Leaflet No.2/82-83

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

Studies on Planting Technique for Teak

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February 1983

ကျွန်းစိုက်ပျိုးနည်းစနစ်များကိုနှိုင်းယှဉ်လေ့လာခြင်း

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ကျွန်းစိုက်ပျိုးနည်းစနစ်ငါးမျိုးကို စိုက်ပျိုးပြုစုရေးရှု့ထောင့်ကသာမက စီးပွားရေးရှု့ထောင့်ကပါ နှိုင်းယှဉ်လေ့လာ၍ တွေ့ရှိချက်များကို တင်ပြဆွေးနွေးထားသောစာတမ်းဖြစ်ပါသည်။ ယင်းစနစ်ငါးမျိုးမှာ -

(၁) သစ်စေ့တိုက်ရိုက်စိုက်ပျိုးနည်း
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Studies on Planting Technique for Teak

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Abstract

A suitable planting technique which is sound both silviculturally and economically needs to be established. In this paper, various planting techniques for teak viz. seed sowing, scarified seed sowing, tubed seedling planting, fresh stump planting and stored stump planting, were tested. The results were discussed suggestions were made.

Contents

Introduction

Teak (*Tectona grandis* Linn.f.) which is one of the most valuable timber species in Burma is well known in the world timber market. It has a great demand both in the local and international market and fetches considerable foreign exchange for the country. According to the Burma Forestry II Project proposal (1978), Teak exports were valued no less than an average of 43 million dollars per year during the period between 1972-1977.

Being a timber of all round utility, the popularity of teak can also be considered as stable. Unlike the species such as Padauk *Petrocarpus macrocarpus* Kurz., Thinwin *Millettia pendula* Benth., Yinma *Chukrasia tabularis* A.Juss., etc. whose beauty has presently attracted the world timber market, teak is not only beautiful, but is also stable, strong, durable, non-corrosive, light, easily workable, seasons well and resistance to termite, fungus and weather (Howard, 1948, Da Costa et.al., 1958, 1961; Rudman et.al., 1966). All these properties make it possible for teak to maintain its position in the international market for such a long period of time.

Up to the present, the production of teak in Burma is mainly from the natural forest which have been worked under the Burma Selection System. However, with the increase in population and the demand for teak both locally and for export (Anon.1980), the Forest Department has become conscious for the need to replace and supplement what has been extracted from the natural forests. This has been done in the form of increasing planting programme throughout the country (See able 1).

According to Kermode (1964), one acre of a fully stocked plantation may well compensate for the removal of some 20 or more mature trees in the natural forests. This may cover more than 20 acres.

Table 1. Planting Programme (1974 - 75 to 1981 - 82)

Year	Area (acres)			
	Teak	Pyinkado	Others	Total
1974 – 75	2,250	148	4,889	7,287
1975 – 76	2,261	729	4,770	7,760
1976 – 77	2,384	1,001	4,470	7,855
1977 – 78	3,385	1,500	3,940	8,825
1978 – 79	4,685	1,000	5,240	10,925
1979 – 80	6,403	1,322	9,023	16,748
1980 – 81	15,711	2,462	17,911	36,084
1981 – 82	21,362	3,623	21,862	46,847

With the increase in the planting programme, the need to adopt a suitable planting method has become apparent. Since 1700 when the oldest plantation in Burma was established at Paletwa (FAO, 1956), the method of planting used were transplanting with ball of earth, seed sowing and stump planting (Kermode, 1964). The latter two methods, especially stump planting was also very widely used in other countries. (FAO, 1956; Kadambi, 1972; Griffith,1942; Laurie, 1934; Kaosa-ard, 1979.) In the past few years, Thailand has developed and adopted the method using stored stump in planting teak. This method gave better survival and height growth than fresh stump (Kaosa-ard,1979).

Another planting method that should be considered was sowing of scarified teak seed direct in the field. Scarified teak seed was found to germinate faster and give a much better germination percent than the unscarified teak seed (Kaosa-ard, 1979; Ko Ko Gyi, 1972;

LARP,1972). This was verified by the test carried out by the seed section at FRI, Yezin (See Table 2). However, its performance in the field has never been tested.

Table 2 : Comparison of germination of scarified and unscarified seed.

	Scarified seed	Unscarified seed	Increased in Germination
Germination %	34.5	14.5	20

Transplanting with ball of earth when the seedlings have 2 pairs of leaves was no longer used because the method being impracticable for planting large areas. However, in Madhya Pradesh and Orissa, 3-4 months old seedling in container which is known as "dona plant" was used (FAO, 1956). This method was said to be more reliable than stump. Thus, in 1980, teak seedlings planted in polythene bags (tubed seedling) was first used by FRI very successfully for planting teak in the species trials at Taungoo, Pyinmana and Yamethin Forest Division. In 1981 and 1982, the East Pegu Yoma Plantation Project also adopted the method of using tubed seedling for planting majority of its area.

So far, the tubed seedling method appeared to be very attractive as it has given high survival percent and good growth. However, controversial ideas existed due to the difficulty in transporting the seedlings to the planting site and the high cost involved in this method.

