



**Government of the Union of Myanmar**  
**Ministry of Forestry**  
**Forest Department**  
**Forest Research Institute**



**Trial Planting of Commercial Species  
in the East Pegu Yoma**

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## အရှေ့ပဲခူးရိုးမတွင်စီးပွားရေးအရအဖိုးတန်သစ်မျိုးများစမ်းသပ်စိုက်ပျိုးခြင်း

ဦးမင်းကိုကိုကြီး၊ B.Sc. (For.) (Rgn.), M.Sc. (ANU)၊ ဌာနမှူး

ဦးအောင်ခင်၊ B.Sc. (For.) (Rgn.)၊ စိုက်ကွက်မှူး

နှင့်

ဦးဇော်ဝင်း၊ B.Sc. (For.) (Rgn.)၊ စိုက်ကွက်မှူး

သစ်တောသုတေသနဌာန၊ ရေဆင်း။

### စာတမ်းအကျဉ်းချုပ်

မြန်မာနိုင်ငံမှ ပြည်ပသို့တင်ပို့ရောင်းချရန်နှင့် ပြည်တွင်းလုံလောက်စွာ သုံးစွဲရန်အတွက် သစ်တော စိုက်ခင်းများတည်ထောင်ရာတွင် ကျွန်းသစ်ကိုသာအဓိကထား၍ စိုက်ပျိုးခဲ့ပါသည်။ ယခုအခါ ကျွန်းသာမက သင်းဝင်၊ ပိတောက်စသော အခြားအဖိုးတန်သစ်မျိုးများကို ကမ္ဘာနှင့်အဝန်း လူကြိုက်များကြသဖြင့် ထိုသစ်မျိုးများကို စိုက်ခင်းများအဖြစ် အောင်မြင်စွာစိုက်ပျိုးနိုင်ရန်နှင့် သစ်တစ်မျိုးတည်း စိုက်ပျိုးခြင်း အားဖြင့် ဖြစ်ပေါ်လာနိုင်သော အန္တရာယ်ကိုကာကွယ်နိုင်ရန် စူးစမ်းလေ့လာမှုများ ဆောင်ရွက်ရန် လိုအပ် လာပါသည်။ အရှေ့ပဲခူးရိုးမဒေသဖြစ်သော ပျဉ်းမနားမြို့နယ်တွင် ပြည်တွင်းသစ် (၁၃) မျိုး၊ နိုင်ငံခြား အပူပိုင်းထင်းရှူးသစ်မျိုး (၄) မျိုးနှင့် အုတ်တွင်းမြို့နယ်တွင် ပြည်တွင်းသစ်မျိုး (၁၃) မျိုး၊ အပူပိုင်းထင်းရှူး (၁)မျိုးတို့ကို စမ်းသပ်စိုက်ပျိုးကြည့်ရာ သစ်တစ်မျိုးနှင့်တစ်မျိုး ရှင်သန်ကြီးထွားမှု၊ ခြားနားခြင်းနှင့် နယ်တနယ်နှင့်တနယ်တွင် သစ်အမျိုးအစားအလိုက် ရှင်သန်ကြီးထွားမှု၊ ခြားနားခြင်းများ တွေ့ရှိခဲ့ရပါသည်။

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### **Abstract**

Teak and Pyinkado used to be the major species both for export and plantation establishment in Burma. However, with the realization of the danger imposed by monoculture and the rising popularity of other valuable hardwood species such as Thinwin, Padauk, etc., the need to know the technique of planting and growth rates of these valuable hardwood species arises. Consequently, species trials were carried out at Kabaung Reserve, Oktwin Township and Ngalaik Reserve, Pyinmana Township during 1980-83. The trials at Kabaung involved 14 species while those at Ngalaik employed 17 species. Both the effect of region and the differences among the species were tested.

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## Trial Planting of Commercial Species in the East Pegu Yoma 1\*

### 1. Introduction and Literature Review

Burma is endowed with many natural resources and timber is one of the most important resources upon which the country depends. Although the forests of Burma are made up of over 1,280 trees species, the country's timber export has been concentrated mainly on Teak (*Tectona grandis* Linn.F.)<sup>2\*</sup>. Moreover, locally, Teak is also preferred both for construction and in furniture making. Consequently, Teak has been the major species in almost all the commercial plantations in Burma since prewar days.

However, in the recent years, there has been a slight change in the pattern of timber export in Burma. The world timber market began to notice some of the other beautiful valuable species namely Padauk (*Pterocarpus macrocarpus* Kurz.), Thin win (*Millettia pendula* Benth.), etc., and they offered very good prices for these timber. Padauk in particular has been greatly sought after for export by the Timber Corporation.

On the other hand the Forest Department has also begun to realize the danger of monoculture. Like any other trees species, Teak has been found to be highly prone to insect attack, namely beehole borer, root borer, leaf skeletoniser, etc., (Aung Zeya, Troup 192 lb). In India Teak was found to be infested with root rot disease which eventually resulted in wind throw (Bakshi). Thus there is possibility that continuous areas of Teak plantation can be destroyed should there be an outbreak of epidemic. Diseases and insects are always present and an outbreak in epidemic form can be devastating especially in a single species plantation (Cromer 1967).

In consideration of the change in the trend of the world timber market and the danger of monoculture, the necessity to plant other valuable species apart from Teak also arises. However, apart from Teak, Pyinkado (*Xylia dolabriformis* Benth.) and Eucalyptus (*Eucalyptus* spp.) performances of other species in the form of plantation and their plantation technique in Burma is still not yet properly recorded. Thus, it was evident that trials should be carried out before these species are planted in plantations.

