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Trial Planting of *Acacia senegal* and *Acacia auriculiformis* in The Central Dry Zone of Myanmar

U Mehm Ko Ko Gyi, B.Sc. (For.) (Rgn.), M.Sc. (ANU), Head of Division
and
U Kyi Win, B.Sc. (For.) (Rgn.), Researcher
Forest Research Institute
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ဆီနီဂေါရှားနှင့် အောရီးရှားသစ်မျိုးများကို မြန်မာပြည်အလယ်ပိုင်းဒေသတွင် စမ်းသပ်စိုက်ပျိုးခြင်း

ဦးမင်းကိုကိုကြီး B.Sc.(For.) (Rgn), M.Sc. (ANU), ဌာနမှူး
နှင့်
ဦးကြည်ဝင်း B.Sc.(For.) (Rgn), သုတေသနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

မြန်မာပြည်အလယ်ပိုင်း မိုးခေါင်ရေရှားဒေသသည် သစ်တောဖုံးလွှမ်းမှုဧရိယာ နည်းပါးခြင်း၊ လူနေထူထပ်ခြင်းတို့ကြောင့် ထင်း၊ မီးသွေး ရှားပါးမှုကို အများဆုံးတွေ့ကြုံရပါသည်။ သို့ဖြစ်ပါ၍ သစ်တောဦးစီးဌာနအနေဖြင့် ထင်းစိုက်ခင်းများကို နှစ်စဉ်ကျယ်ကျယ်ပြန့်ပြန့် စိုက်ပျိုးတည်ထောင်လျက် ရှိပါသည်။ ဤကဲ့သို့ယင်း စိုက်ခင်းများ တည်ထောင်ရာတွင် ဒေသခံ အပူပိုင်းထင်းသစ်မျိုးများသာမက၊ ရေမြေရာသီဥတုနှင့် ကိုက်ညီပြီး စိုက်ပျိုးရန် သင့်တော်သော နိုင်ငံခြားထင်း သစ်မျိုးကိုပါ ရှာဖွေစမ်းသပ်ဖော်ထုတ်ရန်၊ သစ်တောဦးစီးဌာန၊ ညွှန်ကြားရေးမှူးချုပ်မှ ညွှန်ကြားအကြံပြုခဲ့ပါသည်။ သို့ဖြစ်ပါ၍ မင်းဘူးမြို့နယ်၊ ချောက်မြို့နယ်နှင့် ရေနံချောင်းမြို့နယ်တို့တွင် ဆီနီဂေါရှား၊ အောရီးရှား၊ မြန်မာရှား၊ ထနောင်း သစ်မျိုးများဖြင့် ၁၉၈၆ခုနှစ်၌ စမ်းသပ်ကွက်(၅) ကေစီကို စမ်းသပ်စိုက်ပျိုးခဲ့ပါသည်။ ထို့အတူ ကျောက်ပန်းတောင်းမြို့နယ်တွင် ဆီနီဂေါရှား၊ အောရီးရှား၊ မြန်မာရှား သစ်မျိုးများဖြင့် ၁၉၈၆ခုနှစ်၌ စမ်းသပ်ကွက်(၅)ကေစီနှင့် မြင်းခြံမြို့နယ်တွင် ဆီနီဂေါရှား၊ မြန်မာရှား၊ ဘောစကိုင်း သစ်မျိုးများဖြင့် (၃)ကေ စမ်းသပ်စိုက်ပျိုးခဲ့ပါသည်။ ဤသို့ စိုက်ပျိုးခဲ့ရာတွင် မင်းဘူးမြို့နယ်၊ ချောက်မြို့နယ်၊ ရေနံချောင်းမြို့နယ်၊ ကျောက်ပန်းတောင်းမြို့နယ်များ၌ အော်ရီးရှားမှာ စိုက်ပျိုးရန် မသင့်လျော်ကြောင်း တွေ့ရှိရပါသည်။ ဆီနီဂေါရှားကို ကျောက်ပန်းတောင်းမြို့နယ်နှင့် မြင်းခြံမြို့နယ်များတွင် ကောင်းမွန်စွာ ပေါက်ရောက် နိုင်သည်ကိုတွေ့ရှိရပါသည်။ သို့ရာတွင် မိုးရေချိန် ၂၆လက်မနှင့် အထက်ရှိသည့် နေရာများတွင်သာ စိုက်ပျိုးသင့်ကြောင်း လေ့လာတွေ့ရှိရပါသည်။

