	56.5	8	15
11	38.2	6	12	41.6	7.5	13	46.5	8	15
12	31.2	4	8	37.7	5.5	10	41.5	7	12
13	47.2	5.5	12	49.3	6	13	56	8	15
14	32.4	4	10	40.3	6.5	12	44.5	7	14
15	40.6	7	13	45.8	8	14	50.5	9	15
16	32.8	6	11	35.2	7	12.5	39	8	13
17	25.2	3	7						
18	23.6	3	7	35.4	4.5	7.5	40.5	6	9
19	40.2	7	13	43.3	7.5	14	47	8	15
20	30.2	5	11						
21	35.6	6	12						
22	44.6	6	11	48.7	7.5	13	52.5	8	15
23	31.6	6	12	38.6	7.5	14	42	8	15
24	45.6	7	12	49.3	8	13.5	53.5	9	15
25	24	2	8						
26	28.4	3	9	34.2	5.5	11	38.5	7	12
27	38	5.5	11						
28	20.4	2	7	22.8	2.5	8	27.5	5	9
29	32	6	11	35.6	7.5	12.5	40.5	9	14
30	39	7	13	46.2	8	14	50.5	9.5	15
31	33	4	10	37.6	6	11.5	42	7.5	14
32	42.8	7	12						
R1 Av.	**35.33**	**5.2**	**10.8**	**41.32**	**6.7**	**12.4**	**45.84**	**7.8**	**13.7**
Av. DBH	**11.25**			**13.16**			**14.60**		
33	45.6	5	12	49.3	6.5	14	53.5	8	15
34	36.8	2	10	39.3	4.5	12	44.5	7	13
35	17.8	2	7	22.2	3	7.5	26.5	5	9
36	36	6	12	40.3	7	13	45	8	15
37	38.8	6	12	43.4	8	14	46	9	15
38	30.4	4	11	33.7	5	12.5	36.5	7	13
39	37	6	12	43.5	7	14	47.5	9	15
40	34	6	11	38.4	7	12	43.5	8	14
41	39.4	6	13	41.3	7	14	45.5	9	15
42	33	4	10						
43	33.3	5	12	35.6	6	13	40.5	8	13
44	34.8	6	12	39.4	6.5	13.5	44.5	8	15
45	31.8	5	12	35.7	6	13	40	7.5	14
46	41.4	6	12	47.2	7	14	52.5	8	15
47	35.4	6	12						
48	33	5	11	37.6	6	12	41.5	8	14
49	34.8	5	10	39.4	6	11	44	7.5	13
50	30.4	6	11	35.7	7	12	39.5	7	13.5
51	36.6	6	12	40.7	7	13.5	43.5	9	14
52	20.6	2	7	25.4	4	8	28.5	6	9
53	37.6	7	12	43.4	8	14	47	8.5	14
54	33	4	9	40.4	6	11.5	44.5	8	14
55	43.6	7	13	47.2	8.5	14	52	9	15
56	24.8	3	8	29.3	5	9	34	7	10
57	41.6	7	12	46.8	7.5	13	51.5	8.5	15
58	27.6	4	10	30.3	5.5	11	34	7	13

59	25.6	5	11						
60	47.2	8	12	51.4	8.5	13	55.5	9	15
61	22	3	9						
62	30.2	4	10						
63	39.6	8	12						
64	24.4	2.5	8						
65	36.4	6	12	41.7	7	13.5	45	8.5	14
R2 Av.	**34.20**	**5.1**	**10.8**	**39.74**	**6.5**	**12.4**	**44.02**	**7.8**	**13.7**
Av. DBH	**10.89**			**12.66**			**14.0**		
66	41	7	12	48.7	8.5	13	53.5	9	15
67	47.8	7	13	52.8	8.5	14	56.5	9	15
68	31.2	6	10						
69	39.6	6	11	45.2	7	13	51.5	8	15
70	36.6	6	12	42.2	8	14	48	9	15
71	41	6	10	47.7	7	12	51.5	8	14
72	20.6	2	6						
73	38	6	11	42.4	6.5	12	46.5	8	13
74	26.8	6	10	32.3	7	13	36.5	8	14
75	33.8	6	10	36.2	7.5	12	40	8	13
76	27.6	5	12						
77	25.6	5	11	29.8	7	13	56.5	9	15
78	46.2	7	12	52.3	8	14	58	8.5	15
79	49.6	6	12	56.4	7.5	14	61	9	15
80	28.2	5	10						
81	42.6	8	13	52.6	8.5	14	55	9	15
82	49.4	8	12	56.6	9.5	14	61	10	15
83	44.2	8	13						
84	43.2	8	14	49.4	8	15	53	8	16
85	36	5	12						
86	43.4	6	12	48.4	7	14	51.5	8	15
87	29.8	6	12						
88	30.4	4	10	35.2	6	12	40	8	13
89	36	6	13	38.3	7.5	14	43.5	9	15
90	28	5	11						
91	31.8	7	12						
92	54.8	8	12						
93	29.8	6	11						
94	34.6	6	12	39.3	7	14	44	7.5	15
95	21.4	3	8	25.7	5	9	30.5	8	11
96	39	7	13	45.4	8.5	14	51.5	9.5	15
97	41.2	7	13						
R3 Av.	**34.71**	**5.4**	**11.0**	**40.47**	**6.8**	**12.6**	**45.07**	**8.0**	**13.9**
Av. DBH	**11.05**			**12.89**			**14.4**		

Measurement date: March 18, 2002				**Measurement date: March 18, 2003**			**Measurement date: March 20, 2004**		
Treatment 2: PT2 pruning 60%				**Treatment 2: PT2 pruning 60%**			**Treatment 2: PT2 pruning 60%**		
Tree No	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	24.6	2	8	29.3	4	9	36	6	11

2	28	4	9	31.4	5	10	36,5	7	12
3	46.4	6	13.5	52.3	8	15	58,5	8	16
4	27.6	4	10						
5	31	4	10	34.3	6	12	42,5	8	13
6	24	2	8	26.2	3.5	9	31.5	5	11
7	38.8	7	13	45.3	8	15	52.5	9	16
8	45	6	12	49.3	7	14	58.5	9	15
9	25	4	12	41.2	6	12	46.5	8	13.5
10	27.8	4	8						
11	28.2	5	11	31.7	6.5	13	36.5	8	14
12	43	6	13	48.8	8	15	55.5	9	16
13	38	6	10	41.4	7	12	48	8	13.5
14	35	6	12						
15	38.4	6	12	40.2	7	13	46.5	8	14
16	27.4	4	10						
17	25.4	3	6	28.1	4	7.5	37	7	10
18	28.4	2	8						
19	48	7	13	56.2	8.5	15	62.5	9	16
20	23.8	3	7						
21	29.4	5	11	39.4	7	13	46.5	8	14.5
22	34	6	12	38.7	7	13	44.5	8	14.5
23	44	7	12	48.3	8	14	56.5	9	15
24	42.4	7	12	50.1	8.5	15	58	9	16
25	27.4	3	10						
26	40.8	6	12	45.6	8	15	52.5	9	16
27	36.4	6	13	40.7	7	14	46.5	8	15
28	30.8	5	12	35.3	7	13.5	40	8	15
29	29.4	4	10						
30	57.4	8	13	62.5	9.5	15	68.5	11	16
31	32	6	12	36.2	7	13	42.5	8	14
32	21	2	7						
33	28.2	5	11						
34	36.4	6	12	42.3	8	14	48.5	9	15
35	20.8	2	8						
36	35.4	7	12	40.4	8	14	45.5	9	15
37	20	2	7						
38	37.6	8	13	42.6	9	14	47	10	15
R1 Av.	**33.08**	**4.9**	**10.6**	**41.45**	**7.0**	**13.0**	**48.15**	**8.3**	**14.1**
Av. DBH	**10.54**			**13.20**			**15.34**		
39	42	7	13	49.5	8.5	14	55.5	9	15
40	18	2	7						
41	28	4	12.5						
42	26.4	4	10	31.4	6	12	36.5	8	14

43	25	4	11						
44	46	7	13	53.2	9	14	60.5	9	15
45	34	6	12	40.4	8	14	50.5	9	15
46	40	7	13.5	45.3	9	14	50	10	15
47	36	6	12	43.2	7	14	48.5	8	15
48	36	7	11						
49	30.4	5	12	35.8	6	13	39.5	8	14
50	38	5	12	42.7	6	13	48.5	8	14
51	20	2	6						
52	36.4	6	12	43.4	7	13	48.5	8	14
53	30	6	12	36.1	6.5	12	41.5	8	13
54	36	6	13	41.4	7	14	46.5	8	15
55	26	5	11	31.2	6	12	34.5	7	13
56	25.4	2	10						
57	40	8	13.5	47.28	14.5		52.5	9	15
58	34.2	6	12	39.4	6.5	13	43	8	14
59	39.6	6	12	44.7	7	14	48.5	8	15
60	26	4	8						
61	29	4	10	33.4	5	11	37.5	7	12
62	18.6	2	8						
63	30.6	5	11	35.3	6	12	40	7	13
64	20.4	2	6						
65	32	6	13	37.1	7	14	42.5	8	15
66	21.6	2	10						
67	27.8	3	9	33.7	5	10	37.5	7	12
68	36	6	12	42.2	7	13	48.5	8	15
69	32.6	5	11	37.4	6	12	43.5	8	14
70	30.4	6	12.5	35.3	7	13.5	39.5	8	15
71	33	7	12	38.6	7	13	44.5	8	15
72	23	2	9						
73	27	2	9						
74	29.2	5	10	31.5	6	12	36.5	7	13
75	22	2	7						
76	17	1	7						
R2 Av.	**31.34**	**4.8**	**10.7**	**40.04**	**7.0**	**13.1**	**45.83**	**8.2**	**14.1**
Av. DBH	**9.98**			**12.75**			**14.59**		
77	33.6	3	9	38.2	5	10	43.5	7	12
78	34.2	6	12	39.7	7	13	44.5	9	15
79	37	7	13	42.3	7.5	14	48.5	9	15
80	26.4	4	9						
81	29	4	10	33.5	6	12	38	8	14
82	30.6	6	12	36.3	7	13	41.5	8	15
83	28.8	4	10	32.4	5	11	37	7	13

84	22	3	9						
85	18	2	8						
86	34.8	7	13	39.6	7.5	14	45.5	9	15
87	31.8	7	13	37.2	7.5	14	43	9	15
88	31.8	6	12						
89	35.2	7	13	41.5	7.5	14	45.5	9	15
90	33	6	13	37.8	7	14	43	8	15
91	33.8	5	12	36.7	6	13	41.5	8	15
92	18.6	1	5						
93	24.4	2	8						
94	32.2	6	11	37.4	6.5	13	43.5	8	15
95	32.8	6	11	37.1	7	12	42.5	8	15
96	39	6	12	44.3	7	14	48	8	14
97	31.4	5	12	35.3	6	12.5	40	7.5	13
98	36.4	6	12	41.4	7	13	47	8	15
99	23	3	9						
100	44	7	12	48.2	7.5	14	52.5	9	15
101	27.6	3	10						
102	40	8	13	48.7	8.5	14	52.5	9	15
103	34	6	12	39.2	7	13	43	8	14
104	20	3	9						
105	56.2	5	12.5	62.4	7	14	67.5	9	15
106	27.6	5	11	33.6	6	12	37	8	14
107	20.2	2	9						
108	31.6	6	12.5	36.2	7	13	41.5	8	15
109	41	6	13	48.4	7	14	55.5	9	15
110	15	1	5						
111	28.8	4	12	33.4	6	13	38	8	14
112	23	2	7						
113	39	6	11	45.6	7	13	51.5	8	15
114	43	5	12	49.4	7	14	55.5	8.5	15
115	27.2	4	11						
R3 Av.	**31.11**	**4.7**	**10.7**	**39.88**	**7.0**	**13.1**	**45.36**	**8.2**	**14.3**
Av. DBH	**9.91**			**12.70**			**14.45**		

Measurement date: March 19, 2002				**Measurement date: March 18, 2003**			**Measurement date: March 20, 2004**		
Treatment 3: PT3 pruning 70%				**Treatment 3: PT3 pruning 70%**			**Treatment 3: PT3 pruning 70%**		
Tree No.	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	41.2	5	12	44.3	7	13	47	8	14
2	21.8	2	6						
3	23.2	3.5	8	36.2	5	9	40.5	7	10