Thus, it become necessary to look into both the silvicultural and economical sides of all the planting methods. The study was carried out in 3 years. The first set of experiment which was carried out in 1979 comprised only of seed sowing and stump planting. In 1981, seed sowing, scarified seed sowing, stump planting and tubed seedling planting was compared while in 1982 comparison of seed sowing, scarified seed sowing, stump planting, stored stump planting and tubed seedling was carried out.

Experiment of Comparison of seed Sowing and Stump Planting (1979)

Materials and Methods

The seeds used in this study were of Prome origin for seed sowing the seeds were put into a gunny bag and submerged in water for 72 hours (3 days) before sowing in the field. Six seeds were sown at each stake.

The stumps used were obtained from a one year old seedlings which had been raised in nursery beds. Their diameters ranges between 0.6" – 0.8" and the lengths ranges between 8" – 9" each comprising of 1" of the shoot portion. Sharp knives were used to trim the lateral roots and cut off the unwanted root and shoot portion. One stump was planted at each stake.

A randomized block design with 6 replications was used in this study. A spacing of 6' x 6' was adopted and each (5 x 11 rows) plots contained 55 trees.

Three weedings were carried out during the year. However, no patching was done. Survival count and height measurements were carried out in March 1980. i.e 9 months after planting .

Results

Table 3. Results of comparison of seed sowing and stump planting. (1979)

Treatment	Survival %	Height (ft.)
Seed sowing	66.5	0.80
Stump planting	49.7	0.59

Survival Survival of seedlings sown by seed sowing was 66.5% while that obtained by stump planting was 49.7%. Although there is an indication of the superiority of seed sowing to stump planting the difference was statistically not significant.

Height Average height obtained by seed sowing (0.80 ft.) was significantly greater than that obtained by stump planting (0.59 ft.). The difference was significant at 1% level.

Discussion

The results obtained in this experiment was a reverse of what would be expected from seed sowing and stump planting. This is because 1979 was a draught year with only 24 inches of rainfall in the area tested. However, the experiment indicated that although stump planting may be superior to seed sowing both in survival and height growth in most cases, it is safer to use seed sowing method in area where the rainfall is low of unreliable.

Experiment of Comparison of Seed Sowing, Scarified Seed Sowing, Stump Planting and Tubed Seedling Planting (1981)

Materials and Methods

The seeds used in this study for Yamethin were of Ngalaik Reserve, Yamethin Forest Division Origin, while those used for Taungoo were of Katha Origin. For normal seed sowing, the seeds were put in a gunny bag and submerged in water 72 hours (3 days) before sowing in the field. Six seeds were sown at each stake.

Another seed lot was partially scarified, (i.e. removal spongy exocarp) with a machine used for peeling Zi (*Zizyphus jujuba* Lamk.). Teak seeds had to be soaked in water for 12 hours before being put into the machine for scarifying. The machine can scarify one basket of teak seeds in 30 minutes. Scarified seeds were soaked in water for 72 hours (3 days) before sowing in the field. Six seeds were sown at each stake.

The tubed seedlings were raised in the nursery using a soil mixture containing forest soil, sand and manure at the ratio of 2:1:1 by volume respectively. The tube used were polithene bags of size 2" x 5". Seedlings having one pair of leaves were pricked into the plastic tubes in March and planted out in the field in June, i.e. when they were over three months old. One seedling was planted at each stake.

The stumps used were obtained from one year old seedling which had been raised in nursery beds. Their diameters ranges between 0.6" – 0.8" and the lengths ranges between 7"– 9", each comprising of 1" of the shoot portion. Sharp knives were used to trim the lateral roots and cut off the unwanted root and shoot portion. One stump was planted at each stake.

A randomized block design with 6 replications was used in this study. A spacing of 6' x 6' was adopted and each (5 x 11 rows) plot contained 55 trees. Three weedings were carried out during the year. However, no patching was done.

Survival counts and height measurements were carried out in February 1982 (i.e., 8 months after planting). height measurements alone was again taken in November 1982.

The materials and methods outlined above applies both to the experiments carried out at Compartment 72, Ngalaik Reserve, Yamethin Forest Division and Compartment 219, Kabaung Reserve, Sout Taungoo Forest Divisions.

Results

Table 4: Results of comparision of different planting methods for teak (1981).

