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Species Trial for Fuelwood Production

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ထင်းအတွက်သစ်မျိုးများစမ်းသပ်စိုက်ပျိုးခြင်း

ဦးမင်းကိုကိုကြီး B.Sc. (For.) (Rgn.) M.Sc (ANU) ဌာနမှူး
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လူဦးရေနှင့် ရေနံထွက်လောင်စာ ကုန်ဈေးနှုန်း တိုးတတ်လာသည်နှင့်အမျှ ထင်းနှင့်မီးသွေး လိုအပ်ချက်သည် ပိုမိုကြီးမားလာပေသည်။ အထူးသဖြင့် ရန်ကုန်နှင့် အပူပိုင်းဒေသများတွင် ထင်းနှင့်မီးသွေး လုံလောက်စွာ ရရှိရေးအတွက် အလွန်အရေးကြီးနေပြီဖြစ်ပါသည်။ သို့ဖြစ်ပါ၍ယင်းဒေသများတွင် စိုက်ခင်း တည်ထောင်ရာ၌ အထောက်အကူပြုစေရန် ၁၉၈၀ခုနှစ်မှစ၍ သစ်မျိုးစုံ (၁၄)မျိုးကို စတင်စမ်းသပ် စိုက်ပျိုးခဲ့ပါသည်။ စမ်းသပ်စိုက်ပျိုးခဲ့သည့်ဒေသများနှင့် သစ်မျိုးပေါင်းမှာ-မော်ဘီကြီးဝိုင်း၊ မော်ဘီမြို့နယ်တွင်(၈)မျိုး ရှုပါတောင် သာစည်မြို့နယ်တွင်(၇)မျိုးနှင့် အင်ပင်ဝ၊ မိတ္ထီလာမြို့နယ်တွင်(၇)မျိုးဖြစ်ပါသည်။ တွေ့ရှိချက်များကို စာတမ်းတွင် သုံးသပ်ဆွေးနွေးတင်ပြ ထားပါသည်။

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Abstract

With the increase in population and the price of fossil fuel, there is great demand for fuelwood especially in the Rangoon and the dry zone area. Consequently, species selection trials for fuelwood plantation establishment for these area were conducted in 1980. A total of 14 species were tested. Five species were tested at Hmawbi Reserve, Hmawbi Township, 7 species at Yupataung, Thazi Township and 7 species at Inbinwa, Meiktila Township. The results are presented and discussed.

Contents

1. Introduction

Energy shortage in today's world is well accepted (Schenck, 1980). The shortage in energy and the price will increase with the gradual increase in population every day. In order to meet the increasing demand for energy a frantic search for crude oil is going on both on land and sea in Southeast Asia (Schenck, 1980). This reqires very high technology and investment. Even when found, oil resources are not replenishable.

On the other hand, energy from wood and biomass is renewable and involves much smaller investments and technological needs. Consequently, biomass is being considered a major source of energy for development, especially in the developing countries. In the Philippines irrigation pumps, electric generators, fishing boats and ice machines are fueled with wood and charcoal (Little Jr. undated). Charcoal-powered vehicle have also been tried successfully in the Philippines.

However, biomass still serves its original major role for mankind as a fuel for cooking and heating (Sheik and Amjad, 1984). It has been estimated that at least half the timber cut in the world is used for these two purposes (Anon, 1983).

As the population increases and fossil fuel becomes scarce, people tend to depend more and more on wood for fuel. Consequently, fuelwood problems and promise of fuelwood problems and promise of fuelwood plantation have been stressed extensively (Anon 1980 & 1983) (Ko Ko Gyi & Aung Khin 1984) (Pandey 1983) (Wood et.al, 1980) (Schenck 1980). This problem is acute specifically in the developing countries (Wood et.al, 1980). As has already been stated by the author, over one and a half billion people in the developing countries derive 90% of their energy needs from wood and charcoal while another billion people meet at least 50% of their need this way (Ko Ko Gyi & Aung Khin, 1984).

Similar to other developing countries, Burma also has fuelwood problems. The forest area varies from 0.12 acre to 1.77 acre per capita with the low per capita forest area in areas of high population density or in the dry zone area (Ko Ko Gyi and Aung Khin, 1984).

In order to meet the increasing demand for fuelwood by the ever-increasing population, Burma is also increasing it's planting program, especially for village supply. In 1983-84, 15,407 acres were planting for village supply while in 1985-86, the planting has increased to 29,975 acres. 1√

With the ban on use of *Eucaluptus* species, which proved very successful the dry zone, a question arises as to what species should be used especially in the dry zone area. Species trials are now generally accepted as the climatic and biological matching of the site to be planted. Knowledge of the original habitat of the species is rarely enough since it cannot reveal the adaptability of the species to new conditions or its ability to grow satisfactorily on a range of sites (Burley and Wood 1976).

Consequently, in 1980 species trials to determine the suitability of 12 species for fuelwood production were initiated in the drier part of the country at Yupataung, Thazi Township and Inbinwa, Meiktila Township. In 1983 another trial plot was initiated in the vicinity of Rangoon at Hmewbi reserve, Hmawbi Township.

1√ Records from Forest Department, Rangoon.

2. Materials and Methods

The experiments were carried out in three locations. In the dry zone were Yupataung reserve Compartment No. 30 and Inbinwa reserve Compartment No. 10 whereas in the vicinity of Rangoon was Hmawbi reserve Compartment No. 31.

Of the three locations, Inbinwa is the driest with the poorest soil, Yupataung is slightly moister with slightly better soil while, Hmawbi is a high rainfall area but with poor clayey lateritic soil.