4	33	4	9						
5	29.8	5	10	41.3	6	12	46.5	7	13
6	31.4	4	9	37.3	6	11	40.5	7	13
7	35.8	6	11	39.2	7	13	44.5	8	14
8	37	5	11	40.3	6.5	12	45	8	13
-9	24	5	10						
10	31	5	11						
11	26	3	9						
12	27	4	9	30.3	5	11	33.5	6	12
13	26	5	11	34.4	6	12	36	7	13
14	26.8	4	10						
15	29.8	4	10	33.4	6	12	38	7.5	14
16	35.2	5	11	39.6	6	12	42	7	13
17	31	4	11	36.2	6	11	39.5	7	12
18	30.6	4	10	37.8	6.5	13	40.5	8	14
19	25.2	4	11	34.5	6	12	38.5	7	13
20	31.8	5	9						
21	24.2	3	9	27.4	5	10	30.5	6	12
22	26.2	3	10						
23	34	4	11	38.5	6	12	42.5	7	13
24	30.8	5	10	35.8	6	11	38	7	13
25	32	4	11						
26	28.6	5	11	36.2	6.5	12	40.5	8	14
27	27	4	11						
28	28	3	9	34.6	5	10	37.5	6	12
29	33.4	6	12	37.2	6.5	13	42.5	8	14
30	34.6	6	11	38.7	7	13	42	8	14
R1 Av.	**29.88**	**4.3**	**10.1**	**36.66**	**6.1**	**11.8**	**40.28**	**7.2**	**13.0**
Av. DBH	**9.52**			**11.68**			**12.83**		
31	35.8	6	12	41.5	7	13	45.5	8	14
32	30.4	4	10	37.3	6	12	42	7	13
33	30.8	5	12						
34	32.6	5	12	37.6	6	12.5	41	7	13
35	33	5	10	38.4	6	12	42.5	8	13
36	34	6	12						
37	34.4	5	12	39.3	6.5	13	43.5	7.5	14
38	42.8	7	12	47.3	8.5	13	50	9	14
39	32.8	5	11	38.2	7	12	42	7.5	13
40	35.4	5	10	41.6	7	12	44.5	8	14
41	29	4	10						
42	32.2	5	11	37.6	6	12	41.5	7.5	13
43	39	5	11	44.8	7	13	48.5	8	14
44	27	3	9	35.6	6	12	39	7	14

45	43.6	5	11	48.3	7	13	52.5	8	14
46	30.6	4	10	35.4	6	12	39	7	13
47	24	3	10						
48	26.8	4	9						
49	32.8	4.5	10	37.2	6	11	42	7	13
50	27.6	4	8						
51	32	5	11	35.7	6	12	38.5	7	13
52	35	4	11						
53	34.6	5	12	40.3	7	13	44	8	14
54	32.6	4	11	38.7	6	12	42.5	7	13
55	38	4.5	10						
56	26.2	3	9	30.4	5	11	34	6	12
57	26.6	4	9	33.5	6	11	37.5	7	13
58	22	3	9						
59	28	4	9	33.4	6	11	39.5	8	13
60	26.25	4	9	31.3	5	11	36	7	13
61	31.2	6	12						
62	24	3	9						
63	37.4	4	9	42.4	6	12	46	7	14
64	31	4	10	36.3	6	11	40.5	7	13
65	28.4	5	11	33.2	6	12	38	7	13
66	36	5	11						
R2 Av.	**30.58**	**4.4**	**10.3**	**36.89**	**6.2**	**12.0**	**40.62**	**7.3**	**13.2**
Av. DBH	**9.74**			**11.75**			**12.94**		
67	36.2	5	12	41.7	6.5	13	46	7.5	14
68	28.8	4	10	34.4	6	12	38.5	8	13
69	28	3.5	7	34.6	5	8	38.5	7	10
70	25.6	2	7						
71	27	4	8	33.2	5	9	39.5	7	11
72	18	2	7						
73	33.2	5	12	38.4	6.5	13	43.5	8	14
74	28.4	4	10						
75	43.4	7	13	47.2	7.5	14	52	8	15
76	40.8	6	12	48.1	7	13	52.5	8	14
77	56	6	13	62.4	7	14	66	8	15
78	42.6	6	10	47.7	6.5	13	51.5	9	14
79	34.4	5	12	39.3	6	12.5	44.5	8	14
80	37	5	10	43.2	6.5	13	48	8	14
81	31	5	12						
82	18	2	7						
83	28.6	5	9	35.4	6	11	40	7.5	13
84	23	3	9						
85	27	3	7						

86	36.2	5	11	39.3	6	12	44.5	8	13
87	30	2	9	36.4	4	10.5	40.5	6	12
88	35	4	10	40.2	6	12	46	8	14
89	26.6	3	8						
90	40	5	10	47.3	7	12	52.5	8	14
91	46.6	6	12	53.4	7.5	13	57	8	14
92	22.6	2	8						
93	24	4	8						
94	36	5	12	41.4	6.5	13	46.5	8	14
95	33	4	10	37.3	6	11	42	8	13
96	30.2	3	6	35.7	5	8	40.5	7	9
97	19.2	2	7						
98	39.2	5	11	45.4	7	13	50	8	13
99	26	3	8						
100	32.6	3	8	36.7	6	12	41.58	8	14
101	45	4	9	51.3	6	12	56.5	8	14
R3 Av.	**30.94**	**4.3**	**10.0**	**38.25**	**6.2**	**12.0**	**42.26**	**7.5**	**13.2**
Av. DBH	**9.85**			**12.18**			**13.46**		

Measurement date: March 19, 2002				**Measurement date: March 18, 2003**			**Measurement date: March 20, 2004**		
Treatment 4: PT4; Control				**Treatment 4: PT4; Control**			**Treatment 4: PT4; Control**		
Tree No.	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	47.2	8	14	54.4	9	15	58	9	16
2	39.8	3	11	43.2	5	12	48	7	13
3	27.4	2	6						
4	43.2	5.5	11	48.2	6	12	52.5	8	14
5	46.4	6	12	53.7	7	13	58.5	8	14
6	43.2	6	12	52.4	7	13	57	8	14
7	39.8	6	11	44.7	7	13	49.5	8	14
8	53.8	6	12	58.4	7.5	14	64.5	9	15
9	49	6	12	53.2	7	13	57	8	14
10	47.4	7	12	56.4	8.5	15	59	9	15
11	39.6	5	10	48.2	6	12	52	8	13
12	33.8	2	7	39.4	5	9	43.5	8	12
13	45.6	6	11	54.3	7.5	13	58	8	14
14	34.6	4	12	39.2	5	13	43.5	8	14
15	47.4	8	12	55.2	8.5	14	58.5	9	15
16	42.2	6	11	48.3	7	13	52	8	14
17	45.6	6	10	51.5	7	13	54	8	14
18	22	2	7	26.2	4	8	29	6	9
19	45.4	6	12	51.4	7	13	54.5	8	14

20	45.6	6	11	50.3	7	13	54.5	9	14
21	36.6	5	11	42.3	7	13	46	8	14
22	20	4	9	24.3	5	10	27.5	7	12
23	27	7	12	33.6	8	13	36.5	8	14
24	47	7	11	52.3	7.5	13	55.5	9	14
25	34.8	6	11	38.7	7	13	42	8	14
R1 Av.	**40.18**	**5.4**	**10.8**	**46.66**	**6.8**	**12.9**	**50.46**	**8.1**	**13.7**
Av. DBH	**12.79**			**14.86**			**16.07**		
26	43.2	8	13	51.5	9	14	54.5	9	15
27	44	6	12	52.4	7.5	13	55.5	9	14
28	31	4	12	36.4	6	13	39	8	14
29	29.2	4	10	32.5	5	11	36	7	12
30	26.4	1.5	8	31.3	3	9	35.5	6	9
31	27	5	11	34.6	6	12	38.5	8	13
32	38	6	13	41.3	7.5	14	44.5	9	15
33	46	6	13	53.6	8	14	56	8	15
34	32.2	6	10	35.4	6.5	12	38.5	8	13
35	34.2	2.5	9	40.2	5	10	44.5	7	12
36	33	6	12	38.4	7	13	41.5	8	14
37	36	4	9	44.3	6	12	48.5	8	13
38	37.8	2	9	42.5	5	10	45	7	12
39	30	4	10	35.2	5	11	39.5	7	12
40	40.6	7	12	46.3	8	14	49	8	15
41	25.8	2	8	30.3	4	9	33.5	6	10
42	33.8	5	10	38.4	6	12	42.5	8	13
43	30.4	6	11	35.4	6.5	12	38	8	14
44	43.8	6	12	48.3	7	13	52.5	8	14
45	27.7	3	9	33.5	5	10	36	7	12
46	30	4	9	35.4	5	10	39.5	7	12
47	25.6	3	7	30.4	5	9	34.5	7	10
48	30.4	4	8	34.2	6	10	37.5	8	13
49	26.4	3	8	31.2	5	9	34.5	7	10
50	33.2	4	8	38.4	6	10	41	7.5	12
51	31.8	4	9	36.5	5	10	39	7	11.5
52	33	4	9	38.4	5	10	41.5	7	10
53	30	4	9	36.3	6	11	39	7	12.5
54	36	5	11	44.3	7	13	48.5	8	14
R2 Av.	**33.33**	**4.4**	**10.1**	**38.86**	**6.0**	**11.7**	**42.19**	**7.6**	**12.6**
Av. DBH	**10.61**			**12.38**			**13.44**		
55	24.4	3	7	28.4	4	8	32	6	9
56	29.2	4	10	35.7	6	11	39	8	12
57	35	5	12	40.4	6.5	13	44.5	8	14
58	44	6	13	48.2	7	14	52	8	15

59	31.2	4	10	36.6	7.5	13	39.5	9	15
60	39	6	12	45.6	8	14	49	9	15
61	24.8	3	8	28.4	5	9	32.5	7	10
62	29.4	3	8	33.6	5	9	36.5	7	10
63	29	4	9	34.3	6	10	36.5	7	11
64	28.6	4	7	35.4	5	9	37.5	8	11
65	29	4	11	36.7	6	12	39.5	7	13
66	40	7	13	46.4	8.5	14	49	9	15
67	38.8	6	11	44.7	7	13	47.5	8	14
68	36.4	5	12	40.7	6.5	13	43.5	8	14
69	31.8	4	6	36.2	6	8	39.5	8	10
70	23.2	2	6	27.2	3	8	30.5	5	9
71	53.2	4	7	59.4	6	10	63.5	8	13
72	20	1.5	5	25.1	3	7.5	27.5	5	8
73	42	5	8	50.4	7	11	54.5	8	13
74	38.2	6	11	43.5	8	13	46	8	15
75	33.4	4	9	37.1	6	11	40.5	8	13
76	44.4	2	12	50.5	5	14	54.5	8	15
77	31	6	10	37.4	7	12	40.5	8	14
R3 Av.	**33.74**	**4.3**	**9.4**	**39.21**	**6.0**	**11.1**	**42.41**	**7.6**	**12.5**
Av. DBH	**10.74**			**12.49**			**13.51**		

Table 1.3: Measurement data of teak in experimental plots in site III (Pak Check)

Name of owner: Mr. Mai Bai				**Year of planting: 1996**			
Time of measurement: July 26, 2003				**Time of measurement: July 6, 2004**			
Treatment 1: TT1; thinning 25 %				**Treatment 1: TT1; thinning 25 %**			
Before thinning				**After thinning**			
No	**GBH (cm)**	**CH (m)**	**TH (m)**	**Tree No**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	46	8	12	**1**	51	10.5	13
2	42	8	12	**2**	46	11	14
3	30	6	9	**3**	35.5	8	11
4	33	6	9	**4**	47.5	8	12
5	44	6	9	**5**	48	8.5	13
6	40	7	10	**6**	54.5	8	12
7	50	7	10	**7**	36	8	12
8	33	7	11	**8**	47.5	9.5	14
9	45	7	12	**9**	52	9	13
10	48	7	11	**10**	43.5	9	12
11	40	7	11	**11**	46	9.5	13
12	43	8	11	**12**	41.5	10	13
13	38	8	12	**13**	48.5	11	14
14	46	8	12	**14**	38	9.5	13
15	35	7	11	**15**	43	9	13
16	40	7	11	**16**	43.5	8	12
17	40	7	10	**17**	43	8.5	13
18	40	7	10	**18**			
R1 (Av.)	**40.72**	**7.1**	**10.7**	**R1 (Av.)**	**45.0**	**9.1**	**12.8**

Av. DBH	**12.97**			**Av. DBH**	**14.33**		
19	24	5	9	**19**			
20	36	7	10	**20**	39	8	12
21	37	8	11	**21**	40.5	9	13
22	44	7	11	**22**	47	9.5	13
23	35	6	9	**23**	37.5	8	12
24	34	7	9	**24**			
25	39	6	10	**25**	42.5	8	13
26	25	7	9	**26**			
27	50	7	10	**27**	54.5	8.5	12
28	39	7	10	**28**			
29	29	7	9	**29**	42	8	12
30	30	6	9	**30**	32	9	12
31	45	7	10	**31**	33	8	12
32	43	8	11	**32**	48	9	13
33	52	8	12	**33**	56.5	10	13
34	34	7	10	**34**			
R2 (Av.)	**37.25**	**6.9**	**9.9**	**R2 (Av.)**	**43.25**	**8.7**	**12.4**
Av. DBH	**11.86**			**Av. DBH**	**13.77**		
35	34	7	10	**35**	37	8	12
36	51	7	11	**36**	54.5	9	13
37	39	8	11	**37**	42.5	9.5	12
38	37	7	10	**38**	41	8	12
39	39	7	10	**39**	42.5	9	12
40	36	7	10	**40**	39	8.5	13
41	46	8	11	**41**	49.5	9.5	13
42	44	7	11	**42**	47	9.5	13
43	40	4	10	**43**	43.5	8	12
44	35	7	10	**44**	38.5	9	12
R3 (Av.)	**40.1**	**6.9**	**10.4**	**R3 (Av.)**	**43.5**	**8.8**	**12.4**
Av. DBH	**12.77**			**Av. DBH**	**13.85**		