Treatment	Survival %		Height (ft.)			
	Yamethin Feb.82	Toungoo Feb.82	Yamethin		Toungoo	
			Feb.82	Feb.82	Feb.82	Feb.82
Seed	36.1	30.0	0.87	2.97	1.34	5.88
Scarified seed	69.7	45.1	1.21	3.59	1.43	6.38
Seedling	78.2	93.0	1.52	4.38	3.22	10.83
Stump	54.3	57.3	0.89	2.94	1.70	7.56
L.S.D	10.23* 13.87**	5.49* 7.47**	N.S	N.S	0.45* 0.62*	1.26* 1.71**

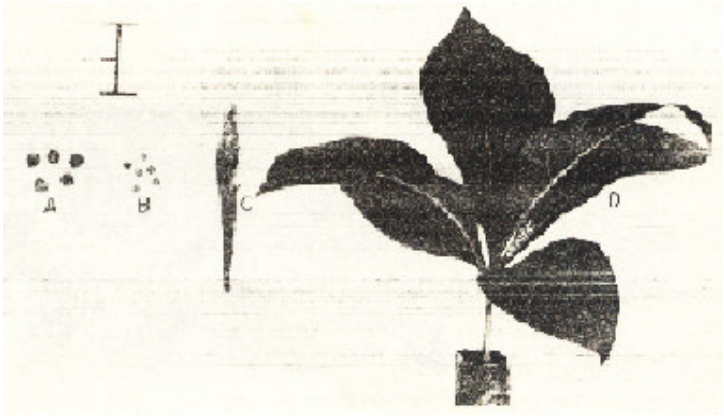


PLATE - 1 Materials used for planting teak.

A - Seed, B - Scarified Seed,

C - Stump, D - Tubed Seedling

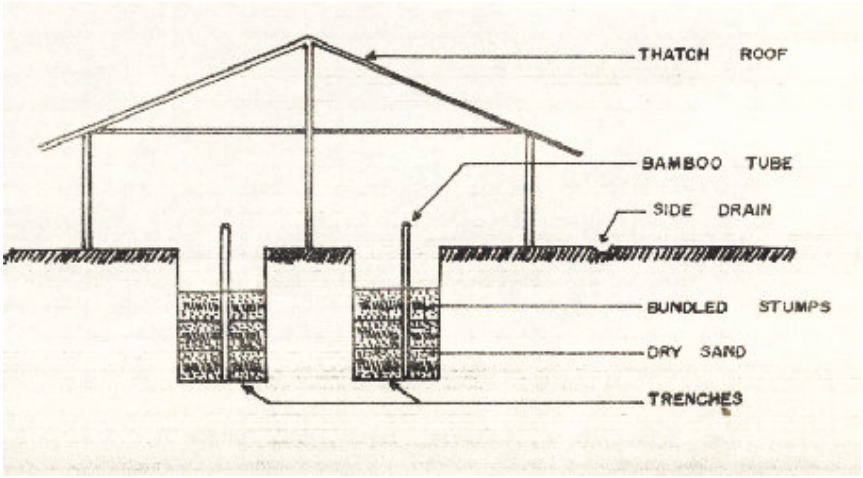


Diagram: Roof and trenches for storing teak stump. (Scale: 1" = 5')

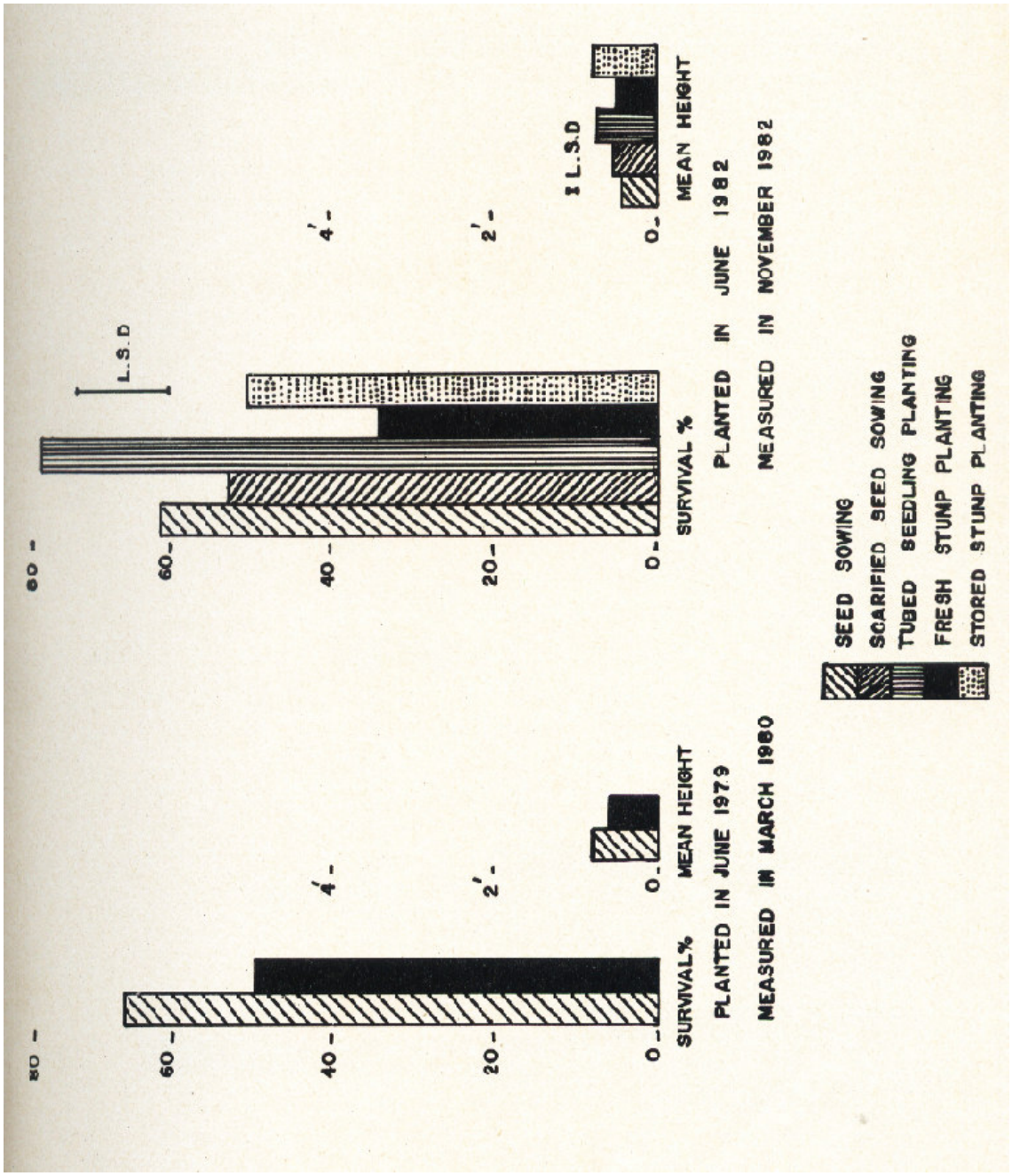
PLATE - 2a 18 months old direct seed sowing plot