Trial Planting of *Acacia senegal* and *Acacia auriculiformis* in the Central Dry Zone of Myanmar

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Forest Research Institute.

Abstract

The heavily populated and scarcely forested central dry zone of Myanmar is one of the areas of the country where there are shortages of fuelwood, post, poles and fodder. Consequently wide scale plantation programme has been launched in this area by the Forest Department. However, in order to fulfill these shortages identification of a broad range of species suitable for different purposes is needed. Species trials consisting of *Acacia senegal, Acacia auriculiformis, Acacia catechu* and *Acacia leucophloea* were conducted at Minbu, Yenangyaung and Chauk Township in 1987. At the same time trials were also conducted at Kyaukpadaung Township with *Acacia senegal, Acacia auriculiformis,* and *Acacia catechu* and at Myingyan Township with *Acacia senegal, Acacia catechu* and *Leucaena leucocephala.* It was found that it is not advisable to plant *Acacia auriculiformis* at Minbu, Yenangyaung and Chauk Townships. *Acacia senegal,* can be planted at Kyaukpadaung and Myingyan Township where the rainfall is 26" and above.

Contents

1. Introduction

The world's forests and woodlands are decreasing at a very fast rate due to the heavy demand for their productive resources. (Turnbull, 1986). Over half of these timber resources which were produced each year has been used as fuelwood (Ayensu, 1980; Turnbull, 1986). The ratio of fuelwood on the total wood cut each year is higher still in developing countries (Ko Ko Gyi, 1980). Thus in order to meet this rising demand establishment of extensive fuelwood plantation is greatly needed. According to an estimate by the Food and Agriculture Organisation of the United Nations, the word's demand on fuelwood alone will require 124 million acres of non-industrial plantations before the year 2000 (Turnbull, 1986). This problem had been widely reviewed and discussed by the author in the research papers submitted to the Myanmar research congress in 1986 and 1988 (Ko Ko Gyi, 1986, Ko Ko Gyi etal,1988, Zaw Win and Ko Ko Gyi, 1988).

However, with the new direction of forestry towards social or community forestry, identification of a broader range of species suitable for domestic fuel, post and poles, fodder, soil improvement, windbreaks and shade and shelter is needed. (Turnbull, 1986, Mc William, 1986).

Myanmar, being one of the developing countries in the world is also faced with the same problems. These problems are more acute in the central dry zone area of the country where the soil is sandy, poor and the rainfall is less than 30". Moreover, the rainy season occurs during the hot summer months and is distributed over an average of 6 months of the year with an average rainfall days of 45 days. Many indigenous species have been tried without much success and so far, *Eucalyptus camaldulensis* was the only species that seemed to do reasonably well.

In view of the success obtained with *Senegal* and *Aurishas* in areas where the rainfall is over 30", it was decided to test this species widely in more adverse areas where the rainfall ranges between 16.4" to 26.1" and soil texture containing 54.2 % to 73.6 % sand. *Senegal sha,* which can grow in areas where the rainfall is as low as 8" appeared to be reasonable, but favourable performance of *Aurisha* was rather doubtful because its natural habitat with the lowest rainfall has 36" of rain annually. (Turnbull, 1986; Ayensu, 1980; Weber 1977).