2.1 Yupataung and Inbiwa

Experimental plots of the same design, number of trees and species were established in both the locations in 1980. The species used were:

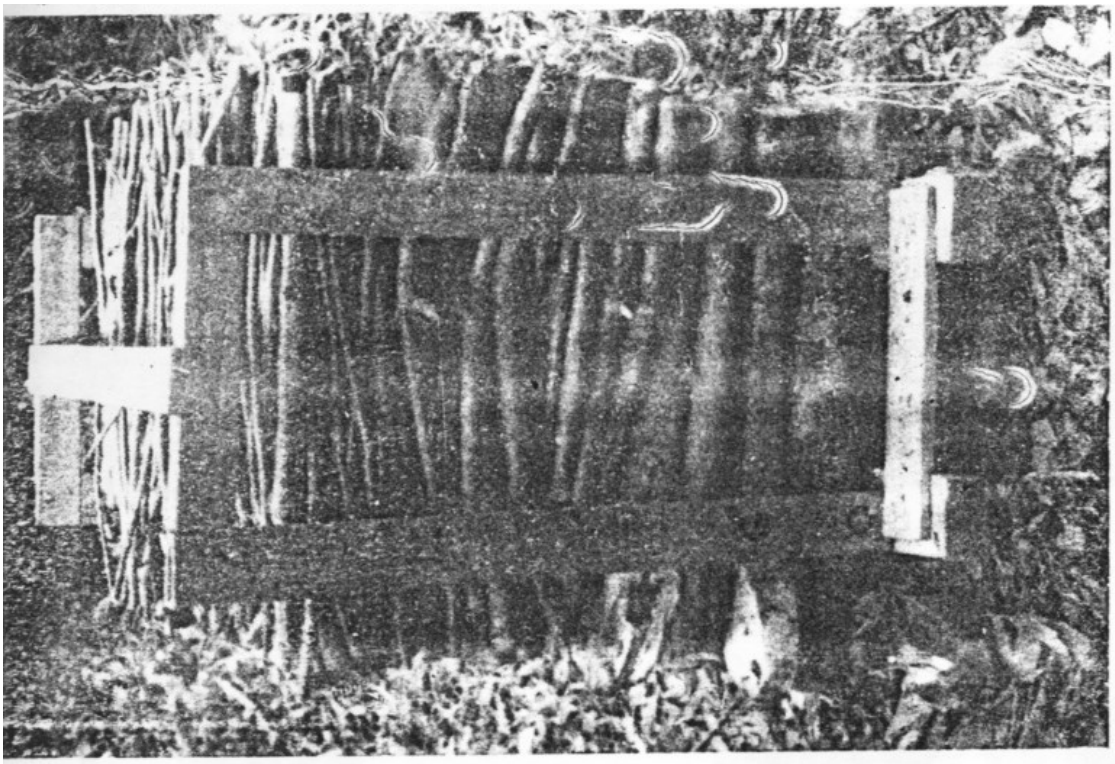
1. Senegal sha (*Acacia senegal* (L.) Willd.)
2. Subyu (*Acacia arabica* Willd.)
3. Sha (*Acacia catechu* Willd.)
4. Kokko (*Albizzia lebbek* Benth.)
5. Mezali (*Cassia siamea* Lam.)
6. Kala padauk (*Dalbergia sissoo* Roxb.)
7. Eucalyptus (*Eucalyptus camaldulensis* Dehnh.)

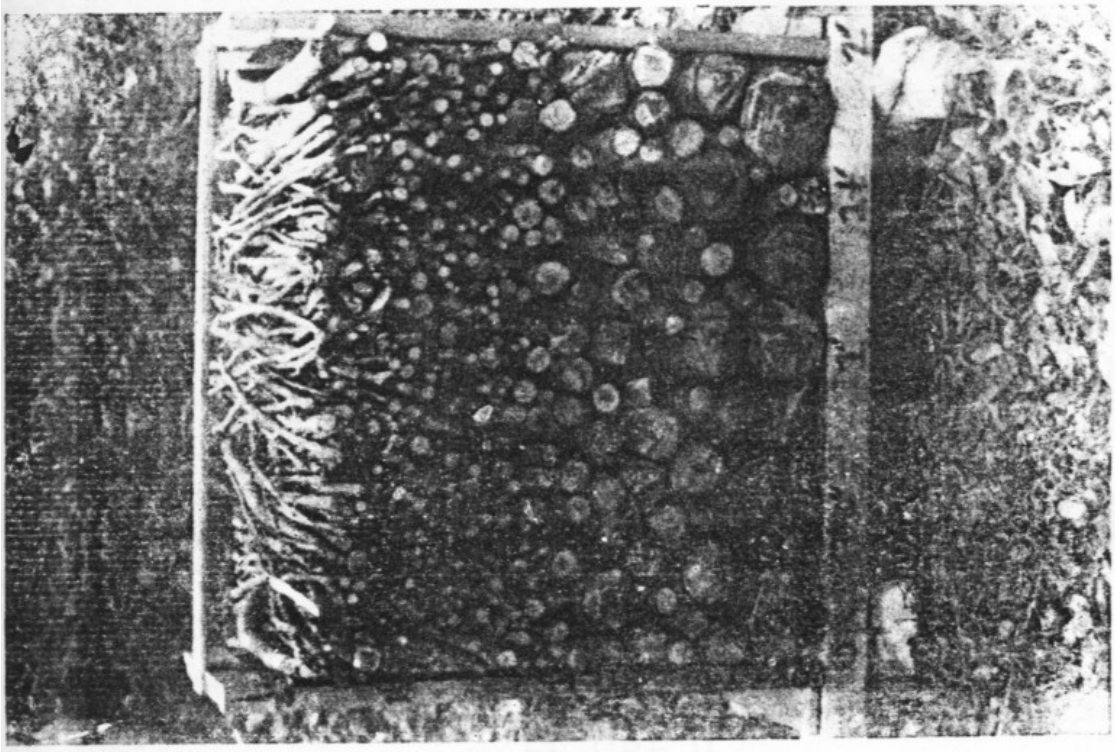
The whole area was cleared and pits were dug at a spacing of 12' x 12'. The seedlings were planted in the last week of June 1980. Weeding and soil working operations were carried out by the Divisional staff according to the Forest Department plantation operation schedule.

