



**Government of Union of Myanmar
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Studies on Different Methods of Planting of Fuelwood Species in High Rainfall Area

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မိုးများသောဒေသ၌ ထင်းသစ်မျိုးများ စိုက်ပျိုးရန် နည်းစနစ်အမျိုးမျိုး ဖော်ထုတ်ခြင်း

ဦးဇော်ဝင်း-၅ (B.Sc. (For.) (Rgn.)) သုတေသနမှူး

ဝSifh

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

စာတမ်းအကျဉ်းချုပ်

သစ်တောဦးစီးဌာနမှ အောက်မြန်မာပြည်မိုးများသောဒေသ ထင်းလိုအပ်ချက်များသည် နေရာများတွင် ထင်းစိုက်ခင်းများကို နှစ်စဉ်ကျယ်ကျယ်ပြန့်ပြန့် တည်ထောင်လျက်ရှိပါသည်။ တည်ထောင်စိုက်ပျိုးရာတွင် ပလပ်စတစ်အိတ်ဖြင့် ပျိုးထောင်ပြီး စိုက်သောနည်းကို အသုံးပြုလျက် ရှိပါသည်။ သို့ရာတွင် တစ်နေရာတည်း၌ စိုက်ခင်းဧရိယာ ဧကများတည်ထောင်ပါက ပျိုးပင်များ စိုက်ကွင်းအတွင်း အချိန်မီ ရောက်ရှိရေးသည် မိုးများဒေသ ဖြစ်သည့်အလျောက် ခက်ခဲကြန့်ကြာမှု ရှိနေမည် ဖြစ်ပါသည်။ သို့ဖြစ်ပါ၍ သယ်ယူရေးခက်ခဲသော ဧရိယာများတွင် အခက်အခဲမရှိ အချိန်မီ စိုက်ပျိုးနိုင်ရေးအတွက်၊ မြေလုံးမဲ့စိုက်၍ ရနိုင်သော သစ်မျိုးများနှင့် အခြားအသုံးပြုနိုင်သည့် စိုက်ပျိုးနည်းများအား ဖော်ထုတ်နိုင်ရန် စူးစမ်းလေ့လာခဲ့ပါသည်။ လေ့လာရာတွင်လည်း အသုံးပြုနိုင်သောအကြီး မြန်မာသစ်မျိုးများဖြစ်သည့် စစ်၊ မယ်ဇလီ၊ ဘောစကိုင်း၊ သင်္ဘောကုက္ကို၊ ကုက္ကိုနှင့် ရေမနေသစ်မျိုးများအား တစ်မျိုးစီလျှင် စိုက်ပျိုးနည်း (၂)နည်းမှ (၆)နည်းဖြင့် ရန်ကုန်တိုင်း တိုက်ကြီးမြို့နယ်ရှိ ၁၉၈၆-ခုနှစ် မာဂရီထင်းစိုက်ခင်းအတွက် (၁၀)ဧက စမ်းသပ်တည်ထောင်ခဲ့ပါသည်။ စမ်းသပ်သည့် ထင်းသစ် (၆)မျိုးမှ မြေလုံးမဲ့ စိုက်လို့ရနိုင်သော ထင်းသစ်မျိုးများမှာ မယ်ဇလီ နှင့် ဘောစကိုင်းများဖြစ်ပြီး မယ်ဇလီသစ်စေ့အား (၁၂)နာရီရေစိမ်ပြီး စိုက်၍လည်း ရနိုင်ကြောင်း တွေ့ရှိရပါသည်။

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Abstract

Since 1985, the Forest Department has been launching a large scale fuelwood plantation programme in high rainfall fuelwood deficit areas. Due to the boggy situation in such areas, transportation of tubed seedlings from the nursery to the planting site is a great problem. With the object of overcoming and direct sowing were tested at Margari, Taikkyi Township in 1986 . Species that were tested were sit, mezali, bawzagaing, thinbaw-kokko, kokko and yemane, and two to six planting methods were applied to the species considered to be appropriate. Out of the six species tested, it was found that bawzagaing can be planted bare-rooted while mezali can be planted either bare – rooted or by direct seedling after soaking the seeds in water for 12 hours.

