Leaflet No. 3/1991

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

Vegetative Propagation of Forest Tree Species from Seedlings and Branch Cuttings

Saw C Doo, B.Sc. (For.) (Rgn.), M.S. (Hawaii), Head of Division
and
Daw Thida Mundt B.Sc. (Bot.) (Mdy.), Researcher
Deputy Res. Asst.
Forest Research Institute
1991

မြန်မာ့သစ်တောတွင် ပေါက်ရောက်သည့် သစ်ပင်ကြီးမျိုးများ၏ ပျိုးပင်နှင့် ကိုင်းဖြတ်များမှ အပင်များ ပေါက်ပွားမှုကို စမ်းသပ်လေ့လာခြင်း

ဦးစောရန်အောင်စီဒူး B.Sc. (For.),(Rgn) M.S (Hawai) ဌာနမှူး
နှင့်
ဒေါ်သီတာမန်း B.Sc (Bot), (Mdy.) လက်ထောက်သုတေသနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

ယခုစမ်းသပ်မှုသည် Clonal Orchard သို့မဟုတ် Clonal Banks သို့မဟုတ် Clonal Plantation တည်ထောင် နိုင်ရန်အတွက် ရည်ရွယ်ပြီး ဆောင်ရွက်ထားခြင်းဖြစ်ပါသည်။ စမ်းသပ်မှု၏ ပထမ အဆင့်အနေဖြင့် တစ်နှစ်သားအရွယ်ရှိ ကျွန်း၊ ဘောစကိုင်း၊ ယမနေ၊ ပျဉ်းကတိုး၊ ပိတောက်၊ မယ်ဇလီနှင့် အော်ရီးရှား ပျိုးပင်များမှ ညှပ်ထားသည့် ကိုင်းဖြတ်များကို စိုက်ပျိုးပါသည်။ ဤစမ်းသပ်မှုတွင် မယ်ဇလီမှ လွဲ၍ အခြားအပင်မျိုးများသည် အတက်၊ အကိုင်းငယ်နှင့် အမြစ်များ နှစ်လအတွင်းထွက်ပြီး အပင် ကောင်းမွန်စွာ ဖြစ်ထွန်းကြောင်းတွေ့ရှိရပါသည်။ စမ်းသပ်မှု၏ ဒုတိယအဆင့် (၁၀) နှစ်သားရှိသော ကျွန်း၊ ပိတောက်၊ ယမနေ၊ ပျဉ်းကတိုး သစ်မျိုးများ၏ ကိုင်းဖြတ်များကို စမ်းသပ်စိုက်ပျိုးခဲ့ပါသည်။ စမ်းသပ်မှု ပျဉ်းကတိုးမှလွဲ၍ ကျန်သစ်မျိုးများ၏ ကိုင်းဖြတ်များမှ အမြစ်များထွက်ရှိခဲ့ပါသည်။

Vegetative Propagation of Tree Species from Seedlings and Branch Cuttings

U Saw Yan Aung C.Doo, B.Sc. (For.),(Rgn) M.S (Hawaii)
Head of Division
and
Daw Thida Mundt, B.Sc (Bot), (Mdy.), Assistant Researcher,
Forest Research Institute.

Abstract

The experiment was conducted to enable for the establishment of clonal orchards or clonal banks or clonal plantation.The first of the experiment was initiated with one year old seedling Cuttings of Teak (TK) *Tectona grandis;* Linn), Bawzagaing (B) *(Leucaena leucocephala* Lam), Padauk (PD) *Pterocarpus macrocarpus;* Kurz), Mezali (MZ) *(Cassia siamea* Lamb), Sha (AC) *Acacia auriculiformis* A. Cunn). In the experiment, apart from Mezali all the Cuttings produce shoots and roots.In the second set of the experiment (10) years old branch cuttings were tried. In this experiment, apart from Pyinkado all the Cuttings produced shoots.

Contents

1. Introduction

Forest tree are usually propagated by seeds, seedlings and stumps. But vegetative propagation is a very useful tool which has been practiced since ages in replicating clonal material.

A modern technique of vegetative propagation by grafting and budding also being used for the establishment of clonal orchard. However, while in the process of grafting and budding wounds are made, which in turn encourage the infection of virulent pathogen. Consequently after years of establishment of Seed Orchard, diseased trees are frequently identified in seed orchard. By taking advantages of the past experiences this experiment is to use branch cutting for the clonal orchard which comparatively is much cheaper and less work.

Since the past decade Myanmar forestry has strongly emphasised on plantation forestry without seed orchard. It is time that the Myanmar Forest Department has their own seed orchard in the vicinity of plantations. A few seed orchards and seed source areas has been established here and there which is not adequate for the thousand areas of plantations that will be established in years to come. This experiment aim at investigating the most cheapest and easiest method for the establishment of Clonal Orchard around the country.

2. Literature Review

Vegetative propagation of Conifers tree from branching has been reported by Gypta & Chandra 1979. (2) Lahiri 1975 (3) report the propagation of *Cupressus* so. by stem Cuttings.

Srivastava 1981 (7) report the vegetative propagation of some *Dipterocarpus* by cuttings.

Root and shoot development of cuttings of bass wood *(Tilia americana)* has been reported by Morsink and Smith 1974 (4).

Trials on rotting of cuttings of Yemane (*Gmelina arborea)* has been reported by Sami and Srivastave 1985 (5).

Vegetative propagation by cuttings of Yemane has also been reported by Florido 1978(1).

Vegetative propagation of Forest trees such as *Populus gamblei, Thuja plicata,* and *Cryptomeria japonica* has been reported by Ak.Lahiri 1979 (3).

3. Materials and Methods

The first set of the experiments were conducted in a green house with an average temperature and relative humidity ranging from 76°F (MIN) - 106 °F (MAX) and 90-93 percent respectively. Misty condition in the green house was provided by intermittent overhead spray, and occasionally by watering three times a day.

The cuttings were of one year old seedlings. The length of cuttings varies from (100-120) mm. The cuttings trials included Teak (TK) (*Tectona grandis*Linn), Thinwin (Th) *(Milletia pendula* Benth), Auri-sha (Ae) (*Acacia auriculiformis* A Cunn), Mezali (Mz) *(Cassia siamea* Lamb)and Bawzagaing(B) *(Leucaena leucocephala* Lam).