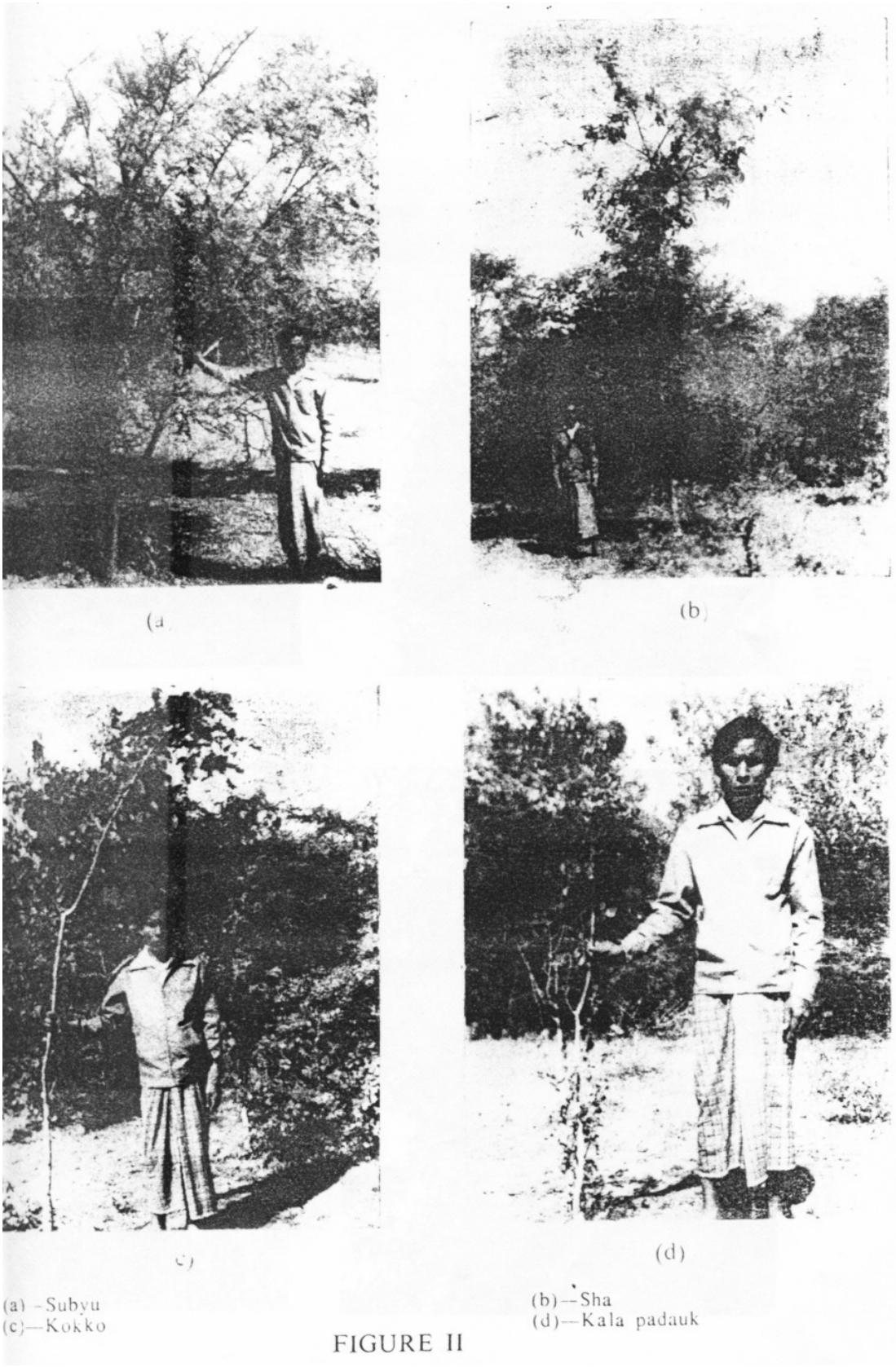
In these experiments, randomized complete block design was used. The experiments were replicated three times and each plot of 0.17 acre, contain 48 seedlings of each of the species listed above. Statistical F and LSD tests of significance were used in the analysis of data.

In order to get an indication of height growth and volume production of the species tested at the fifth years, three trees from each plot were felled (ie. 3 trees x 3 replicates = 9 trees) cut into 1' 6" length and their stacked volume was measured. Branches up to ½ diameter were assessed.

Stacked volume was measured by using a wooden frame two feet long and two feet high (See Figure I.).





