



**Government of Union Of Myanmar
Ministry Of Forestry
Forest Department**



**Studies on Seed Storage, Germination and Growth During
Nursery Stage of some Indigenous and Exotic Species**

Daw Thein Kyi, B.Sc. (Bot.) (Mdy.), Deputy Research Officer,
U Chit Hlaing, B.Sc. (For.) (Rgn.), Senior Research Officer,
and
U Mehm Ko Ko Gyi, B.Sc. (For.) (Rgn.), M.Sc. (ANU),
Head of Division,
Forest Research Institute.
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**ပြည်တွင်းသစ်မျိုးနှင့် နိုင်ငံခြားသစ်မျိုးအချို့တို့၏သို့လှောင်နည်းခန့်ခွဲ
အစေ့ပေါက်နှုန်းနှင့် ပျိုးပင်အဆင့်၌ ကြီးထွားနှုန်းများကို လေ့လာခြင်း**

**ဒေါ်သိန်းကြည်၊ B.Sc.(Bot.) (Mdy.) ဒု-သုတေသနမှူး
ဦးချစ်လှိုင်၊ B.Sc. (For.) (Rgn.) အကြီးတန်းသုတေသနမှူး
နှင့်
ဦးမင်းကိုကိုကြီး၊ B.Sc. (For.) (Rgn.), M.Sc. (ANU) ဌာနမှူး
သစ်တောသုတေသနဌာန**

စာတမ်းအကျဉ်းချုပ်

သစ်တောစိုက်ခင်းများအောင်မြင်စွာ တည်ထောင်နိုင်ရန်အတွက် အောင်လုံကောင်းမွန်သော ပျိုးပင်များ အလုံအလောက်ပျိုးထောင်ထုတ်လုပ်ရန် အရေးကြီးပါသည်။ ပျိုးပင်များ ထုတ်လုပ်နိုင်ရေး အတွက် အစေ့စုဆောင်းခြင်း၊ သန့်စင်သို့လှောင်ခြင်း၊ အစေ့ကို ပြုပြင်ခြင်း၊ အညှောက်ပေါက်ခြင်းနှင့် ၎င်းတို့၏ ကြီးထွားနှုန်းတို့ကို ကြိုတင်သိရှိနားလည်ထားရန် လိုအပ်ပါသည်။

သစ်တောစိုက်ခင်းများကို စီမံချက်များ ရေးဆွဲပြီး အကောင်အထည်ဖော် ဆောင်ရွက်ရာတွင် အထောက်အကူပြုစေရန်အတွက် အထက်ဖော်ပြပါ အချက်အလက်များနှင့် ပါတ်သက်၍ ဒဟတ်၊ မယ်ဇလီ၊ ပိတောက်၊ ပေါက်ပန်းဖြူ၊ စစ်၊ သန်း၊ သင်္ဘောကုက္ကို၊ ယမနေ၊ အော်ရီကူလီဖေါမစ်ရှား၊ ဘောစကိုင်းနှင့် ဆီနီဂေါရှား စသည့်သစ်မျိုး(၁၁)မျိုးကို သစ်တောသုတေသနဌာန၊ ရေဆင်းတွင် လေ့လာခဲ့ပါသည်။

ယင်းသို့လေ့လာရာတွင် သစ်စေ့သို့လှောင်နည်း (၃)မျိုး-(၁) အခန်းအပူချိန် (၂) အအေးခန်း ၂၂ ဒီဂရီစင်တီဂရိတ် (၃) ရေခဲသေတ္တာ ၃ ဒီဂရီစင်တီဂရိတ်တွင် သို့လှောင်ခြင်းတို့ဖြစ်ပြီး၊ အစေ့ပြုပြင်ခြင်း (၄)မျိုး- (၁) ရေအေးတွင် ၂၄နာရီ စိမ်ခြင်း (၂) ရေနွေး ၁၀၀ ဒီဂရီစင်တီဂရိတ်တွင်စိမ်ခြင်း (၃) အပူချိန် ၈၅ ဒီဂရီစင်တီဂရိတ်တွင် ၂ရက်အပူပေးခြင်း (၄) သစ်စေ့အပေါ်ယံအခွံ၏ တစ်စိတ်တဒေသအား ဖွင့်ပေးခြင်းအပြင်၊ အညှောက်ပေါက်ခြင်းနှင့် ပျိုးပင်ငယ် ကြီးထွားနှုန်းတို့ကို သုံးသပ်ဖော်ထုတ် နိုင်ခဲ့ပါသည်။

တွေ့ရှိချက်များမှာ မယ်ဇလီ၊ ပေါက်ပန်းဖြူ၊ သန်း၊ သင်္ဘောကုက္ကိုနှင့် အော်ရီကူလီဖေါမစ်ရှားတို့မှာ အအေးခန်းတွင် ကောင်းစွာသို့လှောင်နိုင်ပြီး၊ ရေမနေမှာမူ ရေခဲသေတ္တာတွင် အကောင်းဆုံးဖြစ်ပြီး၊ ကျန်သစ်မျိုးများမှာမူ ထူးခြားမှု မရှိသည်ကို တွေ့ရှိရပါသည်။ အစေ့ပြုပြင်ခြင်းတွင် မယ်ဇလီ၊ ပိတောက်၊ သန်းတို့အား ရေအေးတွင်စိမ်ခြင်း၊ ဣန်နှင့်ဆီနီဂေါရှားတို့အား ရေနွေး ၁၀၀ ဒီဂရီ စင်တီဂရိတ်တွင် စိမ်ခြင်းသည် အကောင်းဆုံးဖြစ်ကြောင်း တွေ့ရှိရပါသည်။

ဒဟတ်မှာမူ ၈၅ ဒီဂရီစင်တီဂရိတ်တွင် ၂ရက် အပူပေးခြင်းဖြင့် အညှောက်ပေါက်ခြင်းကို များပြားစေပြီး၊ သင်္ဘောကုက္ကို၊ အော်ရီကူလီဖေါမစ်ရှားနှင့် ဘောစကိုင်းတို့မှာ အစေ့အပေါ်အခွံ၏ တစ်စိတ်တဒေသအား ဖွင့်ပေးပါက အညှောက်ပေါက်မှုများပြားတိုးတက်လာသည်ကို တွေ့ရှိရပါသည်။

ပျိုးပင်ငယ်များ၏ အရွယ်အစားသည် အနည်းဆုံး ၁ပေ ရရှိရန်အတွက် လိုအပ်သော အချိန်ကာလမှာ- အော်ရီကူလီဖေါမစ်ရှား (၁၅၁)ရက်၊ ဒဟတ် (၁၄၅)ရက်၊ ပိတောက် (၁၄၄)ရက်၊ မယ်ဇလီ (၁၄၃)ရက်၊ သင်္ဘောကုက္ကို (၁၄၂)ရက်၊ ဆီနီဂေါရှား (၁၂၁)ရက်၊ သန်း (၉၇)ရက်၊ စစ် (၈၉)ရက်၊ ရေမနေ (၈၂)ရက်၊ ဘောစကိုင်း (၈၁)ရက်နှင့် ပေါက်ပန်းဖြူ (၆၁)ရက်တို့ဖြစ်ကြောင်း တွေ့ရှိရပါသည်။

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 Head of Division,
 Forest Research Institute.