Experimental plots were established at Minbu, Yenangyaung, Chauk, Kyaukpadaung and Myingyan Township in 1987. Due to the insufficient number of seedlings available for the experiment, it was possible to establish experimental plots with the same number of species and same design only at Minbu, Yenangyaung, Chauk Townships. Kyaukpadaung and Myingyan Townships have different designs and different number of species.

Experiments at Minbu, Yenangyaung Townships were carried out with the cooperation of Magwe Forest plantation centre (2-3) and considerable help were received from the local staff, Data analysis was carried out with the help of personals from Computer section of the National Forest Inventory Project.

The Major objective of these experiments, as can be seen, was to test the performance of *Auri* and *Senegal shas* in the adverse sites in Myanmar. However, Sha and Htanaung being native species and Bawzagaing, an established exotic species were included for comparison.

2. Materials and Methods

The experiment was carried out in five locations, namely (i)Zi-aing in Minbu Township (ii) Wat-ma-sut in Yenangyaung Township (iii) Sin-ka in Chauk Township, (iv)Kywe-kan in Kyaukpadaung Township and (v)Chin-myit - Kyin in Myingyan Township, in 1987.

Randomized complete block design was use in all the locations except Chin-myit-Kyin at which complete randomized design was used.

Zi-aing, Wat-ma-sut and Sin-ka

The species used in these three locations were;
1. Senegal sha (*Acacia senegal* (L.) Willd)
2. Auri sha (*Acacia auriculiformis* A. Cunn ex. Benth.)
3. Sha (*Acacia catechu* Willd)
4. Hta-naung (*Acacia leucophloea* Willd.)

In each location, the experiment was replicated six times and each plot contains 64 seedlings of each of the species listed above.

Kywe-kan

The species used in these locations were;
1. Senegal sha (*Acacia senegal* (L.) Willd)
2. Auri sha (*Acacia auriculiformis* A. Cunn ex. Benth.)
3. Sha (*Acacia catechu* Willd)

In this location, the experiment was replicated three times and each plot contains 64 seedlings of each of the species listed above.

Chin-myit -kyin

The species used in these locations were;
1. Senegal sha (*Acacia senegal* (L.) Willd.)
2. Sha (*Acacia catechu* Willd.)
3. Bawzagaing (*Leucaena leucocephala* Lam.)

In this location, the experiment was replicated four times and each plot contains 64 seedlings of each of the species listed above.

In all the locations, the area to be planted was cleared and pits were dug at a spacing of 12' x 12' as practiced in the central dry zone of Myanmar. Weeding and soil working operations were also carried out as practiced in the District.

Soil samples from each of the locations were collected at 0-10 cm, 20-40 cm, 60-80 cm, 100-110 cm. Texture, P^H and NPK content of these soil samples were analysed at the soil laboratory in Yezin (See table II).

Climatic data for the above five locations were collected from the nearest available station. Datas presented were average of 10 years (See table I).

Survival and height assessment were carried out in the month of April every year. Statistical F and LSD tests of significance were used in the analysis of data.

Table I. Average rainfall of the locations included in the experiment.

Locations	Average rainfall (in).
Minbu (Zi-aing)	24.92
Yenanchaung (Wat-ma-sut)	16.24
Chauk (Sin-ka)	21.40
Kyaukpadaung (Kywe-kan)	25.81
Myingyan (Chin-myit-kyin)	26.07

Table II. Soil condition of the locations included in the experiment.

Location	P^H	Total N_2%	Available P %	Available K %	Texture		
					Sand %	Silt %	Clay %
Zi-aing	5.8	0.0189	0.0004	0.0066	54.2	28.5	10.8
Wat-ma-sut	6.8	0.0482	trace	0.0079	71.8	13.5	12.3
Sin-ka	7.3	0.0228	trace	0.0038	68.7	13.5	12.3
Kywe-kan	6.5	0.0250	trace	0.0043	65.5	8.0	19.6
Chin-myit-kyin	7.5	0.0130	0.0028	0.0028	73.6	18.5	0.5

Table III. Survival percentage in the first year (1987)

Species	Location				
	Zi-aing	Wat-ma-sut	Sin-ka	Kywe-kan	Chin-myit-kyin
A.auriculiformis	28.1	30.7	34.6	78.6	-
A.senegal	74.5	68.2	59.6	68.8	79.8
A.catechu	29.2	34.6	66.9	55.7	52.1
A. leucophloea	57.3	65.4	72.7	-	-
L.leucocephala	-	-	-	-	57.6

Table IV. Average height in the first and the third years. (ft.)

