

Leaflet No. 5/95-96



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



**Experiment of Seedling Ages and Sizes which should be  
Used in Establishment of Pine Plantations**

**U Kyaw Than, B.Sc. (For.) (Ygn.),**  
**Assistant Research Officer,**  
**Forest Research Institute**  
**March 1996**

ထင်းရှူးစိုက်ခင်းများတည်ထောင်ရာ၌ အသုံးပြုသောပျိုးပင်များ၏ ပျိုးသက်အမျိုးမျိုးကို  
လေ့လာခြင်း

ဦးကျော်သန်း၊ B.Sc. (For.) (Ygn.)  
လက်ထောက်သုတေသနအရာရှိ  
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

ရှမ်းပြည်နယ်တွင် ၁၉၈၀ခုနှစ်မှစ၍ ထင်းရှူးစိုက်ခင်းများကို တည်ထောင်ခဲ့ပါသည်။ စိုက်ခင်း တည်ထောင်ရာ၌ ပျိုးပင်ပျိုးသက်ရင့်လျှင် ပို၍ကောင်းသည်ဟု လက်ခံထားခဲ့ကြသည်။ သို့သော် ပျိုးသက် ရင့်လာသည်နှင့်အမျှ ကုန်ကျစရိတ်များ တိုး၍လာပါသည်။ သို့ပါ၍ မည်သည့်ပျိုးသက်ကို စိုက်ပျိုးလျှင် အကောင်းဆုံးဖြစ်နိုင်ကြောင်း စူးစမ်းလေ့လာခဲ့သည်။ ထင်းရှူးသစ်မျိုး (၄)မျိုးအား ပျိုးသက် (၅)မျိုးစီဖြင့် စမ်းသပ်ရာ (၆)လသားပျိုးသက်ရှိသော ပျိုးပင်အား စိုက်ပျိုးလျှင် သင့်တော်ကြောင်း တွေ့ရပါသည်။

## **Experiment of Seedling Ages and Sizes which should be Used in Establishment of Pine Plantations**

U Kyaw Than, B.Sc. (For.) (Ygn.)  
Assistant Research Officer  
Forest Research Institute

### **Abstract**

Pine plantations were established in the Shan State since 1980. It was accepted that the older seedlings would be better for plantation establishment, but the older the seedling the more expensive it is. Therefore, the optimal seedling age for transplanting was studied. Five seedling age classes of four *Pinus* species were tested; among them the sixth month old seedling is found to be most suitable for pine plantation establishment.

## Contents

	<b>Page</b>
စာတမ်းအကျဉ်းချုပ်	i
Abstract	ii
1. Introduction	1
2. Materials and Methods	1
3. Design	2
4. Method of Analysis	4
5. Results	4
6. Conclusion and Recommendations	10
7. References	

## 1. Introduction

In Shan State due to shifting cultivation, forest fires and grazing the forests become degraded and turn into bare land. Therefore, the coverless lands become eroded in upland area and siltations were found in lowland area. In lowland area, streams, rivers and dams became silting up. Reforestation was therefore urgently needed in the watershed area. The Forest Department carried out this task by planting large-scale forest plantation.

In establishing large-scale plantation, *Eucalyptus grandis*, a fast growing species was first used and found to be growing very well. But due to some controversy on *Eucalyptus*, other species, such as *Pinus kesiya*, *Cassia siamea*, *Luecaena leucocephala*, *Millettia japonica*, *Terminalia oliveri*, etc. were tried out and only one *Pinus* species, *Pinus kesiya*, survived. As the growth of *Pinus kesiya* is very slow, new exotic pines such as *Pinus maximinoi*, *Pinus carabaea*, *Pinus oocarpa*, etc. were tested for plantation establishment.

According to last experiences, the older Pine seedling were found to be more suitable than younger seedling for plantation establishment. But the optimal age for transplanting needs to be known so as to reduce cost and wastage of time. To fulfill this needs, this experiment has been carried out.

Although the name of this experiment is "Experiment on Seedling ages and sizes which should be used in the Establishment of Pine Plantations", this paper will describe the different experiments by using only different seedling age class as the age classes of pine seedlings are almost always correspond to size classes.