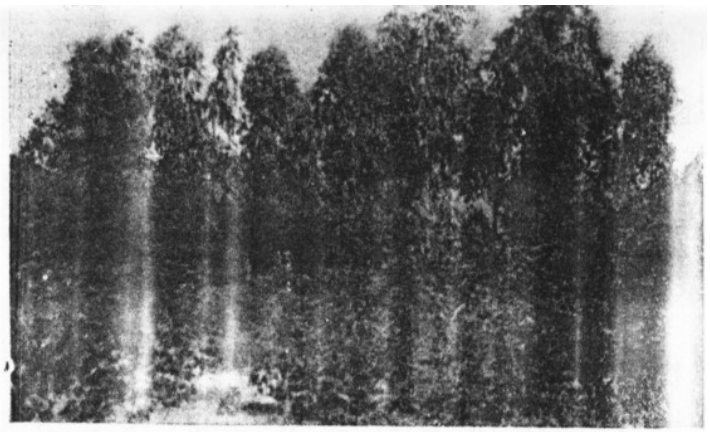


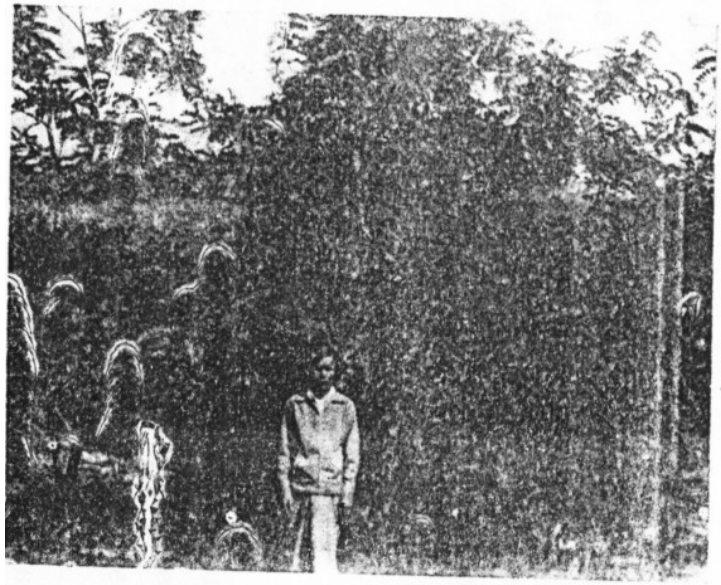
(a) –Subyu
(c)—Kokko

(b)—Sha
(d)—Kala padauk

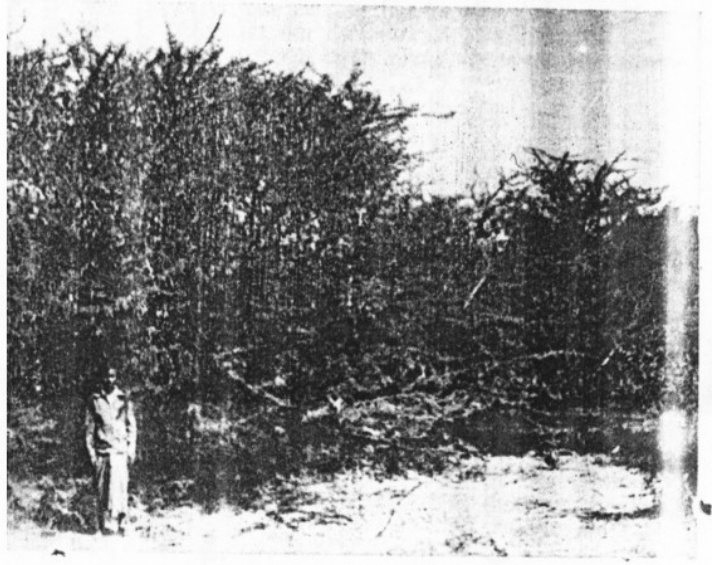
FIGURE II

(a)





(c)



(a)—Eucalyptus camaldulensis
(c)—Mezali

(b)—Eucalyptus camaldulensis
(d)—Senegal Sha

FIGURE III

2.2 Hmawbi

This experiment was initiated in 1983-84. The species used were:

1. Sit	(*Albizzia procera* Benth.)
2. Bonmeza	(*Albizzia chinensis* (Osbeck) Merr.)
3. Falcataria kokko	(*Albizzia falcataria* (L)Fosberg)
4. Mezali	(*Cassia siamea* Lam.)
5. Mahogany	(*Swietenia macrophylla* King.)
6. Sha	(*Acacia catechu* Willd.)
7. Senegal sha	(*Acacia senegal* (L) Willd.)
8. Bawzagaing	(*Leucaena leucocephala* (Lam.) de wit)

The area was cleared and 1' x 1' x 1' pits were dug according to the following spacings. 3' x 5', 5' x 5', 7' x 7' and 9' x 9'. The seedlings were planted in the last week of June 1983. Three weedings were carried out in the first year, two in the second year and two in the third year.

In this experiment, completely randomized design with four replicates was adoped. Each plot was one square chain in area. As different spacings were adoped the number of seedlings in each plot varies from a minimum of 49 to a maximum of 240 seedlings. Statistical F and LSD tests of significance were used in the analysis of data.

3. Results

3.1 Survival

Results of survival at the fourth year for Yupataung and Inbinwa were given in Table I and Figure IV A. The differences in survival of the species in the fourth year were highly significant. For simplicity, ranking of species are given below with lines linking those species that were not significantly different.

Yupataung

Senegal sha ┐
Sha ┘
Eucalyptus ┐
Subyu ┘
Kokko ┐
Mezali │
Kala padauk ┘

Inbinwa

Eucalyptus ┐
Senegal sha ┘
Mezali ┐
Kokko ┘
Sha ┐
Kala padauk │
Subyu ┘

At Yupataung, Senegal sha and Sha gave the best survival, Eucalyptus and Subyu followed second while Kokko, Mezali and Kala Padauk were the poorest.

Results of survival at Inbinwa indicated four categories, Eucalyptus and Senegal sha ranked top, Mezali and Kokko followed second, Sha and Kala padauk third and Subyu was the poorest.