Species	Zi-aing		Wat-ma-sut		Sin-ka		Kywe-kan		Chin-myit-kyin	
	1987	1989	1987	1989	1987	1989	1987	1989	1987	1989
A.auriculiformis	0.80	1.67	1.33	1.35	0.89	2.24	1.06	1.78	-	-
A.senegal	1.09	1.35	0.89	1.38	0.96	0.85	2.49	3.88	1.36	2.91
A.catechu	1.07	1.14	0.75	1.09	1.37	1.26	0.99	2.52	1.20	1.43
A. leucophloea	0.76	1.17	0.59	1.00	0.91	1.02	-	-	-	-
L.leucocephala									2.11	1.70

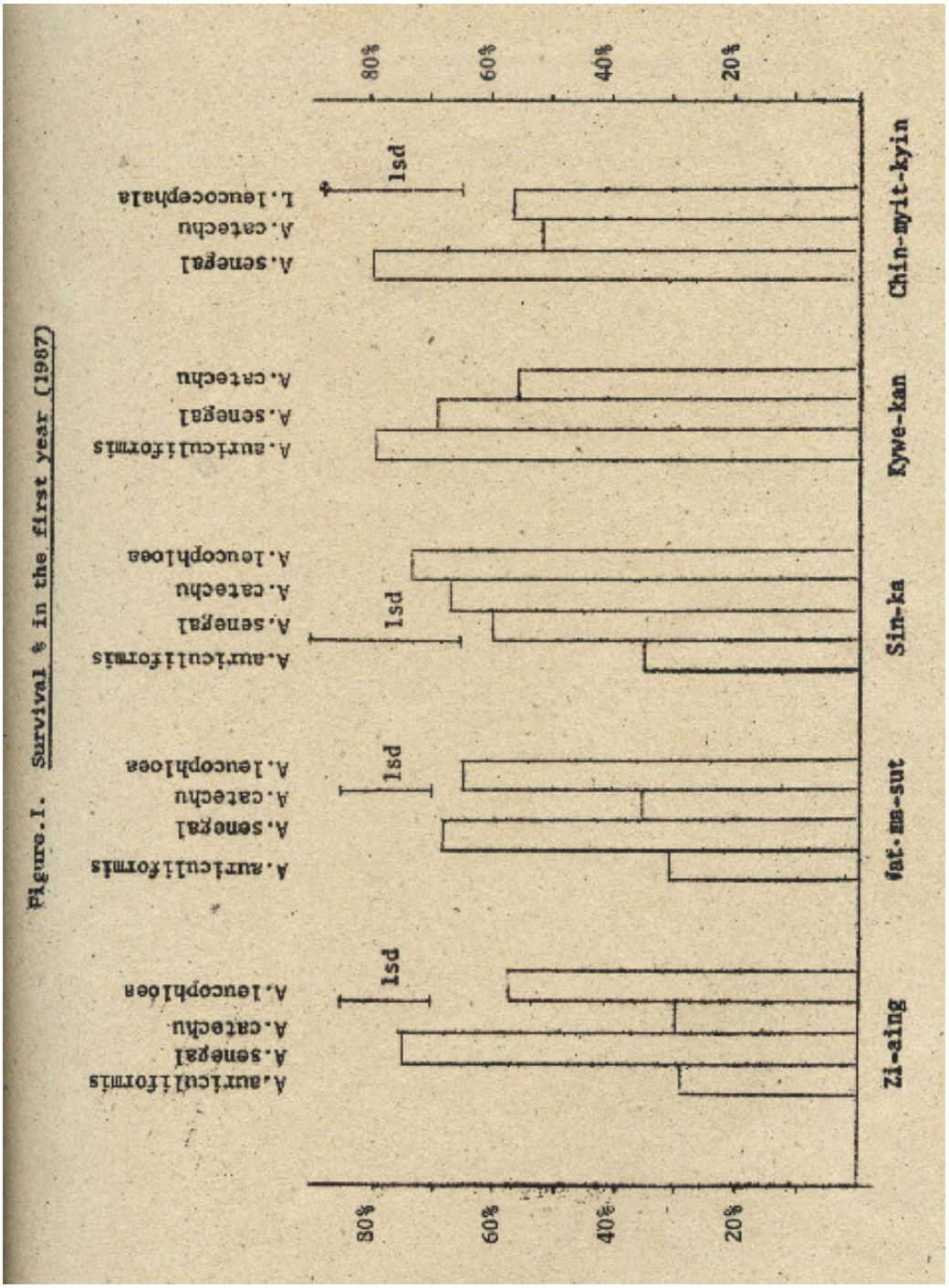
Figure.I. Survival % in the first year (1987)
80%
60%
40%
20%
lsd
A.auriculiformis
A.senegal
A.catechu
A.leucophloea
Zi-aing
A.auriculiformis
A.senegal
A.catechu
A.leucophloea
Fat-ma-sut
A.auriculiformis
A.senegal
A.catechu
A.leucophloea
Sin-ka
A.auriculiformis
A.senegal
A.catechu
Kywe-kan
A.senegal
A.catechu
L.leucocephala
Chin-myit-kyin