## 2. Material and Method

### Seed source

*Pinus maximinoi*, *Pinus carabaea*, *Pinus kesiya* (e) and *Pinus kesiya* (i) were tested. *Pinus maximinoi*, *Pinus carabaea* and *Pinus kesiya* (e) were imported and *Pinus kesiya* (i) was an indigenous species. For details of origin see Table (1).

**Table ( 1) of Seed Source**

No	Species	Seed source					
		Country	Provenance	Lattitude	Longitude	Elevation	Rainfall
1	<i>Pinus maximinoi</i>	Honduras	Chaquite Grade	14.12"N	87.27"W	1200-1800m	1070 mm
2	<i>Pinus carabaea</i>	Honduras	Dulce Nombre de Culmi	15.06"N	85.37"W	500-600 m	1440.6mm
3	<i>Pinus kesiya</i> (e)*						
4	<i>Pinus kesiya</i> (i)	Myanmar	Kalaw	20.04"N		4330 ft	40.89 in

Tested seedling's ages were 3 months, 4 months, 5 months, 6 months and 7 months. Seedling ages and average height, when planting time, were shown in Table (2).

---

\* Data not available

**Table (2) of Seedling ages & average height**

No	Species	Seedling ages	Average height
1.	<i>Pinus maximinoi</i>	7 month	11 inches
2.	<i>Pinus maximinoi</i>	6 month	9 inches
3.	<i>Pinus maximinoi</i>	5 month	7 inches
4.	<i>Pinus maximinoi</i>	4 month	5 inches
5.	<i>Pinus maximinoi</i>	3 month	3.5 inches
6.	<i>Pinus carabaea</i>	7 month	11 inches
7.	<i>Pinus carabaea</i>	6 month	9 inches
8.	<i>Pinus carabaea</i>	5 month	6 inches
9.	<i>Pinus carabaea</i>	4 month	5 inches
10.	<i>Pinus carabaea</i>	3 month	3.5 inches
11.	<i>Pinus kesiya (e)</i>	7 month	9 inches
12.	<i>Pinus kesiya (e)</i>	6 month	7 inches
13.	<i>Pinus kesiya (e)</i>	5 month	5 inches
14.	<i>Pinus kesiya (e)</i>	4 month	3.5 inches
15.	<i>Pinus kesiya (e)</i>	3 month	3 inches
16.	<i>Pinus kesiya (i)</i>	7 month	8 inches
17.	<i>Pinus kesiya (i)</i>	6 month	6 inches
18.	<i>Pinus kesiya (i)</i>	5 month	4.5 inches
19.	<i>Pinus kesiya (i)</i>	4 month	3.5 inches
20.	<i>Pinus kesiya (i)</i>	3 month	2.5 inches

### 3. Design

Factorial Experiment in Randomized block design with 5 replications was adopted in this experiment. Each experimental plots have 36 trees (6 x 6 rows). Trees were planted with 8.5 feet by 8.5 feet spacing.

Four species and five kinds of seedling ages were tested with Factorial Experiment in Randomized block design.

Layout of factorial experiment in randomized block design is as follow.

#### Design of Tested Plot

##### Block 1

4.2	2.3	2.5	1.3	2.2
3.4	3.5	2.1	4.5	4.1
1.2	1.5	4.4	3.1	3.2
1.1	4.3	1.4	2.4	3.3

##### Block 2

1.4	4.2	2.4	2.3	3.2
3.1	4.3	1.2	4.1	3.4
2.5	3.3	2.1	1.5	4.5
1.3	2.2	4.4	3.5	1.1

Block 3

4.4	4.3	1.1	2.4	1.5
3.5	2.3	4.1	4.5	2.1
1.4	1.3	3.2	3.3	4.2
2.2	1.2	3.4	3.1	22.5

Block 4

3.1	4.1	1.2	2.1	1.3
2.2	2.3	3.5	4.5	1.1
2.5	3.4	3.2	1.4	4.4
4.2	1.5	4.3	2.4	3.3

Block 5

2.1	4.2	4.5	1.2	2.5
2.4	2.2	4.4	2.3	4.1
1.3	1.4	3.4	3.1	3.3
4.3	3.5	3.2	1.5	1.1

**Species and seedling ages of Trial plots**

1.1:3 month old *Pinus maximinoi*  
1.2:4 month old *Pinus maximinoi*  
1.3:5 month old *Pinus maximinoi*  
1.4:6 month old *Pinus maximinoi*  
1.5:7 month old *Pinus maximinoi*