Time of measurement: July 26, 2003				**Time of measurement: July 6, 2004**			
Treatment 2: TT2; thinning 50%				**Treatment 2: TT2; thinning 50%**			
Before thinning				**After thinning**			
Tree No	**GBH(cm)**	**CH (m)**	**TH (m)**	**Tree No**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	21	5	7	**1**	24.5	7	9
2	32	6	9	**2**	35	8	11
3	30	5	7	**3**	33	7	10
4	38	6	8	**4**	41.5	8	12
5	26	6	8	**5**	29.5	8	11
6	26	4	6	**6**			
7	24	5	7	**7**			
8	31	6	8	**8**	34	8	11
9	34	6	9	**9**	37.5	8	11
10	33	7	9	**10**	36	8.5	11
11	11	4	6	**11**			
12	21	5	7	**12**			
13	21	4	6	**13**	24	7	10
14	40	6	8	**14**	43.5	8	11
15	34	6	8	**15**	37	7	10
16	24	5	7	**16**			

R1 (Av.)	**27.88**	**5.4**	**7.5**	**R1 (Av.)**	**34.1**	**7.7**	**10.6**
Av. DBH	**8.88**			**Av. DBH**	**10.87**		
17	38	6	8	**17**	42	8	12
18	37	5	7	**18**	40.5	7	9
19	17	3	5	**19**			
20	19	3	5	**20**			
21	25	4	6	**21**	28	6	9
22	31	7	9	**22**	33.5	8	12
23	41	7	10	**23**	44	9	13
24	33	7	10	**24**	36.5	8	12
25	25	6	9	**25**	28.5	8	11
26	21	4	6	**26**	24.5	6	9
27	8	2	4	**27**			
28	15	3	5	**28**	18	4	7
29	24	3	5	**29**			
30	28	4	6	**30**	31.5	6	9
31	29	6	8	**31**	32.5	8	11
32	15	4	6	**32**	18	6	9
33	25	5	7	**33**	28.5	7	10
34	10	2	3	**34**			
35	27	5	7	**35**	31	7	10
36	21	3	5	**36**			
37	27	6	9	**37**	30.5	8	11
38	32	7	10	**38**	35	8	12
39	38	8	11	**39**	41.5	9	13
R2 (Av.)	**25.48**	**4.8**	**7.0**	**R2 (Av.)**	**32.0**	**7.0**	**10.5**
Av. DBH	**8.11**			**Av. DBH**	**10.19**		
40	35	7	10	**40**	38.5	8	12
41	40	7	10	**41**	43.5	8	12
42	29	6	8	**42**	32.5	8	11
43	23	5	7	**43**	25.5	7	9
44	23	5	7	**44**	25	7	9
45	34	6	8	**45**	37.5	8	11
46	17	3	5	**46**			
47	19	4	6	**47**	22.5	6	9
48	11	2	4	**48**			
49	11	2	4	**49**			
50	30	5	7	**50**	33	7	10
51	14	4	6	**51**	19.5	6	8
52	16	4	6	**52**	19.5	6	8
R3 (Av.)	**23.23**	**4.6**	**6.8**	**R3 (Av.)**	**29.7**	**7.1**	**9.9**
Av. DBH	**7.40**			**Av. DBH**	**9.46**		

Time of measurement: July 26, 2003				**Time of measurement: July 6, 2004**			
Treatment 3: TT3; thinning with Farmer practices				**Treatment 3: TT3; thinning with Farmer practices**			
before thinning				**After thinning**			
Tree No	**GBH(cm)**	**CH (m)**	**TH (m)**	**Tree No**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	12	2	4	**1**	14.5	4	6
2	4	1	2	**2**			
3	4	1	2	**3**			
4	24	3	5	**4**	27.5	6	8

5	12	2	4	**5**	15.5	4	6
6	20	4	6	**6**	23	6	9
7	24	5	7	**7**	26.5	6	9
8	22	4	7	**8**	25.5	7	9
9	33	4	7	**9**	36	6	9
10	40	5	8	**10**	43	8	11
11	29	5	7	**11**	31.5	7	10
12	21	4	7	**12**	24.5	6	9
13	13	2	3	**13**			
14	9	1	2	**14**			
15	23	3	5	**15**	25	5	8
16	14	2	4	**16**	17	4	7
17	22	4	6	**17**	25	6	9
18	8	1	2	**18**			
19	19	3	6	**19**	22	5	8
20	18	1	3	**20**	22	5	8
21	24	2	5	**21**	27	5	8
R1 (Av.)	**19.45**	**3.0**	**5.0**	**R1 (Av.)**	**26.22**	**5.8**	**8.6**
Av. DBH	**6.20**			**Av. DBH**	**8.35**		
22	33	6	8	**22**	36	8	11
23	20	4	6	**23**			
24	27	2	4	**24**	30	4	6
25	14	2	4	**25**	17	4	6
26	18	3	5	**26**	20	5	7
27	29	5	7	**27**	31.5	7	9
28	21	5	8	**28**	23.5	8	11
29	24	6	7	**29**	27	8	11
30	30	6	8	**30**	32.5	9	12
31	18	3	6	**31**	20	5	8
32	30	6	8	**32**	33.5	8	11
33	18	3	6	**33**	20	5	8
34	30	6	8	**34**	32.5	8	11
35	21	3	6	**35**	23	5	8
36	22	2	6	**36**	25	5	7
37	32	6	8	**37**	34	8	10
38	41	3	7	**38**	43.5	6	9
39	33	6	8	**39**	35.5	7.5	11
40	17	2	4	**40**			
R2 (Av.)	**25.05**	**4.1**	**6.4**	**R2 (Av.)**	**28.00**	**6.3**	**8.9**
Av. DBH	**7.98**			**Av. DBH**	**8.92**		
41	31	4	6	**41**	33.5	6	8
42	24	3	5	**42**	27	5	7
43	18	4	6	**43**	20	6	8
44	24	2	6	**44**	26.5	5	7
45	18	3	6	**45**	20	6	8
46	22	4	6	**46**	24	6	9
47	21	4	6	**47**	23	7	9
48	26	5	7	**48**	28.5	7	10
49	22	3	7	**49**	24.5	5.5	8
50	40	4	8	**50**	43.5	7	10
51	29	5	9	**51**	31.5	8	11
52	33	5	8	**52**	35.5	8	11

53	23	4	7	**53**	25.5	6	8
54	27	4	7	**54**	30.5	6	9
55	33	4	7	**55**	35.5	6	8
56	19	3	5	**56**	22	5	7
57	26	3	6	**57**	28.5	6	8
R3 (Av.)	**25.31**	**3.8**	**6.6**	**R3 (Av.)**	**27.88**	**6.2**	**8.6**
Av. DBH	**8.06**			**Av. DBH**	**8.88**		

Time of measurement: July 26, 2003				**Time of measurement: July 6, 2004**			
Treatment 4: TT4; Control				**Treatment 4: TT4; Control**			
before thinning				**After thinning**			
Tree No	**GBH (cm)**	**CH (m)**	**TH (m)**	**Tree No**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	58	7	12	**1**	61.5	10	14
2	44	8	12	**2**	46	10.5	14
3	48	8	12	**3**	48.5	10.5	13
4	32	7	9	**4**	34.5	8	12
5	22	5	7	**5**	22.5	7	9
6	37	6	8	**6**	39.5	8	10
7	20	4	6	**7**	22.5	6	8
8	17	3	5	**8**	17.5	4	6
9	24	3	6	**9**	26	4	6
10	42	7	9	**10**	44	8	11
R1 (Av.)	**34.40**	**5.8**	**8.6**	**R1 (Av.)**	**36.25**	**7.6**	**10.3**
Av. DBH	**10.96**			**Av. DBH**	**11.54**		
11	32	7	9	**11**	34.5	8	11
12	34	7	10	**12**	36.5	9.5	12
13	36	7	10	**13**	39.5	8	12
14	37	7	10	**14**	40.5	8.5	13
15	61	7	12	**15**	65.5	9	13
16	28	6	9	**16**	30	7.5	11
17	47	8	12	**17**	50	10.5	13
18	38	5	8	**18**	40.5	7	10
19	35	7	9	**19**	37.5	8	12
20	41	7	9	**20**	44	8	12
21	32	6	9	**21**	34.5	8	11
22	38	6	9	**22**	40	8	12
23	38	6	9	**23**	41	8	13
24	27	6	9	**24**	30.5	8	11
25	41	7	10	**25**	43	9	13
26	46	8	11	**26**	49	9	13
27	29	7	10	**27**	31	9	12
28	47	7	11	**28**	50	9.5	13
29	49	8	12	**29**	53	11	13
30	45	8	12	**30**	48.5	11	13
31	41	8	12	**31**	44.5	11	14
32	30	7	11	**32**	32	9.5	12
R2 (Av.)	**38.73**	**6.9**	**10.1**	**R2 (Av.)**	**41.61**	**8.9**	**12.2**
Av. DBH	**12.33**			**Av. DBH**	**13.25**		
33	54	8	11	**33**	58	9.5	13
34	43	8	11	**34**	47	9	12
35	52	7	10	**35**	55	9.5	13

36	28	7	10	**36**	30.5	8	12
37	29	7	10	**37**	31	9	12
38	35	6	9	**38**	37	8	11
39	26	6	9	**39**	28.5	8	11
40	49	7	10	**40**	51.5	8	12
41	24	7	10	**41**	26.5	9	12
42	27	6	9	**42**	30.5	8	11
43	52	9	12	**43**	55	11	14
44	55	7	10	**44**	58	8.5	12
45	42	7	10	**45**	45	9	12
46	31	6	9	**46**	33.5	8	11
47	22	5	8	**47**	24.5	7	10
48	48	7	10	**48**	51.5	9	12
R3 (Av.)	**38.56**	**6.9**	**9.9**	**R3 (Av.)**	**41.44**	**8.7**	**11.9**
Av. DBH	**12.28**			**Av. DBH**	**13.20**		

Table 1.4: measurement data in experimental plots of teak site IV (Houay Leuang)

Name of owner: Thao Nen **Year of planting: 1996**

Measurement date: July 1, 2003 **Measurement date: July 4, 2004**

Treatment 1: TT1; Thinning 25% **Treatment 1: TT1; Thinning 25%**

Before thinning **After thinning**

Tree No	GBH (cm)	CH (m)	TH (m)	Tree No	GBH (cm)	CH (m)	TH (m)
1	25	5	9	**1**			
2	29	5	9	**2**	36.5	6	10.5
3	24	5	9	**3**	29.5	6	10.5
4	35	5	10	**4**	42.5	7	12
5	26	4	8	**5**	32.5	6	10
6	31	5	9	**6**	37	6.5	11
7	34	5	9	**7**	41	6.5	11
8	23	4	8	**8**	29.5	5.5	9.5
9	29	5	9	**9**	36	6	10.5
10	22	4	8	**10**			
11	23	5	9	**11**			
12	24	5	9	**12**			
13	24	5	9	**13**			
14	35	5	10	**14**	43.5	6.5	11.5
15	30	4	8	**15**	36	5.5	9.5
16	37	5	10	**16**	44	7	12
17	31	5	9	**17**	38.5	6.5	11
18	27	4	8	**18**	33.5	5.5	9.5
19	27	4	8	**19**			
20	28	5	9	**20**	35	6	10.5
21	26	5	9	**21**	32.5	6.5	11
22	30	5	9	**22**	36	6.5	11
23	26	5	9	**23**	32	6.5	11
24	31	5	9	**24**	37	6.5	11
25	26	4	8	**25**	31.5	5.5	9.5
26	30	4	8	**26**	36.5	5.5	9.5
Av. R1	**28.19**			**Av. R1**	**36.03**		
Av. DBH	**8.98**	**4.69**	**8.81**	**Av. DBH**	**11.47**	**6.18**	**10.60**
27	32	5	9	**27**	36.5	6.5	10.5
28	22	5	8	**28**	27.5	6	9.5
29	19	4	7	**29**	23.5	5	8
30	35	4	8	**30**	40.5	6	9.5
31	17	4	6	**31**			
32	21	4	6	**32**	26	4	7
33	24	4	6	**33**	28.5	4	7
34	40	5	9	**34**	46.5	6.5	10.5
35	24	5	7	**35**	28	5	8.5
36	37	5	9	**36**	42	6.5	11