Cuttings were treated with:-

1. Control (Untreated)
2. 500 ppm (IBA-Solution)
3. 1000 ppm (IBA-Solution)
4. 2000 ppm (IBA-Solution)
5. Rotting power (IBA)

The treatments were carried out by dipping the basal ends of the cuttings in the prepared Hormone-concentration for (30) minutes. In all, (50) cuttings were used for each treatment. The cuttings were placed in the plastic bags (8" x 4") in a slanting position. The seedling cuttings were harvested after (11) weeks for evaluation. In the second set of the experiments, branches of Pyindado (*Xylia dolabriformis* Benth), Padauk (*Pterocarpus macrocarpus* Kurz), Teak *(Tectona grandis* Linn) and Yemane *(Gmelina arborea* Roxb) were obtained from 10 years old plantation in Ngalaik Reserve Forests, Pyinmana Township.

The branches were classified into two groups as shown in Table No.(1).

Table (1) Average mid-diameter of branches used in the experiment.

Species Size	Pyinkado	Padauk	Teak	Yemane
A (Small)	6.7 mm	6.0 mm	10.2 mm	7.5 cm
B (Large)	11.5 cm	20.2 cm	14.5 mm	12 mm

The experiment design was a randomized block with (10)replications for each species. Half of the cuttings were treated by dipping the basal ends in 1000 ppm IBA solution for (2) hours. The remaining half of the cuttings were treated. Observations for this experiment were as given below.

The cuttings were harvested after (4) months of growth in the plastic bags (10'x14"). Evaluation of the cuttings were done as in the previous experiment.

Observations and measurements

The following observations were made regularly while the cuttings were in the plastic bags

1. Date of appearance of first green shoot.
2. Number of shoot on a particular day, week.
3. Number of cuttings that produced shoots.
4. Date of cuttings of shoots.

5. Measurement of temperature and relative humidity in the green house .

At the end of the experiment 50 % of the cuttings were harvested to study;-

(a) Callus development in the cuttings in different treatment
(b) height growth of shoots
(c) number of roots and length
(d) oven-dry weight of shoots and roots.

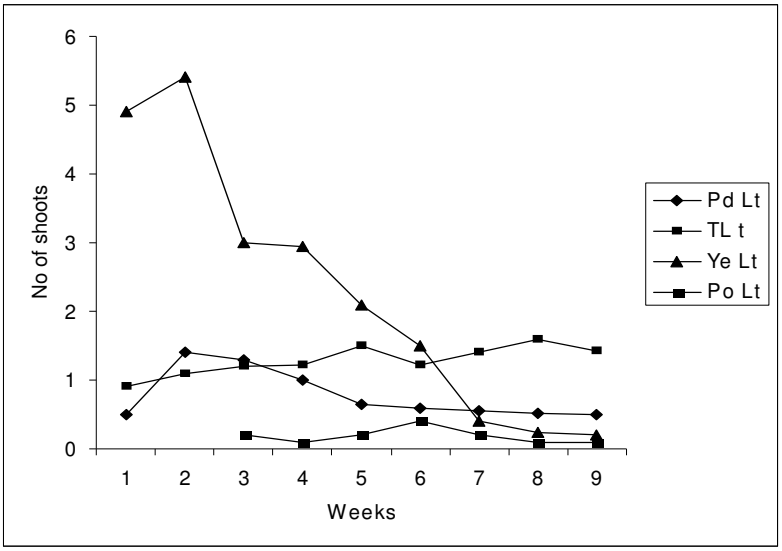
4. Results

In the first set of the experiment, seedling cuttings were removed from the plastic bags (73) days after planting.

Shoot development

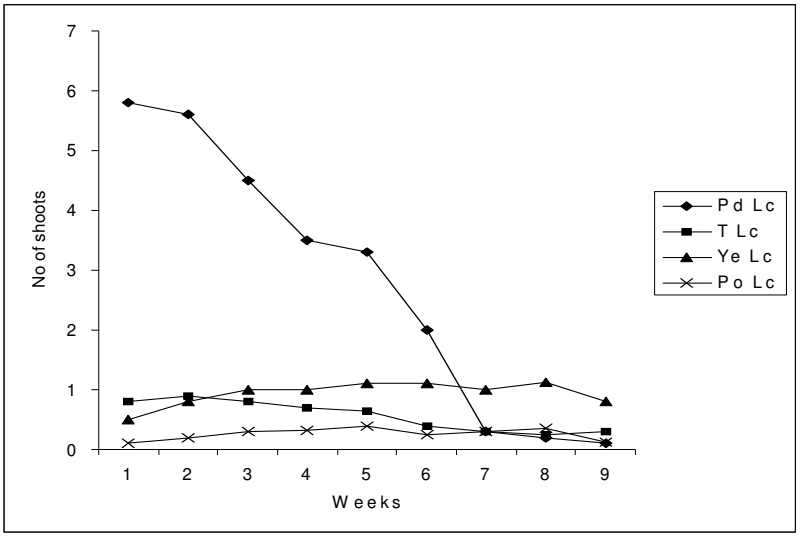
Most of the green buds appeared after 3 days expect Sha (*Acacia auriculiformis* A.cunn). The shoot of Thinwin and Teak developed after (12)days whereas the shoot of Bawzagaing developed after (2) days. The shoots of *Acacia* spp. appeared only after (18) days of planting (Table 1).

Most of the cuttings studied produced shoots whether treated or untreated. But after the reserved food or moisture become exhausted, the shoot wilted and dried. This may be due to the fact that the shoot have no support from the basal ends of the cuttings in the form of food and moisture. The shoots which survived after the development of roots grew rapidly. The shoot growth in different treatment is shown in (Fig.1,2,3,4) and plate(1).Both Bawzagaing and Sha produced an average of 3 shoots and above. Teak and Thinwin produced only one to two shoots per cuttings.



Pd = Padauk Po = Pyinkado
T = Teak L = Large (Size A)
Ye = Yemane t = treated (with Hormone)

Fig. (1) Average no of shoots of Padauk, Teak, Yemane, Pyinkado (Size A) produced within 10 weeks of the experiment.