2.1:3 month old *Pinus carabaea*  
2.2:4 month old *Pinus carabaea*  
2.3:5 month old *Pinus carabaea*  
2.6:6 month old *Pinus carabaea*  
2.7:7 month old *Pinus carabaea*

3.1:3 month old *Pinus kesiya (e)*  
3.2:4 month old *Pinus kesiya (e)*  
3.3:5 month old *Pinus kesiya (e)*  
3.4:6 month old *Pinus kesiya (e)*  
3.5:7 month old *Pinus kesiya (e)*

4.1:3 month old *Pinus kesiya (i)*  
4.2:4 month old *Pinus kesiya (i)*  
4.3:5 month old *Pinus kesiya (i)*  
4.4:6 month old *Pinus kesiya (i)*  
4.5:7 month old *Pinus kesiya (i)*

#### 4. Method of Analysis

The result of the experiments was used to find out the optimal age of seedling of different Pinus species for plantation establishment. Three are four-month old seedlings did not survive and thus they were not included in the analysis. The standard statistical analysis were applied.

#### 5. Result

The survival percents of the three different seedling ages of four Pinus species at the age of three years were calculated and presented in the Table (3), Figure (1) and Figure (2).

**Table (3) Survival% at 3 years old**

Seedlin ages (months)	Species				Sum of Seedling age	Mean survival % of seedling age
	Spp 1	Spp 2	Spp 3	Spp 4		
5 months	66.7	77.7	88.9	113.9	347.2	17.36
6 months	363.9	336.2	355.5	360.6	1416.2	70.81
7 months	312.7	302.1	325	326.1	1265.9	63.295
Sum of Species	743.3	793.7	769.4	800.6		
Mean survival % of species	49.55	32.91	51.29	53.37		

L.S.D of Species = 20.59

L.S.D of Seedling Age = 23.78

The survival% of different seedling ages are significantly different as shown in Table (4)

**Table (4) ANOVA Table of Survival% at 3 year old**

Source of Variation	SS	df	MS	F	F crit
Species	261.53	3	87.18	0.42	2.82
Seedling age	33489.35	2	16744.67	80.55***	3.20
Species, seedling age	152.97	6	25.49	0.12	2.31
Treatment	33903.84583	11	3082.17	14.83	2.01
Block	1577.37	4	394.34	1.90	2.58
Error	9147.19	44	207.89		
Total	44628.4018	59			

From survival study at three year old, six month old seedlings give the best percentage for survival at (70.8 %) followed by seven month old seedlings at (63.3%) and five month old seedlings at (7.4%). Between species, *Pinus kesiya* (i) give the result at (53.37%) followed by *Pinus kesiya* (e) (51.29%), *Pinus maximinoi* (49.55%) and *Pinus carabaea* at (47.73%).



Figure 1.