37	43	5	9	**37**	48.5	6.5	11
38	21	4	7	**38**			
39	25	4	8	**39**	30	6	9.5
40	16	3	6	**40**			
41	25	4	8	**41**	30.5	5.5	9
42	30	4	8	**42**	36.5	5.5	9
43	18	3	6	**43**			
44	18	4	7	**44**	23	5	8.5
45	19	4	7	**45**	25.4	5	8.5
46	19	4	7	**46**			
47	29	5	9	**47**	35.5	6.5	10.5
Av. R2	**25.43**			**Av. R2**	**33.03**		
Av. DBH	**8.10**	**4.24**	**7.48**	**Av. DBH**	**10.52**	**5.59**	**9.22**
48	27	3	7	**48**	33.5	5	8.5
49	17	4	7	**49**			
50	35	6	9	**50**	41.5	6.5	10.5
51	32	6	9	**51**	38	6.5	10.5
52	27	5	7	**52**	33	5	8
53	23	4	7	**53**			
54	21	4	7	**54**	27.5	5	8
55	15	2	6	**55**			
56	33	5	8	**56**	38.5	6	9.5
57	31	5	8	**57**	36.5	6	9.5
58	33	5	8	**58**	38.5	6	9.5
59	34	5	8	**59**	40	6	9.5
60	30	5	8	**60**			
61	33	5	9	**61**	37.5	6.5	11
62	24	5	7	**62**	29.5	5	8
63	15	3	6	**63**			
64	23	4	7	**64**			
65	18	4	6	**65**	23.5	4	7
66	18	2	5	**66**			
67	21	3	7	**67**	25.5	5	8.5
68	21	3	6	**68**	25.5	4.5	7.5
69	27	3	7	**69**	33	5	8.5
Av. R3	**25.36**			**Av. R3**	**33.43**		
Av. DBH	**8.08**	**4.14**	**7.23**	**Av. DBH**	**10.65**	**5.47**	**8.93**

Measurement date: July 1, 2003				**Measurement date: July 4, 2004**			
Treatment 2: TT2; Thinning 50%				**Treatment 2: TT2; Thinning 50%**			
Tree No	**GBH (cm)**	**CH (m)**	**TH (m)**	**Tree No**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	29	5	9	**1**	35	6.5	10.5
2	29	5	9	**2**			
3	31	5	9	**3**	38.5	6.5	10.5
4	38	5	9	**4**	44.5	6.5	10.5

5	22	5	8	**5**			
6	32	4	7	**6**	38	5	8
7	39	5	9	**7**	45	6	10
8	24	4	8	**8**			
9	31	5	9	**9**	37	5.5	10
10	24	4	8	**10**			
11	32	5	9	**11**	39	6	10
12	22	4	8	**12**	40	5.5	9
13	25	4	8	**13**			
14	23	4	8	**14**	29	5.5	9
15	22	4	8	**15**			
16	29	5	9	**16**	34	6	10
17	24	5	9	**17**	29.5	6	10
18	23	4	8	**18**			
19	26	4	8	**19**	31	5	9
20	33	5	9	**20**	49.5	6	10
Av. R1	**27.90**			**Av. R1**	**37.69**		
Av. DBH	**8.89**	**4.55**	**8.45**	**Av. DBH**	**12.00**	**5.85**	**9.73**
21	25	5	8	**21**	33.5	5.5	8.5
22	26	5	9	**22**	35	6	10
23	26	4	7	**23**			
24	29	5	9	**24**	36.5	6	10
25	23	4	8	**25**			
26	28	5	9	**26**			
27	33	5	9	**27**	40	6.5	10
28	36	5	9	**28**	44.5	6.5	10
29	31	5	9	**29**	38	6	10
30	27	5	9	**30**			
31	31	5	9	**31**	38.5	6	10
32	38	6	10	**32**	45	6.5	11
33	24	5	9	**33**			
34	28	5	9	**34**	35.5	6	10
35	25	4	8	**35**			
36	31	4	9	**36**	39	6	10
Av. R2	**28.81**			**Av. R2**	**38.55**		
Av. DBH	**9.18**	**4.81**	**8.75**	**Av. DBH**	**12.28**	**6.10**	**9.95**
37	35	5	9	**37**	42.5	6	10
38	31	5	9	**38**	37.5	6	10
39				**39**			
40	34	5	10	**40**	40.5	6.5	11
41	23	4	8	**41**	28	5	8.5
42	24	4	9	**42**			
43	26	5	9	**43**	44	6	10
44	31	4	8	**44**	37	5	8.5
45	24	4	8	**45**			

46	31	4	9	**46**	38	6	10
47	27	5	9	**47**			
48	32	5	9	**48**	38.5	6	10
49	34	5	10	**49**	40.5	6.5	11
50	37	5	10	**50**	43.5	6.5	11
51	20	4	7	**51**			
52	28	5	9	**52**	34	6	10
53	32	6	10	**53**	40.5	6.5	11
54	18.5	3	6	**54**			
55	38	6	10	**55**	45.5	6.5	11
Av. R3	**29.19**			**Av. R3**	**39.23**		
Av. DBH	**9.33**	**4.67**	**8.83**	**Av. DBH**	**12.53**	**6.04**	**10.15**

Measurement date: July 1, 2003				**Measurement date: July 5, 2003**			
Treatment 3 : TT3; Farmer practice				**Treatment 3 : TT3; Farmer practice**			
Tree No	**GBH (cm)**	**CH (m)**	**TH (m)**	**Tree No**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	23	4	7	**1**			
2	28	5	9	**2**	32.5	6	10
3	32	5	9	**3**	36	6	10
4	31	5	9	**4**	35.5	6	10
5	26	5	9	**5**	31	6	10.5
6	30	5	9	**6**	34.5	6	10.5
7	24	5	9	**7**	28.5	6	10.5
8	31	6	10	**8**	36.5	6.5	11
9	30	6	10	**9**	35.2	6.5	11
10	32	6	10	**10**	37	6.5	11
11	26	4	8	**11**	29.5	5.5	9
12	26	4	8	**12**			
13	27	4	8	**13**	32.5	5.5	9
14	30	6	10	**14**	35	7	11
15	38	6	10	**15**	42	7	11
16	33	6	10	**16**	37.5	7	11
Av. R1	**29.19**			**Av. R1**	**34.51**		
Av. DBH	**9.30**	**5.13**	**9.06**	**Av. DBH**	**10.99**	**6.25**	**10.39**
17	33	6	10	**17**	37	6.5	11
18	26	5	9	**18**	29.5	6	10
19	36	6	11	**19**	40.5	7	12
20	33	6	10	**20**	36.5	6.5	11
21	26	5	8	**21**	29.5	5.5	9
22	31	5	9	**22**	34	6	10
23	32	5	9	**23**	35.5	6	10
24	33	6	10	**24**	37.5	6.5	11
25	36	6	11	**25**	40	7	12
26	30	6	10	**26**	33.5	6.5	11
27	39	6	11	**27**	43	7	12

28	17	4	6	**28**			
29	18	3	6	**29**			
30	35	6	11	**30**	38	7	12
31	32	5	10	**31**	35.5	6.5	11
32	30	5	10	**32**	34.5	6.5	11
33	35	6	11	**33**	38.5	7	12
34	33	5	10	**34**	36.5	6.5	11
Av. R2	**30.83**			**Av. R2**	**36.22**		
Av. DBH	**9.85**	**5.33**	**9.56**	**Av. DBH**	**11.57**	**6.50**	**11.00**
35	31	5	9	**35**			
36	33	5	9	**36**	38.5	6	10
37	32	5	10	**37**	38	6.5	11
38	29	6	11	**38**	35.5	7	12
39	31	5	10	**39**	37	6.5	11
40	28	6	10	**40**	34	7	12
41	34	5	10	**41**	39.5	6.5	11
42	31	6	11	**42**	36.5	7	12
43	28	5	9	**43**	33.5	6	10.5
44	34	5	10	**44**	38	7	12
45	32	5	10	**45**	36.5	7	12
46	30	5	9	**46**	35	6	10
47	28	5	10	**47**	32	6.5	11
48	33	6	11	**48**	37.5	7	12
Av. R3	**31.00**			**Av. R3**	**36.27**		
Av. DBH	**9.87**	**5.29**	**9.93**	**Av. DBH**	**11.55**	**6.62**	**11.27**

Measurement date: July 1, 2003				**Measurement date: July 5, 2004**			
Treatment 4 : TT4; Control				**Treatment 4 : TT4; Control**			
Tree No	**GBH (cm)**	**CH (m)**	**TH (m)**	**Tree No**	**GBH (cm)**	**CH (m)**	**TH (m)**
1	40	6	12	**1**	44.5	6.5	13
2	30	6	11	**2**	34	6.5	12.5
3	30	6	11	**3**	34	7	12.5
4	37	6	11	**4**	41.5	7	12.5
5	36	5	10	**5**	41	6	11.5
6	25	5	9	**6**	30.5	5.5	10.5
7	33	5	10	**7**	36.5	5.5	11.5
8	22	5	10	**8**	26	5.5	11.5
9	23	5	9	**9**	27.5	5.5	10.5
10	23	5	9	**10**	28	5.5	10.5
11	22	5	9	**11**	27	6	10.5
12	27	4	8	**12**	32.5	5.5	9
13	35	5	10	**13**	39.5	5.5	11.5
14	25	5	9	**14**	29.5	5.5	10.5
15	32	5	10	**15**	36	5.5	11.5
16	37	6	12	**16**	42	6.5	13

17	41	6	12	**17**	46.5	6.5	13
18	39	6	11	**18**	45	6.5	13
19	38	6	12	**19**	43	6.5	13
20	34	6	11	**20**	39.5	6.5	12
21	21	4	7	**21**	27	4.5	7.5
22	32	4	9	**22**	37.5	5	10.5
23	22	4	8	**23**	27	5	9
Av. R1	**30.61**			**Av. R1**	**35.46**		
Av. DBH	**9.75**	**5.22**	**10.00**	**Av. DBH**	**11.29**	**5.89**	**11.33**
24	24	5	9	**24**	28	6	10.5
25	23	4	7	**25**	27.5	5	8
26	27	5	9	**26**	30.5	6	10.5
27	27	5	9	**27**	30	6	10.5
28	24	5	9	**28**	28	6	10.5
29	29	5	9	**29**	32.5	6	10.5
30	31	6	10	**30**	35.5	6.5	11
31	34	6	10	**31**	38	7	11
32	35	7	11	**32**	39.5	7.5	12
33	31	7	11	**33**	35.5	7.5	12
34	23	6	9	**34**	27.5	7	10.5
35	33	7	11	**35**	37.5	8	12
36	17	4	7	**36**	22	5	8
37	27	5	9	**37**	33.5	6	10.5
38	21	5	9	**38**	25	6	10.5
39	22	5	9	**39**	26	6	10
40	26	5	9	**40**	31.5	6	10
41	22	5	9	**41**	26.5	6	10.5
42	25	5	9	**42**	29.5	6	10.5
43	27	4	8	**43**	32.5	5	9.5
44	23	4	8	**44**	27	5	9.5
45	17	4	7	**45**	21.5	5	8
46	26	5	9	**46**	30.5	6	10.5
47	29	5	9	**47**	33	6	10.5
Av. R2	**25.96**			**Av. R2**	**30.35**		
Av. DBH	**8.27**	**5.17**	**9.00**	**Av. DBH**	**9.67**	**6.1**	**10.3**
48	23	5	8	**48**	28.5	6	9
49	16	3	7	**49**	20	4	8
50	27	6	9	**50**	32.5	7	10.5
51	25	5	8	**51**	28.5	6	9
52	17	3	7	**52**	21	3.5	8
53	20	2	5	**53**	24.5	2	6
54	25	5	8	**54**	28.5	6	9
55	26	5	8	**55**	30.5	6	9.5
56	34	6	9	**56**	38	7	10.5
57	23	5	8	**57**	28.5	6	9

58	32	6	9	**58**	37.5	7	10.5
59	25	4	7	**59**	30	4.5	8
60	32	6	9	**60**	36.5	7	10.5
61	40	6	8	**61**	44.6	7	9.5
62	18	3	7	**62**	22	3.5	8
63	20	3	7	**63**	24.5	3.5	8
64	19	3	7	**64**	22	4	8
65	14	2	5	**65**	17.5	2	6
66	23	4	7	**66**	26.5	5	8
67	18	3	7	**67**	21	4	8
68	31	5	8	**68**	35	6	9.5
Av. R2	**24.19**			**Av. R2**	**28.46**		
Av. DBH	**7.70**	**4.29**	**7.52**	**Av. DBH**	**9.06**	**5.10**	**8.69**

Appendix 2: Basal area and annual volume increments of teak at four sites: Site I (Lathahae); Site II (Had Soa); site III (Pak Check) and site IV (Houay Leuang)

Table 2.1: Basal area increment of teak at site I (Lathahae) and site II (Had Soa)