In 1980, the East Pegu Yoma Plantation Project was initiated. To support the planting program of the country, trials of other commercial species apart from Teak, were to be included as is component of the Project. Majority of the work of these trials was carried out by the Forest Research Institute. The trials were financed by the East Pegu Yoma Plantation Project. Species to be tested were selected in consultation with the Director General's Office and a work plan and experimental design was prepared. (Doo and Cunia). This trial planting of commercially valuable species in large scale is the first of its kind to be conducted in Burma.

The advisability of species trials is now generally accepted as climatic and ecological matching of the site to be planted. The original habitat of the species is rarely enough since it cannot reveal the adaptability of the species new conditions of its ability to grow satisfactorily on a range of sites (Burley and Wood).

Species trials are normally carried out in three phases i.e. (i) the species elimination phase (ii) the species testing phase and (iii) the species proving phase (Burley and Wood) (Metro). The species elimination phase is the mass screening of a large number of possible species in small plots for a short period ( $1/10 - 1/5$  rotation) to determine survival and promise

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1\* Major financial and materials support, provided by East Pegu Yoma Plantation Project, U Khin Hlaing, Director.

2\* See appendix VI for scientific names of species.

of reasonable growth. The species testing phase is assigned for the critical testing or comparison of a reduced number of promising species in larger plots for longer period ( $1/4$  -  $1/2$  rotation). The species proving phase is to confirm, under normal plantation conditions, the superiority of a few probably species (Burley and Wood).

The species trials reported in this paper were designed to cover both the species elimination phase and species testing phase. This paper deals primarily with the first or species elimination phase.

## **2. Materials and Methods**

Species trial was carried out simultaneously at compartment (219) Kabaung Reserve, Oktwin Township and at compartment (72) Ngalaik Reserve, Pyinmana Township. The details are presented below.

### **Compartment (219) Kabaung Reserve**

#### **1. Site Preparation**

The standard site preparation method was adopted, i.e., felling, burning, Kyunkwe (Reburning) and staking.

#### **2. Species**

Fourteen species were included in this part of the study. They are: 1\*

Teak

Pyinkado

Padauk

Yemane

Thinwin

Yinma

Tamalan

Taukkyan

Thitkado

Pantama

Mahogany

Ma-u-lettan-she

Sit

Pine

#### **3. Spacing**

Four spacings were adopted in this study, i.e., 7' x 7', 8' x 8', 9' x 9' and 10' x 10'.

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1\* See Appendix VI for scientific names of species

#### **4. Sites**

Only two sites were included in the study, i.e., ridge and slope.

#### **5. Experimental Design**

Randomized block design was used in conducting this study. Fifty-six 80' x 80' plots were laid out on the ridge and 56 similar size plots were laid out on the slope. Each of the species listed were randomly allotted to four plots on the ridge and four plots on the slope. The four spacings adopted were then randomly allotted to the four plots on the ridge and the four plots on the slope for each species. The total number of plots for the whole experiment in this region thus = 14 species x 4 spacings x 2 sites = 112 plots.

#### **6. Weeding**

Three weedings were carried out in the first year, three in the second year, two in the third year and one in the fourth year.

#### **7. Measurements**

Survival and height measurements were taken in the first year (i.e. after the first rainy season) and height and girth were measured in the second and third year. Pine and Thitkado were replanted due to low survival. Statistical analyses were carried out only for survival in the first year and height and girth measurements in the third year. Weather data was assembled for the two areas (See appendix I).

#### **Compartment (72) Ngalaik Reserve**

The material and methods used in this region were as given below.

##### **1. Site Preparation**

The standard site preparation method was adopted, i.e., felling, burning, Kyunkwe and staking.

##### **2. Species**

Seventeen species were included in this study. They are: 1\*

Teak

Pyinkado

Padauk

Yemane

Thinwin

Yinma

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\*  
1 See Appendix VI for scientific names of species.

Tamalan  
Taukkyan  
Thitkado  
Pantama  
Mahogany  
Ma-u-lettan-she  
Sit  
Pine (1)  
Pine (2)  
Pine (3)  
Pine (4)

### **3. Spacing**

Four spacings were adopted in this study, i.e., 7' x 7', 8' x 8', 9' x 9' and 10' x 10'.

### **4. Sites**

Three sites were included in the study, i.e., ridge, slope and bottom.

### **5. Experimental Design**

Randomized block design was used in conducting this study. Sixty-eight 80' x 80' plots were laid out on the ridge and 68 on the slope and 68 at the bottom. Each of the species listed for this region were randomly allotted to four plots on the ridge, four on the slope and four at the bottom. The four spacings adopted were then randomly allotted to the four plots on the ridge, four on the slope and four at the bottom for each species. The total number of plots for the whole experiment in this region thus = 17 species x 4 spacings x 3 sites = 204 plots.

### **6. Weeding**

Three weedings were carried out in the first year, three in the second year, two in the third year and one in the fourth year.

### **7. Measurements**

Survival and height measurements were taken in the first year (i.e. after the first rainy season). In the second and third year only height and diameter were measured. Survival count and measurements for all the Pines and all the species planted at the bottom of the ridge were omitted as they were almost a complete failure. The stock of Tamalan also diminished drastically in the second and third year and the species also was rejected. Statistical analyses were carried out only for survival in the first year and height and girth measurements in the third year.

### **Computation**

Comparisons of the survival in the first year, height and girth measurements in the third year and the effect of region in the third year were statistically analysed.