Pd = Padauk Po = Pyinkado
T = Teak L = Large (Size A)
Ye = Yemane c = control (without Hormone)

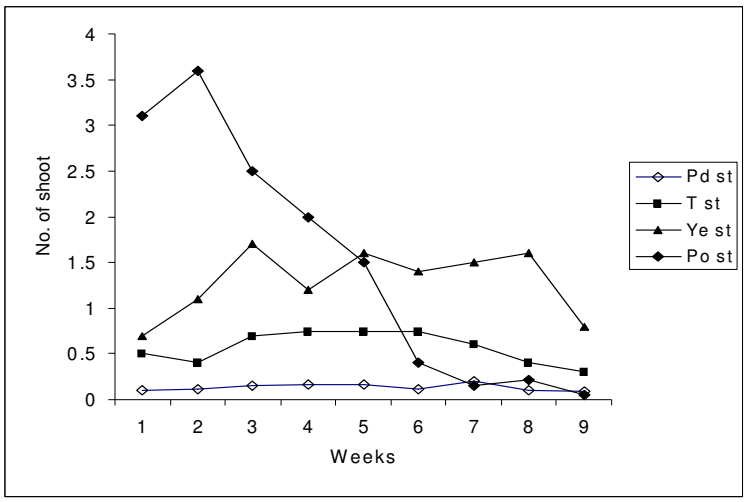
Fig. (2) Average no of shoots of Padauk, Teak, Yemane, Pyinkado (Size A) produced within 10 weeks of the experiment.

Table (1) Appearance of green buds on the Cuttings.

Treatment	Day of appearance of green bud				No. of Cuttings which produced bud in days			
	Th	B	Tk	Ac	Th	B	Tk	Ac
Control	12th	2 th	12 th	-	1	10	3	-
500 ppm IBA	12th	2 th	12 th	-	4	9	1	-
1000 ppm IBA	12th	2 th	12 th	-	5	7	7	-
2000 ppm IBA	12th	2 th	12 th	18th	2	9	1	5
Rooting –Power	12th	2 th	12 th	19th	3	3	3	1

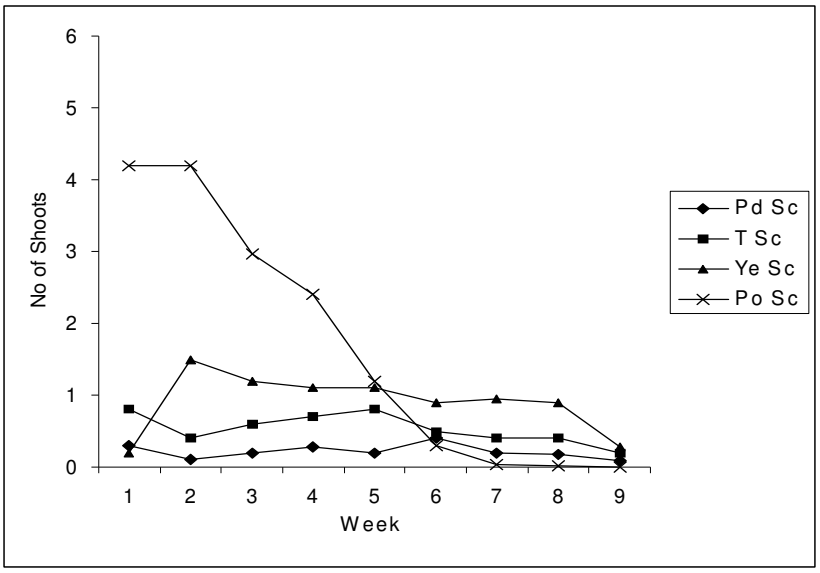
Table. (2) Percentage of rooted seedling cuttings of different treatments.

Treatments	Percentage of root-cuttings			
	Th	B	Tk	Ac
Control	41	42	63	81
IBA500 ppm	82	61	43	82
IBA 1000 ppm	81	82	79	78
IBA 2000 ppm	42	63	65	94
Rooting -Power (IBA)	81	61	62	73



Pd = Padauk
T = Teak
Ye = Yemane
Po = Pyinkado
s = small (Size B)
t = treated (with Hormone)

Fig. (3) Average no of shoots of Padauk, Teak, Yemane, Pyinkado (Size B) produced within 10 weeks of the experiment.



Pd = Padauk Po = Pyinkado
T = Teak s = small (Size B)
Ye = Yemane c = control (without Hormone)

Fig. (4) Average no of shoots of Padauk, Teak, Yemane, Pyinkado (Size B) produced within 10 weeks of the experiment.

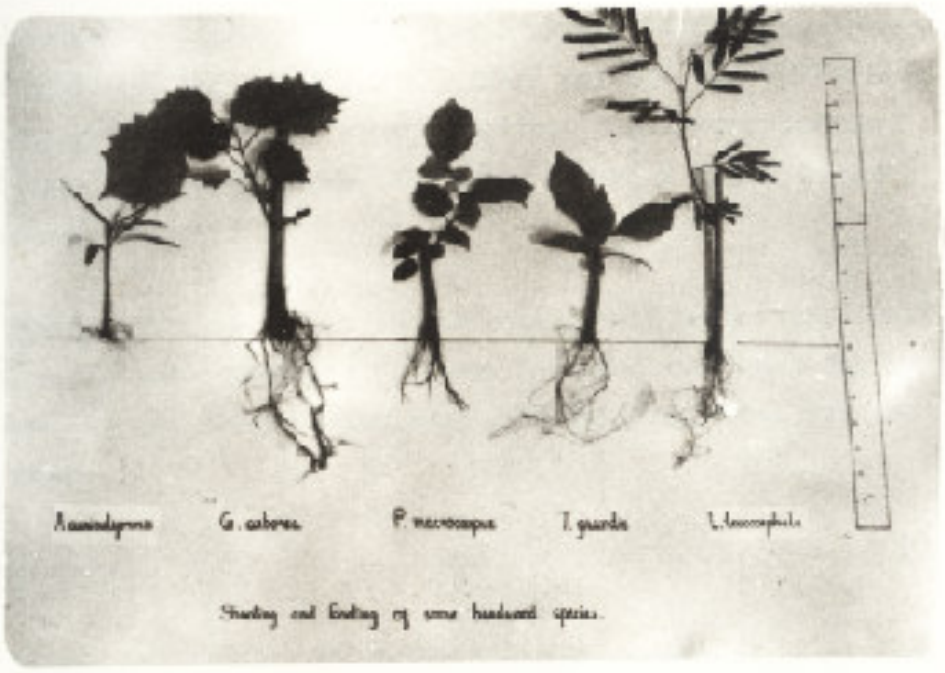


Plate I. Shoots and roots development of Acacia auriculiformis, Gmelina arborea, Pterocarpus macrocarpus, Tectona grandis, and Leucaena leucocephala.