Treatment	Pseudo replicate	Basal area increment at Site I (Lathahae)			Basal area increment at Site II (Had Soa)		
		BA02 (m^2)	BA03 (m^2)	BA04 (m^2)	BA02 (m^2)	BA03 (m^2)	BA04 (m^2)
TP1 (50%)	R1	0.011	0.011	0.014	0.013	0.014	0.017
	R2	0.009	0.009	0.013	0.012	0.013	0.015
	R3	0.009	0.010	0.014	0.014	0.013	0.016
	Average	**0.009**	**0.010**	**0.014**	**0.013**	**0.013**	**0.016**
TP2 (60%)	R1	0.008	0.011	0.012	0.012	0.012	0.016
	R2	0.008	0.009	0.012	0.010	0.010	0.013
	R3	0.008	0.010	0.012	0.011	0.011	0.014
	Average	**0.008**	**0.010**	**0.012**	**0.011**	**0.011**	**0.015**
TP3 (70%)	R1	0.009	0.011	0.014	0.009	0.009	0.011
	R2	0.009	0.011	0.015	0.010	0.010	0.012
	R3	0.010	0.010	0.013	0.011	0.012	0.015
	Average	**0.009**	**0.010**	**0.014**	**0.010**	**0.010**	**0.013**
TP4 (Untr.)	R1	0.009	0.012	0.014	0.017	0.022	0.026
	R2	0.008	0.011	0.015	0.012	0.016	0.018
	R3	0.009	0.012	0.016	0.012	0.016	0.019
	Average	**0.009**	**0.012**	**0.015**	**0.014**	**0.018**	**0.021**

Table 2.2: Mean annual volume increment of teak at site I (Lathahae) and site II (Had Soa)

Treatment	Pseudo replicate	Mean annual volume increment of teak at Site I (Lathahae), ($m^3 \cdot 0.05ha^{-1} \cdot year^{-1}$)		Mean annual volume increment of teak at site II (Had Soa) ($m^3 \cdot 0.05ha^{-1} \cdot year^{-1}$)	
		2002-2003 (1 year)	2002-2004 (2 years)	2002-2003 (1 year)	2002-2004 (2 years)
	R1	0.3	1.1	0.3	1.0
	R2	0.3	1.1	0.3	0.9
	R3	0.4	1.3	0.0	0.7
TP1 (50%)	Total	**1.0**	**3.4**	**0.6**	**2.6**
	R1	0.5	0.9	0.4	1.3
	R2	0.3	0.6	0.2	1.0
	R3	0.4	1.0	0.4	1.2
TP2 (60%)	Total	**1.2**	**2.5**	**1.1**	**3.6**
	R1	0.5	1.3	0.1	0.5
	R2	0.4	1.3	0.2	0.6
	R3	0.3	1.2	0.4	1.0
TP3 (70%)	Total	**1.3**	**3.8**	**0.7**	**2.2**
	R1	0.5	1.1	0.9	1.4
	R2	0.8	1.9	0.7	1.2
	R3	0.6	1.3	0.6	1.0
TP4 (Untr.)	Total	**1.8**	**4.3**	**2.1**	**3.6**

Table 2.3: Basal area increment (BAI) of teak at site III (Pak Check) and site IV (Houay Leuang)

Treatment	Pseudo replicate	Basal area increment of teak at Site III (Pak Check), m^2		Basal area increment of teak at Site IV (Houay Leuang), m^2	
		2003	2004	2003	2004
TT1 (25%)	R1	0.017	0.020	0.008	0.010
	R2	0.015	0.013	0.007	0.009
	R3	0.017	0.019	0.007	0.008
	Average	**0.016**	**0.017**	**0.007**	**0.009**
TT2 (50%)	R1	0.008	0.008	0.008	0.010
	R2	0.007	0.008	0.009	0.010
	R3	0.006	0.007	0.008	0.011
	Average	**0.007**	**0.008**	**0.008**	**0.010**
TT3 (Farm.p.)	R1	0.004	0.005	0.009	0.011
	R2	0.007	0.008	0.010	0.012
	R3	0.007	0.008	0.010	0.012
	Average	**0.006**	**0.007**	**0.010**	**0.012**
TT4 (Untr.)	R1	0.014	0.015	0.010	0.013
	R2	0.016	0.018	0.007	0.010
	R3	0.016	0.019	0.006	0.009
	Average	**0.015**	**0.017**	**0.008**	**0.010**

Table 2.4: Mean annual volume increment of teak at site III (Pak Check) and site IV (Houay Leuang)

Treatment	Pseudo replicate	Mean annual volume increment of teak at Site III (Pak Check), (m3. 0.05ha-1 . year-1)	Mean annual volume increment of teak at site IV (Houay Leuang) (m3. 0.05ha-1 . year-1)
		2003-2004 (1 year)	2003-2004 (1 year)
TT1 (25%)	R1	0.4	0.3
	R2	0.1	0.2
	R3	0.2	0.2
	Total	**0.7**	**0.7**
TT2 (50%)	R1	0.1	0.2
	R2	0.2	0.1
	R3	0.1	0.2
	Total	**0.5**	**0.5**
TT3 (Farm.pract.)	R1	0.2	0.2
	R2	0.2	0.2
	R3	0.2	0.2
	Total	**0.5**	**0.6**
TT4 (Untr.)	R1	0.1	0.4
	R2	0.5	0.3
	R3	0.3	0.2
	Total	**1.0**	**0.9**

Appendix 3: Analysis of statistics at four experimental sites

Appendix 3.1: Analysis of statistics in site I (Lathahae)

ONE-WAY AOV FOR DBH_02 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.72393	0.57464	4.84	0.0331
WITHIN	8	0.94917	0.11865		
TOTAL	11	2.67310			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	1.70	3	0.6368
COCHRAN'S Q	0.5262		
LARGEST VAR / SMALLEST VAR	7.6161		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.15200
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	9.5069	3	0.4997
2	8.6075	3	0.2690
3	9.5624	3	0.1811
4	9.2197	3	0.3460
TOTAL	9.2241	12	0.3445

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_02 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	9.5624	I
1	9.5069	I
4	9.2197	I I
2	8.6075	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6485
STANDARD ERROR FOR COMPARISON 0.2812

ONE-WAY AOV FOR CH_02 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.64904	0.54968	12.32	0.0023
WITHIN	8	0.35697	0.04462		
TOTAL	11	2.00600			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.40	3	0.9403
COCHRAN'S Q	0.3388		
LARGEST VAR / SMALLEST VAR	2.4160		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.16835
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV

1	4.2640	3	0.1582
2	4.3978	3	0.2459
3	5.2206	3	0.1905
4	4.4959	3	0.2382
TOTAL	4.5946	12	0.2112

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_02 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	5.2206	I
4	4.4959	.. I
2	4.3978	.. I
1	4.2640	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.3977
STANDARD ERROR FOR COMPARISON 0.1725

ONE-WAY AOV FOR TH_02 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.20199	0.40066	3.89	0.0552
WITHIN	8	0.82349	0.10294		
TOTAL	11	2.02548			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.50	3	0.9193

COCHRAN'S Q 0.3387
LARGEST VAR / SMALLEST VAR 2.9200
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.09924
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	9.3310	3	0.2185
2	9.2801	3	0.3515
3	10.076	3	0.3179
4	9.6294	3	0.3734
TOTAL	9.5792	12	0.3208

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_02 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	10.076	I
4	9.6294	I I
1	9.3310	.. I
2	9.2801	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6041

STANDARD ERROR FOR COMPARISON 0.2620

ONE-WAY AOV FOR DBH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	2.63112	0.87704	5.80	0.0209
WITHIN	8	1.20871	0.15109		
TOTAL	11	3.83983			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.10	3	0.3767

COCHRAN'S Q 0.6183
LARGEST VAR / SMALLEST VAR 11.701
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.24198
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	11.886	3	0.6113
2	11.219	3	0.1787
3	11.730	3	0.3944
4	10.692	3	0.2078
TOTAL	11.382	12	0.3887

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	11.886	I
3	11.730	I
2	11.219	I I
4	10.692	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.7319
STANDARD ERROR FOR COMPARISON 0.3174

ONE-WAY AOV FOR CH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	16.0494	5.34979	111.13	0.0000
WITHIN	8	0.38511	0.04814		
TOTAL	11	16.4345			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.14	3	0.2467

COCHRAN'S Q 0.5917
LARGEST VAR / SMALLEST VAR 21.281
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.76722
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	5.7142	3	0.0732
2	6.7446	3	0.3375

3	8.3644	3	0.1083
4	5.4004	3	0.2481
TOTAL	6.5559	12	0.2194

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	8.3644	I
2	6.7446	.. I
1	5.7142	 I
4	5.4004	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.4131
STANDARD ERROR FOR COMPARISON 0.1791

ONE-WAY AOV FOR TH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	3.26299	1.08766	10.06	0.0043
WITHIN	8	0.86462	0.10808		
TOTAL	11	4.12761			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.48	3	0.9234

COCHRAN'S Q 0.3799
LARGEST VAR / SMALLEST VAR 3.0084
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.32653
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	10.942	3	0.3297
2	11.572	3	0.3238
3	12.193	3	0.2336
4	10.932	3	0.4052
TOTAL	11.410	12	0.3288

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	12.193	I
2	11.572	.. I
1	10.942	 I
4	10.932	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6190
STANDARD ERROR FOR COMPARISON 0.2684

ONE-WAY AOV FOR DBH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	5.40450	1.80150	16.61	0.0008
WITHIN	8	0.86762	0.10845		
TOTAL	11	6.27213			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.11	3	0.9905

COCHRAN'S Q 0.2975
LARGEST VAR / SMALLEST VAR 1.5470
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.56435
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	13.739	3	0.3546
2	12.529	3	0.2888
3	13.575	3	0.3092
4	12.161	3	0.3593
TOTAL	13.001	12	0.3293

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	13.739	I
3	13.575	I
2	12.529	.. I
4	12.161	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6201
STANDARD ERROR FOR COMPARISON 0.2689

ONE-WAY AOV FOR CH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	18.2029	6.06763	124.55	0.0000
WITHIN	8	0.38974	0.04872		
TOTAL	11	18.5926			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.16	3	0.2443

COCHRAN'S Q 0.6493
LARGEST VAR / SMALLEST VAR 31.690
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.00630
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	6.4341	3	0.1435
2	7.6867	3	0.3557
3	9.3179	3	0.0632
4	6.2273	3	0.2092

TOTAL	7.4165	12	0.2207

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	9.3179	I
2	7.6867	.. I
1	6.4341	 I
4	6.2273	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.4156
STANDARD ERROR FOR COMPARISON 0.1802

ONE-WAY AOV FOR TH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	3.13406	1.04469	13.26	0.0018
WITHIN	8	0.63024	0.07878		
TOTAL	11	3.76430			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.65	3	0.8852

COCHRAN'S Q 0.4193
LARGEST VAR / SMALLEST VAR 3.2474
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.32197
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	12.368	3	0.2373
2	13.113	3	0.3635
3	13.567	3	0.2017
4	12.372	3	0.2933
TOTAL	12.855	12	0.2807

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	13.567	I
2	13.113	I
4	12.372	.. I
1	12.368	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.5285
STANDARD ERROR FOR COMPARISON 0.2292

ONE-WAY AOV FOR DBH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	2.17447	0.72482	7.08	0.0122
WITHIN	8	0.81956	0.10244		
TOTAL	11	2.99403			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.15	3	0.2462

COCHRAN'S Q 0.7541
LARGEST VAR / SMALLEST VAR 13.872
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.20746
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	2.3787	3	0.1493
2	2.6120	3	0.1549
3	2.1678	3	0.5559
4	1.4725	3	0.2334
TOTAL	2.1578	12	0.3201

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	2.6120	I
1	2.3787	I
3	2.1678	I
4	1.4725	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6026
STANDARD ERROR FOR COMPARISON 0.2613

ONE-WAY AOV FOR CH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	8.77469	2.92490	222.18	0.0000
WITHIN	8	0.10531	0.01316		
TOTAL	11	8.88000			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.23	3	0.5263

COCHRAN'S Q 0.6107
LARGEST VAR / SMALLEST VAR 9.6526
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.97058
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	1.4502	3	0.0879
2	2.3468	3	0.0972
3	3.1437	3	0.1793
4	0.9045	3	0.0577
TOTAL	1.9613	12	0.1147

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	3.1437	I
2	2.3468	.. I
1	1.4502	 I
4	0.9045	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2160
STANDARD ERROR FOR COMPARISON 0.0937

ONE-WAY AOV FOR TH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.86709	0.62236	53.97	0.0000
WITHIN	8	0.09226	0.01153		
TOTAL	11	1.95934			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.41	3	0.3320

COCHRAN'S Q 0.6537
LARGEST VAR / SMALLEST VAR 21.242
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.20361
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	1.6110	3	0.1736
2	2.2924	3	0.0377
3	2.1171	3	0.0892
4	1.3026	3	0.0812
TOTAL	1.8308	12	0.1074