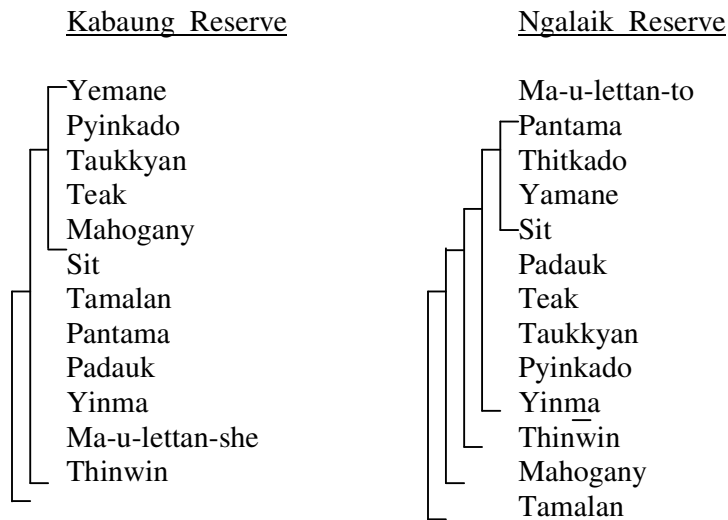
### 3. Results

#### Climate

Climatic conditions of the two regions of the test areas are shown in Appendix I.

#### Survival

Results of survival for Kabaung Reserve and Ngalaik Reserve are given in Table 1 and Figure 1. The differences in survival of the species tested were found to be significant (See Appendix II). For simplicity, ranking of species are given below with lines linking those species that were not significantly different.



#### Kabaung Reserve

Since ranking of survival percent tends to form groups that overlap, it can be said generally that Yemane, Pyinkado, Taukkyan, Teak and Mahogany had very good survival in the first year. Survival for Thinwin is poor while those of the remaining species can be considered as average. Survival for Pine was so low that it was rejected.

#### Ngalaik Reserve

Ma - u - lettan - to gave significantly the best survival percent in the Ngalaik Reserve. Ranking of survival of the remaining species tends to form groups that overlap. It can be said generally that Pantama, Thitkado, Yemane and Sit give average survival while the remaining species were poor. The survival for all the Pines were so low that they had to be rejected.

#### Height

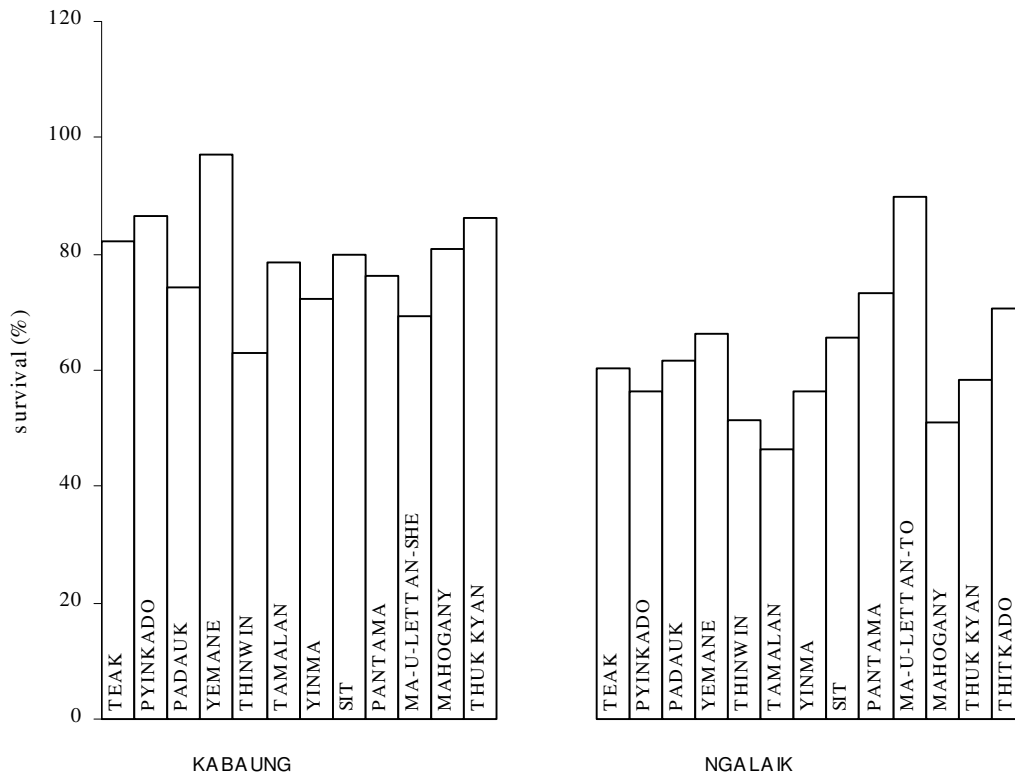
Results of height measurements for the species tested at the Kabaung Reserve are given in Table 2. and Figure 2. and those at the Ngalaik Reserve are given in Table 2. and Figure 3. The differences in height growth of the species tested at 40 months age were found to be highly significant. (See Appendix IIIa. IVa). Rankings are given diagrammatically below with lines linking those species that were not significantly different.

**Table 1. Survival Comparison of Tested Species at Kabaung and Ngalaik Reserves (March 1982)**

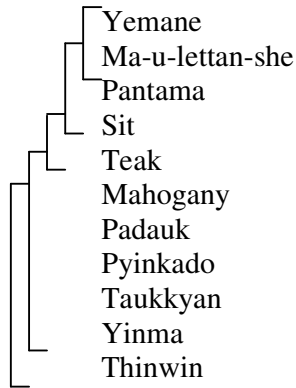
Species	Survival (percent)	
	Kabaung	Ngalaik
Teak	82.1	60.2
Pyinkado	86.5	56.8
Padauk	74.4	61.5
Yemane	97.2	66.4
Thinwin	63.1	51.5
Yinma	72.2	56.5
Tamalan	78.5	46.3
Taukkyan	86.2	58.5
Thitkado		70.7
Pantama	76.1	73.3
Mahogany	81.0	51.1
Ma-u-lettan-she	69.4	
Ma-u-lettan-to		89.9
Sit	80.0	65.5

**FIGURE – I**

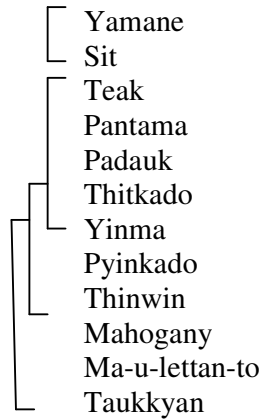
Survival percentage comparison of tested species at Kabaung & Ngalaik reserve.