Rotting

Treated Cuttings showed a little higher rooting percentage than the untreated ones (Table3). There was not much difference between the treated Cuttings except cuttings which were treated with 1000 ppm IBA and 2000 ppm IBA, which showed a little higher percentage of rooting.

There was no variation in the root growth among individual Cuttings in the same treatment. It was also observed that the best root growth was not always associated with the best shoot growth at this stage.

Root development

Figure 10,11,12,13 showed the mode length of roots with respect to treatment. Treatment with 2000 ppm IBA showed the best growth with an average of 16-17 cm in Bawzagaing and Teak. All in all, treatment with 500 ppm IBA and Rooting power IBA did not showed much response. Analysis of Variance have no significant value between treatment. However, there was significant between growth of shoot among species (Table 4.).

The initiation of adventitious roots appeared to be associated with callus formation. Cutting which failed to develop callus had their shoots dried up before the termination of the experiment.

There was much variation in the root growth among individual cuttings in the same treatment. It was also observed that the best root growth was not always associated with the best shoot growth at this stage.

Table (3) Number, length and dry weight of shoot and root Per Cutting in different treatments (Mean Values)

Parameter	Control				500 ppm IBA				1000 ppm IBA				2000 ppm IBA				Rooting power IBA			
	Th	B	Tk	Ac	Th	B	Tk	Ac	Th	B	Tk	Ac	Th	B	Tk	Ac	Th	B	Tk	Ac
Shoot No.	1	3	1	3	2	2	2	2	1	2	2	2	2	3	1	3	2	2	2	2
Root No.	3	9	3	11	8	8	3	6	2	6	8	11	2	2	5	3	4	4	6	2
Shoot Length (cm)	5.1	8.5	1.9	1.6	1.5	1.3	1.2	1.3	1.5	9.2	2.5	1.8	10.2	11.8	1.4	2.0	4.0	12.8	1.4	2.7
Root Length (cm)	6.2	10.5	18.1	5.4	8.1	16.0	10.8	7.2	3.0	12.0	20.1	5.0	5.2	16.0	17.5	8.0	5.5	12.7	13.4	7.5
Shoot Dry-wt.	0.5	0.69	0.69	0.4	3.2	1.92	0.29	0.8	0.4	0.4	3.12	0.42	0.72	3.31	0.58	1.13	0.98	2.1	0.57	0.9
Root Dry-wt	0.09	0.1	0.11	0.08	0.5	0.17	0.07	0.09	0.2	0.13	0.65	0.05	0.3	0.23	0.15	0.17	0.1	0.28	0.11	0.12

Th = Thinwin, B= Bawzagaing, Tk = Teak, Ac = Acacia

Table (4) Analysis of variance .

Parameter	F. Value	
	Treatment	Species
Root length	- 1.5512	-2.5337 Ns
Root number	1.2229	0.4424 Ns
Root dry - weight	0.4846	0.6528 Ns
Shoot weight	2.1714	8.2446 **
Shoot number	0.3487	2.9779 Ns
Shoot dry- weight	0.4846	0.6528 Ns

** - Significant at 1 %
* - Significant at 5 %
Ns - Not Significant

Root/ Shoot ratio

A comparison of mode length of root, shoot indicated in Figure (1) for Teak, Figure (2) for Acacia, Figure (3) for Thinwin and Figure (4) for Bawzagaing. In all the cases most of the root length grew longer than the shoot in the initial stage of the growth. AR/S ratio in Figure (5) depict the 2000 ppm IBA treatment is more favorable in the root and shoot development. Treatment with rooting power showed a less development of root/ shoot in all the species and also was with the untreated ones.

Shoot development

In the second sets of the experiments, where branch Cutting were tried, Padauk shoots started to develop after 3 days followed by Yemane, and Teak. Most of the Cutting produced shoot in the 1st week after planting. In the 2nd week almost all of the Cuttings of Padauk, Yemane and Teak produced shoots except Pyinkado. The development of shoots after 8 weeks of planting were shown in plate II, III, IV and VI.

In The trial both size (A) and size (B) of Padauk produced shoots. The average No.of shoots of size (A) and size (B) were 6 shoots per cutting and 4 shoots per cutting respectively. Most of the shoots started to wilt after the 6th week and all the shoots eventually dried after the 8th week. It was observed that size (A) of the Padauk Cuttings produced more shoot than size (B), Fig. 6.

In the case of Teak, the Cuttings produced at least 1-2 shoots in the 2nd week and eventually dried up in the 8th week after planting. There was a little different in shoot production in the 2nd week giving more shoots on size (A) and less on size (B).

However, after the 5th week equal number of shoots remained for another two weeks. (Fig. 7)

Both, size (A) and size (B) of Yemane produced maximum shoot on the 2nd week. There is not much difference in the number of shoots. The average number of shoots for both sizes were 1-2 shoots per Cutting. A few shoots still remain after the 8th week of planting. (Fig. 9)

As in the case of Pyinkado there was only one to two shoot from 3-4 Cuttings. Most of the Cutting do not produce shoots both from size (A) and size (B) (Fig. 8).

Root development

All the branch Cuttings were kept in the green house for (10) weeks. Examination of the development of roots were made once a week. In all the cases no root development was observed except in one or two branch Cuttings of Teak which produced shoot.

Hormone treatment

As there was no root development in the branch Cutting the effect of hormone can not be determined.