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	2.2924	I
3	2.1171	I
1	1.6110	.. I
4	1.3026	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2022
STANDARD ERROR FOR COMPARISON 0.0877

ONE-WAY AOV FOR DBH_A2 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	2.94287	0.98096	4.83	0.0334
WITHIN	8	1.62598	0.20325		

TOTAL	11	4.56885

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.42	3	0.4902
COCHRAN'S Q	0.4321		
LARGEST VAR / SMALLEST VAR	14.816		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.25924
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	4.2317	3	0.1540
2	3.9211	3	0.4450
3	4.0123	3	0.4899
4	2.9415	3	0.5927
TOTAL	3.7767	12	0.4508

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_A2 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	4.2317	I
3	4.0123	I
2	3.9211	I
4	2.9415	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.8488
STANDARD ERROR FOR COMPARISON 0.3681

ONE-WAY AOV FOR CH_A2 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	10.3764	3.45881	248.02	0.0000
WITHIN	8	0.11157	0.01395		
TOTAL	11	10.4880			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.76	3	0.4294
COCHRAN'S Q	0.6076		
LARGEST VAR / SMALLEST VAR	12.141		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.14829
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	2.1701	3	0.0528
2	3.2889	3	0.1164
3	4.0973	3	0.1841
4	1.7313	3	0.0745
TOTAL	2.8219	12	0.1181

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_A2 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	4.0973	I
2	3.2889	.. I
1	2.1701	 I
4	1.7313	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2223
STANDARD ERROR FOR COMPARISON 0.0964

ONE-WAY AOV FOR TH_A2 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	2.09389	0.69796	41.41	0.0000
WITHIN	8	0.13484	0.01686		
TOTAL	11	2.22873			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	1.41	3	0.7036

COCHRAN'S Q 0.5471
LARGEST VAR / SMALLEST VAR 4.8103
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.22704
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	3.0370	3	0.0920
2	3.8324	3	0.1921
3	3.4911	3	0.1201
4	2.7422	3	0.0876
TOTAL	3.2757	12	0.1298

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_A2 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	3.8324	I
3	3.4911	.. I
1	3.0370	 I
4	2.7422	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2444
STANDARD ERROR FOR COMPARISON 0.1060

Basal area and mean annual volume increment at site I (Lathahae)

ONE-WAY AOV FOR BA_02 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	4.161E-06	1.387E-06	3.36	0.0755
WITHIN	8	3.299E-06	4.123E-07		
TOTAL	11	7.460E-06			

CHI-SQ DF P

BARTLETT'S TEST OF
EQUAL VARIANCES 3.87 3 0.2753
COCHRAN'S Q 0.6883
LARGEST VAR / SMALLEST VAR 17.538
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 3.249E-07
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	9.358E-03	3	1.065E-03
2	7.923E-03	3	3.351E-04
3	9.374E-03	3	2.544E-04
4	8.877E-03	3	5.806E-04
TOTAL	8.883E-03	12	6.421E-04

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA02 BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
3	9.374E-03	I
1	9.358E-03	I
4	8.877E-03	I I
2	7.923E-03	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.209E-03
STANDARD ERROR FOR COMPARISON 5.243E-04

ONE-WAY AOV FOR BA03 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	6.466E-06	2.155E-06	4.47	0.0402
WITHIN	8	3.860E-06	4.825E-07		
TOTAL	11	1.033E-05			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.75	3	0.8622

COCHRAN'S Q 0.4126
LARGEST VAR / SMALLEST VAR 3.8967
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 5.576E-07
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.0103	3	8.924E-04
2	9.834E-03	3	7.254E-04
3	0.0105	3	6.349E-04
4	0.0118	3	4.521E-04
TOTAL	0.0106	12	6.946E-04

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA03 BY TREATMENT

HOMOGENEOUS
TREATMENT MEAN GROUPS

4	0.0118	I
3	0.0105	.. I
1	0.0103	.. I
2	9.834E-03	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.308E-03
STANDARD ERROR FOR COMPARISON 5.672E-04

ONE-WAY AOV FOR BA04 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.423E-05	4.743E-06	6.56	0.0150
WITHIN	8	5.781E-06	7.226E-07		
TOTAL	11	2.001E-05			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.73	3	0.8664

COCHRAN'S Q 0.3250
LARGEST VAR / SMALLEST VAR 3.5329
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.340E-06
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.0136	3	9.627E-04
2	0.0121	3	5.156E-04
3	0.0140	3	8.709E-04
4	0.0152	3	9.692E-04
TOTAL	0.0138	12	8.500E-04

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA04 BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
4	0.0152	I
3	0.0140	I
1	0.0136	I I
2	0.0121	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.601E-03
STANDARD ERROR FOR COMPARISON 6.941E-04

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ONE-WAY AOV FOR MEAN ANNUAL VOLUME INCREMENT OF LATHAHAE 2002-2003 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.12285	0.04095	3.60	0.0653
WITHIN	8	0.09088	0.01136		

TOTAL 11 0.21374

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.52	3	0.3179

COCHRAN'S Q 0.4456
LARGEST VAR / SMALLEST VAR 30.747
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.00986
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.3398	3	0.0257
2	0.3914	3	0.1166
3	0.4240	3	0.1046
4	0.6082	3	0.1423
TOTAL	0.4409	12	0.1066

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF LTH BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
4	0.6082	I
3	0.4240	I I
2	0.3914	.. I
1	0.3398	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2007
STANDARD ERROR FOR COMPARISON 0.0870

ONE-WAY AOV FOR MEAN ANNUAL VOLUME INCREMENT OF LATHAHAE 2002-2004 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.30561	0.10187	4.11	0.0489
WITHIN	8	0.19852	0.02482		
TOTAL	11	0.50413			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.49	3	0.2132

COCHRAN'S Q 0.7686
LARGEST VAR / SMALLEST VAR 15.579

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.02568
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.8080	3	0.0700
2	0.4532	3	0.1132

3	0.8329	3	0.0725
4	0.8226	3	0.2762
TOTAL	0.7292	12	0.1575

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF LATHAHAE BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
3	0.8329	I
4	0.8226	I
1	0.8080	I
2	0.4532	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2966
STANDARD ERROR FOR COMPARISON 0.1286

Appendix 3.2: Analysis of statistic in site II (Had Soa)

ONE-WAY AOV FOR DBH_02 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	4.19976	1.39992	3.13	0.0876
WITHIN	8	3.58145	0.44768		
TOTAL	11	7.78122			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	6.50	3	0.0895

COCHRAN'S Q 0.8354
LARGEST VAR / SMALLEST VAR 46.305
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.31741
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	11.067	3	0.1797
2	10.176	3	0.3188
3	9.9700	3	0.4009
4	11.385	3	1.2231
TOTAL	10.649	12	0.6691

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_02 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
4	11.385	I
1	11.067	I I
2	10.176	I I
3	9.9700	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.2598
STANDARD ERROR FOR COMPARISON 0.5463

ONE-WAY AOV FOR CH_02 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.07011	0.35670	4.48	0.0399
WITHIN	8	0.63702	0.07963		
TOTAL	11	1.70712			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	8.27	3	0.0408

COCHRAN'S Q 0.8358
LARGEST VAR / SMALLEST VAR 99.343
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.09236
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	5.1373	3	0.0518

2	4.8354	3	0.0975
3	4.3056	3	0.2002
4	4.7059	3	0.5160
TOTAL	4.7460	12	0.2822

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_02 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	5.1373	I
2	4.8354	I I
4	4.7059	I I
3	4.3056	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306   REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.5313
STANDARD ERROR FOR COMPARISON 0.2304

ONE-WAY AOV FOR TH_02 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.62643	0.54214	3.67	0.0628
WITHIN	8	1.18233	0.14779		
TOTAL	11	2.80876			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	8.12	3	0.0436

COCHRAN'S Q 0.7431
LARGEST VAR / SMALLEST VAR 76.135
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.13145
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	10.911	3	0.1013
2	10.682	3	0.0760
3	10.049	3	0.3686
4	10.110	3	0.6628
TOTAL	10.438	12	0.3844

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_02 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	10.911	I
2	10.682	I I
4	10.110	.. I
3	10.049	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306   REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.7238
STANDARD ERROR FOR COMPARISON 0.3139

ONE-WAY AOV FOR DBH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.39228	0.46409	0.83	0.5119
WITHIN	8	4.45161	0.55645		
TOTAL	11	5.84388			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	9.39	3	0.0246
COCHRAN'S Q	0.8820		
LARGEST VAR / SMALLEST VAR	91.038		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS -0.03079
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	13.223	3	0.1468
2	13.923	3	0.1961
3	13.022	3	0.4500
4	13.240	3	1.4012
TOTAL	13.352	12	0.7460

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	13.923	I
4	13.240	I
1	13.223	I
3	13.022	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.4045
STANDARD ERROR FOR COMPARISON 0.6091

ONE-WAY AOV FOR CH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	15.4539	5.15128	46.04	0.0000
WITHIN	8	0.89504	0.11188		
TOTAL	11	16.3489			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	9.44	3	0.0239
COCHRAN'S Q	0.7714		
LARGEST VAR / SMALLEST VAR	107.17		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.67980
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	6.4829	3	0.0706
2	7.8765	3	0.3067
3	8.4780	3	0.0568

4	5.5938	3	0.5876
TOTAL	7.1078	12	0.3345

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	8.4780	I
2	7.8765	I
1	6.4829	.. I
4	5.5938	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6298
STANDARD ERROR FOR COMPARISON 0.2731

ONE-WAY AOV FOR TH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	4.45720	1.48573	9.64	0.0049
WITHIN	8	1.23341	0.15418		
TOTAL	11	5.69060			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.74	3	0.1920

COCHRAN'S Q 0.7562
LARGEST VAR / SMALLEST VAR 23.027
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.44385
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	12.880	3	0.1911
2	13.352	3	0.3060
3	12.401	3	0.1423
4	11.704	3	0.6829
TOTAL	12.584	12	0.3927

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	13.352	I
1	12.880	I I
3	12.401	.. I I
4	11.704	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.7393
STANDARD ERROR FOR COMPARISON 0.3206

ONE-WAY AOV FOR DBH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	5.73783	1.91261	3.17	0.0854
WITHIN	8	4.82897	0.60362		
TOTAL	11	10.5668			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	10.13	3	0.0175

COCHRAN'S Q 0.9322
LARGEST VAR / SMALLEST VAR 76.031
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.43633
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	15.243	3	0.1721
2	16.274	3	0.2368
3	15.501	3	0.2794
4	14.338	3	1.5002
TOTAL	15.339	12	0.7769

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	16.274	I
3	15.501	I I
1	15.243	I I
4	14.338	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.4628
STANDARD ERROR FOR COMPARISON 0.6344

ONE-WAY AOV FOR CH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	20.6416	6.88054	62.09	0.0000
WITHIN	8	0.88648	0.11081		
TOTAL	11	21.5281			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.71	3	0.2945

COCHRAN'S Q 0.6786
LARGEST VAR / SMALLEST VAR 22.697
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.25658
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	7.2786	3	0.1151
2	8.8086	3	0.2774
3	9.7877	3	0.2286
4	6.4092	3	0.5484
TOTAL	8.0710	12	0.3329

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	9.7877	I
2	8.8086	.. I
1	7.2786	 I
4	6.4092	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306   REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6268
STANDARD ERROR FOR COMPARISON 0.2718

ONE-WAY AOV FOR TH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	5.35842	1.78614	10.67	0.0036
WITHIN	8	1.33869	0.16734		
TOTAL	11	6.69711			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.23	3	0.5270

COCHRAN'S Q 0.5278
LARGEST VAR / SMALLEST VAR 12.408
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.53960
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	14.575	3	0.4033
2	14.920	3	0.3535
3	14.382	3	0.1687
4	13.148	3	0.5944
TOTAL	14.256	12	0.4091

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	14.920	I
1	14.575	I
3	14.382	I
4	13.148	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306   REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.7702
STANDARD ERROR FOR COMPARISON 0.3340

ONE-WAY AOV FOR DBH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	6.68437	2.22812	54.95	0.0000

WITHIN	8	0.32440	0.04055
TOTAL	11	7.00876	

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.05	3	0.5630
COCHRAN'S Q	0.6060		
LARGEST VAR / SMALLEST VAR	7.1329		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.72919
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	2.1565	3	0.1174
2	3.7468	3	0.1346
3	3.0520	3	0.3135
4	1.8555	3	0.1789
TOTAL	2.7027	12	0.2014

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	3.7468	I
3	3.0520	.. I
1	2.1565	 I
4	1.8555	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.3791
STANDARD ERROR FOR COMPARISON 0.1644

ONE-WAY AOV FOR CH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	20.8362	6.94541	123.01	0.0000
WITHIN	8	0.45169	0.05646		
TOTAL	11	21.2879			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	8.17	3	0.0427
COCHRAN'S Q	0.7091		
LARGEST VAR / SMALLEST VAR	107.10		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.29632
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	1.3456	3	0.0387
2	3.0412	3	0.4002
3	4.1725	3	0.2430
4	0.8878	3	0.0719
TOTAL	2.3618	12	0.2376