PLATE - 2b 18 months old direct scarified seed sowing plot

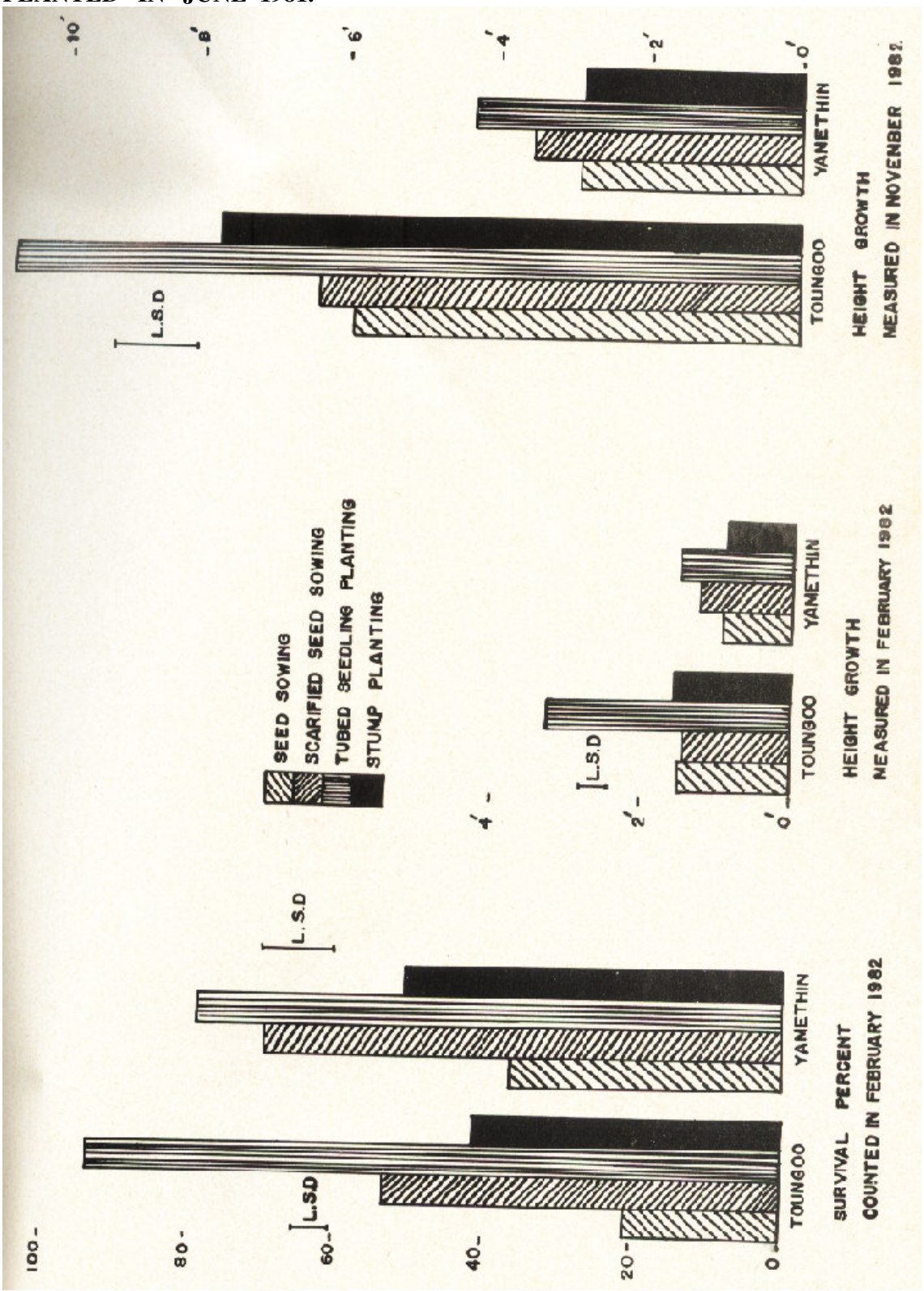
PLATE - 3a 18 months old plot planted with stump