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1. Introduction

- 1.1 Burma has always been considered rich in its natural resources, particularly in forest resources. So far as the forest resources is concerned this statement may be true particularly in that part of the country where the population is sparse and there is enough timber and fuel for domestic use. However, there are many regions in the country where fuelwood is scarce either due to the concentration of the population or adverse climatic condition.(e.g. central dry zone of Burma)
- 1.2 Consequently, the Forest Department is putting an extensive area of fuelwood plantation included in its annual planting programme of 80,000 acres. These fuelwood plantations are located mainly in the vicinity of the fuelwood deficit areas such as Rangoon, Mandalay, the Dry Zone Area, etc. For the supply of Rangoon area and its vicinity, extensive areas have been planted in Margari Reserve, Taikkyi Township. Four thousand acres were planted in 1985 and 4400 acres in 1986.
- 1.3 However, there were problems implanting such vast flat area with high rainfall. Even though the seedlings for planting were raised in time, there was difficulty in transportation of tubed seedlings to the planting site because -
 - (a) due to high rainfall, the ground was too soft and boggy for transportation with tractors.
 - (b) the time of transporting seedlings coincide with the time for planting paddy, consequently, bullock cart and labourers were scarce.
- 1.4 In the second year, ie. 1986, the problem was partially solved by establishing three scattered flying nurseries in the area to be planted. Although the distance for the tubed seedlings to be transported was greatly reduced, this method resulted in higher cost for seedling production. Moreover, expert supervision was more difficult.
- 1.5 Thus, in order to solve this transportation problem, an experiment was designed to study the planting technique of a few prospective fuelwood species. This study aimed at finding alternative planting methods in which good planting or sowing materials could be easily transported to the planting site.
- 1.6 Three methods of planting were considered for trial, (i) seed sowing (ii) bare root planting and (iii) puddle not planting.
- 1.7 According to Chapman and Allan (1978), if direct seed sowing method is to be used, seeds should be pretreated before being put out in the field. Out of the many seed pretreatment methods that have been tried in forestry research, only those that are practical for use in the field were tested, (Chapman, Allan, 1978; Ko Ko Gyi, 1972; Thein kyi, Chit Hlaing & Ko Ko Gyi, 1987)
- 1.8 In bare root planting, it is very important that the roots of the seedlings are not severely damaged nor lose too much moisture (Kamweti, 1982). If root moisture can be conserved and the roots do not dry off, some seedlings can be transported and planted bare rooted. (Kamweti, 1982)
- 1.9 There are many methods of conserving root moisture in order that the roots do not dry off in bare root planting. (Chapman and Allan, 1978) However, only the

puddle root planting method, which is the most practical for the area to be tested was used.

- 1.10 Both bare root and puddle root planting methods were tried because some species can conserve their root moisture quite well without any root treatment. Species with such capability can be successful particularly in the high humidity of high rainfall area.
- 1.11 This study was conducted in Compartment (4) of Margari Reserve, Taikkyi Township. Six species were tested. Two to six planting methods were tried for each species.

2. Materials And Methods

2.1 Site preparation

The standard site preparation method was used, ie. Site clearing, burning, kyunkwe and staking were carried out. Being a flat area, a small mound was made at every stake to avoid excessive water logging.

2.2 Species and planting methods used

Six fuelwood species were included in this experiment. For each species two to six appropriate planting or sowing methods were tested. In order to simplify the description in this paper, code Nos. were assigned to all the treatments as follows.

Species	Treatment	Code No.
Sit	Seed soaked in boiling water and left to cool for 24 hrs.	01
Sit	Seed not pretreated	02
Sit	8 inches tubed seedling	03
Sit	Seedling lifted in the evening and planted bare root the next morning	04
Sit	Seedling lifted in the morning and planted bare root the same day	05
Sit	Seedling lifted and roots dipped in thick mud water (road puddle) in the evening and planted the next morning	06
Thinbaw-kokko	Seed not pretreated	07
Thinbaw-kokko	Seed partially scarified	08
Thinbaw-kokko	8 inches tubed seedling	09
Thinbaw-kokko	Seedling lifted in the evening and planted bare root the next morning	10
Thinbaw-kokko	Seedling lifted in the morning and planted bare root the same day	11
Thinbaw-kokko	Seedling lifted and root puddled in the evening and planted the next morning	12
Mezali	Seed not pretreated	13

Mezali	Seed soaked in water for 12 hrs.	14
Mezali	8 inches tubed seedling	15
Species	Treatment	Code No.
Mezali	Seedling lifted in the evening and planted bare root the next morning	16
Mezali	Seedling lifted in the morning and planted bare root the same day	17
Mezali	Seedling lifted and root puddled in the evening and planted the next morning	18
Bawzagaing	Seed not pretreated	19
Bawzagaing	Seed soaked in water for 24 hrs.	20
Bawzagaing	Seed partially scarified	21
Bawzagaing	Seedling lifted in the evening and planted bare root the next morning	22
Bawzagaing	Seedling lifted in the morning and planted bare root the same day	23
Bawzagaing	Seedling lifted and root puddled in the evening and planted the next morning	24
Yemane	Seed not pretreated	25
Yemane	Seed soaked in water for 12 hrs.	26
Kokko	Seed not pretreated	27
Kokko	Seed partially scarified	28

All the seeds and seedlings were either direct sown or plated out in the field after being treated with the above treatments. All the seedlings used were 8 inches tall.

2.3 Spacing

A spacing of 3 ft x 3 ft were adopted for all the treatments.

2.4 Weeding and Patching

Three weedings were carried out during the year. In order to get a precise data on survival, patching was not done.

2.5 Experimental design

Randomized complete block design (RCBD) was used. The experiment was replicated 4 times and each plot contained 64 trees (8 trees x 8 rows). Statistical F and LSD tests of significance were used in the analysis of data.

2.6 Data collection

Survival counting was carried out twice during the year. The first counting was carried out in December 1986, which was the normal practice in the Forest Department, while, the second counting was carried out in May 1987. The results of December 1986 survival counting minus that of May 1987 counting gave a crop in survival.

Height measurements were carried out in May 1987, ie. 11 months after sowing and planting.

3. Results

3.1 Survival

The results of survival in December 1986 and May 1987 were given in Tables I & II and Figure 1 respectively. The differences in survival among the treatments were found to be highly significant both in December 1986 and May 1987. (Appendices IA & IB). For simplicity, rankings of the treatments are given below and in figure 1, with lines linking those treatments that were not significantly different.