Abstract

Production of sufficient number of healthy and suitable size seedlings plays a very important role in the establishment of a successful forest plantation. It is therefore, essential to know in advance the right time for seed collection, processing, storage, pretreatment, germination and growth of the required seedlings. With a view to help planning the establishment of forest plantation, the above mentioned aspects of 11 species ie. dahat, mezaki, padauk, paukpan-byu, sit, than, thinbaw-kokko, yemane, auriculiformis sha, bawzagaing and senegal sha were studied at the FRI, Yezin. Three different methods of storage (ie. room temperature, air conditioned room at 22°C and refrigeration 3°C), were employed and 4 different methods of pretreatment (ie. soaking in cold water for 2 days and partial scarification), were given and germination and growth were assessed. It was found that mezali, paukpan-byu, than, thinbaw-kokko and auriculiformis sha store well in air conditioned room. Yemane gives very good results when stored under refrigeration, while no difference was found in the remaining species tested. Mezali, padauk and than gave the best germination when pretreated with cold water, while sit and senegal sha responded well to boiling water treatment. Dahat seed increased in germination when pretreated by heating to 85 C and thinbaw-kokko, auriculiformis sha and bawzagaing was found to improve in germination when partially scarified. To reach a plantable size of approximately one foot, auriculiformis sha 151 days, dahat 145 days, padauk 144 days, mezali 143 days, thinbaw-kokko 142 days, senegal sha 121 days, than 97 days, sit 89 days, yemane 82 days, bawzagaing 81 days and paukpan-byu 61 days.

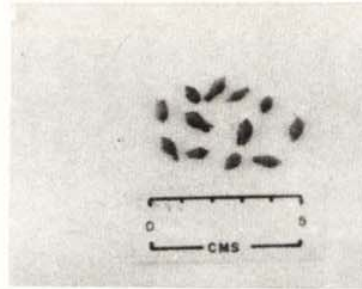
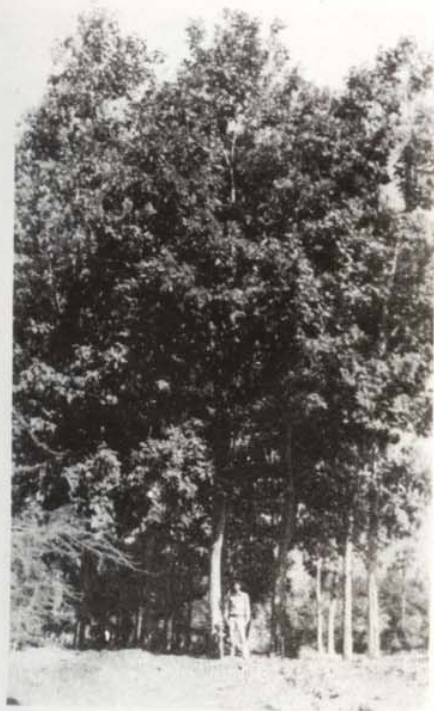
Contents

	Page
Abstract.....	i
1. Introduction	1
2. Materials and Methods	2
3. Results	6
4. Discussion	10
5. Conclusion	12
References	

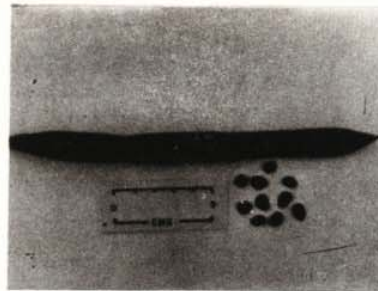
1. Introduction

- 1.1 Trees are being planted increasingly every year in many countries of the world. According to the estimate by Lanly (as cited by Willan, 1985), the forest plantations in the tropical countries will increase from 11.5 to 17.0 million hectares between 1980 and 1985. An increase of 48% in five years.
- 1.2 In Burma also, a greater emphasis on plantation forestry is given than in the past. A remarkable decision was being made to launch a large scale plantation programme on the basis of raising one acre of commercial plantation with high value species for every 40 tons of logs extracted from the forests. (Sein Maung Wint)
- 1.3 During the fourteen years period from 1948 to 1961, the total acreage of forest plantations established was 4748 acres, which averages to 340 acres annually. Since 1962, plantation establishment has been gradually increased. Under the Second (1974-75 to 1977-78), Third (1975-79 to 1981-82) and Fourth (1982-83 to 1985-86) Four Year plans, plantation establishment programme in Burma has increased from 30608 acres to 1,08,611 acres and 3,02,649 acres respectively. Further more, the Forest Department is now given the task to increase the plantation programme to 3,20,000 acres under the current Fifth (1986-87 to 1989-90) Four year plan (Ba Thwin, in Burmese, 1986).
- 1.4 As can be seen from the above, in Burma, the importance of plantation forestry is indisputable. The responsibility now lies on the Forest Department on how to carry out this tremendous task successfully and produce good, healthy and high yielding plantations. The answer lies in the adoption a combination of intensive site preparation with the use of suitable size, uniform and well grown nursery stock.
- 1.5 Production of nursery stock as mentioned above depended greatly on the understanding and quality of the seed used. With the present plantation target, it is estimated that the minimum requirement of seedling stock just for initial planting is 48 millions. In order to get this quantity of suitable size seedling annually, it is important that methods of seed collection, processing, storage, pretreatment, germination and growth are well established. Consequently this paper was developed with whatever information is institute. It is hoped that the data in this paper could be of some use in the country's plantation programme.

Figure 1.

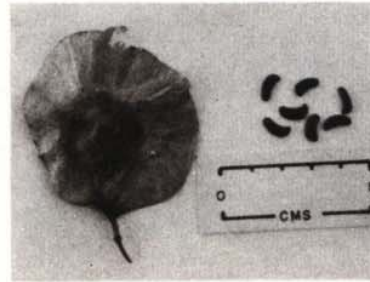


(a) Dahat

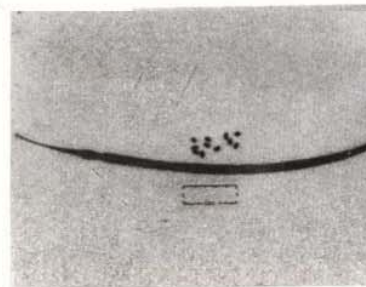
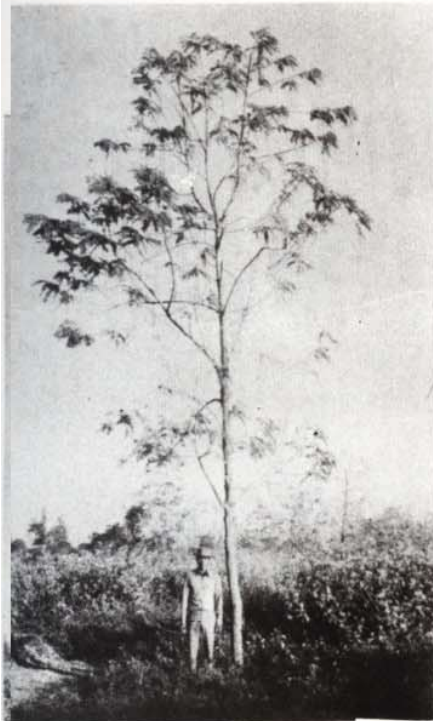


(b) Mezali

Figure 2.