PLATE - 3b 18 months old plot planted with tubed seedlings

DIAGRAM II SURVIVAL PERCENT AND MEAN HEIGHT COMPARISON OF DIFFERENT PLANTING METHODS OF TEAK AT MOSWE



PLANTED IN JUNE 1981.



Survival There appear to be definite differences between treatments (Table 4). For simplicity, rankings are given below with lines linking treatments which did not differ significantly.

Yamethin	Taungoo
Seedling, Scarified seed	Seedling
Stump	Stump
Seed	Scarified seed
	Seed

In the trial at Yamethin, the difference between seedling and scarified seed was not significant. However, both seedling and scarified seed were significantly better than stump while seed sowing was significantly the poorest. The differences were significant at 1% level.

However, at Taungoo where the rainfall is between 60-80 inches, seedling was the best while stump stood second, scarified seed third and seed the poorest. The differences were significant 1% level.

Height Although seedling and scarified seed indicated a better height growth at Yamethin the differences between treatment was statistically not significant.

Yamethin Feb. 82	**Yamethin Nov. 82**	**Taungoo Feb. 82**	**Taungoo Nov. 82**
Seedling, Scarified seed, Stump, Seed	Seedling, Scarified seed, Seed, Stump	Seedling	Seedling
		Stump, Scarified seed, Seed	Stump, Scarified seed, Seed

However, at Taungoo where the rainfall was higher, height measurements taken in February 1982 (i.e., after the first rain) showed seedling to be significantly the most superior, while there was no significant difference in height between stump, scarified seed and seed. Height measurements taken in November 1982, (i.e., after the second rain) also rank seedling to be the best while stump stood in the second place. The differences were significant. There was however still no difference between scarified seed and seed.

Discussion

Use of seedling or scarified seed in the low rainfall area like Yamethin appeared to be the best.

However, in area like Taungoo where the rainfall is higher, use of tubed seedling is silviculturally the best. From Silviculture point of view, it is definitely unwise to use either direct seed sowing or direct scarified seed sowing in such area. Use of stump should be considered as it usually gives better results than what is obtained in this experiment. (Blanford, 1931; Kaosa-ard, 1969; Khin Hlaing, 1982).

Experiment on Comparison of Seed Sowing, Scarified Seed Sowing, Stump Planting, Stored Stump Planting and Tubed Seedling Planting (1982)

Materials and Methods

This experiment was conducted in Compt. 72 Ngalaik Reserve. The seeds used in this study were also of Ngalaik Reserve, Yamethin Forest Division Origin. For normal seed sowing, the seeds were put in a gunny bag and submerged in water for 72 hours (3 days) before sowing in the field. Six seeds were sown at each stake. Another seed lot was partially scarified, (i.e. removal of the spongy exocarp) with a machine used for peeling Zi (*Zizyphus jujuba* Lamk.). Teak seeds had to be soaked in water for 12 hours before being put into the machine for scarifying. The machine can scarify one basket of teak seeds in 30 minutes. Scarified seeds were soaked in water for 72 hours (3 days) before sowing in the field. Six seeds were sown at each stake.

The tubed seedlings were raised in the nursery using a soil mixture containing forest soil, sand and manure at the ratio of 2:1:1 by volume respectively. The tubed used were polythene bags of size 2" x 5". Seedlings having one pair of leaves were pricked into the plastic tubes in March and planted out in the field in June, i.e. when they were over three months old. One seedling was planted at each stake.

The stumps used were obtained from one year old seedling which had been raised in nursery beds. Their diameters ranges between 0.6"–0.8" and the lengths ranges between 7"–9", each comprising of 1" of the shoot portion. Sharp knives were used to trim the lateral roots and cut off the unwanted root and shoot portion. One stump was planted at each stake.

Stored stumps were prepared using the method developed by the Teak Seed Centre in Thailand. (Apichart Kaosa-ard, 1979). For this study, storage pit which was 6 ft. long, 3 ft. wide and 4½ ft deep were dug on high ground at FRI Moswe Compt. The pit was roofed with thatch and drains were dug all around it so as to prevent water entering the pit during the early mango shower. The roof was also meant to keep the pit cool (see diagram I). Dry cool sand was spread at the bottom of the pit up to a thickness of 6", and teak stump bundled into 50 stumps bundles were placed in the pit in an upright position. The stumps were then covered with dry cool sand up to a thickness of 4". On this another layer of stump was put in and which were again covered with a layer of 4" thick of cool dry sand. A hollow bamboo tube was inserted in the middle of the pit up to the lowest stump layer. A thermometer was placed in the bamboo tube and the temperature was checked daily. A rise in temperature indicates sprouting of the stump, in which case the whole storage pit needs to be dug up and checked.