Results of the differences in survival at the second year for Hmawbi were also highly significant (See Table III, Figure VI). Ranking of species are given below with lines linking those species that were not significantly different.

3.2 Hmawbi

Bawzagaing (K 132)
Bawzagaing (K 62)
Bawzagaing (K 28)
Mezali
Bonmeza
Sha
Sit
Mahogany
Senegal sha
Falcataria Kokko

Table I. Data for Survival and height of 4 year old trees Fuelwood Trial.

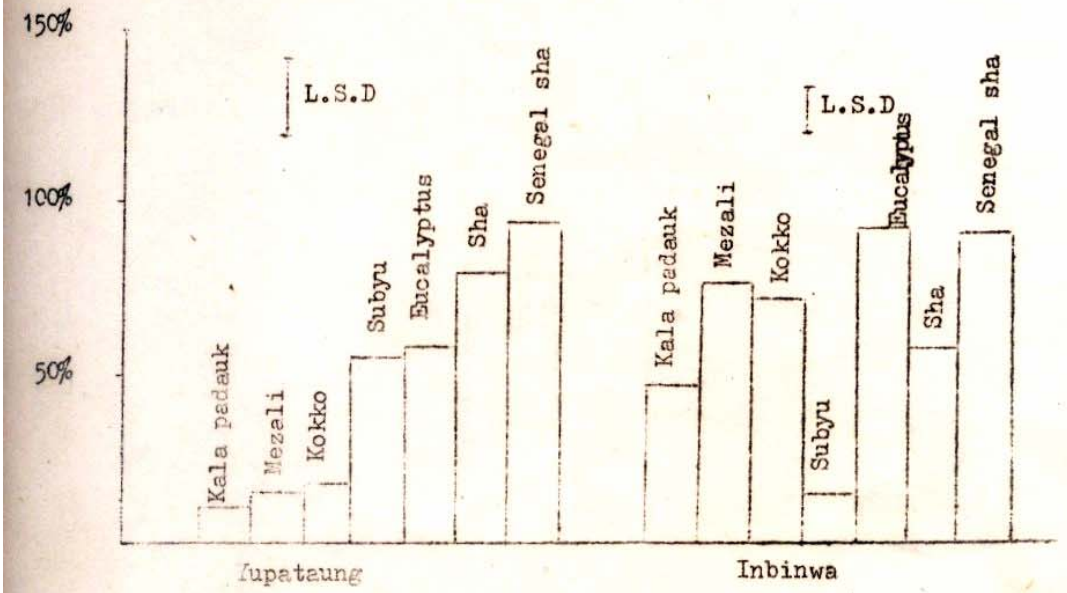
Species	Survival at Yupataung (%)	Survival at Inbinwa (%)	Mean Height at Yupataung (ft)	Mean Height at Inbinwa (ft)
Senegal sha	94.5	90.3	10.9	5.1
Sha	79.2	56.3	10.8	4.8
Eucalyptus	56.9	91.7	25.0	12.4
Subyu	54.6	14.6	10.8	3.4
Kokko	18.1	70.8	4.4	5.1
Mezali	16.0	75.7	11.4	5.3
Kala padauk	11.8	47.2	2.4	2.5

Table II. Data Summary for Height and Volume of 5 year old trees Fuelwood Trial.

Species	Mean Height at Yupataung (%)	Mean Height at Inbinwa (%)	Stacked Vol./ Tree at Yupataung (cft)	Stacked Vol./ Tree at Yupataung (cft)
Eucalyptus	35.2	18.6	17.6	2.1
Senegal sha	18.6	9.3	110.4	1.9
Sha	17.1	10.3	6.0	1.8
Mezali	15.9	8.3	8.1	3.7
Subyu	15.8	_	6.3	_
Kokko	7.0	13.3	_	2.8
Kala padauk	4.4	4.1	_	_

Comparison of Survival % and Height Growth of Tested Species.