Kabaung Reserve



Ngalaik Reserve



**Kabaung Reserve**

Since ranking of height tends to form groups that overlap, it can be said generally that Yemane and Ma-u-lettan –she showed the best height growth, Pantama, Sit and teak showed reasonably good height growth. Height growth of the remaining species can be considered as average.

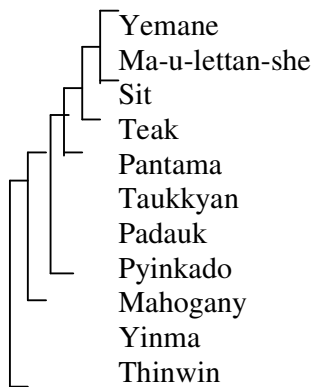
**Ngalaik Reserve**

In this region, Yamane and Sit were significantly the best in height growth. Since ranking of heights for the remaining species tends to form groups that overlap, it can be said generally that Teak, Pantama, Padauk, Thitkado and Yinma showed reasonably good height growth whereas the height growth of the remaining species can be considered as average.

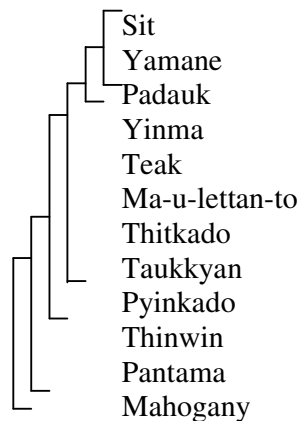
**Girth**

Results of growth in girth for the species tested at Kabaung Reserve were as given in Table 2 and Figure 2 and those at Ngalaik Reserve were as given in Table 2. and Figure 3. The differences in girth of the species tested at 40 months of age were found to be highly significant. (See Appendix III b, IV b). Rankings were given diagrammatically below with lines linking those species that were not significantly different.

Kabaung Reserve



Ngalaik Reserve



**Table 2. Mean Height and Girth Comparison of Test Species at Kabaung and Ngalaik Reserves**

(October 1984)

Species	Kabaung		Ngalaik	
	Height (ft)	Girth (in)	Height (ft)	Girth (in)
Teak	11.0	7.3	12.9	8.9
Pyinkado	9.1	5.0	10.0	6.2
Padauk	9.6	5.5	12.6	9.5
Yemane	18.6	11.6	15.8	12.6
Thinwin	7.4	4.0	9.6	5.6
Yinma	7.7	4.1	11.1	9.0
Taukkyan	8.2	5.8	8.8	7.2
Thitkado			12.0	8.7
Pantama	14.6	6.5	12.7	5.3
Mahogany	9.7	4.6	9.2	4.5
Ma-u-letten-she	16.6	10.2		
Ma-u-letten-to			9.2	8.9
Sit	13.8	9.0	15.7	14.4

### **Kabaung Reserve**

Since ranking of girth measurements also tends to form groups that overlap, it can be said generally that Yemane and Ma-u-letten-she showed very good growth in girth, while Sit, Teak and Pantama showed reasonably good results. The remaining species can be considered as average.

### **Ngalaik Reserve**

Here again ranking of girth measurements tends to form groups that overlap. Thus generally, it can be said that Sit and Yemane showed very good growth in girth. Padauk, Yinma, Teak, Ma-u-letten-to, Thitkado, Taukkyan and Pyinkado can be considered as reasonably good while the remaining species can be considered as average.

### **Comparison of the effect of region on height and girth of species tested**

The effect of region on height and girth of some of the species tested were found to be significantly different as shown in Table 3.

The effect of region was found to be significant only on Padauk, Yemane, Yinma and Sit. As is evident from the Table 3, Padauk and Yinma grown at Ngalaik were very significantly greater both in height and girth measurements than those grown at Kabaung. However, Yemane grown at Kabaung was very significantly better in height growth than those at Ngalaik. However, the difference in the girth measurements for Yemane was not significant. The effect of region on Sit was very significant only in the girth measurement. Sit at Ngalaik was much greater in girth measurement than that at Kabaung.