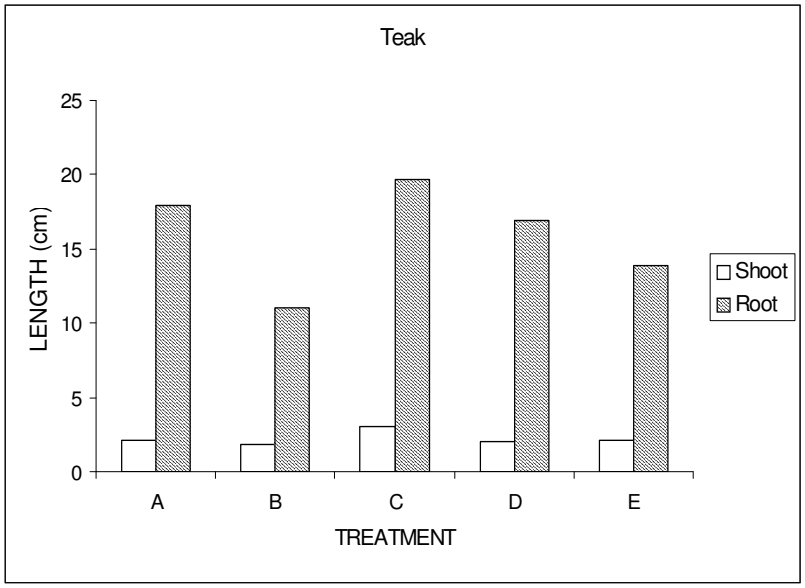


Fig. 10 Mode length of root and shoot of Teak . (T)

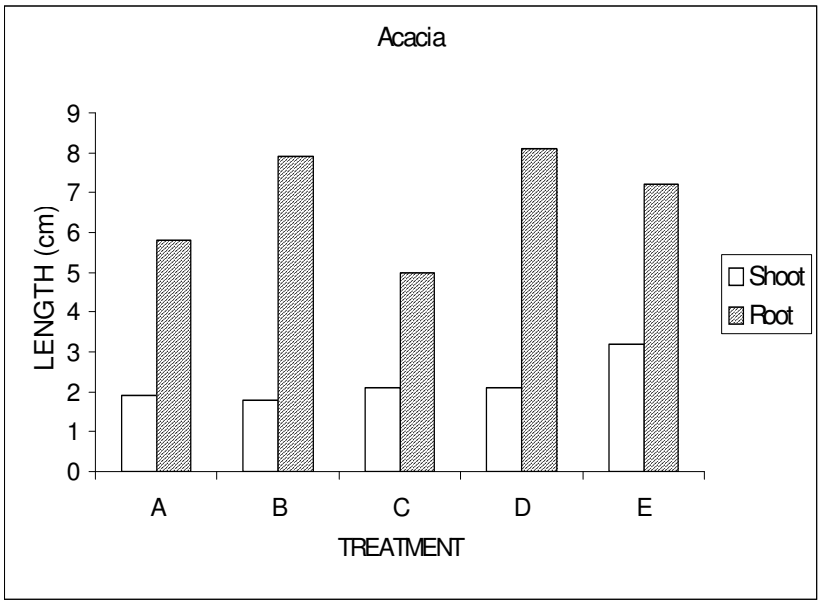


Fig. (11) Mode length of root and shoot of Acacia (Ac)

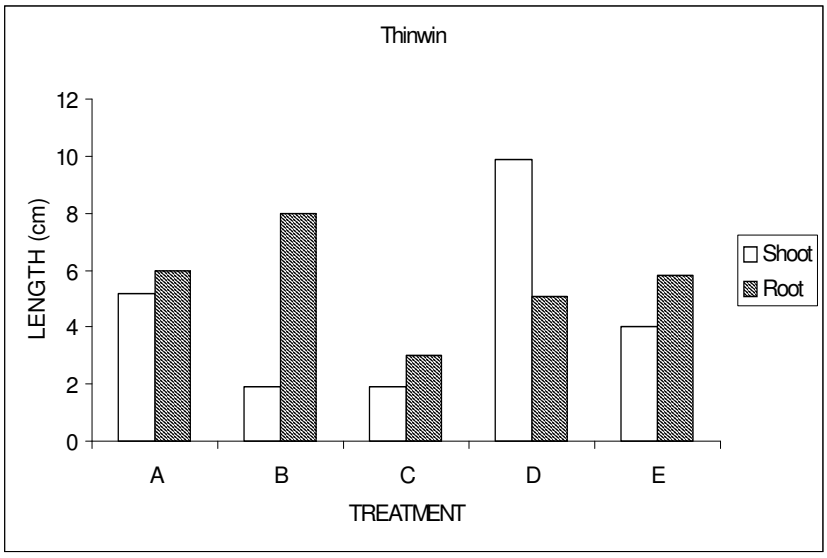


Fig . (12)- Mode length of root and shoot Thinwin . (TH)

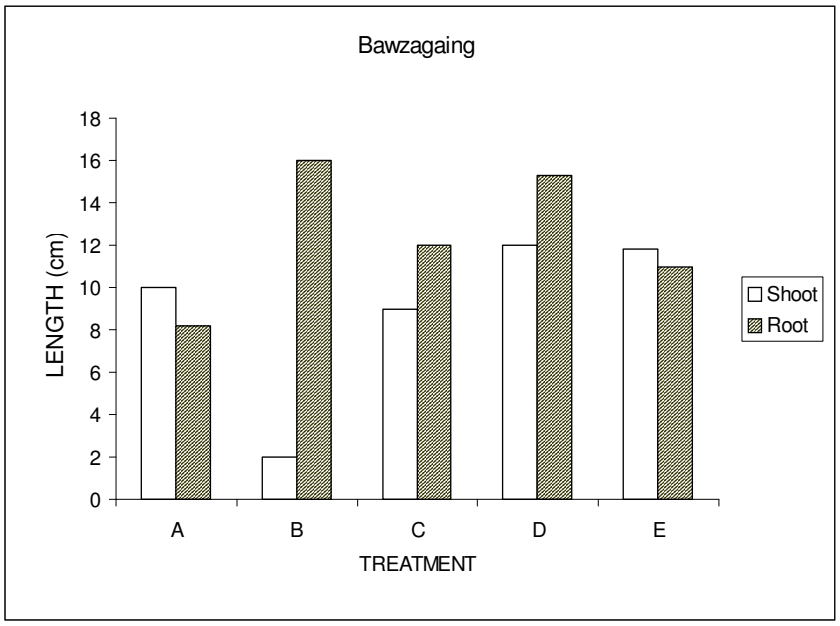


Fig. (13)- Mode length of root and shoot Bawzagaing . (B)

A= Control , B=IBA (500)ppm,C= IBA (1000) ppm, D=IBA (2000)ppm, E=Rooting powder.