(a) Padauk

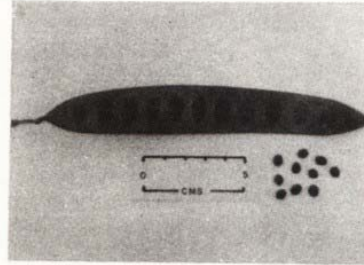


(b) Pauk pan-byu

Figure 3.



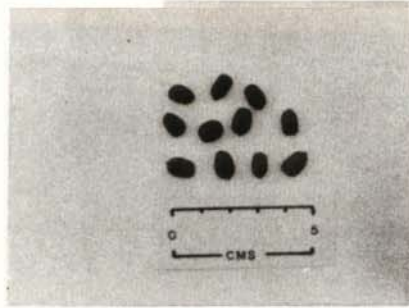
(a) Sit



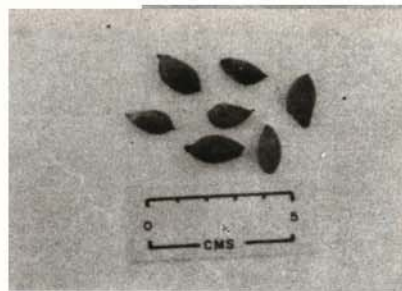
(b) Than



Figure 4.

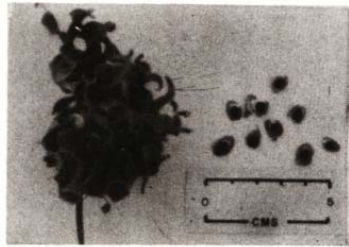
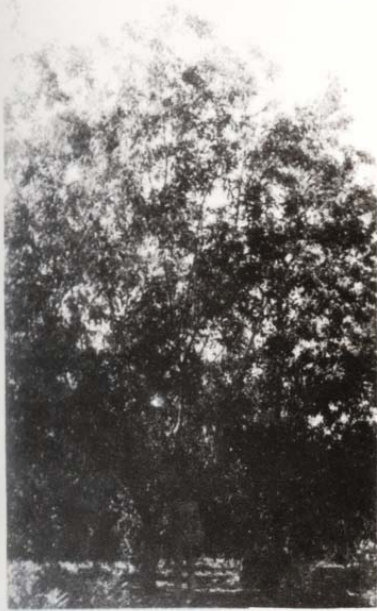


(a) Thinbaw-kokko

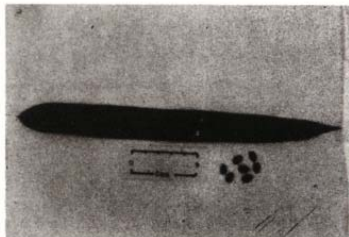


(b) Yemane

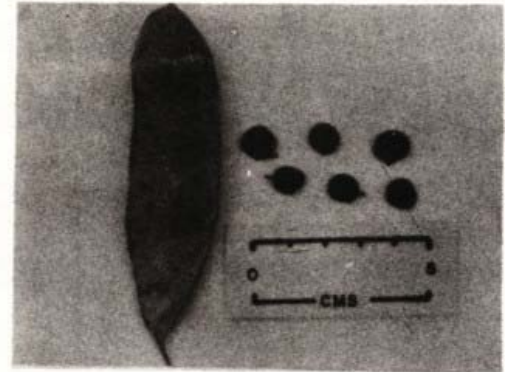
Figure 5.



(a) Auriculi formis Sha



(b) Bawzagaing



(a) Senegal Sha

2. Materials and Methods

- 2.1 After seed collection in the field, experiments were carried out at the research nursery, F.R.I., Yezin. Out of altogether 11 species tested, 8 were indigenous and the rest 3 were exotic. The species tested were:-

Indigenous

- (1) Dahat (*Tectona hamiltoniana* wall.)
- (2) Mezali (*Cassia siamea* Lam.)
- (3) Padauk (*Pterocarpus macrocarpus* Kurz.)
- (4) Paukpan-byu (*Sesbania grandiflora* pers.)
- (5) Sit (*Albizzia procera* Benth.)
- (6) Than (*Terminalia oliveri* Brandis)
- (7) Thinbaw-kokko (*Samanea usaman* (Jacq.) Merr.)
- (8) Yemane (*Gmelina arborea* Roxb.)

Exotic

- (9) Auriculiformis (*Acacia auriculiformis* A.Cunn.ex Sha Benth.)
- (10) Bawzagaing (*Leucaena leucocephala* Lam.)
- (11) Senegal Sha (*Acacia Senegal* (L.) Willd.)

2.2 Seed Source and Time of Collection

	<u>Species</u>	<u>Source</u>	<u>Time of Collection</u>
(1)	Dahat	Taungdwingyi	November, 1983.
(2)	Mezali	Yezin	Februar, 1984.
(3)	Padauk	Pyinmana	January, 1983.
(4)	Paukpan-byu	Yezin	May, 1984.
(5)	Sit	Yezin	February, 1984.
(6)	Than	Taungdwingyi	February, 1983.
(7)	Thinbaw-Kokko	Yezin	May, 1984.
(8)	Yemane	Taunglelon	May, 1984.
(9)	Auriculiformis Sha	Yezin	December, 1984.
(10)	Bawzagaing	Yezin	February, 1983.
(11)	Senegal Sha	Yupataung	January, 1983.

2.3 Seed Collection

Very simple methods of seed collection were employed for the species tested. Dahat, Mezali, Paukpan-byu, Sit, Than, Bawzagaing, Auriculiformis Sha, and Senegal sha seeds were collected from the ground by using an eztened pruner. Fruts of most of these species dehisce and the seeds scattered when they are fully ripe. So collection of seeds of these species had to be done when the seed is mature and Just before the frui9ts dehisce. In the case of Padauk, Yemane and Thinbaw-kokko, ripe and fallen seeds can simply be collected from the ground.

2.4 Seed Processing

- 2.4.1 Dahat :- Collection of seed was done usually in November. Collected seeds were put in gunny bags and taken to the seed laboratory, Yezin for cleaning, drying and storage. On arrival, seeds were dried in the sun for 2-3 days. Winnowing and

cleaning were done manually to separate the sound seeds from inert materials. The seeds were then stored in the storage room.