**FIGURE II** Girth and height growth comparison of trial species at different ages (Kabaung reserve)

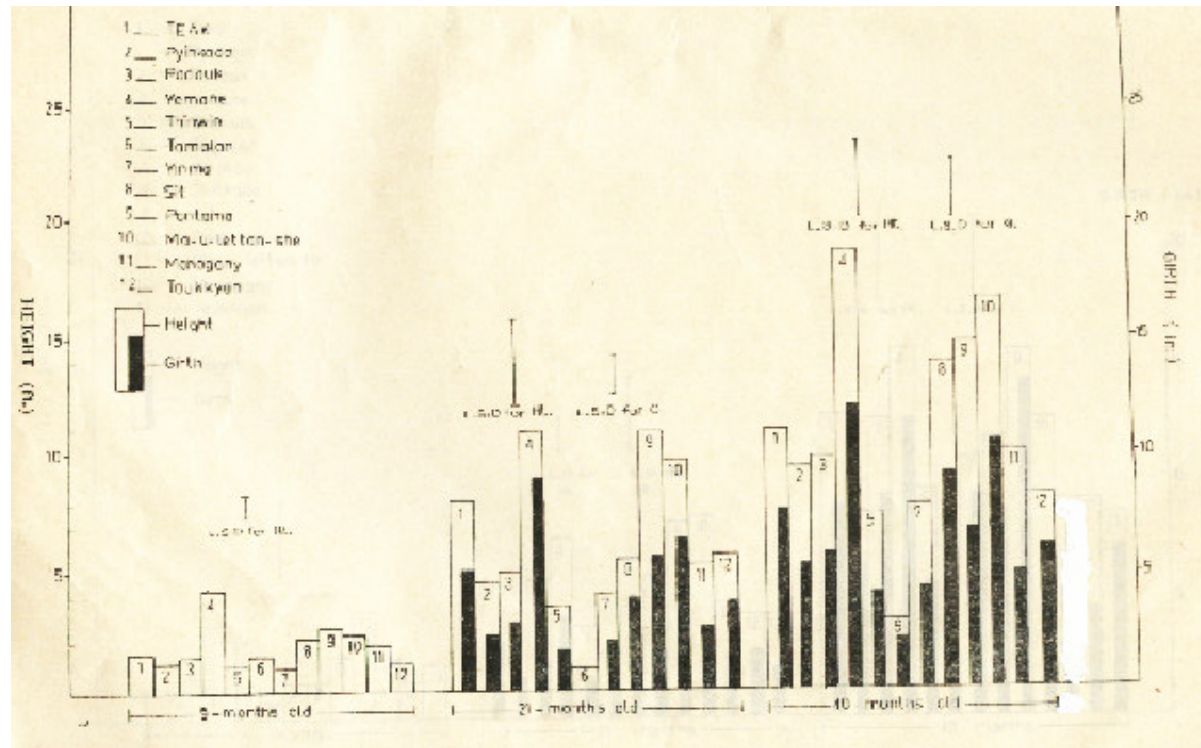
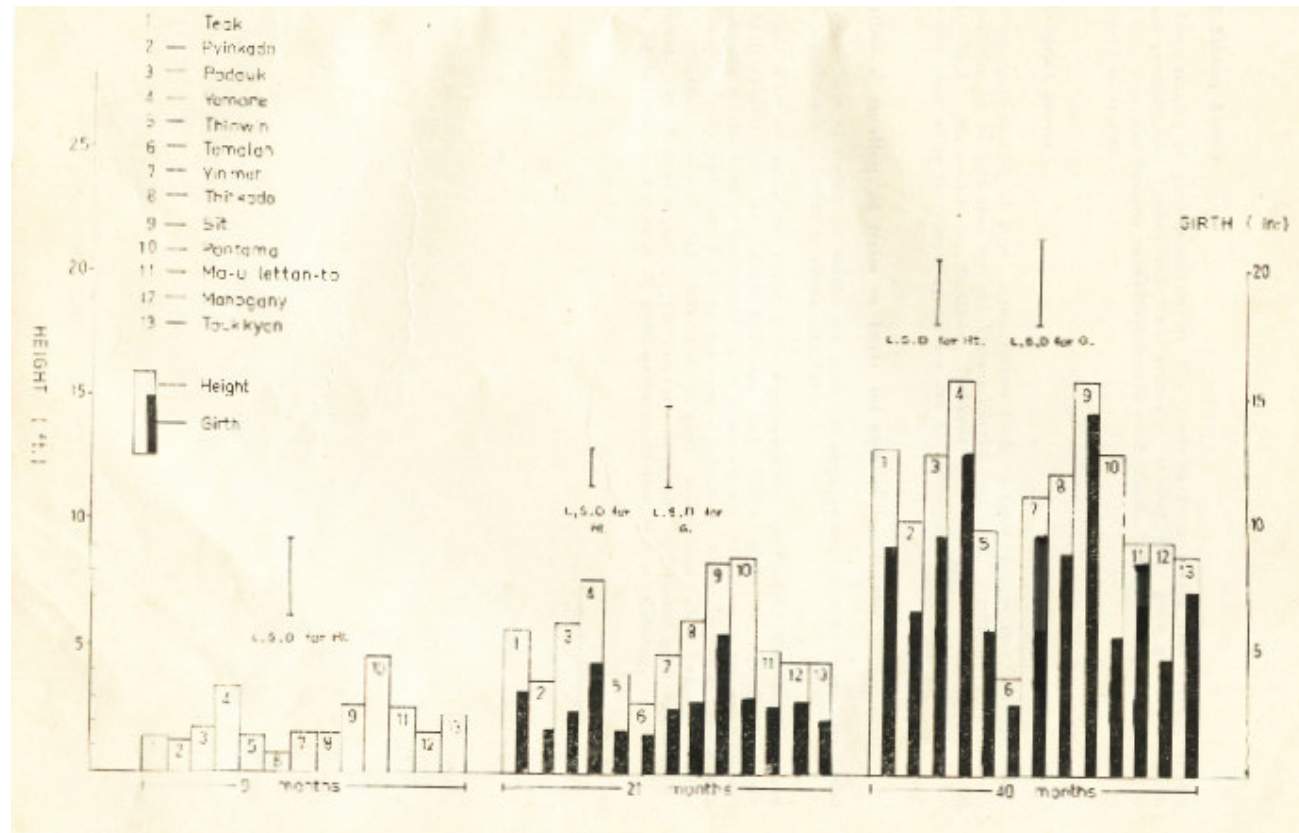