A- Survival %



B - Height Growth

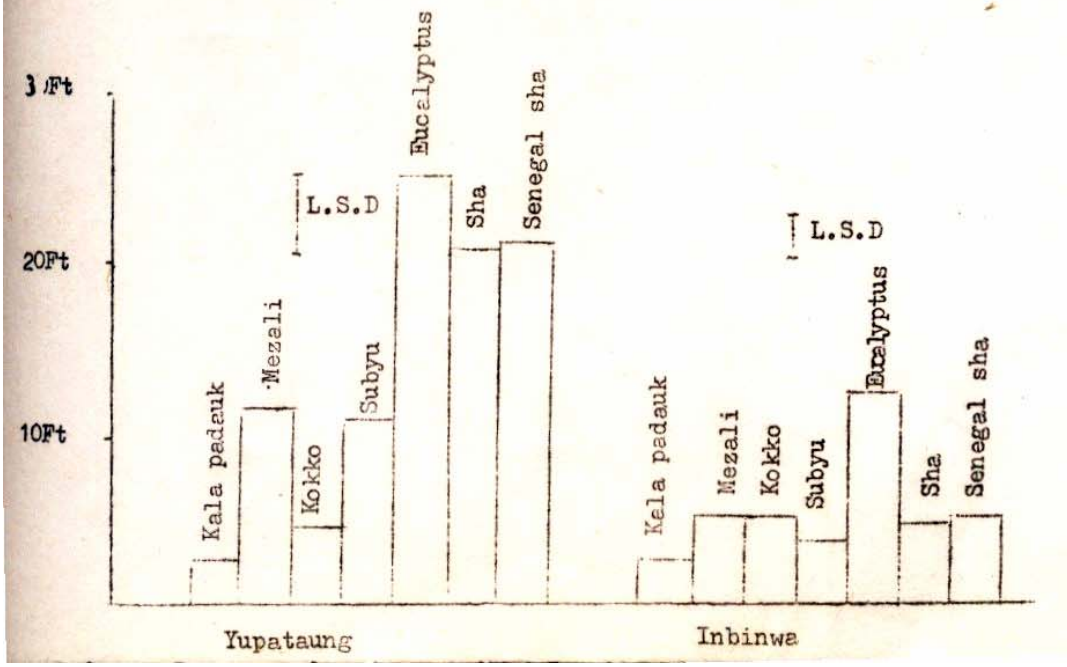
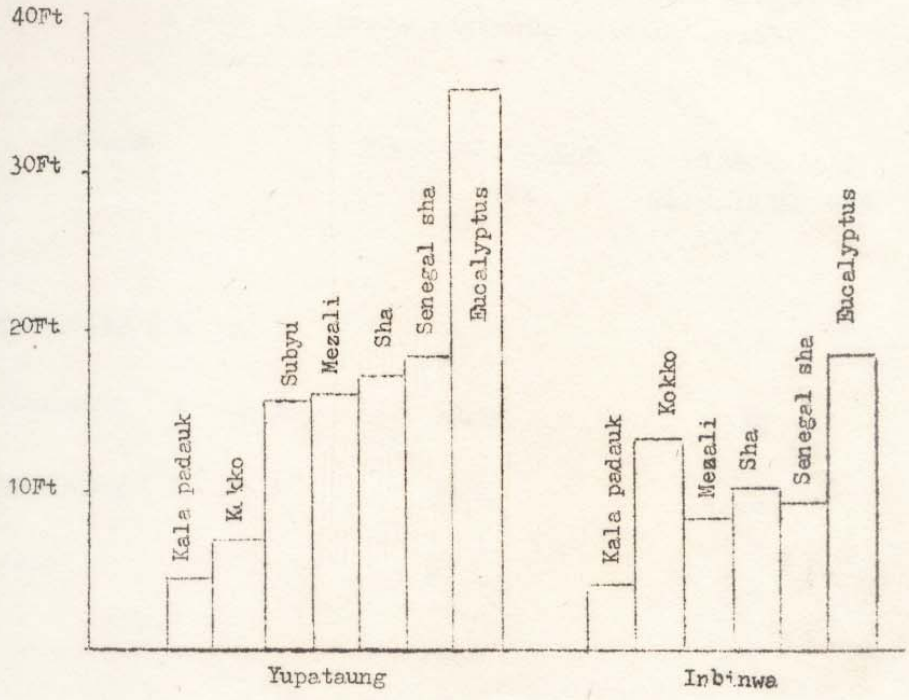


Figure. V

Comparison of Height Growth and Volume/Tree of 5 - Yr. old Trial.