- 2.4.2 Mezali: - Pods were collected and put in gunny bags, filled with pods were left in the sun for approximately 5 days after which the bags were thrashed and the seeds were separated from the debris by winnowing. The pure seeds were then again dried in the sun for 2-3 days. The seeds were then stored in the storage room.
- 2.4.3 Padauk : -Collection of fruits was done from November to January . The fruits were first cut open by scissors and the seeds were extracted. Extracted seeds were immersed in water to separate the sound seeds from impurities and empty ones. Seeds. These were immediately sun-dried for 2 days. After drying, the seeds were stored in the storage room.
- 2.4.4 Paukpan-byu: - Collection of pods were done from February to may. Unlike Mezali, the pods had to be gently hammered with a small hammer to split it open and extract the seed. Winnowing was done in order to separate the good seeds from inert materials. After a proper sun drying for 2 cabs, the dried seeds were stored in the storage room.
- 2.4.5 Sit : - Collection of pods was done from January to February before the pods dehisce, The pods were put in gunny bags and left in the sun for 5-7 days during which the pods dehisce and the seed got separated. Most of Sit seeds were greatly infested with insects, in order to separate gook seeds from these infested seeds and inert materials, the seeds were immersed in water. Those that sink were good seeds and they were immediately dried in the sun for 2 days before being treated with insecticide and stored.
- 2.4.6 Than : - Seed collection was done in January and February. After collection, insect infested seeds and inert materials were pocked out manually. The seeds were then sun- dried for 2 cays before storage.
- 2.4.7 Thinbaw-kokko : - Pod collection was done from March to May. The seeds were separated from the pods first by hammering the pods with a hammer. These were then immersed in water and agitated until the seeds were clean. The seeds were then dried in the sun 4 days before being stored.
- 2.4.8 Yemane : -Mature fruits, which were yellowish in colour , were collected from the ground in April to may. Depulping needs to be done soon after arrival. The pulp was softened by soaking in water for about 4 to 6 days Then the flesh was macerated against a half-inch mesh wire. The seeds which sinks were then separated from the floating macerated pulp. The seeds were then sun-dried for 2-3 days before storage.
- 2.4.9 Auriculiformis Sha : - The ear-pod-wattles were collected in December and January. The pods were collected from the ground by means of an extended pruner before the dehisce. Collected pods were spread out on a mat and placed in the sun for 3 days to dehisce. The seeds were then separated from the pods manually. Seed cleaning and drying were also done before storage.
- 2.4.10 Bawzagaing : - mature seeds, fallen from the tree were collected from the ground by sweeping. Seeds were purified by winnowing after which they were sun dried for 3 days. Bawzagaing usually produce seeds enormously.

- 2.4.11 Senegal Sha : - The pods were collected in January. The freshly collected pods were spread out and sun-dried for 3 days. The seeds were then separated from the pods manually. Purification was done by winnowing and seeds were again sun dried for one day after which the seeds were treated with insecticide and stored.

2.5 Number of seeds per unit volume and unit weight

- 2.5.1 Condensed milk tin (CMT) which is very commonly used as a measuring unit in Burma was used as a standard unit in determining the number of seeds per unit volume. The capacity of CMT is equivalent to 320 cubic centimeter.
- 2.5.2 Seed lot of each of the tested species were first divided down repeatedly until seed sample of the volume required is approximately reached. Assessment of the number of seeds per CMT was replicated three times and the average was calculated.
- 2.5.3 Similarly, seeds of each of the species tested were sampled and the number of seeds per kilogram was assessed. One kilogram of seeds were weighed on an electrical precision balance and the number of seeds were counted. The process was repeated three times.

2.6 Storage

- 2.6.1 Storage were done soon after the seeds were purified and dried in the sun. With the facilities available at the FRI, Yezin, three methods of storage were tested. They are :- (i) Storage under refrigeration (3° C) (ii) Storage in Air conditioned room (20° C-25° C) (iii) Storage at room temperature (30° C-33° C).
- 2.6.2 Dahat, Mezali, Padauk, Paukpan-byu, Sit, Than, Thinbaw-Kokko, Bawzagaing and Senegal sha were stored and tested under (i) Air conditioned room and (ii) Room temperature. Only Auriculiformis sha and Yemane were tested under (i) Refrigeration (ii) Air conditioned room and (iii) Room temperature.
- 2.6.3 Seeds of all the species were put in air tight containers before being stored in the respective storage rooms.

2.7 Seed Pretreatment

- 2.7.1 Different pretreatment tests were carried out for different species as required. For the 11 species tested, 4 pretreatment methods were used. viz. (i) Soaking in cold water (ii) Soaking in boiling water (iii) Partial scarification and (iv) Heating at 85° C.
(i) Soaking in cold water
- 2.7.2 Mezali, Than and Padauk seeds were sampled and soaked in cold water for 24 hours. Four hundred pretreated seeds and 400 control seeds were then germinated in a germination box containing pure sand. These were watered twice a day.
(ii) Soaking in boiling water
- 2.7.3 Sit and Senegal sha seeds were sampled and soaked in boiling water which was left to cool for 24 hours. The volume of boiling water used was twice that of the seeds

pretreated. Four hundred pretreated and 400 control seeds then germinated in germination boxes containing pure sand. These were watered twice a day.

(iii) Partial Scarification

2.7.4 Auriculiformis sha, Bawzagaing and Thinbaw-kokko seeds were used in this pretreatment method. Four hundred seeds each of the three species tested were clipped open slightly with a secateurs. Care should be taken not to clip the seed at or near the micropyle and also not to damage the cotyledon. Only a slight opening which will allow water to permeate is sufficient. These seeds and 400 control seeds of each of the 3 species were then germinated in a germination box containing pure sand. These were watered twice a day.

(iv) Heating at 85°C

2.7.5 Only dahat seeds were used in this pretreatment method. Four hundred Dahat seeds were sampled and heated in a precision oven at 85°C for 2 days. These pretreated seeds and 400 control seeds were germinated in a germination box containing pure sand. These also were watered twice a day.

2.7.6 No pretreatment test was carried out for Yemane and Paukpanbyu as their germination percents were quite high.

2.8 Germination

2.8.1 All the pretreated and control seeds were germinated in a 61 cm x 61 cm x 15 cm germination box containing pure sand. Germination was recorded daily and the germinated seeds were marked by putting tooth picks on the sides of them.

2.8.2 For Bawzagaing, mezali, Padauk and Sit, lines one cm deep and 5 cm apart were drawn on the sand in the germination box. The seeds were then sown in these lines 0.42 cm apart, and were covered with loose sand. Watering was done with fine spray once at 8 a.m. and another at 3 p.m. Auriculiformis Sha, Dahat, Paukpan-Byu and Senegal Sha were similarly germinated except that the spacing between the lines were reduced to 4cm.