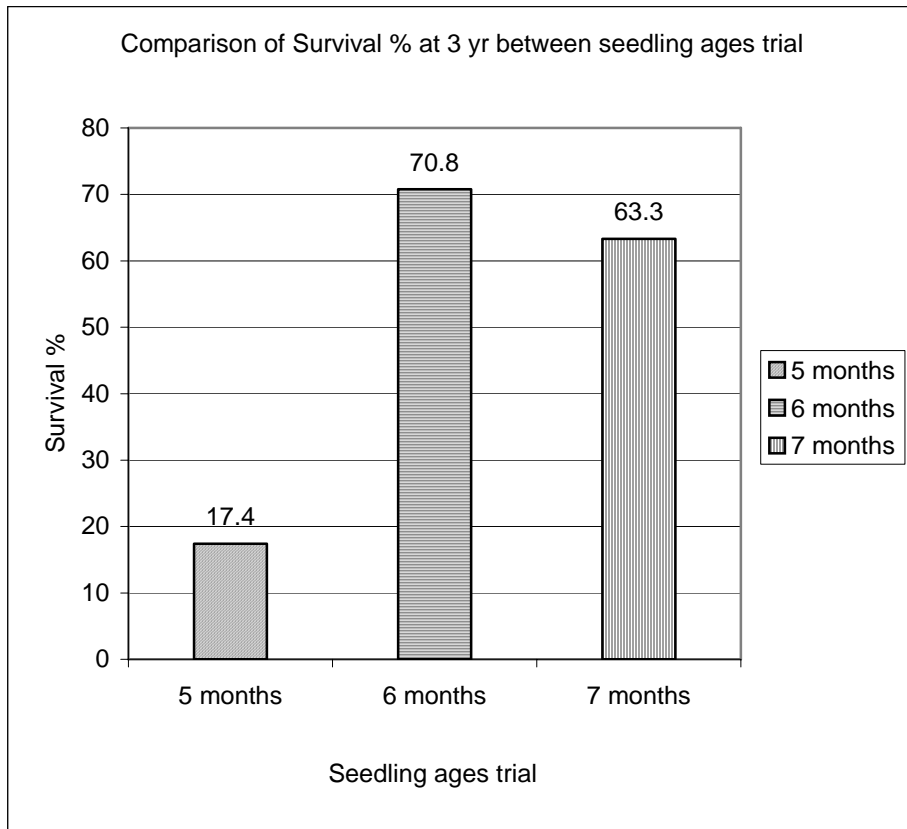
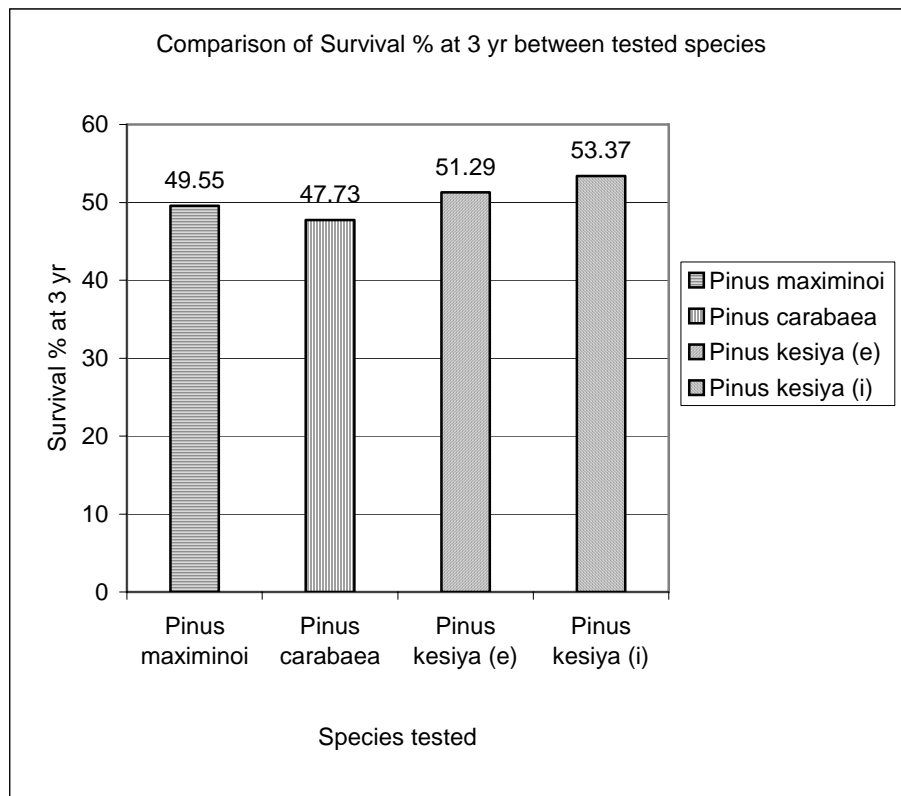


figure 2.