FIGURE III Girth and height growth comparison of trial species at different ages (Ngaik reserve)

REFERENCE



**Table 3. Comparison of the effect of region on height and girth measurements**

Species	Height		Girth	
	Kabaung	Ngalaik	Kabaung	Ngalaik
Teak	11.0	12.9	7.3	8.9
Pyinkado	9.1	10.0	5.0	6.2
Padauk	9.6**	12.6	5.5**	9.5
Yemane	18.6**	15.8	11.6	12.6
Thinwin	7.4	9.6	4.0	5.6
Yinma	7.7**	11.1	4.1**	9.0
Taukkyan	8.2	8.8	5.8	7.2
Pantama	14.6	12.7	6.5	5.3
Mahogany	9.7	9.2	4.6	4.5
Sit	13.8	15.7	9.0**	14.4

\*\* Very Significant different (1 level)

### Field Observation of Species

1. Teak                    Apart from being attacked by some defoliator, no serious damage was observed in the teak plots. (Figure IV a)
2. Pyinkado            No insect attack was observed in the Pyinkado plots (Figure IV b)
3. Padauk                Only minor insect attack on the leaf was observed during the early part of the rainy season. This does not appear to affect the growth very significantly.
4. Yemane                This species is highly prone to insect attack. Both shoot borer and leaf miner were observed to attack the species annually, killing the plant in some cases. However, due to its good coppicing power, it either sent up a new coppice shoot or lateral shoot which resulted in branchiness at very young age (Figure V a)
5. Thinwin                This species is prone to attack by leaf miners from the nursery stage. However, this is not serious enough to kill the plant. Survival was poor and unpredictable. (Figure V b)
6. Yinma                 This species grows vigorously especially at Ngalaik Reserve. However, it was found to be highly prone to shoot and stem borers, which sometimes causes the shoot to dry up or die. (Figure V c)
7. Tamalan              No insect attack was observed, but growth was found to be very slow.
8. Taukkyan             Very branchy, the leaves were often attacked by an insect. However, the damage is not serious as in Yinma. (Figure IV c)
9. Thitkado              This species grows vigorously especially at Ngalaik Reserve. . However, it was also observed to be highly prone to insect attack, especially by shoot and stem borers, and by termites. These often resulted in the death of the plant as the shoots dried out or died. (Figure IV d)
10. Pantama             This species demonstrated very good growth in the first year. However, in the subsequent years, it developed very poor crown formation. No insect attack was observed. (Figure VIa.)
11. Mohogany            This species was also observed to be highly prone to attack by shoot and stem borer (See Figure IV d). This caused the stem to dry up and sometime resulted in death (Figure V d).
12. Ma-u-lettan-to      No insect attack was observed. It demonstrated good height growth with the lower branches being naturally pruned. (Figure VI b)
13. Sit                    This species was observed to be very vigorous in growth, branchy and very good in crown formation. Termite attack on the species was observed but was not serious enough to kill the plant (Figure VI c).
14. Pines                 Sporadic attack by termites was observed in the Pine Plots. Trial in both the regions were a failure. Majority of the mortality was observed in the dry season of the first year.



## **4. Discussion**

### **Survival**

The rankings for survival in the first year only were given. This is in line with the practice in the Forest Department where the usual procedure is to make survival counts during December of the first year after the seedlings have been planted. This assumes that such an evaluation was sufficient to judge the survival of the plantation.

However, as was described in the observation previously, most of the species tested were highly prone to insect attack which probably causes mortality in the subsequent years. Thus, survival in the subsequent years may be more due to insect attack rather than to environmental factors.

In Kabaung Reserve five Species (Yemane, Pyinkado, Thaukkyan, Teak and Mahogany) gave very good survival, and seven species (Sit, Tamalan, Padauk, Pantama, Yinma, Ma-u-lettan-she and Thinwin) showed good survival in the first year. However, survival in the third year was very poor for 3 species, namely Mahogany (11.4%), Yinma (20%) and Thinwin (13.4%).

Similarly in the first year in Ngalaik Reserve 4 species (Pantama, Thitkado, Yemane and Sit) showed good survival, and 5 species (Padauk, Teak, Taukkyan, Pyinkado and Yinma) showed average survival. However, third year survival was very poor in 2 species, namely Thitkado (23.8%) and Yinma (29.8%). Thus, unless insect control measures can be applied, care should be taken in using the survival results of the first year especially for Mahogany, Thitkado, Yinma and Thinwin.

### **Height and Girth**

Although Mahogany and Yinma in Kabaung Reserve and Mahogany, Yinma and Thitkado in Ngalaik Reserve did not rank very high in the scale, these species have potential and should have performed much better.

As mentioned earlier, Mahogany, Yinam and Thitkado were badly attacked by insects annually. The most damaging was the shoot borer which killed the leader and consequently checked the height growth. Yemane also was attacked by these insects but, due to its quick recovery in sending up vigorous new shoots, the species still managed to rank high compared to others. If the growth has not been disturbed by insect attack, undoubtedly the performance of this species in height growth would have been much better. Ranking of the girth measurements for both the regions expect for Pantama, Pyinkado and Taukkyan.

### **Effect of Region on growth of the species tested**

From the results of the study, the difference in region (See Appendix I) was found to have a significant effect only on the growth of Padauk, Yemane, Yinma and Sit.

Padauk, Yinma and Sit appear to prefer the Ngalaik (Pynmana) Region which has a lower rainfall and less of rainy days than Kabaukg (Oktwin). Moreover, the Ngalaik Region also has a higher temperature during the rainy (growing) season, especially in August (Appendix I). As temperature is one of the factors which triggers growth, this may be the reason which makes this Region preferable for these species. Yemane, on the other hand, prefers the moister Kabaung Region.