2.8.3 Germination of Than, Thinbaw-kokko, and Yemane were also similarly carried out except that the lines drawn on the sand were 1.5 cm deep and 5 cm apart.

2.8.4 Germination was expressed both as germination percent and germination value. Method of calculation of "germination value" which expresses both the speed and totality of germination was developed by Czabator (1962), According to this method, germination value (GV) is expressed as

$$GV = PV \times MDG$$

Where PV=Peak value and

MDG=mean daily germination

2.8.5 Peak value which is the measure of the vigor of the seed is expressed in terms of highest germination percent in relation to elapse of time from the start of the test. This is determined by successively dividing the cumulative germination percent by the number of days until a quotient giving the highest value (ie PV) is obtained. Mean

daily germination is the average number of seeds germinated pre day of the actual test period to the date of last measurement. It is calculated by dividing the total germination percent on the closing day by the total number of days.

2.9 Transplanting

2.9.1 Seedlings of all the species were transplanted into individual containers when they have one pair of leaves. The containers used were 17.8 cm x 7.6 cm polythene bags containing 1:2:6 mixture of sand, manure and forest soil respectively. The seedlings that were pricked out from the germination box were first put in a bucket containing water before being transplanted into the polythene containers. This is done to avoid the roots from being desiccated. This process is best done in the evening when it is cool. Watering was done with fine spray twice a day.

2.10 Height Growth

2.10.1 For height measurements, 25 seedlings of average and equal height were selected. First measurements were taken 30 days after germination. Subsequent height measurements were taken every 15 days until the seedlings were round about 31 cm high.

2.10.2 Height growth curves were drawn for each species and the number of days taken to reach the height of 31 cm. were read out from the graphs (See figure 7,8,9 and 10).

3. Results

3.1 The results of assessment of the number of seeds per unit weight (kilogram) and per unit volume (CMT) is as given in table 1 below.

Table 1. Number of Seeds per Unit Weight and Unit Volume.

Sr. No.	Species	Number of Seeds	
		Per Kilogram	Per CMT
1	Dahat	32713	3450
2	Mezali	32630	6730
3	Padauk	19740	4400
4	Paukpa-byu	32020	4870
5	Sit	24700	4970
6	Than	7510	195
7	Thinbaw-kokko	4190	1290
8	Yemane	1910	340
9	Auriculiformis Sha	48000	3960
10	Bawzagaing	14370	3890
11	Senegal Sha	14600	3000

3.2 Storage

3.2.1 The results of the effect of different methods of storage on germination was given in table 2.

- 3.2.1.1 Dahat :- No differences were observed among the series of germination tests carried out for seeds stored in the conditioned room and in room temperature.
- 3.2.1.2 Mezali :- Mezali stored better in the air conditioned room than in room temperature. Germination for the seeds stored in the air conditioned room was found to be appreciably good up to the 14th month of storage.
- 3.2.1.3 Padauk :- No differences were observed among the series of germination tests carried out for the seeds stored in the air conditioned room and in room temperature.
- 3.2.1.4 Paukpan-byu :- Paukpan-byu stored better in the air conditioned room than in room temperature. Germinations for seeds stored in the air conditioned room was found to be appreciably good up to the end of the test ie. 27th month.
- 3.2.1.5 Sit :- No differences were observed among the series of germination tests carried out for the seeds stored in the air conditioned room and in room temperature.
- 3.2.1.6 Than :- Than stored better in the air conditioned room than in room temperature. Germination for the seeds stored in the air conditioned room was appreciably good up till the 19th month.
- 3.2.1.7 Thinbaw-kokko :- Thinbaw-kokko stored better in the air conditioned room than in room temperature. Germination for the seed stored in the air conditioned room was appreciably good up till the end of the experiment on the 14th month.
- 3.2.1.8 Yemane :- Yemane stored slightly better in the air conditioned room than in room temperature. However, it stored best under refrigeration. Germination for the seed stored in refrigeration gave appreciably good results up till the 17th month of storage.
- 3.2.1.9 Auriculiformis Sha :- The seeds of this species stored best in the air conditioned room than under refrigeration and room temperature. The seeds stored in the air conditioned room responded appreciably well only up till the 5th month of storage.
- 3.2.1.10 Bawzagaing :- No differences were observed among the series of germination tests carried out for seeds stored in the air conditioned room and in room temperature. In both cases, the seeds stored appreciably well up till the 27th month of storage or may be more.
- 3.2.1.11 Senegal Sha :- No differences were observed among the series of germination tests carried out for seeds stored in the air conditioned room and in the room temperature. In both cases, the seeds stored appreciably well only up till the 5th month of storage.

3.2.2 Seed Pretreatment

- 3.2.2.1 The effect of pretreatments on seeds of the species tested was as given in table 3.

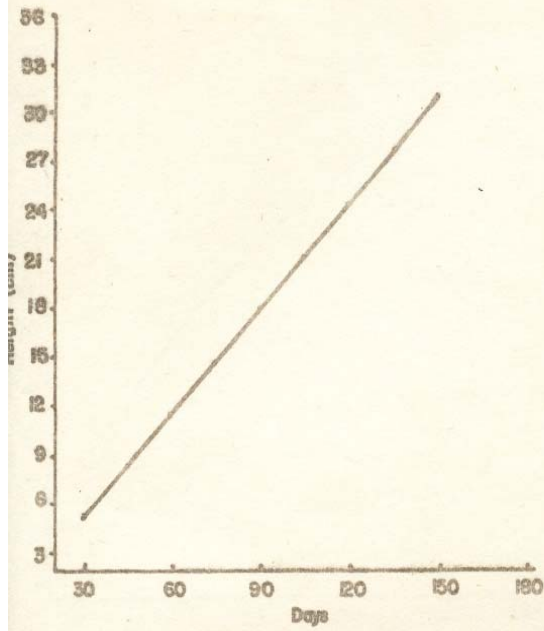
- 3.2.2.2 Dahat :- Dahat seeds, after being pretreated by heating in an oven at 85° C for two days, increased in germination from the normal 16% to 30.5%. The GV also increased from 0.64 to 2.84.
- 3.2.2.3 Mezali :- Mezali seeds after being soaked in cold water for 24 hours increased in germination from the normal 45.2% to 59.5%. GV also increased from 6.65 to 19.67.
- 3.2.2.4 Padauk :- Padauk seeds after beings soaked in cold water for 24 hours increased in germination from the normal 45.8% to 65.5%. GV also increased from 9.00 to 14.00.
- 3.2.2.5 Sit :- Sit seeds after being pretreated with boiling water increased in germination from the normal 40% to 80%. GV also increased from 6.44 to 44.75.
- 3.2.2.6 Than :- Than seeds after being soaked in cold water for 24 hours increased in germination from the normal 35.3%.Gvalso increased from 1.88 to 4.25.
- 3.2.2.7 Thinbaw-kokko:- Thinbaw- kokko seeds after being partially scarified increased in germination from the normal 65% to 100%.GV also increased drastically from 24.78 it 302.38.
- 3.2.2.8 Auriculiformis Sha: -out of the three pretreatments applied partial scarification was the best, and was followed by soaking in boiling water and control. The germination percent increased from the normal 8% to 40.3% and 60% respectively. Similarly GV also increased from the normal 0.09to 2.37 and 21.6 respectively.
- 3.2.2.9 Bawzagaing :- Out of the three pretreatments applied, partial scarification was the best and was followed by soaking in cold water and control. The germination percent increased from the normal 20% to 25.3% and 95%respectively.GV also increased from the normal 0.75 and 332.43 respectively.
- 3.2.2.10 Senegal Sha :- Senegal Sha seeds, after being pretreated with boiling water increase in germination from the normal 45% to 75.3%. GV also increased from 16.17 to 44.43.