A - Height Growth



B - Stacked Vol per Tree

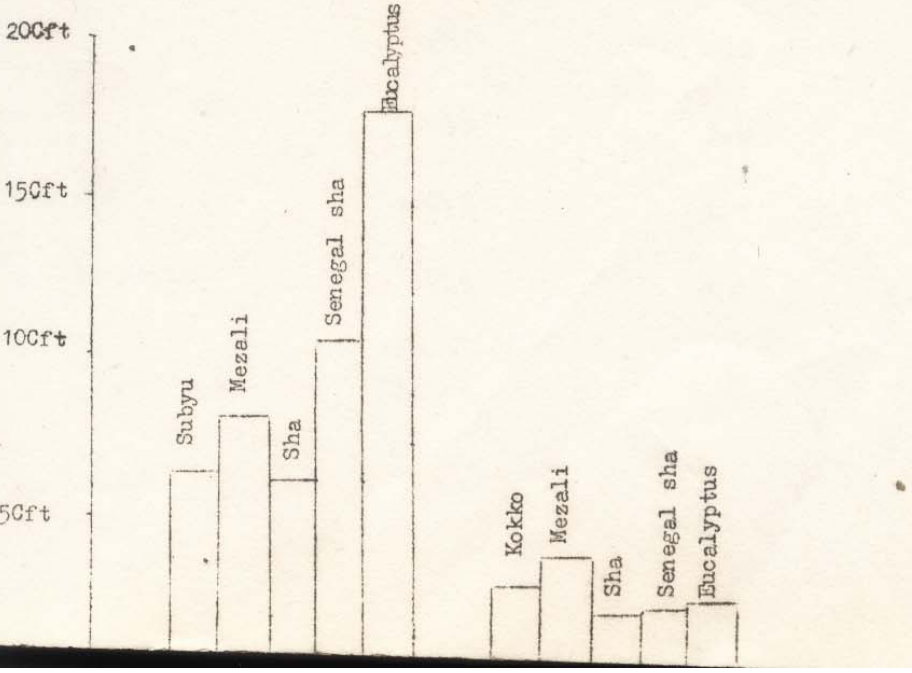
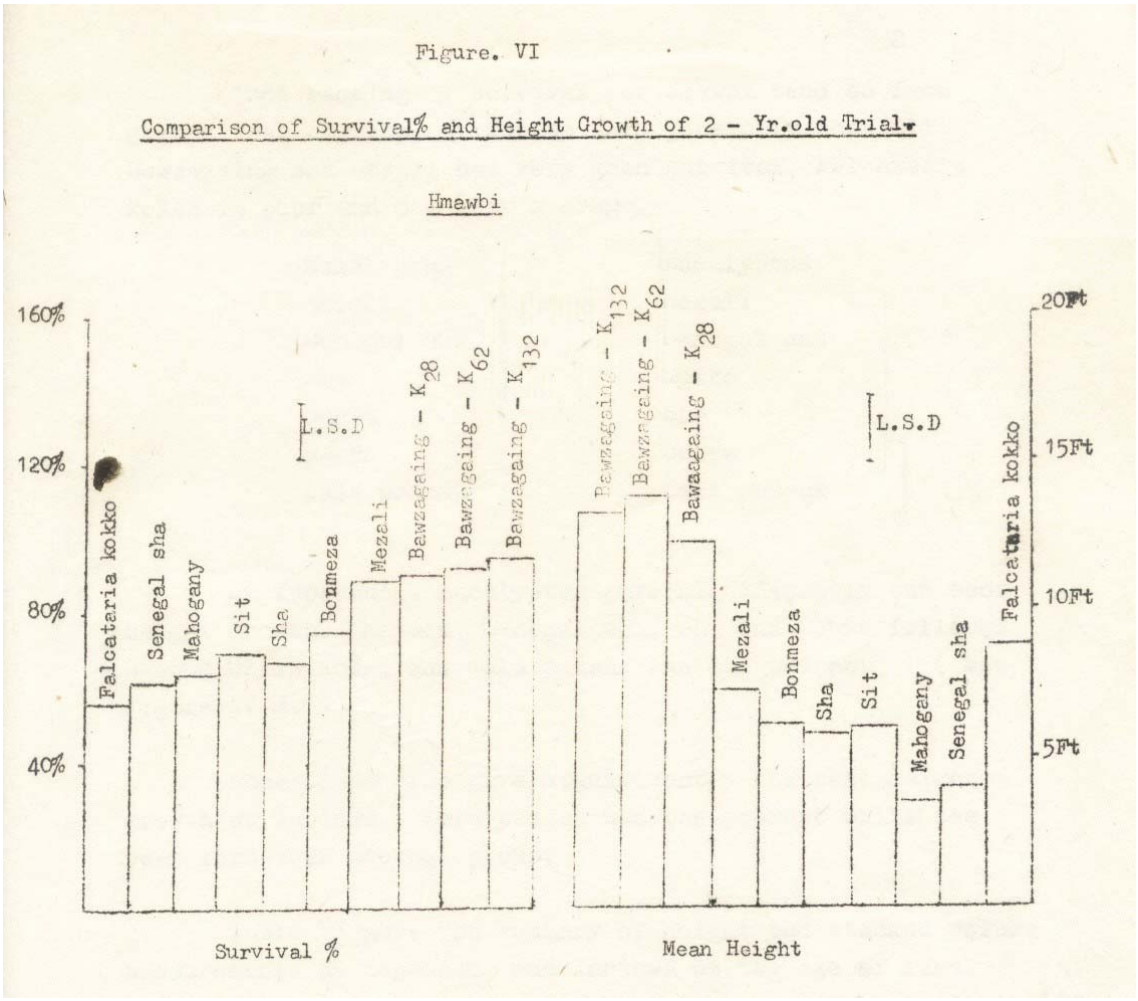


Table III. Data Summary for Survival and Mean Height of 2 year old trees Fuelwood Species Trial (Hmawbi)

Species	Survival at the 2nd year (%)	Mean Height of 2 year old (ft)
Bawzagaing (K 132)	94.1	13.4
Bawzagaing (K 62)	90.6	13.9
Bawzagaing (K 28)	89.6	12.4
Mezali	87.8	7.2
Bonmeza	74.4	6.1
Sha	64.7	5.8
Sit	63.7	6.0
Mahogany	62.6	3.6
Senegal sha	60.5	4.1
Falcataria kokko	54.3	8.8



Since ranking of survival for Hmawbi tend to from groups that overlap, it can be said generally that all Bawzagaing and Mezali has very good survival, Falcataria kokko is poor and the rest average.

3.3 Mean Height and Volume

Results of mean height at the fourth year for Yupataung and Inbinwa were given in Table I and Figure IV B. The differences in heights were highly significant Rankings of species are given below with lines linking those species that were not significantly different.

Yupataung	Inbinwa
Eucalyptus	Eucalyptus
Mezali	Mezali
Senegal sha	Senegal sha
Sha	Kokko
Subyu	Sha
Kokko	Subyu
Kala padauk	Kala padauk

At Yupataung, Eucalyptus gave significantly the best height growth. Mezali, Senegal sha, Sha and Subyu followed second while Kokko and Kala padauk was the poorest (See Figure IV B.)

Eucalyptus also give significantly the best height growth at Inbinwa. Kala padauk was the poorest while the rest formed an average group.

Table II gave the summary of height and stacked volume measurements at Yupataung and Inbinwa at the age of five. The results will not be described as they are not statistically analysed.

Result of the difference in height growth in the second year at Hmawbi were also highly significant (See Table III, Figure VI). Ranking of species are given below with lines linking those species that were not significantly different.

Hmawbi
Bawzagaing (K 62)
Bawzagaing (K 132)
Bawzagaing (K 28)
Falcataria Kokko
Mezali
Bonmeza
Sit
Sha
Senegal sha
Mahogany

At Hmawbi, Bawzagaing gave significantly the best height growth. The remaining species tended to form groups that overlap and Mahogany were poor and the Bonmeza and Sit average and Falcataria Kokko and Mezali above average.

4. Discussion

This experiment was conducted in such a way so as to conform with the divisional practice at that time. Consequently all cultural operations were carried out by the divisional staff in the same way as the adjoining plantation.

In the dry zone where cattle feed is scarce, grazing may be very difficult to control in fuelwood plantations. Thus, it is also important to select species that are not subject to increase the changes for success in establishing a fuelwood plantations.