(a)

Teak established -1981  
40 months old.



(b)

Pyinkado established - 1981  
40 months old



(c)

Taukkyan established - 1981  
40 months old.



(d)

Thitkado established - 1981  
40 months old

**FIGURE IV**



(a)

Yemane established – 1981  
40 months old



(b)

Thinwin established - 1981  
40 months old



(c)

Yinma established – 1981  
40 months old



(d)

Mahogany established - 1981  
40 months old

**FIGURE V**



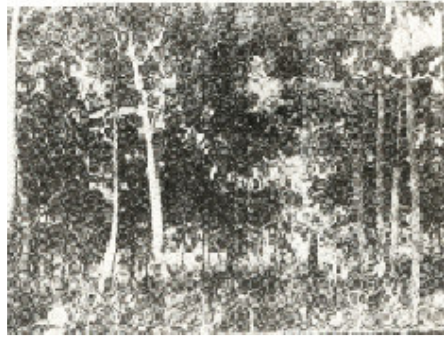
(a)

Pantama established - 1981  
40 months old



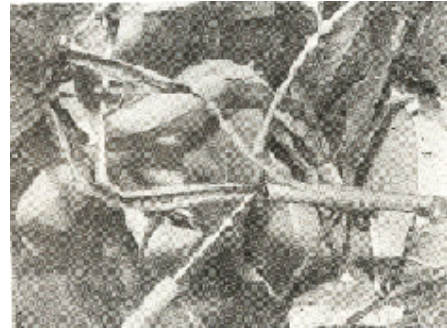
(b)

Ma-u-lettan-to established - 1981  
40 months old



(c)

Sit established - 1981  
40 months old



(d)

Mahogany stem damaged by stem borer.

**FIGURE VI**

## 5. Conclusions

1. Since most of the hardwood species are highly Prone to insect attack great care should taken in the choice of species and in using a monoculture
2. Provided that the insect problem can be controlled, the species listed below in order of preference can be used for planting in the stated region. Choice of species will depend of course upon the object of management.

### **Kabaung Reserve**

Yemane  
Ma-u-lettan-she  
Pantama  
Sit  
Teak  
Mahogany  
Padauk  
Pyinkado  
Taukkyan  
Yinma

### **Ngalaik Reserve**

Yamane  
Sit  
Teak  
Pantama  
Padauk  
Thitkado  
Yinma  
Pyinkado  
Ma-u-lettan-she  
Taukkyan

3. If insect control is not available, the species listed below in order of preference for each Region, can be used for planting in that region. Again choice of species here depends upon the object of management.

### **Kabaung Reserve**

Yemane  
Ma-u-lettan-she  
Pantama  
Sit  
Teak  
Padauk  
Pyinkado  
Taukkyan

### **Ngalaik Reserve**

Yemane  
Sit  
Teak  
Pantama  
Padauk  
Pyinkado  
Ma-u-lettan-to  
Taukkyan

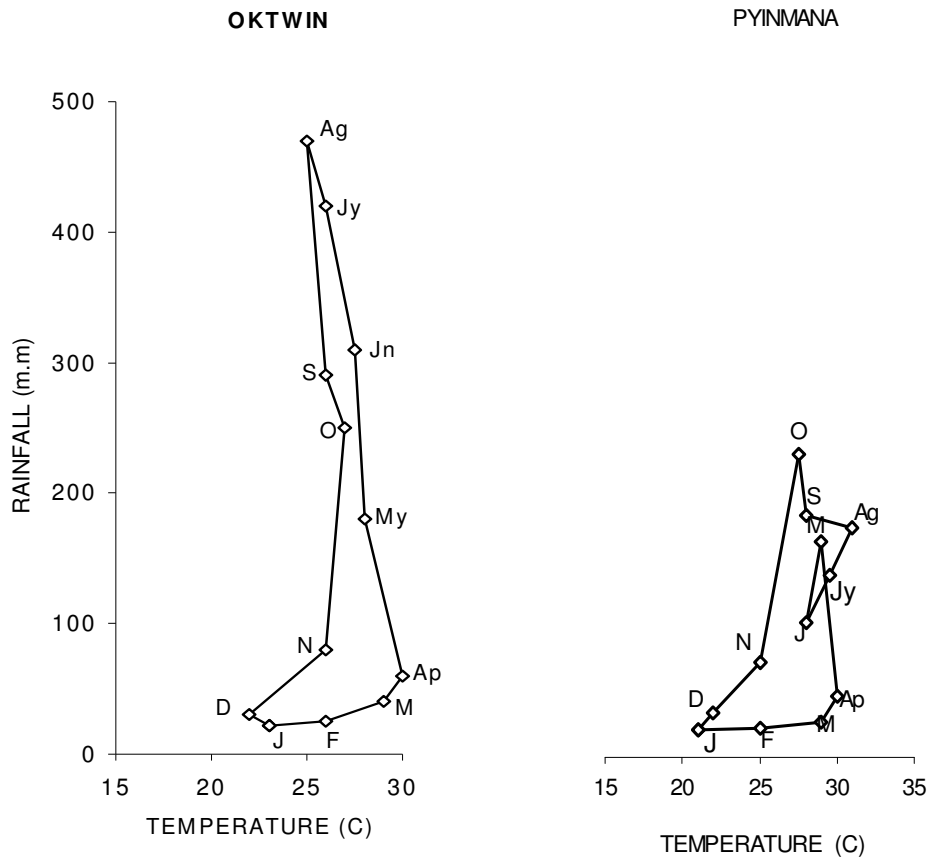
4. Padauk, Sit and Yinma grows better at Ngalaik than at Kabaung. Yemane on the other hand prefers Kabaung to Ngalaik.