Plate II. Shoot development from the apical bud of Teak branch cutting after (8) weeks of planting.

Plate III. Shoot development from the lateral bud of Teak branch cutting after (8) weeks of planting.

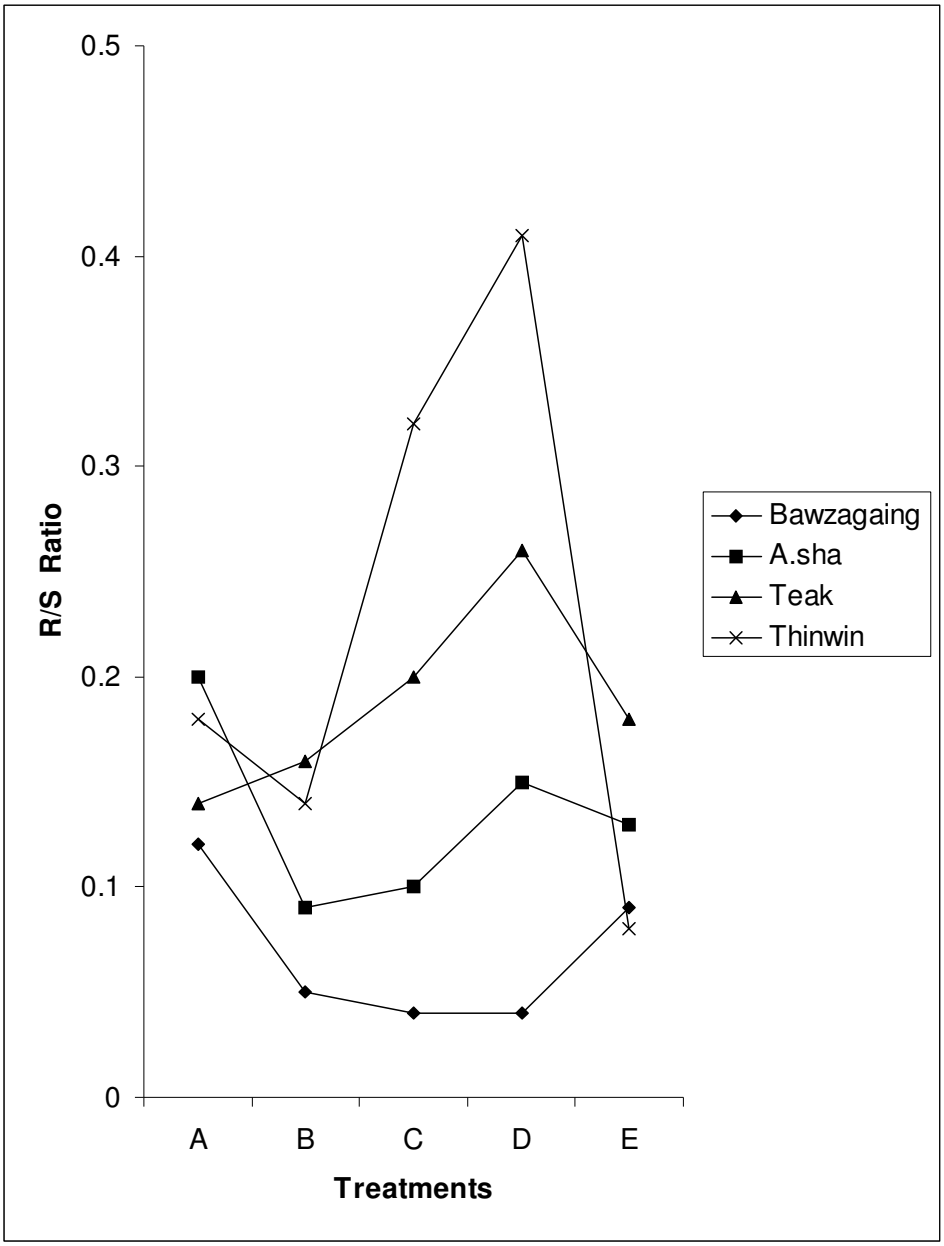


Fig (5). Root-Shoot (R/S)ratio

A= control, B= IBA (500)ppm, C=IBA (1000)ppm, D=IBA (2000)ppm E= Rooting powder (IBA)

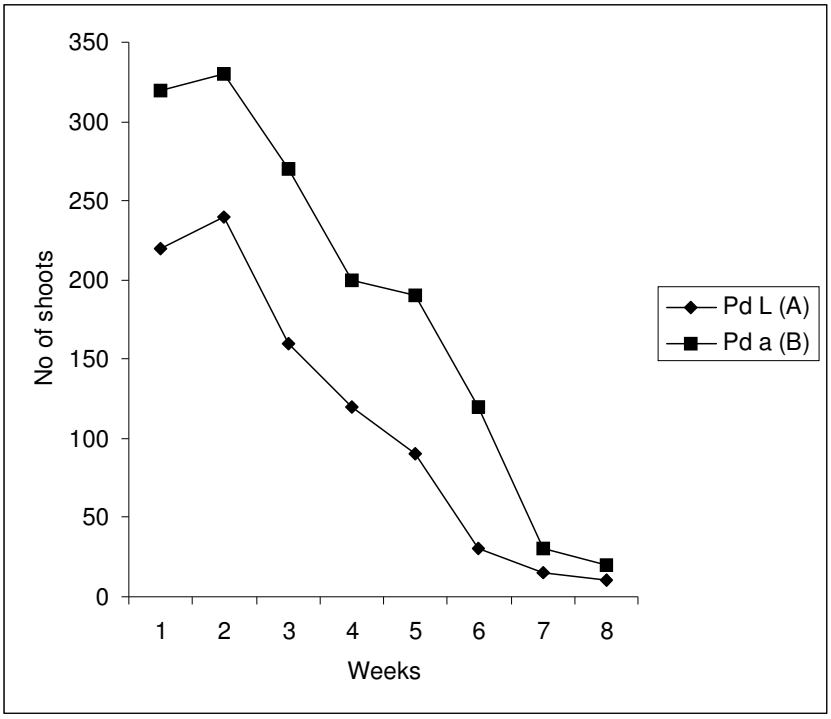


Fig (6) Comparison of the development of shoots from Padauk cutting (Size A & B)