3. Results

The result of survival in the first year and height growth in the first and the third year were as shown in table III & IV and figure I & II.

The result comparison of locations for each species in terms of survival and height growth in the first year and height growth in the third year was as given in table III , IV & figure I , II.

Survival

The result survival in each of the location tested were found to be significantly different expect for these at Kywe-kan. (See Appendix I (a), II (a), III (a), IV (a) & V (a). For simplicity, ranking of the species for each location are given below with lines linking these species that not significantly different.

Zi-aing	Wat-ma-sut	Sin-ka
Senegal sha	Senegal sha	Hta-naung
Hta-naung	Hta-naung	Sha
Sha	Sha	Senegal sha
Auri sha	Auri sha	Auri sha

Kywe-kan	Chin-myit-kyin
Auri sha	Senegal sha
Senegal sha	Bawzagaing
Sha	Sha

The results of survival of the species tested at Zi-aing and Wat-ma-sut were very similar. In both the location, the survival of Senegal sha and Hta-naung were significantly better than that of Sha and Auri sha.

At Sin-ka, Auri sha was significantly the poorest whereas Hta-naung, sha and Senegal sha tended to form a group.

The differences in survival of species tested in Kywe-kan was not significant.

Senegal sha was significantly the best at Chin-myit-kyin however the different between Bawzagaing and sha was not significant.

Height growth

The differences in height measurements taken in the first year (1987) and the third year (1989) were found to be significantly different in all the locations tested except at Wat-ma-sut where the differences in height measurements taken in 1989 were not significantly different. (See Appendix I (b) (c), II (b) (c), III (b) (c), IV (b) (c), & V (b) (c)). Rankings are given below with lines linking those species that were not significantly different.