December 1986 survival count showed that treatment No. 19, id. Bawzagaing seed sowing (not pretreated), and treatment No. 20, ie. Bawzagaing seed sowing (seed soaked in water for 2 days) were significantly the poorest. As ranking of the remaining species overlap, it could be said that generally, treatment Nos. 22, 09, 03, 23, 24, 15, 18, 08, 13, 17 & 07 were the best. Treatment Nos. 16, 06, 01, 05, 11, 28, 04, 02, 27, & 10 followed second and treatment Nos. 12, 26, 25 & 21 were poor.

May 1987 survival count tended to form groups that overlap. Thus, it can be stated that generally, that generally, treatment Nos, 22, 15, 24, 09, 14, 13, 18, & 23 gave the best survival. Treatment Nos, 08, 03, 28, 17, 27, 16, 07, 05, & 26 were poor while treatment Nos. 12, 06, 01, 11, 10, 25, 04, 02, 21, 19, & 20 were the poorest.

3.2 Drop in Survival percent between December 1986 to May 1987.

The results of drop in survival percent between December 1986 to May 1987 were as given in Table III and Figure 2. The differences in the drop in survival within the 5 months period were found to be highly significant (Appendix IIA). Ranking of the drop in survival is given in Figure 2, with lines linking those data that were not significantly different.

Table I. Mean Survival Percent December 1986

Code No.	Mean Survival (%)	Code No	Mean Survival (%)
01	68.75	15	86.96
02	58.59	16	71.09
03	89.84	17	75.00
04	58.68	18	80.47
05	67.58	19	10.55
06	70.70	20	10.94
07	73.83	21	30.47
08	78.90	22	94.14
09	91.80	23	89.45
10	52.73	24	89.45
11	64.45	25	42.18
12	52.34	26	48.43
13	78.90	27	57.42
14	86.32	28	64.06

Table II. Mean Survival Percent May 1987

Code No.	Mean Survival (%)	Code No.	Mean Survival (%)
01	38.30	15	83.59
02	23.04	16	49.08
03	53.51	17	50.78
04	30.47	18	70.70
05	42.19	19	8.20
06	38.67	20	7.42
07	48.83	21	18.75
08	60.15	22	91.01
09	78.91	23	70.70
10	35.70	24	83.20
11	37.50	25	34.37
12	39.06	26	42.18
13	73.43	27	49.60
14	75.78	28	52.34

Table III. Results of drop in Survival percent between December 1986 to May 1987.

Code No.	Drop in survival (%)	Code No.	Drop in Survival (%)
01	30.47	15	3.37
02	35.54	16	22.01
03	36.33	17	24.22
04	30.47	18	9.76
05	25.39	19	2.34
06	32.18	20	3.52
07	25.00	21	11.72
08	18.75	22	3.12
09	12.90	23	18.75
10	19.53	24	6.25
11	26.95	25	7.81
12	13.28	26	6.25
13	5.47	27	7.81
14	10.54	28	11.72

Figure 1. Rankings of mean survival percentage.

<u>Code No.</u>	<u>Mean Survival (%)</u> <u>(December, 1986)</u>	<u>Code No.</u>	<u>Mean Survival (%)</u> <u>(May, 1987)</u>
22	94.14	22	91.01
09	91.80	15	83.59
03	89.84	24	83.20
23	89.45	09	78.91
24	89.45	14	75.78
15	86.96	13	73.43
14	86.32	18	70.70
18	80.47	23	70.70
08	78.90	08	60.15
13	78.90	03	53.51
17	75.00	28	52.34
07	73.83	17	50.78
16	71.09	27	49.60
06	70.70	16	49.08
01	68.75	07	48.83
05	67.58	05	42.19
11	64.45	26	42.18
28	64.06	12	39.06
04	58.68	06	38.67
02	58.59	01	38.30
27	57.42	11	37.50
10	52.73	10	35.70
12	52.34	25	34.37
26	48.43	04	30.47
25	42.18	02	23.04
21	30.47	21	18.75
20	10.94	19	8.20
19	10.55	20	7.42
LSD (0.05) =	14.76	LSD (0.05) =	18.27