The stumps used were raised in Moswe nursery beds. They were 12 months old. The size and procedure used for stump preparation were the same as in the normal stump described above. The storage period for this experiment was 6 months. One stump was planted at each stake. A randomized block design with 6 replications was used in this study. A spacing of 9' x 9' was adopted and each (5 rows x 5 rows) plots contained 25 trees. Three weedings were carried out during the year. However, no patching was done. Survival count and height measurement were carried out on the 10th November 1982. (i.e., 5 months after planting).

Results

Table 5 Results of comparison of different planting methods for teak (1981).

Treatment	Survival %	Height (ft.)
Seed	61.3	1.46
Scarified seed	52.8	0.57
Seedling	78.7	0.72
Stored stump	33.3	0.79
Fresh stump	49.3	0.51
L.S.D	13.29* 17.91* *	0.08* 0.11**

Survival Use of tubed seedling give significantly the best survival. Although seed sowing ranked second, scarified seed third and fresh stump fourth, the differences between these three treatments were not significant stored stump was significantly the poorest in survival.

Survival %	**Height**
Seedling	Stored stump
Seed	Seedling
Scarified seed	Scarified seed
Fresh stump	Fresh stump
Stored stump	Seed

Height Stored stump gave the best height growth while seedling ranked second and their differences were significant. Although scarified seed ranked third, fresh stump fourth and seed fifth, the differences between scarified seed and fresh stump and stored stump and seed were not significant. However, scarified seed was significantly better than seed.

Discussion

The results of this experiment again indicated the danger of using stump either stored or fresh, in area where the rainfall is not reliable. The rainfall was very poor and erratic after the stumps were planted and there was 10 days break in rain soon after the leaves sprouted. This resulted in high mortality. However, this situation did not affect the tubed seedling nor the seedlings that germinated from seed to a great extent in survival.

However, the height growth of stored stumps as would be expected (Khin Hlaing, 1982; Kaosa-ard, 1979) shoot up and superceded even the top ranking tubed seedling. Thus, if regular rainfall can be assured, stored stump has great potential as a technique for planting teak. More research is needed in this respect.

Cost Analysis for Different Planting Technique for Teak

While conducting the experiment, expenditure incurred in the establishment of the plots were recorded and cost analysis for each method was made. The analysis made however is only up to the stage of patching up which is exclusive of weeding. Cost per acre for major items were as given below. (For detail analysis, see appendix 1.)

1. Direct seed sowing method

Cost of seed	=	Kyats	3.24
Cost of pretreating seeds	=		0.11
Cost of sowing	=		9.75
Cost for patching	=		13.00
Total cost for sowing seed	=		26.10

2. Scarified seed sowing method

Cost of seeds	=	Kyats	3.60
Cost of pretreating seeds	=		0.11
Cost of scarifying the seeds	=		2.84
Cost of sowing	=		9.75
Cost for patching	=		10.40
Total cost for sowing scarified seed	=		26.70

3. Planting with tubed seedlings

Cost of making germination bed	=	Kyats	0.65
Cost of making bamboo transplant bays	=		0.65
Cost of pretreatment and sowing at bed	=		2.975
Cost of sand for germination bed	=		1.50
Cost of seeds	=		0.30
Cost of soil mixture	=		1.28
Cost of filling the tubes with soil mixture and placing the tubes transplant bay	=		10.96
Cost of watering the germinating bed	=		3.90
Cost of watering the transplant bays	=		11.70
Cost of patching, weeding, shifting the tube in the nursery	=		11.70
Cost of transplanting	=		5.48
Cost of bamboo shades	=		3.00
Cost of plastic bags	=		18.00
Cost of transportation	=		12.00
Cost of planting	=		39.00
Cost of patching	=		5.1
Total cost for planting tubed seedling	=		126.41

4. Stump Planting

Cost of land clearing	=	Kyats	1.55
Cost of seeds	=		5.00
Cost of making nursery bed	=		13.00
Cost for sowing	=		6.50
Cost for weedling	=		19.50
Cost of fencing	=		7.00
Cost of preparing stumps	=		15.20
Cost of planting	=		19.50
Cost of transporation	=		0.60
Cost of patching	=		5.85
Total cost for stump planting	=		99.70

5. Stored stump planting

Cost of routine stump planting	=	Kyats	93.70
Cost of storage	=		25.64
Total cost for stored stump planting	=		119.34

Summary

Planting technique	Cost per acre
Seed sowing	26.10
Scarified seed sowing	26.70
Tubed seedling planting	126.41
Stump planting	93.70
Stored stump planting	119.34

Discussion

From monetary point of view, it is clear that the most desirable method for planting teak would be in the order-seed sowing, scarified seed sowing, stump planting, stored stump planting and tubed seedling planting. This trend is almost the reverse when considered from the silviculture point of view. Thus, a compromisation is needed in deciding which method to use when planting teak.