Zi-aing

1987	1989
Senegal sha	Auri sha
Sha	Senegal sha
Auri sha	Hta-naung
Hta-naung	Sha

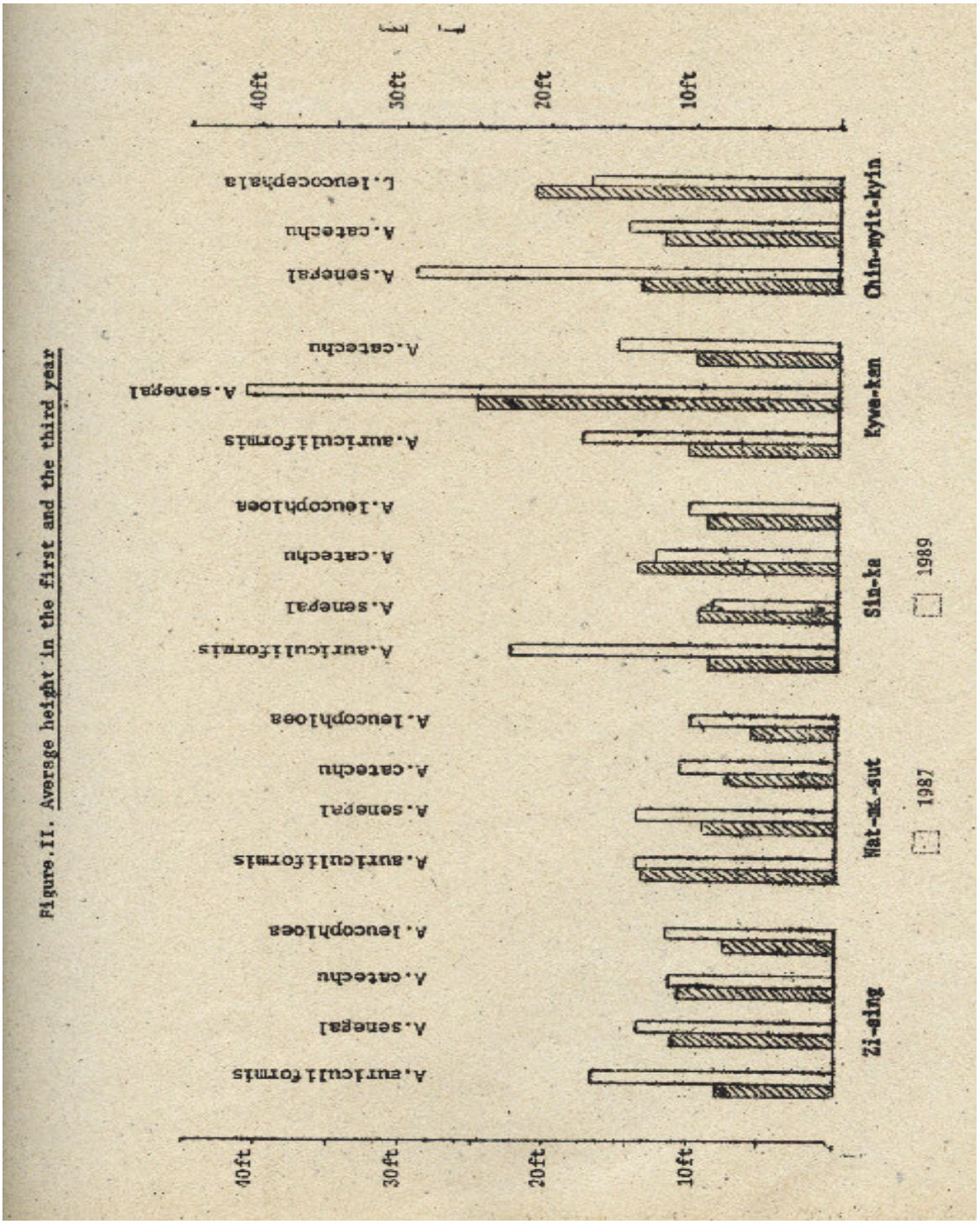

Figure.11. Average height in the first and the third year

Height measurements taken in 1987 at Zi-aing showed that Senegal sha and Sha were significantly better than Auri sha and Hta-naung. However, in 1989, Auri sha demonstrated the best height growth, Senegal sha followed second while Hta- naung and Sha were significantly the poorest.