Table IV. Height Measurements May 1987

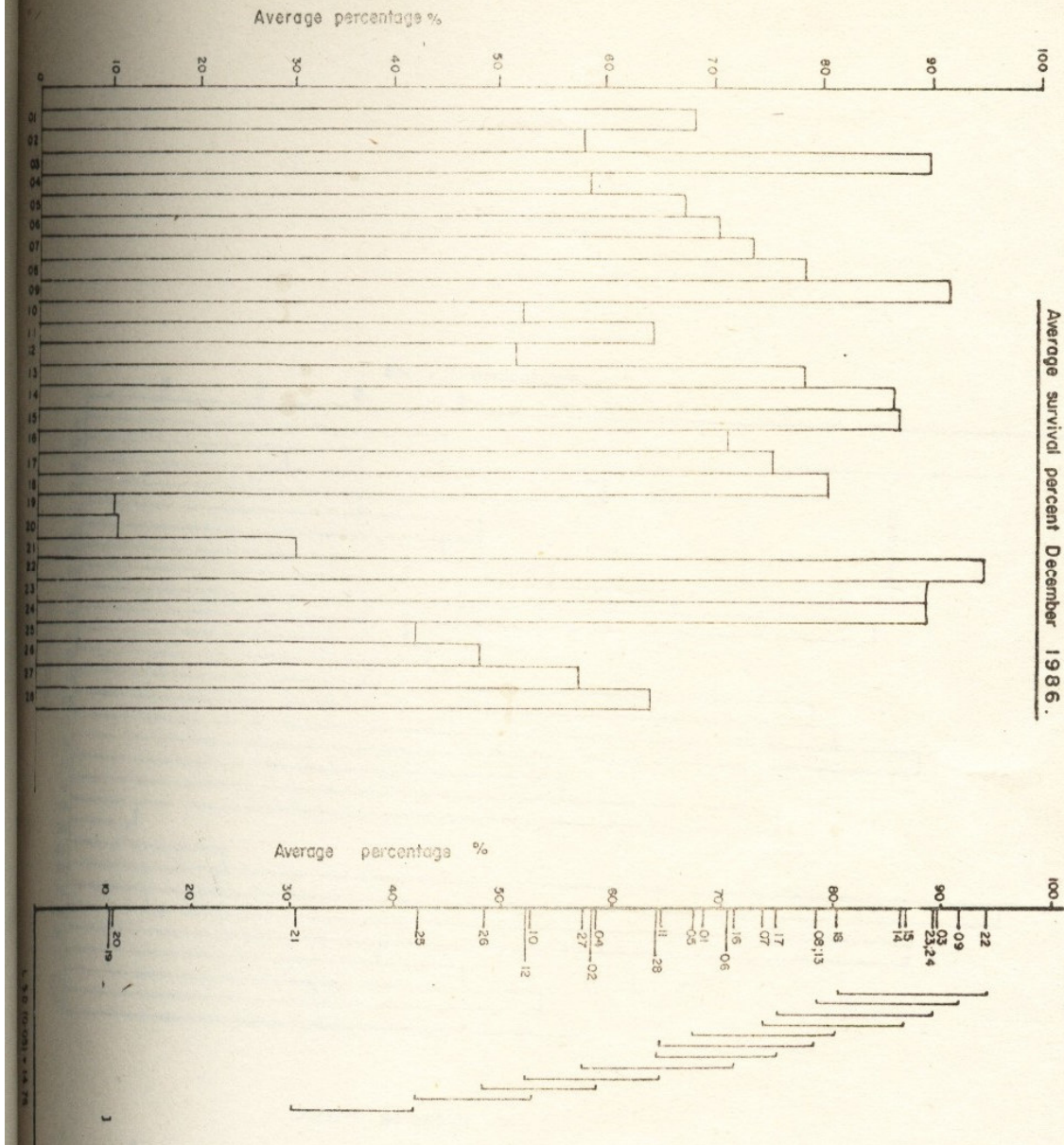
Code No.	Average height (inches)	Code No.	Average height (inches)
01	6.67	15	17.21
02	6.35	16	10.83
03	13.35	17	21.92
04	11.16	18	16.44
05	12.41	19	8.97
06	11.87	20	7.44
07	6.96	21	9.95
08	7.23	22	45.60
09	10.90	23	37.60
10	7.59	24	37.90
11	7.50	25	16.02
12	7.59	26	14.51
13	14.47	27	7.97
14	12.13	28	9.14

Figure 2. Rankings of drop in survival percentage and average height.

<u>Code No.</u>	<u>Drop in Sur. (%)</u>	<u>Code No.</u>	<u>Average ht.</u>
19	2.34	22	45.60
22	3.12	24	37.90
15	3.37	23	37.60
20	3.52	17	21.92
13	5.47	15	17.21
24	6.25	18	16.44
26	6.25	25	16.02
25	7.81	26	14.51
27	7.81	13	14.47
18	9.76	03	13.35
14	10.54	05	12.41
21	11.72	14	12.13
28	11.72	06	11.87
09	12.90	04	11.16
12	13.28	09	10.90
08	18.75	16	10.83
23	18.75	21	9.95
10	19.53	28	9.14
16	22.01	19	8.97
17	24.22	27	7.97
07	25.00	10	7.59
05	25.39	12	7.59
11	26.95	11	7.50
01	30.47	20	7.44
04	30.47	08	7.23
06	32.18	07	6.96
02	35.54	01	6.76
03	36.33	02	6.35
LSD (0.05)	= 16.52	LSD (0.05)	= 5.59

Figure. 3.

Average survival percent December 1986.