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	4.1725	I
2	3.0412	.. I
1	1.3456	 I
4	0.8878	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.4474
STANDARD ERROR FOR COMPARISON 0.1940

ONE-WAY AOV FOR TH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.96116	0.65372	10.18	0.0042
WITHIN	8	0.51359	0.06420		
TOTAL	11	2.47475			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	6.57	3	0.0868

COCHRAN'S Q 0.7059
LARGEST VAR / SMALLEST VAR 64.164
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.19651
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	1.9691	3	0.0998
2	2.6700	3	0.2505
3	2.3525	3	0.4257
4	1.5936	3	0.0532
TOTAL	2.1463	12	0.2534

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	2.6700	I
3	2.3525	I I
1	1.9691	.. I I
4	1.5936	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.4771
STANDARD ERROR FOR COMPARISON 0.2069

ONE-WAY AOV FOR DBH_A2 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	17.9070	5.96901	124.32	0.0000
WITHIN	8	0.38411	0.04801		
TOTAL	11	18.2911			

CHI-SQ DF P

BARTLETT'S TEST OF
EQUAL VARIANCES 4.41 3 0.2209
COCHRAN'S Q 0.5105
LARGEST VAR / SMALLEST VAR 23.013
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.97366
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	4.1767	3	0.0653
2	6.0979	3	0.1065
3	5.5305	3	0.3131
4	2.9531	3	0.2800
TOTAL	4.6896	12	0.2191

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_A2 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	6.0979	I
3	5.5305	.. I
1	4.1767	 I
4	2.9531	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.4126
STANDARD ERROR FOR COMPARISON 0.1789

ONE-WAY AOV FOR CH_A2 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	27.3139	9.10463	243.50	0.0000
WITHIN	8	0.29913	0.03739		
TOTAL	11	27.6130			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	12.18	3	0.0068

COCHRAN'S Q 0.9347
LARGEST VAR / SMALLEST VAR 147.65
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 3.02241
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	2.1413	3	0.0870
2	3.9733	3	0.3739
3	5.4821	3	0.0308
4	1.7032	3	0.0352
TOTAL	3.3250	12	0.1934

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_A2 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	5.4821	I

2	3.9733	.. I
1	2.1413	 I
4	1.7032	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.3641
STANDARD ERROR FOR COMPARISON 0.1579

ONE-WAY AOV FOR TH_A2 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	3.22138	1.07379	13.86	0.0016
WITHIN	8	0.61967	0.07746		
TOTAL	11	3.84105			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.29	3	0.3495

COCHRAN'S Q 0.3692
LARGEST VAR / SMALLEST VAR 24.027
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.33211
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	3.6646	3	0.3020
2	4.2379	3	0.3154
3	4.3333	3	0.3382
4	3.0380	3	0.0690
TOTAL	3.8185	12	0.2783

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_A2 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	4.3333	I
2	4.2379	I
1	3.6646	.. I
4	3.0380	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.5240
STANDARD ERROR FOR COMPARISON 0.2272

Basal area and mean annual volume increments at site II (Had Soa)

ONE-WAY AOV FOR BA02 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	2.571E-05	8.569E-06	2.71	0.1152
WITHIN	8	2.527E-05	3.159E-06		
TOTAL	11	5.098E-05			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.30	3	0.3475

COCHRAN'S Q 0.7294
LARGEST VAR / SMALLEST VAR 8.8668
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.803E-06
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.0132	3	1.108E-03
2	0.0107	3	1.074E-03
3	0.0103	3	1.020E-03
4	0.0136	3	3.036E-03
TOTAL	0.0120	12	1.777E-03

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA02 BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
4	0.0136	I
1	0.0132	I
2	0.0107	I
3	0.0103	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 3.346E-03
STANDARD ERROR FOR COMPARISON 1.451E-03

ONE-WAY AOV FOR BA03 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.021E-04	3.402E-05	8.42	0.0074
WITHIN	8	3.234E-05	4.042E-06		
TOTAL	11	1.344E-04			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.29	3	0.2322

COCHRAN'S Q 0.7391
LARGEST VAR / SMALLEST VAR 21.115
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 9.994E-06
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.0131	3	7.523E-04
2	0.0114	3	1.103E-03
3	0.0104	3	1.561E-03
4	0.0180	3	3.457E-03
TOTAL	0.0132	12	2.011E-03

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA03 BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
4	0.0180	I
1	0.0131	.. I

2	0.0114	.. I
3	0.0104	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 3.785E-03
STANDARD ERROR FOR COMPARISON 1.642E-03

ONE-WAY AOV FOR BA04 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.135E-04	3.783E-05	6.42	0.0160
WITHIN	8	4.717E-05	5.896E-06		
TOTAL	11	1.606E-04			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.59	3	0.3093

COCHRAN'S Q 0.6751
LARGEST VAR / SMALLEST VAR 21.295
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.064E-05
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.0161	3	8.647E-04
2	0.0147	3	1.693E-03
3	0.0127	3	2.012E-03
4	0.0210	3	3.990E-03
TOTAL	0.0161	12	2.428E-03

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA04 BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
4	0.0210	I
1	0.0161	.. I
2	0.0147	.. I
3	0.0127	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 4.572E-03
STANDARD ERROR FOR COMPARISON 1.983E-03
===

ONE-WAY AOV FOR MAN VOLUME INCREMANT AT HADSOA 2002-2003 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.48978	0.16326	8.03	0.0085
WITHIN	8	0.16256	0.02032		
TOTAL	11	0.65234			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.25	3	0.9697

COCHRAN'S Q 0.3044
LARGEST VAR / SMALLEST VAR 2.0456
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.04765
EFFECTIVE CELL SIZE 3.0

	SAMPLE	GROUP	
TREATMENT	MEAN	SIZE	STD DEV
1	0.2059	3	0.1431
2	0.3625	3	0.1100
3	0.2344	3	0.1573
4	0.7138	3	0.1548
TOTAL	0.3792	12	0.1425

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF HADSOA BY TREATMENT

		HOMOGENEOUS
TREATMENT	MEAN	GROUPS
4	0.7138	I
2	0.3625	.. I
3	0.2344	.. I
1	0.2059	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2684
STANDARD ERROR FOR COMPARISON 0.1164

ONE-WAY AOV FOR MEAN ANNUAL VOLUME INCREMENT AT HADSOA 2002-2004 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.52021	0.17340	4.16	0.0474
WITHIN	8	0.33314	0.04164		
TOTAL	11	0.85335			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.73	3	0.8665

COCHRAN'S Q 0.4298
LARGEST VAR / SMALLEST VAR 3.3810
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.04392
EFFECTIVE CELL SIZE 3.0

	SAMPLE	GROUP	
TREATMENT	MEAN	SIZE	STD DEV
1	0.8751	3	0.1455
2	1.1914	3	0.1665
3	0.7258	3	0.2676
4	1.2144	3	0.2146
TOTAL	1.0017	12	0.2041

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF HADSOA 2002-2004 BY TREATMENT

HOMOGENEOUS

TREATMENT	MEAN	GROUPS
4	1.2144	I
2	1.1914	I
1	0.8751	I I
3	0.7258	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.3842
STANDARD ERROR FOR COMPARISON 0.1666

Appendix3.3: Analysis of statistic in site III (Pak Check)

ONE-WAY AOV FOR DBH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	60.1917	20.0639	30.68	0.0001
WITHIN	8	5.23115	0.65389		
TOTAL	11	65.4228			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.58	3	0.9012

COCHRAN'S Q 0.4247
LARGEST VAR / SMALLEST VAR 3.1957
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 6.47000
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	12.534	3	0.5896
2	8.1299	3	0.7397
3	7.4119	3	1.0540
4	11.857	3	0.7809
TOTAL	9.9832	12	0.8086

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	12.534	I
4	11.857	I
2	8.1299	.. I
3	7.4119	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.5225
STANDARD ERROR FOR COMPARISON 0.6602

ONE-WAY AOV FOR DBH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	51.0023	17.0008	41.67	0.0000
WITHIN	8	3.26422	0.40803		
TOTAL	11	54.2666			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.09	3	0.3778

COCHRAN'S Q 0.5770
LARGEST VAR / SMALLEST VAR 10.365
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 5.53092
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	13.986	3	0.3014
2	10.174	3	0.7066

3	8.7148	3	0.3167
4	12.665	3	0.9704
TOTAL	11.385	12	0.6388

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	13.986	I
4	12.665	.. I
2	10.174	 I
3	8.7148	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.2027
STANDARD ERROR FOR COMPARISON 0.5216

ONE-WAY AOV FOR CH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	21.2534	7.08447	31.08	0.0001
WITHIN	8	1.82329	0.22791		
TOTAL	11	23.0767			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.33	3	0.3430

COCHRAN'S Q 0.4364
LARGEST VAR / SMALLEST VAR 23.646
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.28552
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	6.9620	3	0.1297
2	4.9243	3	0.3991
3	3.6135	3	0.5811
4	6.5280	3	0.6307
TOTAL	5.5070	12	0.4774

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	6.9620	I
4	6.5280	I
2	4.9243	.. I
3	3.6135	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.8989
STANDARD ERROR FOR COMPARISON 0.3898

ONE-WAY AOV FOR CH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	13.6221	4.54071	25.57	0.0002
WITHIN	8	1.42045	0.17756		
TOTAL	11	15.0426			

	CHI-SQ	DF	P
BARTLETT'S TEST OF			
EQUAL VARIANCES	2.66	3	0.4467
COCHRAN'S Q	0.6466		
LARGEST VAR / SMALLEST VAR	9.9532		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 1.45439
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	8.8753	3	0.2148
2	7.2606	3	0.3682
3	6.1123	3	0.2632
4	8.3733	3	0.6777
TOTAL	7.6554	12	0.4214

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	8.8753	I
4	8.3733	I
2	7.2606	.. I
3	6.1123	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.7934
STANDARD ERROR FOR COMPARISON 0.3441

ONE-WAY AOV FOR TH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	37.2604	12.4201	28.32	0.0001
WITHIN	8	3.50892	0.43861		
TOTAL	11	40.7694			

	CHI-SQ	DF	P
BARTLETT'S TEST OF			
EQUAL VARIANCES	1.94	3	0.5860
COCHRAN'S Q	0.4466		
LARGEST VAR / SMALLEST VAR	5.6154		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 3.99384
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	10.353	3	0.3944
2	7.089	3	0.3736
3	6.0154	3	0.8852
4	9.5371	3	0.8220
TOTAL	8.2489	12	0.6623

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	10.353	I
4	9.5371	I
2	7.0897	.. I
3	6.0154	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306   REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.2470
STANDARD ERROR FOR COMPARISON 0.5407

ONE-WAY AOV FOR TH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	23.9602	7.98673	24.65	0.0002
WITHIN	8	2.59173	0.32397		
TOTAL	11	26.5519			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	5.98	3	0.1125

COCHRAN'S Q 0.8127
LARGEST VAR / SMALLEST VAR 25.092
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.55426
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	12.527	3	0.2059
2	10.355	3	0.3979
3	8.710	3	0.2049
4	11.467	3	1.0262
TOTAL	10.765	12	0.5692

CASES INCLUDED 12   MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
1	12.527	I
4	11.467	I
2	10.355	.. I
3	8.710	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306   REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.0717
STANDARD ERROR FOR COMPARISON 0.4647

ONE-WAY AOV FOR DBH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P

BETWEEN	3	2.33103	0.77701	4.08	0.0497
WITHIN	8	1.52494	0.19062		
TOTAL	11	3.85597			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	8.74	3	0.0329

COCHRAN'S Q 0.7177
LARGEST VAR / SMALLEST VAR 284.55
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.19546
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	1.4520	3	0.4212
2	2.0438	3	0.0439
3	1.3030	3	0.7397
4	0.8080	3	0.1895
TOTAL	1.4017	12	0.4366

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	2.0438	I
1	1.4520	I I
3	1.3030	I I
4	0.8080	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.8220
STANDARD ERROR FOR COMPARISON 0.3565

ONE-WAY AOV FOR CH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.91566	0.30522	8.96	0.0062
WITHIN	8	0.27266	0.03408		
TOTAL	11	1.18832			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.88	3	0.2744

COCHRAN'S Q 0.7420
LARGEST VAR / SMALLEST VAR 13.253
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.09038
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	1.9133	3	0.0874
2	2.3363	3	0.1360
3	2.4988	3	0.3180
4	1.8453	3	0.0951
TOTAL	2.1484	12	0.1846

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	2.4988	I
2	2.3363	I
1	1.9133	.. I
4	1.8453	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.3476
STANDARD ERROR FOR COMPARISON 0.1507

ONE-WAY AOV FOR TH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	3.16201	1.05400	5.29	0.0265
WITHIN	8	1.59390	0.19924		
TOTAL	11	4.75591			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.61	3	0.2027