Table 3. Effect of Seed Pretreatment on the Germination of Seeds of the Species Tested.

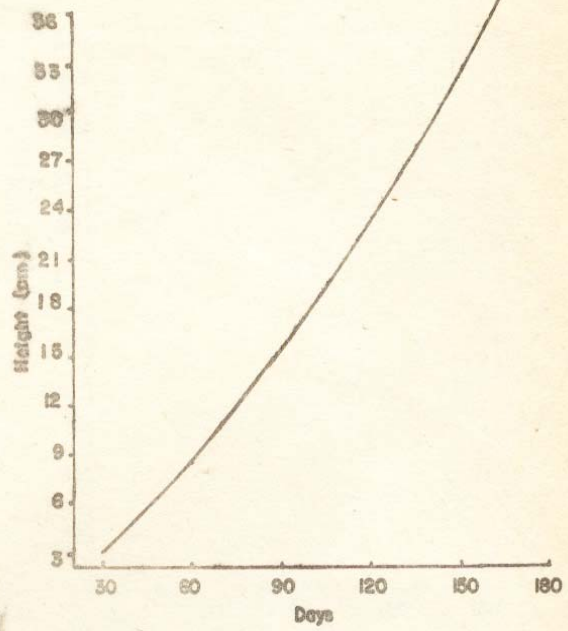
Sr. No	Species	Soaking in cold water		Soaking in boiling water		Partial Scarification		Heating at 85°C		Control	
		Ger. %	GV	Ger. %	GV	Ger. %	GV	Ger. %	GV	Ger. %	GV
1	Dahat	-	-	-	-	-	-	30.5	2.84	16.0	0.64
2	Mezali	59.5	19.67	-	-	-	-	-	-	45.2	6.65
3	Padauk	65.5	14.00	-	-	-	-	-	-	45.8	9.00
4	Paukpan-byu	-	-	-	-	-	-	-	-	95.3	180.40
5	Sit	-	-	80.0	44.75	-	-	-	-	40.0	6.44
6	Than	50.3	4.25	-	-	-	-	-	-	35.3	1.88
7	Thinbaw-Kokko	-	-	-	-	100.0	302.38	-	-	65.0	24.78
8	Yemane	-	-	-	-	-	-	-	-	90.8	14.48
9	Auriculiformis Sha	-	-	40.3	2.37	60.0	21.6	-	-	8.0	0.09
10	Bawzagaing	25.3	1.76	-	-	95.0	332.43	-	-	20.0	0.75
11	Senegal Sha	-	-	75.3	44.43	-	-	-	-	46.0	16.17

Table 4. Seedling Height Growth

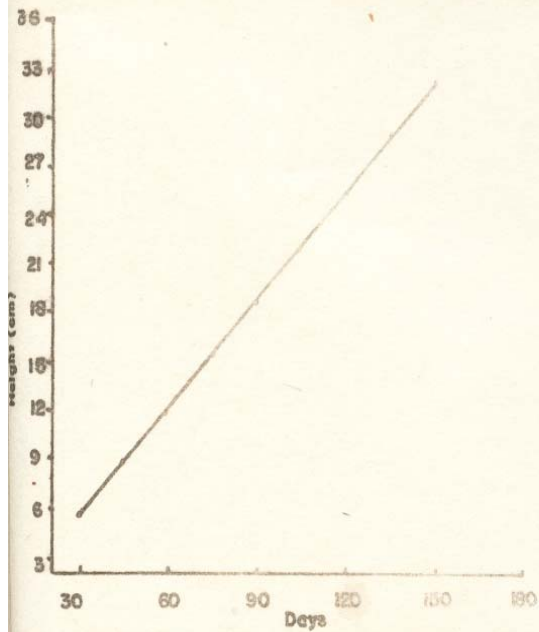
Sr. No	Species	Size Trans - planted (cm)	Height Measurements									
			30 days	45 days	60 days	75 days	90 days	105 days	120 days	135 days	150 days	165 days
1	Dahat	1.5	2.9	4.6	8.3	13.5	17.8	22.8	25.2	26.9	28.4	31.4
2	Mezali	3.3	4.5	8.5	12.5	14.3	17.2	20.5	23.5	30.8		
3	Padauk	3.3	5.5	8.6	12.3	16.1	18.25	23.4	24.9	27.6	31.6	
4	Paukpan-byu	5.3	12.5	20.3	34.8							
5	Sit	4.4	8.6	10.2	16.5	22.9	30.8					
6	Than	2.5	4.8	8.9	14.9	21.8	28.5	33.5				
7	Thinbaw-Kokko	3.5	7.9	11.1	16.9	20.2	24.3	26.5	29.7	30.1	31.4	
8	Yemane	3.3	7.5	12.7	20.5	29.2	33.9					
9	Auriculiformis Sha	3.5	5.7	7.8	11.5	14.9	18.1	20.9	23.9	27.5	31.6	
10	Bawzagaing	3.3	6.5	14.1	25.2	29.7	32.7					
11	Senegal Sha	3.3	12.7	17.8	21.5	24.9	26.5	29.5	30.7			