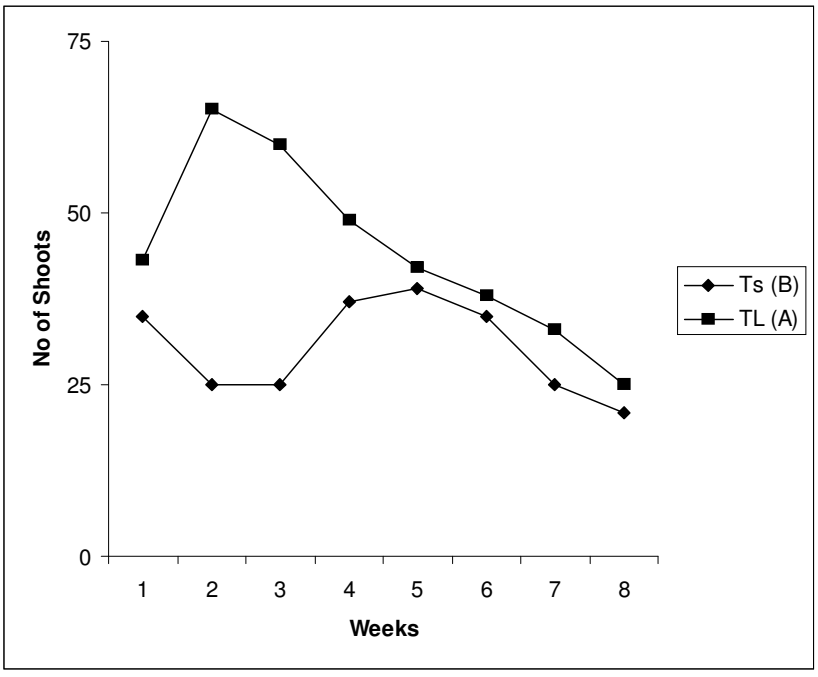


Fig (7) Comparison of the development of shoots from Teak cutting (Size A & B)

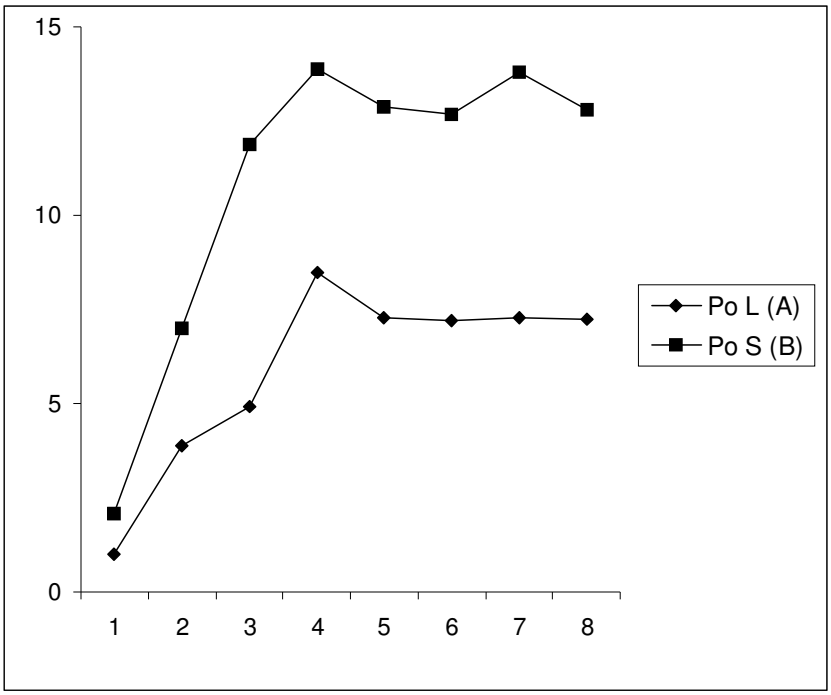


Fig. (8) No. of Shoots of Pyinkado produced within 10 weeks of the experiment.

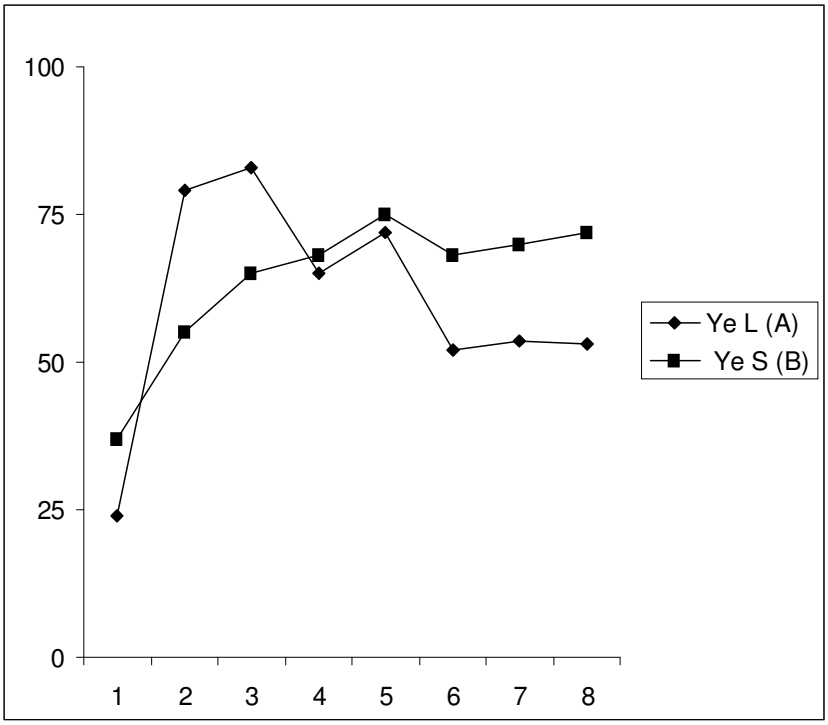


Fig. (9) No. of Shoots of Pyinkado produced within 10 weeks of the experiment.