COCHRAN'S Q 0.7937
LARGEST VAR / SMALLEST VAR 15.115
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.28492
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	2.1739	3	0.2652
2	3.2655	3	0.2286
3	2.6953	3	0.7953
4	1.9303	3	0.2046
TOTAL	2.5162	12	0.4464

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	3.2655	I
3	2.6953	I I
1	2.1739	.. I
4	1.9303	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.8404
STANDARD ERROR FOR COMPARISON 0.3645

Basal area and maen annual volume increment at site III (Pak Check)

ONE-WAY AOV FOR BA03 BY TREATMENT

SOURCE DF SS MS F P

BETWEEN	3	2.459E-04	8.195E-05	47.17	0.0000
WITHIN	8	1.390E-05	1.737E-06		
TOTAL	11	2.598E-04			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.25	3	0.9699
COCHRAN'S Q	0.3159		
LARGEST VAR / SMALLEST VAR	2.0319		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.674E-05
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.0161	3	1.260E-03
2	7.372E-03	3	1.039E-03
3	6.110E-03	3	1.482E-03
4	0.0153	3	1.445E-03
TOTAL	0.0112	12	1.318E-03

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA03 BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
1	0.0161	I
4	0.0153	I
2	7.372E-03	.. I
3	6.110E-03	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 2.482E-03
STANDARD ERROR FOR COMPARISON 1.076E-03

ONE-WAY AOV FOR BA_04 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	2.931E-04	9.769E-05	19.39	0.0005
WITHIN	8	4.031E-05	5.038E-06		
TOTAL	11	3.334E-04			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.76	3	0.1903
COCHRAN'S Q	0.6554		
LARGEST VAR / SMALLEST VAR	51.653		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 3.088E-05
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.0175	3	3.634E-03
2	7.947E-03	3	5.057E-04
3	7.203E-03	3	1.641E-03
4	0.0174	3	1.999E-03
TOTAL	0.0125	12	2.245E-03

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA_04 BY TREATMENT

		HOMOGENEOUS
TREATMENT	MEAN	GROUPS
1	0.0175	I
4	0.0174	I
2	7.947E-03	.. I
3	7.203E-03	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 4.226E-03
STANDARD ERROR FOR COMPARISON 1.833E-03
==

ONE-WAY AOV FOR MAEN ANNUAL VOLUME INCREMENT AT PAKCHECK 2003-2004 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.05097	0.01699	1.16	0.3834
WITHIN	8	0.11724	0.01465		
TOTAL	11	0.16820			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	7.13	3	0.0677
COCHRAN'S Q	0.4666		
LARGEST VAR / SMALLEST VAR	132.21		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 7.782E-04
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	0.2481	3	0.1654
2	0.1665	3	0.0636
3	0.1613	3	0.0144
4	0.3198	3	0.1643
TOTAL	0.2239	12	0.1211

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF PC BY TREATMENT

		HOMOGENEOUS
TREATMENT	MEAN	GROUPS
4	0.3198	I
1	0.2481	I
2	0.1665	I
3	0.1613	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.2279
STANDARD ERROR FOR COMPARISON 0.0988

Appendix 3.4: Analysis of statistic in site IV (Houay Leuang)

ONE-WAY AOV FOR DBH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	3.04844	1.01615	2.65	0.1207
WITHIN	8	3.07333	0.38417		
TOTAL	11	6.12177			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.33	3	0.2279
COCHRAN'S Q	0.7254		
LARGEST VAR / SMALLEST VAR	22.098		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.21066
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	8.3848	3	0.5142
2	9.1295	3	0.2246
3	9.6730	3	0.3272
4	8.5730	3	1.0558
TOTAL	8.9401	12	0.6198

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	9.6730	I
2	9.1295	I I
4	8.5730	I I
1	8.3848	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.1670
STANDARD ERROR FOR COMPARISON 0.5061

ONE-WAY AOV FOR CH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.26408	0.42136	4.31	0.0438
WITHIN	8	0.78256	0.09782		
TOTAL	11	2.04664			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.83	3	0.1849
COCHRAN'S Q	0.7014		
LARGEST VAR / SMALLEST VAR	23.031		

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.10785
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	4.3556	3	0.2960
2	4.6764	3	0.1315

3	5.2480	3	0.1092
4	4.8899	3	0.5239
TOTAL	4.7925	12	0.3128

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	5.2480	I
4	4.8899	I I
2	4.6764	I I
1	4.3556	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.5889
STANDARD ERROR FOR COMPARISON 0.2554

ONE-WAY AOV FOR TH_03 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	4.28687	1.42896	2.28	0.1559
WITHIN	8	5.00648	0.62581		
TOTAL	11	9.29335			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.77	3	0.1895

COCHRAN'S Q 0.6199
LARGEST VAR / SMALLEST VAR 38.176
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.26772
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	7.8371	3	0.8498
2	8.6778	3	0.2016
3	9.5155	3	0.4344
4	8.8413	3	1.2457
TOTAL	8.7179	12	0.7911

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_03 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	9.5155	I
4	8.8413	I I
2	8.6778	I I
1	7.8371	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.4895
STANDARD ERROR FOR COMPARISON 0.6459

ONE-WAY AOV FOR DBH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	8.09138	2.69713	6.02	0.0189
WITHIN	8	3.58178	0.44772		
TOTAL	11	11.6732			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.25	3	0.2358

COCHRAN'S Q 0.7421
LARGEST VAR / SMALLEST VAR 18.929
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.74980
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	10.879	3	0.5182
2	12.272	3	0.2650
3	11.396	3	0.3509
4	10.007	3	1.1528
TOTAL	11.138	12	0.6691

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	12.272	I
3	11.396	I I
1	10.879	.. I I
4	10.007	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.2598
STANDARD ERROR FOR COMPARISON 0.5463

ONE-WAY AOV FOR CH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.13333	0.37778	3.10	0.0890
WITHIN	8	0.97393	0.12174		
TOTAL	11	2.10727			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.24	3	0.3568

COCHRAN'S Q 0.5808
LARGEST VAR / SMALLEST VAR 16.130
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.08535
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	5.7451	3	0.3777
2	5.9949	3	0.1324
3	6.4722	3	0.2097
4	5.6969	3	0.5318

TOTAL 5.9773 12 0.3489
CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	6.4722	I
2	5.9949	I I
1	5.7451	.. I
4	5.6969	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.6570
STANDARD ERROR FOR COMPARISON 0.2849

ONE-WAY AOV FOR TH_04 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	2.81825	0.93942	1.33	0.3316
WITHIN	8	5.66007	0.70751		
TOTAL	11	8.47832			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	4.74	3	0.1915

COCHRAN'S Q 0.6231
LARGEST VAR / SMALLEST VAR 39.389
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.07730
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	9.5840	3	0.8914
2	9.9449	3	0.2116
3	10.909	3	0.4768
4	10.103	3	1.3279
TOTAL	10.135	12	0.8411

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_04 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
3	10.909	I
4	10.103	I
2	9.9449	I
1	9.5840	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 1.5837
STANDARD ERROR FOR COMPARISON 0.6868

ONE-WAY AOV FOR DBH_A1 BY TREAT_NO

SOURCE DF SS MS F P

BETWEEN 3 5.36494 1.78831 374.93 0.0000
WITHIN 8 0.03816 0.00477
TOTAL 11 5.40310

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.28	3	0.5171

COCHRAN'S Q 0.4950
LARGEST VAR / SMALLEST VAR 12.351
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.59451
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	2.4946	3	0.0754
2	3.1421	3	0.0565
3	1.7229	3	0.0277
4	1.4342	3	0.0972
TOTAL	2.1984	12	0.0691

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF DBH_A1 BY TREAT_NO

TREAT_NO	MEAN	HOMOGENEOUS GROUPS
2	3.1421	I
1	2.4946	.. I
3	1.7229	 I
4	1.4342	 I

ALL 4 MEANS ARE SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1300
STANDARD ERROR FOR COMPARISON 0.0564

ONE-WAY AOV FOR CH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.61229	0.20410	18.12	0.0006
WITHIN	8	0.09011	0.01126		
TOTAL	11	0.70239			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.04	3	0.5646

COCHRAN'S Q 0.4186
LARGEST VAR / SMALLEST VAR 8.7712
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.06428
EFFECTIVE CELL SIZE 3.0

TREAT_NO	SAMPLE MEAN	GROUP SIZE	STD DEV
1	1.3896	3	0.0817
2	1.3185	3	0.0464
3	1.2242	3	0.1373
4	0.8070	3	0.1318
TOTAL	1.1848	12	0.1061

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF CH_A1 BY TREAT_NO

HOMOGENEOUS

TREAT_NO	MEAN	GROUPS
1	1.3896	I
2	1.3185	I
3	1.2242	I
4	0.8070	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1998
STANDARD ERROR FOR COMPARISON 0.0867

ONE-WAY AOV FOR TH_A1 BY TREAT_NO

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.46833	0.15611	38.94	0.0000
WITHIN	8	0.03207	0.00401		
TOTAL	11	0.50041			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	0.72	3	0.8676

COCHRAN'S Q 0.4388
LARGEST VAR / SMALLEST VAR 3.7548
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.05070
EFFECTIVE CELL SIZE 3.0

TREAT_NO	MEAN	SAMPLE SIZE	GROUP STD DEV
1	1.7470	3	0.0433
2	1.2671	3	0.0614
3	1.3932	3	0.0579
4	1.2615	3	0.0839
TOTAL	1.4172	12	0.0633

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF TH_A1 BY TREAT_NO

HOMOGENEOUS

TREAT_NO	MEAN	GROUPS
1	1.7470	I
3	1.3932	.. I
2	1.2671	 I
4	1.2615	 I

THERE ARE 3 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1192
STANDARD ERROR FOR COMPARISON 0.0517

Basal area and mean annual volume increment at site IV (Houay Leuang)

ONE-WAY AOV FOR BA03 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	7.427E-06	2.476E-06	2.20	0.1664

WITHIN	8	9.022E-06	1.128E-06		
TOTAL	11	1.645E-05			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	6.33	3	0.0967

COCHRAN'S Q 0.7941
LARGEST VAR / SMALLEST VAR 69.577
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 4.493E-07
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	7.447E-03	3	6.820E-04
2	8.412E-03	3	2.269E-04
3	9.513E-03	3	6.419E-04
4	7.785E-03	3	1.893E-03
TOTAL	8.289E-03	12	1.062E-03

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA03 BY TREATMENT

TREATMENT	MEAN	HOMOGENEOUS GROUPS
3	9.513E-03	I
2	8.412E-03	I I
4	7.785E-03	I I
1	7.447E-03	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 2.000E-03
STANDARD ERROR FOR COMPARISON 8.671E-04

ONE-WAY AOV FOR BA04 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	1.091E-05	3.637E-06	1.73	0.2375
WITHIN	8	1.680E-05	2.100E-06		
TOTAL	11	2.771E-05			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	2.89	3	0.4087

COCHRAN'S Q 0.6778
LARGEST VAR / SMALLEST VAR 10.573
COMPONENT OF VARIANCE FOR BETWEEN GROUPS 5.126E-07
EFFECTIVE CELL SIZE 3.0

TREATMENT	SAMPLE MEAN	GROUP SIZE	STD DEV
1	9.038E-03	3	1.161E-03
2	9.973E-03	3	7.338E-04
3	0.0117	3	9.059E-04
4	0.0105	3	2.386E-03
TOTAL	0.0103	12	1.449E-03

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF BA04 BY TREATMENT

		HOMOGENEOUS
TREATMENT	MEAN	GROUPS
3	0.0117	I
4	0.0105	I
2	9.973E-03	I
1	9.038E-03	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.
CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 2.728E-03
STANDARD ERROR FOR COMPARISON 1.183E-03
==

ONE-WAY AOV FOR MEAN ANNUAL VOLUME INCREMENT AT HOUAU LEUANG 2003-2004 BY TREATMENT

SOURCE	DF	SS	MS	F	P
BETWEEN	3	0.03161	0.01054	1.98	0.1962
WITHIN	8	0.04265	0.00533		
TOTAL	11	0.07426			

	CHI-SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	3.17	3	0.3655

COCHRAN'S Q 0.4358
LARGEST VAR / SMALLEST VAR 20.141

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 0.00174
EFFECTIVE CELL SIZE 3.0

	SAMPLE	GROUP	
TREATMENT	MEAN	SIZE	STD DEV
1	0.2310	3	0.0905
2	0.1644	3	0.0581
3	0.1949	3	0.0215
4	0.3021	3	0.0964
TOTAL	0.2231	12	0.0730

CASES INCLUDED 12 MISSING CASES 0

LSD (T) COMPARISON OF MEANS OF HL BY TREATMENT

		HOMOGENEOUS
TREATMENT	MEAN	GROUPS
4	0.3021	I
1	0.2310	I I
3	0.1949	I I
2	0.1644	.. I

THERE ARE 2 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.306 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1375
STANDARD ERROR FOR COMPARISON 0.0596