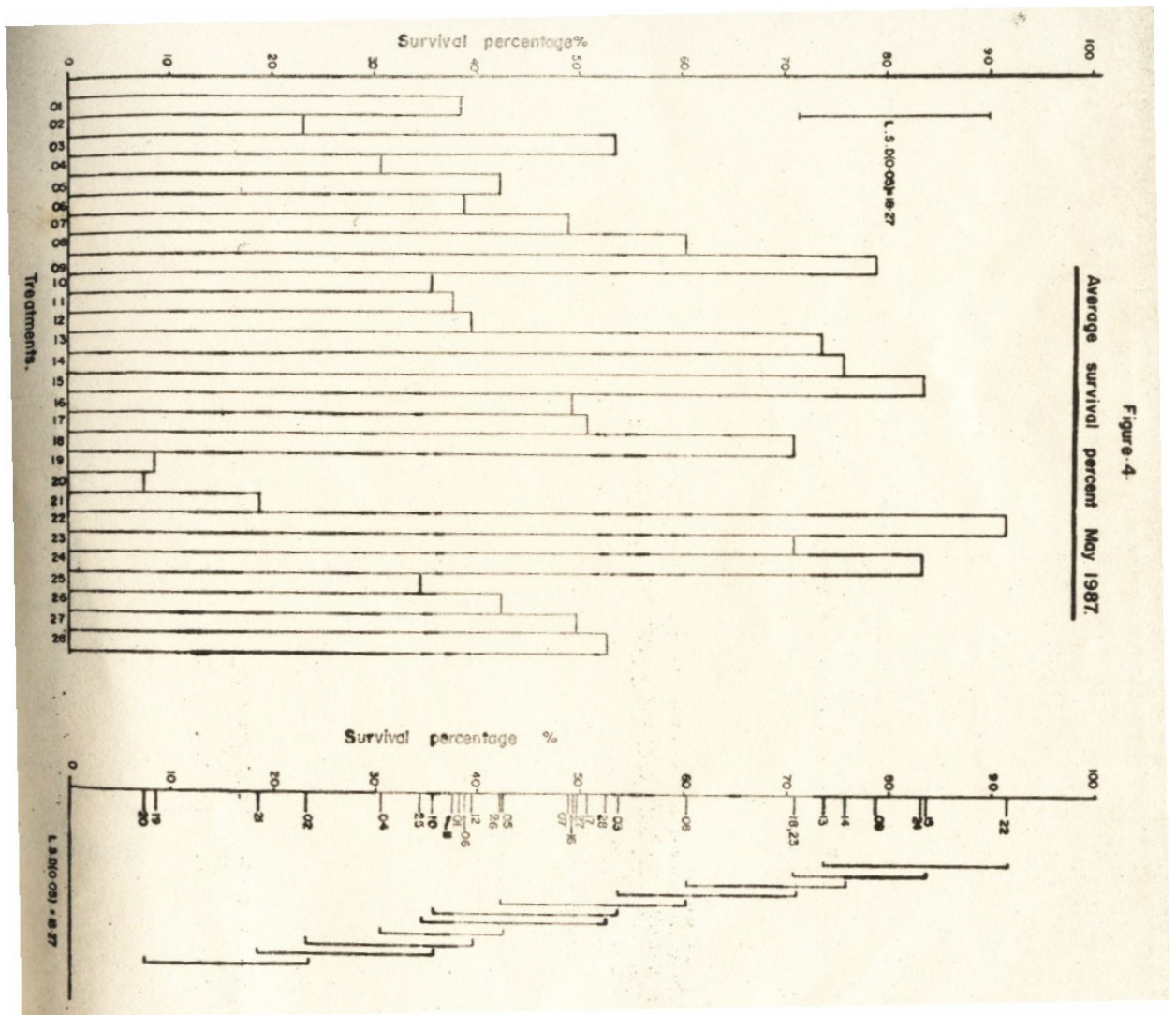
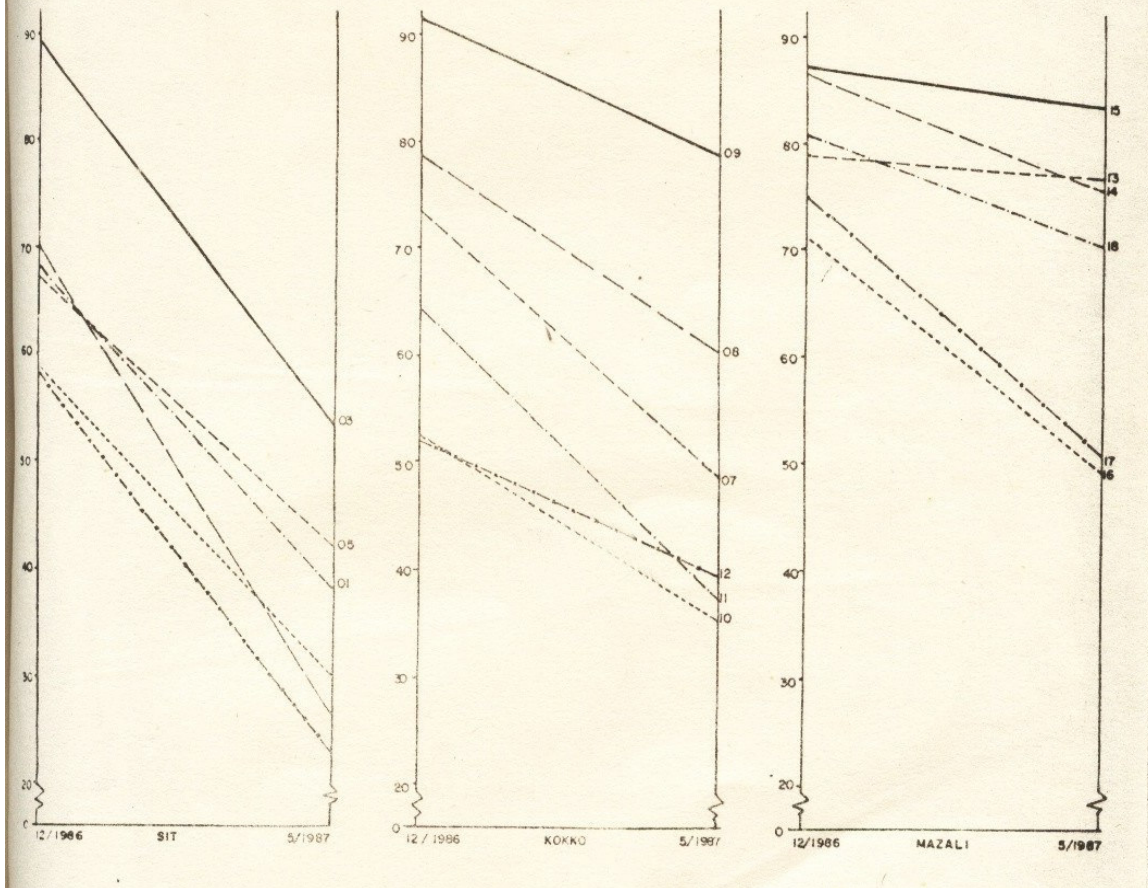