Plate IV. Shoot development from lateral buds of Padauk (Pterocarpus macrocarpus) cuttings after (4) weeks of planting.

Plate V. Shoot development from lateral bid of Sha (Acacia auriculiformis) (4) weeks after planting.

Plate VI. Shoot development from lateral bud of Bawzagaing (Leucaena leucocephala) (4) weeks after planting.

5. Discussion

Experiment conducted with one year old seedlings of Teak, Bawzagaing, Padauk and Acacia produced both shoots and roots satisfactorily. Although there is not much significant in the case of treatments, a 2000 ppm (IBA) showed a better result in the development of shoots and roots. This can be attributed to three factors. Firstly, the Cuttings were taken from young 11-12 months nursery bound plants before the end of juvenile period. Secondly, the Cuttings rooted easily because of the absence of a sclerenchyma layer around the phloem. Many workers have noted that the presence of sclerenchyma tissue acts as a mechanical barrier to root initiation in the Cuttings. Thirdly intermittent misting applied at a particular schedule resulted in higher relative humidity in the green house.

There was no effect of hormone treatment among species or within the species. This may be due to the fact that a new method of impregnation of hormone should betried inoder to have the hormone solution penetrate the innercell which could produce more Callus.

As of observed, most of the roots initiated its roots from the Callus if not altogether.

In the case of branch Cuttings of Teak, Yemane, Sha and Pyinkado although the shoots developed profusely, rooting has not been observed. As the branches were of 10 years old, root initiation was difficult due to the very thick scleranchyma around basal ends. A new technique to have more hormone penetrate into the basal cells will be tried although there were many shoots produced in the stem, the shoots dried out because the shoots spent up the reserved food and moisture already existing in the Cuttings Another point is to develop a better misty condition more efficiently in the green house. This experiment is the first of its kind which has been initiated. Through experiment it is believed, setting aside other species, Teak branch can be propagated for the many purposes involved in tree improvement program.

The establishment of Teak clonal orchard

Through the experience from the previous experiments a new Mist Chamber was established having control of light intensity, temperature and relative humidity.

Materials for the establishment of clonal orchard were collected from Katha Reserve Forest, Chatthin Reserve Forest, Naung Cho Reserve Forest, Pinlong Reserve Forest, Ngalaik Reserve Forest and Palwe Reserve Forest.

Materials collected included branches from the best tree of the region which has average age of 90-100 years old. The brunches were excised on both ends. Each excised branch measured 20-25 cm long and 5-8 mm in diameter.

A mixture of 1:1:2 sand, manure and soil were used as media in the polyethylene plastic bags.

The cuttings were than put into the bag and transfer to the Mist Chamber for the development of shoots and roots.

The temperature and relative humidity were maintained at 25° C-30° C and 70-90 % throughout the experiments.

The experiments conducted included Hormone treatment of the cuttings. 1000 ppm of IBA (Indole Dutyric Acid), NAA (Nephathalene Acetic Acid) and IAA (Indole Acetic Acid) were used.

Results, (Shoot development)

In all the experiments it was observed that the buds of the cutting appeared on the first week of the experiments.

There was an average of (10) percent shoot development in the first week followed by an average of (63) percent after the third week. However most of the cuttings did not produce shoots after the fourth week Table (1).

Hormone treatment

Observation of hormone treatment after (8) weeks indicated that the cuttings produced shoots with an average of 48 percent in NAA, 57 percent in IBA, 54 percent in IAA and 33 percent in control Table (2).

Table (1) Present shoot development of Teak Branch Cuttings without Hormone treatment.

Code No.	G.B.H	Height	1st week	2nd week	3rd week	4th week
01	6'12"	95'	9.6	34.5	54.5	83.6
02	5'4"	85'	3.8	24	49	59.6
03	6'5"	100'	15	68	81.6	-
04	6'6"	100'	16.6	50	74.4	-
05	7'8"	105'	10.6	40	56	-
06	7'6"	135'	17	58.5	79	-
07	6'6"	100'	3.3	27.1	54.2	-

Table (2) Percent shoot development of Teak Branch Cuttings after (8) weeks of planting.

Code	Hormone Treatment			
	NAA	IBA	IAA	Control
011	32	48	32	16
022	52	60	76	28
033	60	64	56	56

NAA = 1000 ppm Nephthalene Acetic Acid.
IBA = 1000 ppm Indole Butyric Acid.
IAA = 1000 ppm Indole Acetic Acid.

Root development

Root development of teak branch cuttings initiate with the Callus formation. As the cambium activated the Callus, root developed after (8) weeks of planting. However abundant growth of adventitious root was formed only after (16) weeks of planting. Only then these plant were safe for transfer for hardening.

Table (3) Percent root development of teak branch cuttings after (16) weeks of planting.
.

Code No.	%
01	39
02	38
03	11
04	34
05	18
06	69
07	15

References

(1) Flrido, L.V.1979. Vegetative propagation by cuttings of Yemane (*Gmelina arborea* Roxb.) using growth regulators Sylvatrop Philipp. For. Res. Jour .3(2) 115-122.

(2) Gupta and J.P Chandra. 1979. Vegetative propagation of coniferous forest trees species from branch. Cuttings with the help of mist chamber The Indian Forester Vol.105, N0.6

(3) Lahiri, AK (1979). Vegetative propagation of Forest trees the Indian Forester 1979. Vol.105, N0.2.

(4) Mersink, W.A.G and V.G Smith 1974. Root and Shoot development of cuttings of Base wood (*Tilia americana)* Can. Jour For. Res. 4 .246-49.

(5) Sami and Srivastara P.B. L. (1985). Trials on rooting of cuttings of (*Gmelina arborea*) root. Vol.48,No.3.

(6) Sing T.K Srivastara P.B.C. (1985). Trials on rooting of cuttings of (*Gmelina arborea* Roxb) the Malasian.

(7) Srivastawa P.B.L. and Penguang Maggil 1981. Vegetative propagation of some Dipterocarpus by cuttings Mal. For. 44(223)301-313.