The use of tubed seedling may appear very attractive silviculturally, but the cost involved and practicability makes it less desirable when planting large areas with rough terrain, transportation of the seedlings can be a problem. It is not only expensive, but need a lot of labourers, which at present is very difficult to organised. Moreover, a big good nursery with full facilities will also be needed to raise the seedling required and transport them to a trucking point in the planting site.

Stored stump planting and stump planting, although also expensive much easier to execute. The survival percent can also be improved with proper timing and careful planting. However, they are limited to high rainfall area.

The method which is the cheapest and easiest to execute is the seed sowing and scarified seed sowing method. However, they are limited to low rainfall area.

Conclusion

From the results obtained and the condition of the present situation, it is suggested that:

(i) Scarified seed sowing technique should be used in the low rainfall and inaccessible area.

(ii) Stored stump or stump should be used in inaccessible area where rainfall is reliable

(iii) Tubed seedling should be used only in accessible area. The terrain should be gentle and there must be no labour problem. It is also necessary to have full facilities for the nursery and for transportation.

Appendix I

Establishment Costs for 1 Acre of Teak Established Under Different planting Methods

Calculations for all the planting methods were made for 9' x 9' spacing, i.e. 540 trees per acre.

1. Direct seed sowing method

One basket or 1,9000 seeds – Kyats 20

$$\therefore \text{ 1 seed} = \frac{20 \times 100}{1,9000} = 0.1 \text{ pya}$$

6 seeds were sown at each stake

$$\therefore \text{ Total No. of seeds required for 1 acre} = 540 \times 6 = 3,240$$

$$\text{Cost of seed per acre} = \frac{3.240 \times 0.1}{100} = \text{Kyats } 3.24$$

Cost of alternately soaking and drying of 10 baskets of teak seed = 1 man/ day = Kyats 6.50

$$\text{10 baskets can be used for} = \frac{10 \times 19000}{3,240} = 58.6 \text{ acres}$$

$$\text{Cost of pretreating seed for 1 acre} = \frac{6.50 \times 100}{58.6} = 11 \text{ pyas}$$

One man takes 12 hours to sow 1 acre,

$$\text{Cost for sowing 1 acre} = 6.5 \times \frac{12}{8} = \text{Kyats } 9.75$$

Calculation for patching up is based on 50%
Survival and transplanting extra seedlings with ball of earth. This was carried out by 4 man/days per acre,

$$\text{Cost for patching 1 acre} = \frac{4 \times 6.5 \times 50}{100} = \text{Kyats } 13.00$$

Total cost for direct seed sowing = 3.24 + 0.11 + 9.75 + 13.00 = Kyats 26.10

2. Scarified seed sowing

100 seeds scarified by machine will produce 90 scarified seeds.

$$\text{So seeds required for one acre} = \frac{3{,}240 \times 100}{90} = 3{,}600 \text{ seeds}$$

$$\text{Cost of seeds per acre} = \frac{3{,}600 \times 0.1}{100} = \text{Kyats } 3.6$$

Cost of pretreating seed for 1 acre = Kyats 0.11

15 Kyats was paid for scarifying one basket of seed.

$$\text{Cost of scarifying the seeds for 1 acre} = \frac{3{,}600 \times 15}{19{,}000} = \text{Kyats } 2.84$$

Cost of sowing 1 acre = Kyats 9.75

Calculation for patching up is based on 60%
Survival and transplanting extra seedlings with ball of earth. This was carried out by 4 man/days per acre,

$$\text{Cost for patching 1 acre} = \frac{4 \times 6.5 \times 40}{100} = \text{Kyats } 10.40$$

Total cost for scarified seed sowing = 3.6+0.11+2.84+9.75+10.40 = Kyats 26.70

3. Planting with tubed seedlings

Seedling required for one acre = 540

25% surplus for patching and damages caused during transportation, etc. $\frac{135}{675}$

∴ for 100 acre = 67,500 seedlings need.

(50' x 4') germination bed can be made by 1 man/day

Cost of making 10 germination beds = 10 x 6.5 = Kyats 65.00

Cost for making 10 bamboo transplant bays = 10 x 6.5 = Kyats 65.00

Seed pretreatment and seed sowing = 1½ man/day per bed.

∴ Cost of pretreatment and sowing = 9.75 x 10 = Kyats 97.50

One bed needs 100 cu.ft. of sand.

∴ Cost of sand for 10 Germination beds = 15 x 10 = Kyats 150

4 pyi of seed can be sown in 1 seed bed.

∴ Cost of seeds for 10 beds = ¼ x 20 x10 = Kyats 50,00

Required soil mixture by volume for 67,500 seedlings.

3.14 x $^{1}/_{12}$ x $^{1}/_{12}$ x $^{5}/_{12}$ x 67,500 = 613 cu.ft.

20 % surplus = $\frac{122}{735}$ cu.ft.