(a) Auriculiformis Sha



(b) Dahat

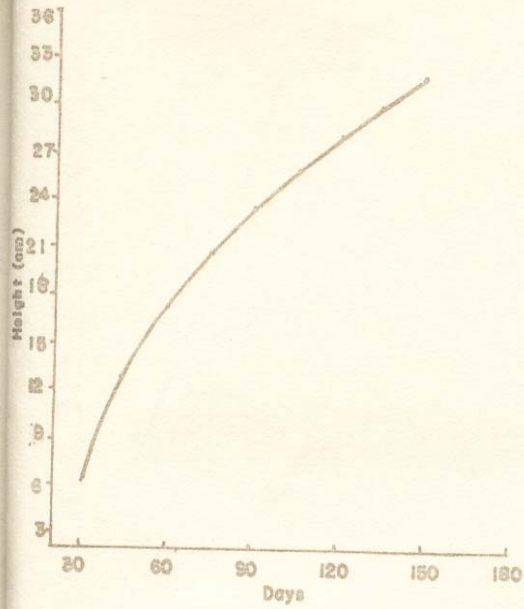


(c) Padauk

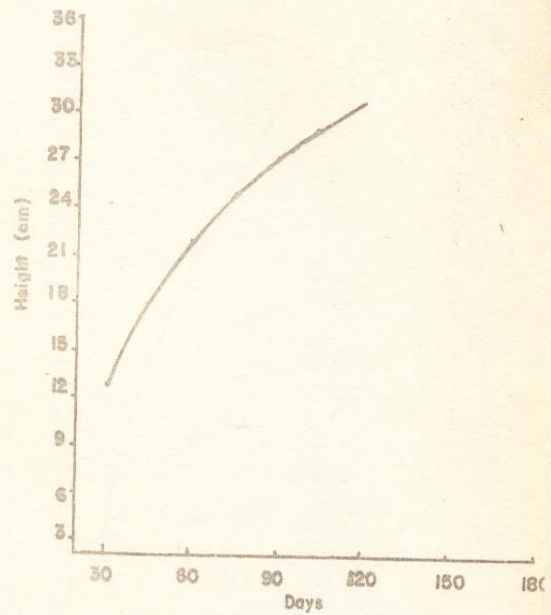


(d) Mezali

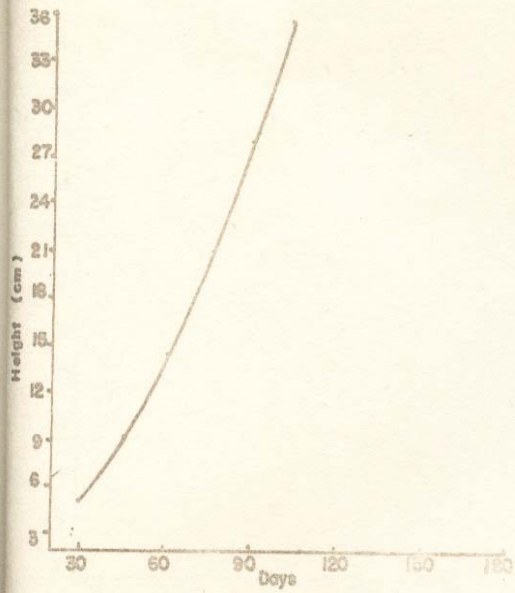
Figure 7. Height Growth.



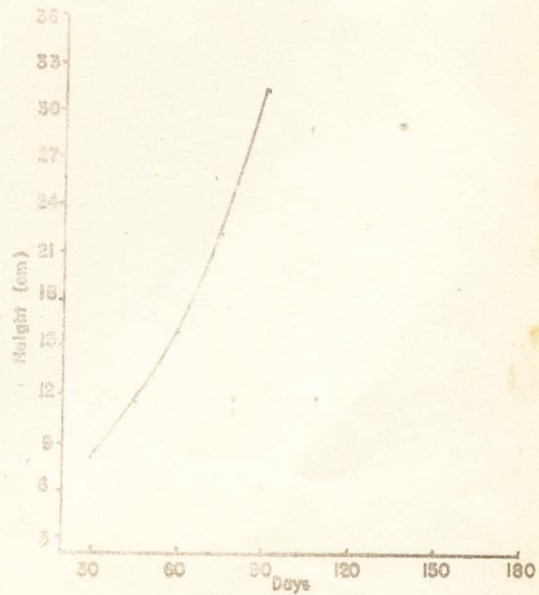
(a) Thinbaw-kokko



(b) Senegal Sha

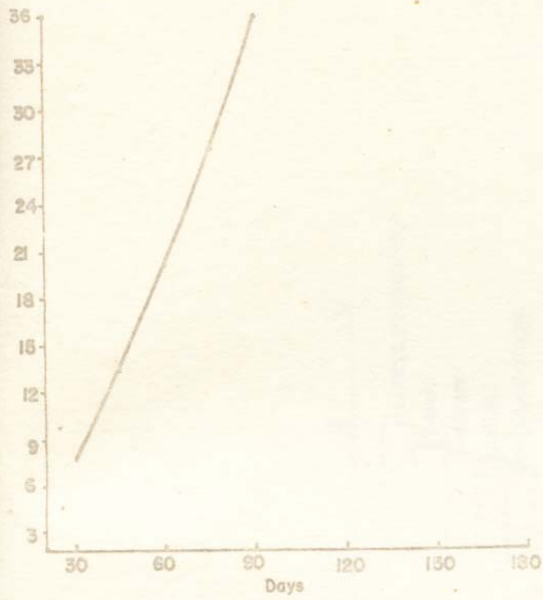


(c) Than

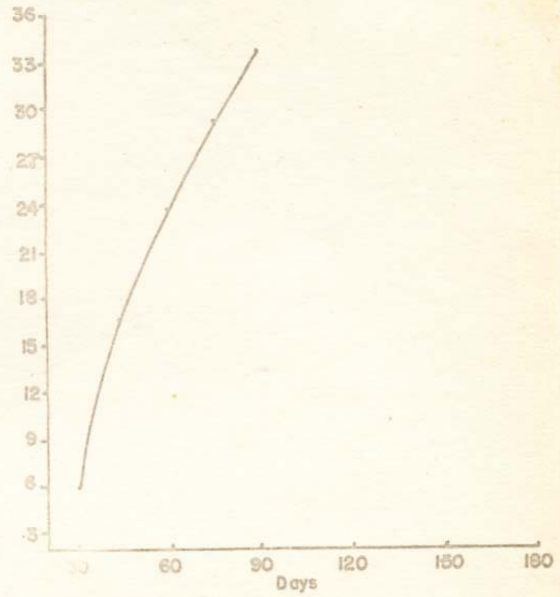


(d) Sit

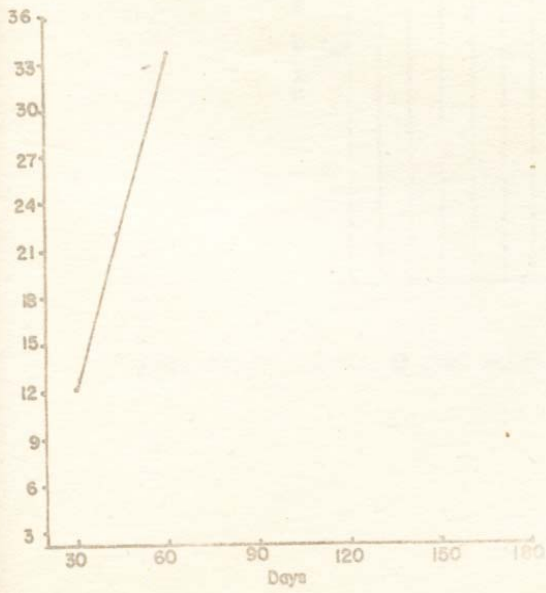
Figure 8. Height Growth.



(a) Yemane



(b) Bawzagaing



(c) Paukpan-byu

Figure 9. Height Growth.