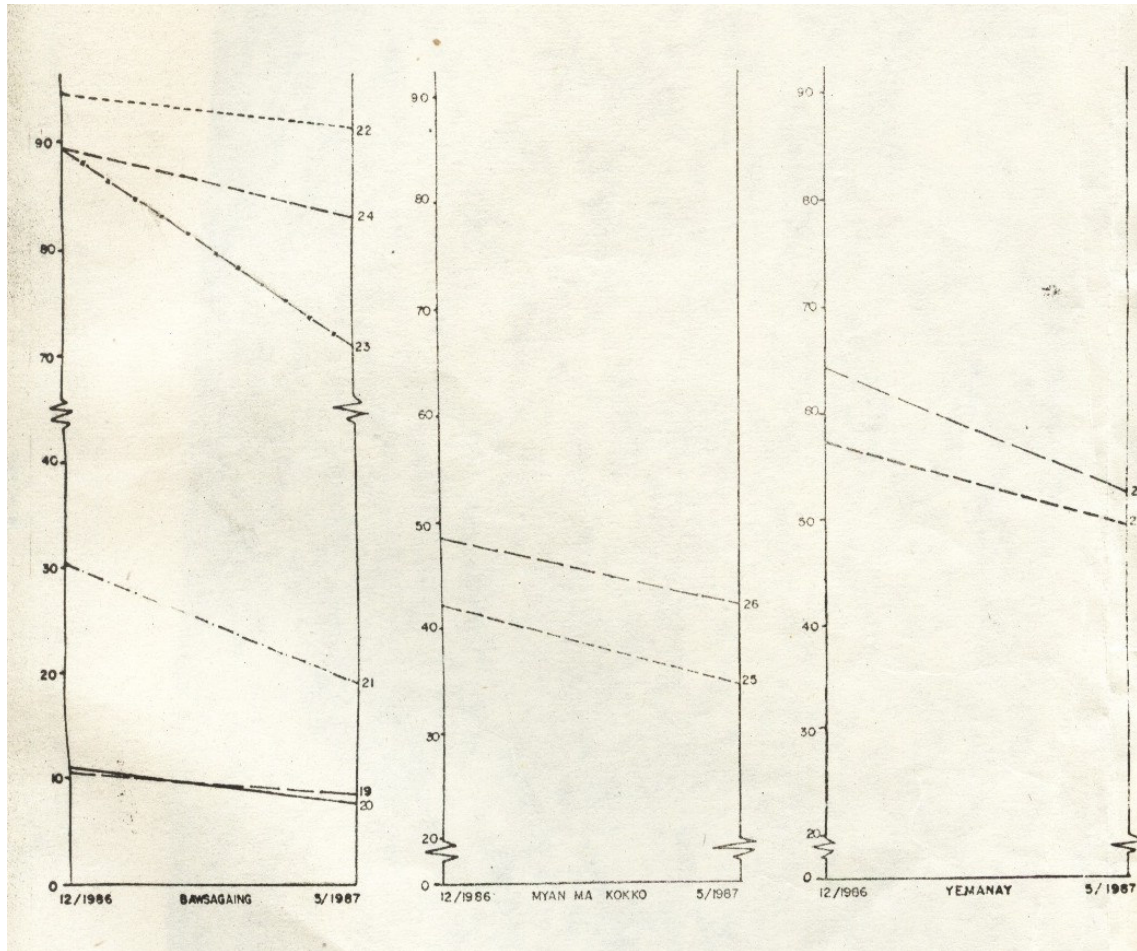
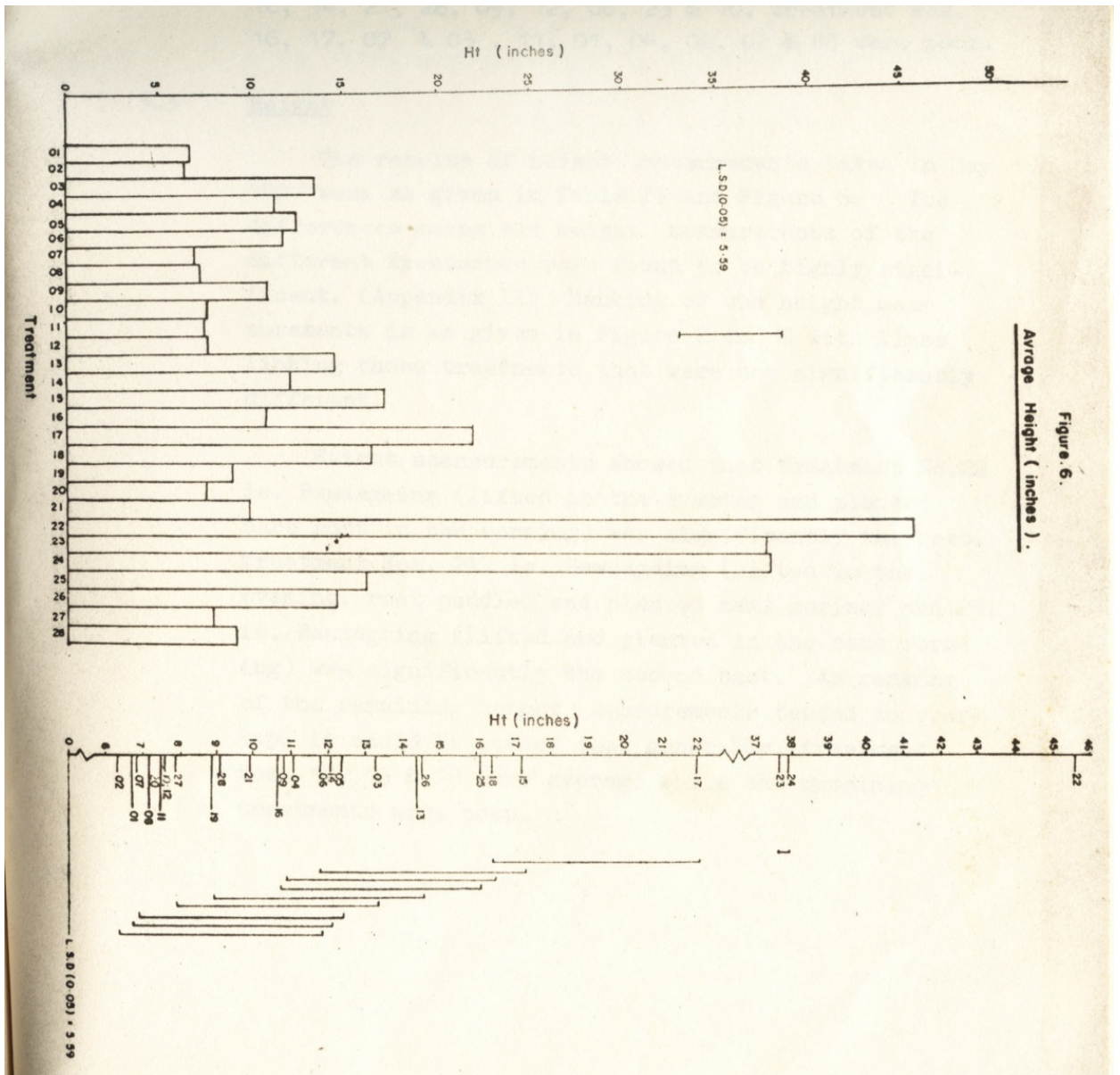