Wat-ma-sut

1987	1989
Auri sha	Senegal sha
Senegal sha	Auri sha
Sha	Sha
Hta-naung	Hta-naung

At Wat-ma-sut, height measurements taken in 1987 also showed Auri sha to be significantly the best Senegal sha and Sha followed second and Hta-naung significantly the poorest. The differences in height measurements taken in 1989 were not significant.

Sin-ka

1987	1989
Sha	Auri sha
Senegal sha	Sha
Hta-naung	Hta-naung
Auri sha	Senegal sha

Sha was significantly the best in height measurement taken in 1987 at Sin-ka. The differences between Senegal sha, Hta-naung and Auri-sha were significant. In 1989, Auri sha stood out to be the best while no significant differences were observed between Sha, Hta-naung and Senegal sha.

Kywe-kan

1987	1989
Senegal sha	Senegal sha
Auri sha	Sha
Sha	Auri sha

At Kywe-kan, Senegal sha gave significantly the best height growth in 1987. The difference between Auri sha and Sha was not significant. In 1980, the height growth of the species tested tended to overlap. Senegal sha however tended to be the most superior while Auri sha was poor.

Chin-myint-kyin

1987	1989
Bawzagaing	Senegal sha
Senegal sha	Bawzagaing
Sha	Sha

Bawzagaing was significantly the best in height growth at Chin-myint-kyin in 1987. The difference between Senegal sha and Sha was not significant. In 1989, Senegal sha turn out to be the best while the difference between Bawzagaing and Sha was not significant.

4. Discussion

Some of the seedlings included in the experiment died during the severe hot season and sending up shoots again during the rains. This resulted in the height measurements to be rather erratic. In some locations, it can be seen that height measurement taken in 1989 was even smaller than that taken in 1987.

Height growth of all the species (except Auri sha) at Zi-aing, Wat-ma-sut and Sin-ka were found to be very poor, beings less than one foot in a period of two years. Although height growth of Auri sha at Sin-ka was quite impressive, the seedlings were very spindly and unhealthy and the possibility of their survival in these locations seems rather doubtful.

Survival of Auri sha at Kywe-kan was reasonably good and height growth in 1989 could have been much more than was presented in table IV. Moreover it also appear to be healthy. However, the species was badly attacked by shoot borer, causing the shoot and top branches to break down and thus affecting the average height.

There did not seem to be any correlation between the performance of the species and the rainfall so far as Zi-aing, Wat-ma-sut and Sin-ka were concerned. However, Acacia senegal appears to perform much better at Kywe-kan and Chin-myit-kyin where the rainfall is over 25" (See table IV & figure II). The influence of soil characteristics of the location tested towards the performance of the species was also not observed. This can be because both *Acacia senegal* and *Acacia auriculiformis* can grow on a great variety of soils (Turnbull, 1989).

5. Conclusion

(1) It is not suitable to plant *Auri sha* in any of the four locations (i.e. Zi-aing, Wat-ma-sut, Sin-ka and Kywe-kan) tested.

(2) Senegal sha can be planted at Kywe-kan and Chin-myit-kyin but not advisable to be planted at Zi-aing, Wat-ma-sut and Sin-ka. However, if a choice has to be made for these three locations from among the species tested, Senegal sha should be selected.

(3) In order to get a reasonably good height growth, it is advisable to plant Senegal sha only where the rainfall is 26" and above.

(4) More research work is needed in order to identify the most suitable species for these adverse sites.