The areas especially Yupataung, are heavily grazed and deficient in fuelwood, so also are subjected to illicit felling. The results obtained can therefore be considered to reflect a combination of silvicultural and social effects.

Senegal sha - The species showed good survival both at Yupataung and Inbinwa. This may be due to the fact that it is not grazed by cattle and goats and that villagers still does not accept it as fuelwood. Volume production was also high at Yupataung, but was poor at Inbinwa. It's performance however was very poor in the high rainfall area like Hmawbi.

Subyu - Survival of the species was very poor both at Yupataung and Inbinwa. This may be because they are grazed by goats when young and also that they perfer moister site like along the stream bank in the dry zone. However, a few that survived performed equally well as Sha (See Table II.)

Sha - Survival of the species was very good at Yupataung but poor at Inbinwa. The species was found to be heavily cut for fuelwood in the fifth year. Destruction by grazing was not found. Height and volume production was found to be average at Yupataung but poor at Inbinwa.

In the wet area like Hmawbi, where the soil is also poor, survival for sha is moderate while the height growth is comparatively poor.

Kokko - The species is heavily grazed upon and the leaves are also collected for animal feed. This may be part of the reasons why the species gave very poor survival and growth at Yupataung. It showed slightly better results at Inbinwa which is more remote. Survival was also poor at Hmawbi, but those that survived, gave good height growth.

Mezali - This species is also grazed by cattle and goats when young. This is evident from the fact that survival was very poor at Yupataung and good at Inbinwa which is far from villages, Moreover, growth at Yupataung was better than at Inbinwa (See Table I and II). The species was also found to be heavily cut for fuel in the fifth year. Those left showed very good growth and yield quite a high volume per tree (See Table II).

The species also gave good survival and growth in wet area like Hmawbi.

Kala padauk - The species gave very poor survival and growth both at Yupataung and Inbinwa. Those that are left are too small and volume measurement even cannot be taken.

Eucalyptus - This species gave very good survival at Inbinwa and slightly poor at Yupataung. This is because it grows so well at Yupataung that it has been used as fuelwood at a very young age. Growth of this species is the best both at Yupataung and Inbinwa (See Table I and II). Best of all is that it is not grazed upon by goats and cattle.

Sit - This species was tested at Hmawbi only. Both survival and height growth as compared to other species were average.

Bonmeza - The species was also tested only at Hmawbi. Both survival and height growth as compared to other species were average. The species is highly prone to insect attack.

Mahogany - This species was tested only at Hmawbi. Although it prefer high rainfall area, survival was moderate and growth was poor due to the poor soil of the area tested.

Bawzagaing - This species was also tested only at Hmawbi. All the tree strains tested gave the best survival and height growth.

Falcataria kokko – This species was tested only at Hmawbi. Survival was poor but those that survived gave moderately good height growth. This may be because the species prefers continuous raingfall distribution with only short dry periods and requires good soil.

5. Conclusion

1. Among the species tested, Eucalyptus, Senegal sha and Sha was found to be the most suitable species for Yupataung and Inbinwa.

2. If grazing can be controlled during the first three years, Mezali can also be used at Yupataung and Inbinwa.

3. Among the species tested at Hmawbi, Bawzagaing and Mezali were found to be the most suitable.

4. Grazing problem should also be seriously considered in the selection of species especially in the dry zone. Additional trials should identify the grazing losses to better evaluate the species growth and value.

Appendix I A. Analysis of Variance for Height Growth of 4 years old Trial (Yupataung).

Sourece of Variation	Sum of Squares	d.f.	Mean Square	F - ratio
Treatment	946.405	6	157.7342	25.1477**
Block	22.1499	2	11.0705	1.7657
Error	62.7231	10	6.2723	
Total	1031.2780	18		
L.S.D = 4.6				

Appendix I B. Analysis of Variance for Height Growth of 4 years old Trial (Inbinaw).

Sourece of Variation	Sum of Squares	d.f.	Mean Square	F - ratio
Treatment	187.3345	6	31.2224	20.4362**
Block	4.8151	2	2.4076	1.5759
Error	16.8063	11	1.5278	
Total	208.9559	19		
L.S.D = 2.2				

Appendix II A. Analysis of Variance for Survival (%) of 4 year old Trial (Yupataung).

Sourece of Variation	Sum of Squares	d.f.	Mean Square	F – ratio
Treatment	19428.7930	6	3238.1321	22.8939*
Block	364.9531	2	182.4766	1.2901
Error	1414.4062	10	141.4406	
Total	21208.1523	18		
L.S.D = 21.6				

Appendix II B. Analysis of Variance for Survival (%) of 4 year old Trial (Inbinwa).

Sourece of Variation	Sum of Squares	d.f.	Mean Square	F – ratio
Treatment	13268.0078	6	2211.3347	35.6169**
Block	72.4219	2	36.2109	0.5832
Error	682.9531	11	62.0866	
Total	14023.3828	19		
L.S.D = 14.2				

Appendix III A. Analysis of Variance for Height Growth of 2 year old Trial (Hmawbi).

Sourece of Variation	Sum of Squares	d.f.	Mean Square	F - ratio
Treatment	525.1924	9	58.3547	21.1303**
Block	26.3828	3	8.7943	3.1844*
Error	74.5647	27	2.7617	
Total	626.1399			
L.S.D = 2.4				

Appendix III B. Analysis of Variance for Survival of 2 year old Trial (Hmawbi).

Sourece of Variation	Sum of Squares	d.f.	Mean Square	F - ratio
Treatment	8035.5469	9	892.8386	7.4976**
Block	830.5781	3	276.8594	2.3249
Error	3215.2344	27	119.0828	
Total	12081.3594	39		
L.S.D = 15.8				

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