Figure 5.

Drop in survival percent.





Since the ranking tended to overlap, it could be said that generally, the drop in survival was lowest in treatment Nos. 19, 22, 15, 20, 13, 24, 26, 25, 27, 18, 14, 21, 28, 09, 12, 08, 23 & 10. Treatment Nos. 16, 17, 07 & 05, 01, 04, 06, 02 & 03 were poor.

3.3 Height

The results of height measurements taken in May 1987 were as given in Table IV and Figure 6. The differences among the height measurements of the different treatments were found to be highly significant. (Appendix II) Ranking of the height measurements is as given in Figure 2 and 6 with lines linking those treatments that were not significantly different.

Height measurements showed that treatment No. 22 i.e. Bawzagaing (lifted in the evening and planted bare root in the morning) was significantly the best. Treatment Nos. 24 and 26, Bawzagaing (lifted and planted in the same morning) was significantly the second best. As ranking of the remaining height measurements tended to overlap, it could be stated that generally, treatment Nos. 17, 15 & 18 were average while the remaining treatments were poor.

4. Discussion

The normal practice in the establishment of fuelwood plantation is to raise seedlings in 3 in. x 7 in. polythene bags a few months prior to planting. These heavy tubed seedlings have to be transported to the planting site in time at the break of monsoon, and, as mentioned earlier, this can be quite a problem when vast area has to be planted especially in a flat and high rainfall area.

The answer to this is to use either bare root planting or direct seedling methods. Different methods were tested and survival countings were carried out twice to see if the seedling that survive up till December can also survive the dry hot season.

4.1 Sit

Sit is one of the species used in the Magari fuelwood plantation. Thus, all the six treatments tested included this species. Out of the six, only the standard method, i.e. Tubed seedling gave good results (i.e. 89.8%) in the December counting. However, the drop in survival during the hot season was very high (See Fig. 5), leaving only 53.5% in May 1987. This may be due to high fungus and insect attack. Height growth also was comparatively poor. (See Fig. 6) The remaining 5 treatments gave very poor results.

4.2 Thinbaw-kokko

Just like Sit, Thinbaw-kokko was also tested with all the six treatments. From the results obtained, it was clear that treatment Nos. 09 (8" tubed seedling), 08 (seed partially scarified) and 07 (seed not pretreated) were among the best in December counting, while the rest were below average. However, the drop in survival during the hot season for treatment No. 07 was very high (see Fig. 5), leaving only 48.8% survival in May. Height growth also was poor for this treatment (See Fig. 6).