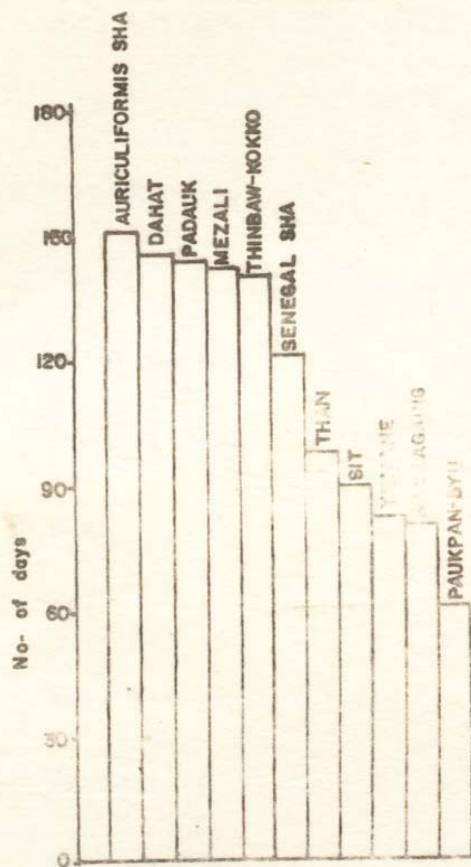


Figure 10. Comparison of time taken to reach a plantable size of 31cm height.

Table 5. Time taken to reach a plantable size of 31 cm.

Sr. No.	Species	Days
1	Auriculiformis Sha	151
2	Dahat	145
3	Padauk	144
4	Mezali	143
5	Thinbaw-Kokko	142
6	Senegal Sha	121
7	Than	97
8	Sit	89
9	Yemane	82
10	Bawzagaing	81
11	Paukpan-byu	61

3.2.2.11 Paukpan-byu and Yemane :- Paukpan-byu and Yemane without being pretreated gave very good germination of 95.3% and 90.8% respectively.

3.2.3 Seedling Height Growth

3.2.3.1 Seedling height growth was as given in Table 4 and Figures 7,8,9 & 10. In order to reach a plantable size of 31 cm in height, Auriculiformis Sha took 151 days, Dahat 145 days, Padauk 144 days, Mezali 143 days, Thinbaw-Kokko 142 days, Yemane 82 days, Bawzagaing 81 days and Paukpan-byu took 61 days.

4. Discussion

4.1 With the increase in the plantation programme and consequently the need to know more about seed and growth of seedlings, it is hoped that this paper could be of some use to the forest department.

4.2 Under “Materials and Methods”, materials and methods used in seed collection, seed processing, seed storage, seed pretreatment, seed germination and assessment of seedling height growth were described.

4.3 Seed Collection

4.3.1 There are many varieties of methods and equipments used in the collection of tree seed. Willan (1985) classified them into:

- (i) Collection of fallen fruits or seeds from the forest floor.
- (ii) Collection from the crown of felled trees.
- (iii) Collection from standing trees with access from the ground.
- (iv) Collection from standing trees with access by climbing, and
- (v) Collection from standing trees with other means of access.

4.3.2 The easiest and the most convenient method, which is greatly used is the collection of fallen fruits or seeds from the forest floor. However, by using this

method, identification of the mother tree is not possible especially when collecting seeds from a group of the same species or from plantations.

4.4 Seed Processing

4.4.1 In countries where facilities are available, machineries are being used for seed extraction, seed dewinging, seed cleaning, seed grading and control of moisture content. All these processes were done manually because the amount of seed required for the test was small. However, for a large scale collection, facilities to execute the above processes will be needed.

4.4.2 The number of seeds per unit weight and unit volume was assessed and the results included so that it can be used in the estimation of the quantity of seed required by the officer in charge of a plantation.

4.5 Seed Storage

4.5.1 Seeds are living materials and usually under suitable conditions, germination takes place and this transform the embryo within the seed into independent seedlings.

4.5.2 Normally, at maturity and seed shed, many seeds have lost a greater part of moisture in earlier stages. With this lost in moisture, the metabolic activity of the seed is reduced and consequently the embryo is put in a temporary resting state. In non-dormant seeds, this can easily be reactivated by suitable conditions such as adequate moisture, favourable temperatures, adequate gas exchange, and for some species, light. (Krugman *et. al.* (1974) as cited by Willan 1985).

4.5.3 Thus, if these conditions, particularly moisture content and temperature, can be controlled, most seeds can be stored reasonably well.

4.5.4 In this experiment, although the seeds were dried in the sun before storage, their moisture contents were not determined. Temperature was the only factor that was properly applied and recorded. Even then as can be seen from the results, most seeds stored well in air conditioned room where the temperature is low. This is because the rate of respiration is lower at lower temperature and this lengthens the life span of seeds in storage (Willan ,1985).

4.6 Seed Pretreatment and Germination

4.6.1 According to Willan (1985), germination consists of three overlapping processes: -*(i)* Absorption of water mainly by imbibition, causing a swelling of the seed and eventual splitting of the seed-coat *(ii)* Enzymatic activity and increased respiration and assimilation rates and *(iii)* Cell enlargement and divisions resulting in emergence of radicle and plumule.

4.6.2 All the pretreatment methods applied in this experiment were to facilitate better absorption of water by imbibition, and the majority of the species tested responded very well to the methods applied. No pretreatments were applied. No pretreatments were applied to Paukpanbyu and Yemane as their normal germination rate was quite high ie. Above 90%.

4.7 Seedling Height Growth

- 4.7.1 Seedling height growth is presented in this paper in terms of the number of days required for the respective seedlings to reach a plantable size. A plantable size in this paper is arbitrarily fixed at 31cm (12 inches). It is hoped that these data will be useful in planning nursery work for these species.

5. Conclusion

- 5.1 In conclusion, it is recommended that: (1) After collection and processing, Mezali, Paukpanbyu, Than, Thinbaw-kokko, and Auriculiformis Sha, should be stored in air conditioned room, Yemane under refrigeration; Dahat, Paddauk, Sit, Bawzagaing and Senegal Sha in room temperature.
- (2) Before germination, Mezali, Padauk and Than seeds should be soaked in cold water for 24 hours, Sit and Senegal Sha seeds should be soaked in twice it's volume of boiling water and lift to cool for 24 hours; Thinbaw-kokko, Auriculiformis Sha and Bawzagaing seed should be partially scarified. Dahat seed should be heated to 85°C for 2 days.
- (3) When planning nursery work the following species should be sown prior to the date of planting as prescribed as follows: Auriculiformis Sha 151 days, Dahat 145 days, padauk 144 days, Mezali 143 days, Thinbaw-kokko 142 days, Senegal Sha 121 days, Than 97 days, Sit 89 days, Yemane 82 days, Bawzagaing 81 days and Paukpanbyu 61days.
- (4) Further research should also be done on other commercially important species and more emphasis should be made on the moisture content of seeds.

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