## Appendix I

### A. Mean monthly humidity and mean annual rainfall for Oktwin and Pyinmana area.

Area	Lat.	Mean Monthly Humidity (%)												Annual mean	No. of rainy days	Mean annual rainfall(mm)
		J	F	M	A	M	J	J	A	S	O	N	D			
Oktwin	18°32'N	68.95	26.27	56.0	55.13	71.09	85.36	88.77	88.72	84.13	81.86	77.68	74.2	71.51	104	1802.5
Pyinmana	19°38'N	58.5	6.0	10.8	35.44	39.45	85.9	95.6	14.82	15.89	87.7	61.34	11.8	74.45	82	1092.5

### B. Climograms showing the intensity and distribution of monthly rainfall and monthly temperature of above area.



## Appendix II

### A. Analysis of Variance for Survival Percentage of Tested Species (Kabaung Reserve)

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Site	560.6667	1	560.6667	3.3926
Spacing	1139.8750	3	379.9580	2.2991
Species	5780.4583	11	525.4960	3.1798 **
Error	13220.9583	80	165.2620	
<b>Total</b>	<b>20701.958</b>	<b>95</b>		

L.S.D = 17.10

### B. Analysis of Variance for Survival Percentage of Tested Species (Ngalaik Reserve)

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Site	5.6875	1	5.6875	0.0225
Species	10008.3125	12	834.0260	3.305**
Site x Species	5334.34	12	445.3617	1.7649
Error	16654.125	66	252.335	
<b>Total</b>	<b>32012.468</b>	<b>91</b>		

L.S.D = 14.2735

## Appendix III

### A. Analysis of Variance for Forty-months-old Tree Height of Tested Species (Kabaung Reserve)

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Replicate	11.7612	1	11.7612	2.2644
Site	28.6743	1	28.6743	5.5206**
Species	622.0830	10	62.2083	11.9769**
Site x Species	59.7271	10	5.9727	1.1499
Error	109.0749	21	5.1940	
<b>Total</b>	<b>831.3205</b>	<b>43</b>		

L.S.D = 3.3342

### B. Analysis of Variance for Forty-months-old Tree Girth of Tested Species (Kabaung Reserve)

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Replicate	0.0096	1	0.0096	0.0039
Site	0.1364	1	0.1364	0.0550
Species	272.3651	10	27.23651	10.9911**
Site x Species	17.2317	10	1.72317	0.6954
Error	42.0392	21	2.4781	
<b>Total</b>	<b>331.782</b>	<b>43</b>		

L.S.D = 2.3031



## Appendix IV

### A. Analysis of Variance for Forty-months-old Tree Height of Tested Species (Ngalaik Reserve)

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Replicate	1.8644	1	1.8644	0.6637
Site	10.0467	1	10.0467	3.5762
Species	265.5551	11	24.1414	8.5933**
Site x Species	58.4796	11	5.3163	1.8924
Error	64.6144	23	2.8093	
<b>Total</b>	<b>400.5602</b>	<b>47</b>		

L.S.D = 2.4521

### B. Analysis of Variance for Forty - months - old Tree Girth of Tested Species (Ngalaik Reserve)

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Replicate	2.6744	1	2.6744	0.5843
Site	4.6190	1	4.6190	1.0091
Species	352.4594	11	32.0418	7.0004**
Site x Species	31.6243	11	2.8749	0.6281
Error	105.2743	23	4.5771	
<b>Total</b>	<b>496.6514</b>	<b>47</b>		

L.S.D = 3.1300

## Appendix V

### A. Analysis of Variance to Compare the Effect of Region on Height of Species Tested

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Region	2.8548	1	2.8548	0.7134
Species	583.8859	10	58.3886	14.5909**
Region x Species	264.4250	10	26.4425	6.6078**
Pooled Error		44	4.0017	
Total	851.1657	65		

L.S.D = 2.7724

### B. Analysis of Variance to Compare the Effect of Region on Girth of Species Tested

Source of Variation	Sum of Squares	d.f	Mean Square	F-ratio
Region	60.0932	1	60.0932	17.0352**
Species	497.8991	10	49.7899	14.1144**
Region x Species	118.2192	10	11.8219	3.3513**
Pooled Error		44	3.5276	
Total	676.2119	65		

L.S.D = 2.6030

## Appendix VI

### Scientific Names of Species in the Paper

Teak	( <i>Teatona grandis</i> Linn.f.)
Pyinkado	( <i>Xylia dolarbriformis</i> Benth.)
Padauk	( <i>Pterocarpus macrocarpus</i> Kurz.)
Yemane	( <i>Gmelina arbore</i> Roxb.)
Thinwin	( <i>Millettia pendula</i> Benth.)
Yinma	( <i>Chukrasia tabularis</i> A.Juss)
Tamalan	( <i>Dalbergia oliveri</i> Gamble)
Thitkado	( <i>Cedrela toona</i> Roxb.)
Pantama	( <i>Melia azadarach</i> Linn.)
Mahogany	( <i>Swietenia macrophylla</i> King.)
Ma-u-lettan-she	( <i>Anthocephalus cadamba</i> Miq.)
Ma-u-lettan-to	( <i>Nauclea orientalis</i> Linn.)
Sit	( <i>Albizzia procera</i> Benth.)
Pines (1)	( <i>Pinus caribaea</i> Var.car.)
Pines (2)	( <i>Pinus caribaea</i> Var.hon.)
Pines (3)	( <i>Pinus caribaea</i> Var.bah.)
Pines (4)	( <i>Pinus oocarpa</i> )
Eucalyptus	( <i>Eucalyptus</i> spp.)

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