The drop in survival during the hot season for treatment Nos. 08 and 09 was above the average (See Fig. 5), leaving 62.2% and 78.9% survival respectively in May. Height growth for both treatments however was poor. This may be because the

species itself is slow growing in the first year as the normal planting method (09) was also poor in height growth.

4.3 Mezali

Mezali was also given all the six treatments that were tested. From the results obtained, treatment Nos. 15(8" tubed seedling), 14 (seed soaked in water for 12 hrs.), 18 (seedling lifted and root puddled in the evening and planted the next morning) and 17 (seedling lifted in the morning and planted bare root the same day) were the best in December survival counting. Treatment No. 16 was poor.

However, treatment No. 17 had a very high drop in survival during the hot season (see Fig.5) leaving survivals of 50.8% in May. (See Fig. 4) The drop in survival for treatment Nos. 15, 13, 18 & 14 were very low (See Fig. 5), leaving survivals of 83.6%, 73.4%, 70.7% and 75.8% respectively in May. (See Fig.4)

Height growth for treatment Nos. 17, 15 and 18 were average (See Fig.2). The remaining three treatments have poor height growth. Although treatment No 17 gave average height growth, its survival after the hot season was poor and should therefore be considered with care.

Treatment Nos. 13 & 14 height measurements were slightly below the average because tubed and open rooted seedlings have the advantage of growing a few months earlier in the nursery than direct sown seedlings. However, since their survival after the hot season was good, they could also be considered favourably. Since there was no significant difference between treatment Nos. 13 and 14, it is considered unnecessary to use treatment No. 14 which involve extra work of soaking the seeds in water for 12 hrs.

4.4 Bawzagaing

Bawzagaing was also treated with all the six treatments tested. Results of the survival count in December showed that treatment Nos. 22 (seedling lifted in the evening and planted bare root the next morning), 23 (seedling lifted and root puddled in the evening and planted the next morning) were best, while the remaining three treatments were very poor. (See Fig. 1 and 3)

The drop in survival during the hot season was slight for all the treatments, leaving treatment Nos. 22, 23 and 24 with 91.0 %, 70.7 % survival in May. (See Fig.1 and 5)

Since height growth for treatment Nos. 22, 23 and 24 were also the best, these three techniques can be considered very favourably in the establishment of fuelwood plantation.

4.5 Yemane

Only two treatments were applied to Yemane i.e. treatment nos. 25 (seed not treated) and 26 (seed soaked in water for 12 hrs.). Both the treatments gave very poor survival. (See Fig. 3) Height growth also was below average. (See Fig.6) However, as the treatment given to this species was not complete, further study is needed before a conclusion can be made.

4.6 Kokko

Only two treatments were applied to this species ie. treatment Nos. 27 (seed not pretreated) and 28 (seed partially scarified). Survival and height growth for both the treatments were poor. (See Fig.3 & 6) However, as the treatment given to this species was not complete, further study is needed before a conclusion can be made.

5. Conclusion

From the present investigation and results obtained, it can be concluded that in flat and high rainfall area like Margari:

- 5.1 Bawzagaing can be planted by (a) lifting seedling in the evening and planted bare root the next morning (b) lifting seedling in the morning and planted bare root the same day and (c) lifting seedling in the evening, root puddled and planted the next morning.
- 5.2 Mezali can be planted by lifting seedling in the evening, root puddle and planted the next morning.
- 5.3 Mezali can also be planted by direct sowing of seeds not pretreated. Height measurements in the first years however will be slightly less than tubed or open rooted seedlings.
- 5.4 Mezali can be planted by lifting the seedling in the morning and planted bare root the same day. Survival however is slightly poorer than the above two methods.
- 5.5 Thinbaw-kokko can be planted by direct sowing, partially, of scarified seed.

APPENDIX I.

(A) Analysis of variance of for survival percentage (December, 1986).

Source of variation	Sum of squares	d.f	Mean of squares	F. ratio
Block	291.451	3	97.151	0.856067
Treatment	53956.207	27	1998.378	17.609222**
Error	9192.264	81	113.485	
Total	63439.922	111		

L.S.D (0.05) = 14.764196

(B) Analysis of variance of survival percentage (May, 1987).

Source of variation	Sum of squares	d.f	Mean of squares	F. ratio
Block	2026.770	3	675.590	3.887823*
Treatment	54780.876	27	2028.921	11.675844**
Error	14075.439	81	173.771	
Total	70883.085	111		

L.S.D (0.05) = 18.269621

APPENDIX II

(A) Analysis of variance for eleven-months-old tree height of tested treatments.

Source of variation	Sum of squares	d.f	Mean of squares	F. ratio
Block	3457.986	3	1152.662	8.110455
Treatment	12457.653	27	461.394	3.246502**
Error	11511.762	81	142.120	
Total	27427.401	111		

L.S.D (0.05) = 16.52226

(B) Analysis of variance for eleven-months-old tree height of tested treatments.

Source of variation	Sum of squares	d.f	Mean of squares	F. ratio
Block	31.181	3	10.394	0.639265
Treatment	10893.814	27	403.475	24.815658**
Error	1316.969	81	16.259	
Total	12241.964	111		

L.S.D (0.05) = 5.5883844

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