Soil mixture ratio = 2 forest soil :1 sand : 1 manure by volume

∴ Forest Soil = $\frac{735 \text{ x } 2\text{x } 15 \text{ kyat}}{4 \text{ x } 100 \text{ cu.ft}}$ = 55.12 = Kyats 55.15

Sand = $\frac{735 \text{ x } 1\text{x } 15}{4 \text{ x } 100}$ = 27.56 = Kyats 27. 60

Manure = $\frac{735 \text{ x } 1\text{x } 25}{4 \text{ x } 100}$ = 45.94 = Kyats 45. 95

Here, cost of forest soil, sand and manure were Kyats 15,
Kyats 15 and Kyats 25 per 100 cu.ft. respectively.

∴ Cost of soil mixture = 55.15 + 27.60 + 45.95 = Kyats 128.70

Cost for filling the tubes with soil mixture and placing the tubes in transplant bay.
400 tubes can be carried out by 1 man/day.

∴ $\frac{67{,}500 \text{ x } 6.5}{400}$ = Kyats 1,096.90

Cost of watering the germination bed = $\frac{6.5 \text{ x } 30 \text{ x } 10}{5}$ = Kyats 390

(5 beds by a labourer for 30 days)

Cost of watering the seedling in transplant bags = $\frac{6.5 \times 90 \times 10}{5}$ = Kyats 1170

(5 beds by a labourer for 90 days)

Cost of patching, weeding, shifting the tube in the nursery = 2 x 30 x 3 x 6.5 = Kyats 1170

Cost of transplanting = $\frac{6.7,500 \times 6.5}{800}$ = Kyats 548.45

(800 seedling by a labourer)

Cost of bamboo shades (6' x 6') = 3 x 100 = Kyats 300
300 x (2" x 5") plastic bags weigh 1lb.

$\therefore$ 67,500 bags = $\frac{6.7,500}{300}$ = 225 lbs.

1 lb. plastic bags cost 8 Kyats
$\therefore$Cost of plastic bags = 8 x 225 = Kyats 1,800
Thus, cost for 67,500 seedling = Kyats 7,031.55
$\therefore$Seedling cost for one acre = Kyats 70.31
Cost of transporation by carts per acre = 2 x 6 Kyats = Kyats 12
[One cart load (270 seedlings) costs 8 Kyats]
Cost of planting per acre = 6 x 6.50 = Kyats 39
(2 men to transport the seedlings and 4 men to plant)
So transportion and planting cost Kyats 51.
Calculation for patching is based on 90% survival.

Cost for patching per care = $\frac{10}{100}$ x 51 = Kyats 5.1

Total cost for planting tubed seedling = 70.31 + 12 + 39 + 5.10 = Kyats 126.41

4. Stump planting

Calculations is based on 70% survival percent.
$\therefore$70,200 stumps will be required for 100 acres.
One 50' x 4' seed bed can produced sufficient stumps to plant and patch 1 acre.
Cost of land clearing for nursery bed = Kyats 200 per acre
Excluding paths around the bad 60% of the area can be used for nursery bed.
$\therefore$333.33 sq.ft. is needed for a bed.

Cast of land clearing for a bed = $\frac{202 \times 333.33}{43,560}$ = Kyats 1.55

Cost of 4 pyis of seeds to plant 1 acre	= ¼ x 20	= Kyats 5
Cost of making nursery bed for one acre	= 2 x 6.50	= Kyats 13
Cost for sowing 1 nursery bed	= 1 x 6.50	= Kyats 6.50
Cost for weedling 1 nursery bed (3 times x one man/day)	= 3 x 6.50	= Kyats 19.50
Cost of fencing nursery beds for an acre		= Kyats 7.00
Cost of preparing stumps for planting 1 acre (300 stumps/man day)		= Kyats 15.20
Cost of planting per acre (3 men/day per acre)	= 3 x 6.50	= 19.50

Cost of transportation per acre $= \frac{6}{10}$ = Kyats 0.60

(One cartlosd = 7,000 stumps)

Cost of patching per acre $= 19.50 \times \frac{30}{100}$ = Kyats 5.85

Total cost of stump planting = 1.55 + 5 + 13+ 6.50 + 19.50 +7 + 15.20 + 19.50 + 0.60 + 5.85 = Kyats 93.70

5. <u>Stored stump planting</u>

Cost of routing stump planting per acre		= Kyats 93.70
Construction of storage shed required:		
digging of 6' x 3' x 4.5' pits	= 2 x 10 k	= Kyats 20
100 thatch @ Kyats 50 per 100		= Kyats 50
Shed construction 2 man/days		= Kyats 13
Cost of bamboo and posts 2 man/days		= Kyats 13
Cost of sand = 150 cu.ft. x 15 Kyats/100 cu.ft.		= Kyats 22.50
Cost for putting in and taking out the stumps (2 man/days)		= Kyats 13.00

Two pit can store 1,800 x 2 = 3.600 stumps at the cost of Kyats 131.50

$\therefore$ Cost of storage for one acre = (702 stumps) $= \frac{131.50 \times 702}{3,600}$ = Kyats 25.64

`Total coast of stored stump planting per acre = 93.70 + 25.64 = Kyats 119.34

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