Appendix I (a) Analysis of variance for survival percentage in the first year (1987). Zi-aing

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	5	1273.2	254.6	
Species	3	9210.2	3070.1	20.671**
Error	15	2227.8	148.5	
Total	23	12711.2		
	LSD =	14.99		

Appendix I (b) Analysis of variance for height growth in the first year (1987). Zi-aing

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	5	0.053948	0.010790	
Species	3	0.532142	0.177381	18.604 **
Error	15	0.143015	0.009534	
Total	23	0.729104		
	LSD =	0.12		

Appendix I (c) Analysis of variance for height growth in the third year (1980). Zi-aing

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	5	0.54477	0.10895	
Species	3	1.06717	0.35572	19.677**
Error	15	0.27117	0.01808	
Total	23	1.88311		
	LSD =	0.165		

Appendix II(a) Analysis of variance for survival percentage in the first year (1987). Wat-ma-sut

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	5	486.7	97.3	
Species	3	7053.2	2351.1	15.961**
Error	15	2209.5	147.3	
Total	23	9749.3		
	LSD =	14.93		

Appendix II (b) Analysis of variance for height growth in the first year (1987). Wat-ma-sut

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	5	0.11534	0.02307	
Species	3	1.81101	0.60367	42.027**
Error	15	0.21546	0.01436	
Total	23	2.14181		
	LSD =	0.147		

Appendix II (c) Analysis of variance for height growth in the third year (1989). Wat-ma-sut

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	5	0.9616	0.1923	
Species	3	0.6580	0.2193	1.984(N.S)
Error	10	1.1052	0.1105	
Total	18	2.7248		

Appendix III (a) Analysis of variance for Survival percentage in the first year (1987). Sin-ka

Source of variation	d.f		Sum of squares	Mean squares	F-ratio
Block	5		378.0	75.6	
Species	3		5053.3	1684.4	4.016*
Error	15		6291.9	419.5	
Total	23		11723.2		
	LSD	=	25.2		

Appendix III (b) Analysis of variance for height growth in the first year (1987). Sin-ka

Source of variation	d.f		Sum of squares	Mean squares	F-ratio
Block	5		0.11641	0.02328	
Species	3		0.92363	0.30788	11.328**
Error	15		0.40769	0.02718	
Total	23		1.44773		
	LSD	=	0.20		

Appendix III (c) Analysis of variance for height growth in the third year (1989). Sin-ka

Source of variation	d.f		Sum of squares	Mean squares	F-ratio
Block	5		1.9370	0.3874	
Species	3		6.9724	2.3241	6.97**
Error	15		5.0018	0.3335	
Total	23		13.9111		
	LSD	=	0.71		

Appendix IV (a) Analysis of variance for Survival percentage in the first year (1987). Kywe-kan

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	2	307.6	153.8	
Species	2	792.6	396.3	1.091(N.S)
Error	4	1453.5	363.4	
Total	8	2553.7		

Appendix IV (b) Analysis of variance for height growth in the first year (1987). Kywe-kan

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	2	0.3694	0.1847	
Species	2	4.2849	2.1425	15.502*
Error	4	0.5528	0.1382	
Total	8	5.2072		
	LSD =	0.84		

Appendix IV (c) Analysis of variance for height growth in the third year (1989). Kywe-kan

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Block	2	3.4448	1.7224	
Species	2	6.7970	3.3983	7.559*
Error	4	1.7984	0.4496	
Total	8	12.0401		
	LSD =	1.52		

Appendix V (a) Analysis of variance for survival percentage in the first year (1987). Chin-myit-kyin

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Species	2	1716.09	858.05	5.28*
Error	9	1461.80	162.42	
Total	11	3177.89		
	LSD =	20.38		

Appendix V (b) Analysis of variance for height growth in the first year (1987). Chin-myit-kyin

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Species	2	1.79	0.895	19.04*
Error	9	0.42	0.047	
Total	11	2.21		
	LSD =	0.35		

Appendix V (c) Analysis of variance for height growth in the third year (1989). Chin-myit-kyin

Source of variation	d.f	Sum of squares	Mean squares	F-ratio
Species	2	4.94	2.47	13.72**
Error	9	1.64	0.18	
Total	11	6.58		
	LSD =	0.68		

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