The average heights of different species and difference seedling ages at the age five years are presented in Table (3), Figure (3) and Figure (4).

**Table (5) Average height at 5 years old**

Seedlin ages (months)	Species				Sum of Seedling age	Mean survival % of seedling age
	Spp 1	Spp 2	Spp 3	Spp 4		
5 months	42.60	38.30	21.40	22.60	124.9	6.245
6 months	96.60	92.60	55.20	56.60	301	15.05
7 months	96.00	94.40	57.60	57.20	305.2	15.26
Sum of Species	235.20	225.30	134.20	136.40		
Mean height of species	15.68	15.02	8.95	9.09		

L.S.D of Species = 3.93

L.S.D of Seedling Age = 3.40

The average height of four pinus species are significantly different as shown in Table (6).

**Table (6) ANOVA Table of average height at 5 year old**

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>F crit</i>
Species	604.46	3	201.49	7.10	2.82
Seedling age	1058.95	2	529.47	18.67	3.20
Species, seedling age	52.99	6	8.83	0.31	2.31
Treatment	1716.40	11	156.04	5.50	2.01
Block	62.71	4	15.68	0.55	2.58
Error	1247.63	44	28.36		
Total	3026.74	59			

At five-year-old stage, the seven month old seedlings give the best result in height growth (15.26') followed by six month old seedlings (15.05'). Species wise, *Pinus maximinoi* gives the best result in height growth (15.68') followed by *Pinus carabaea* (15.02').

Figure 3

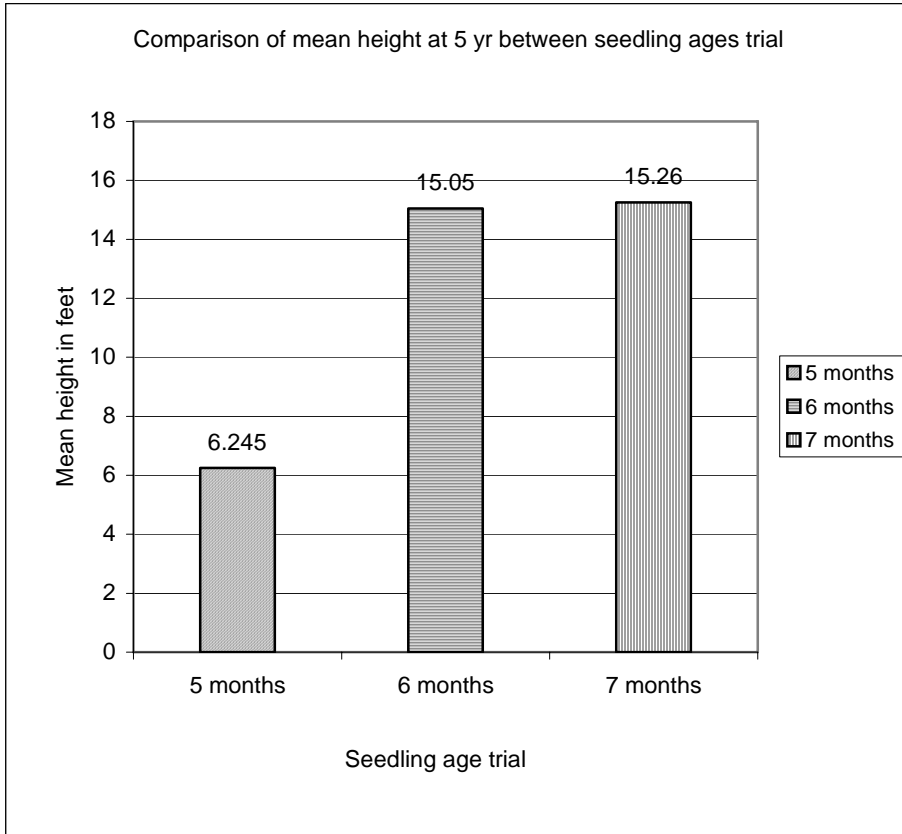
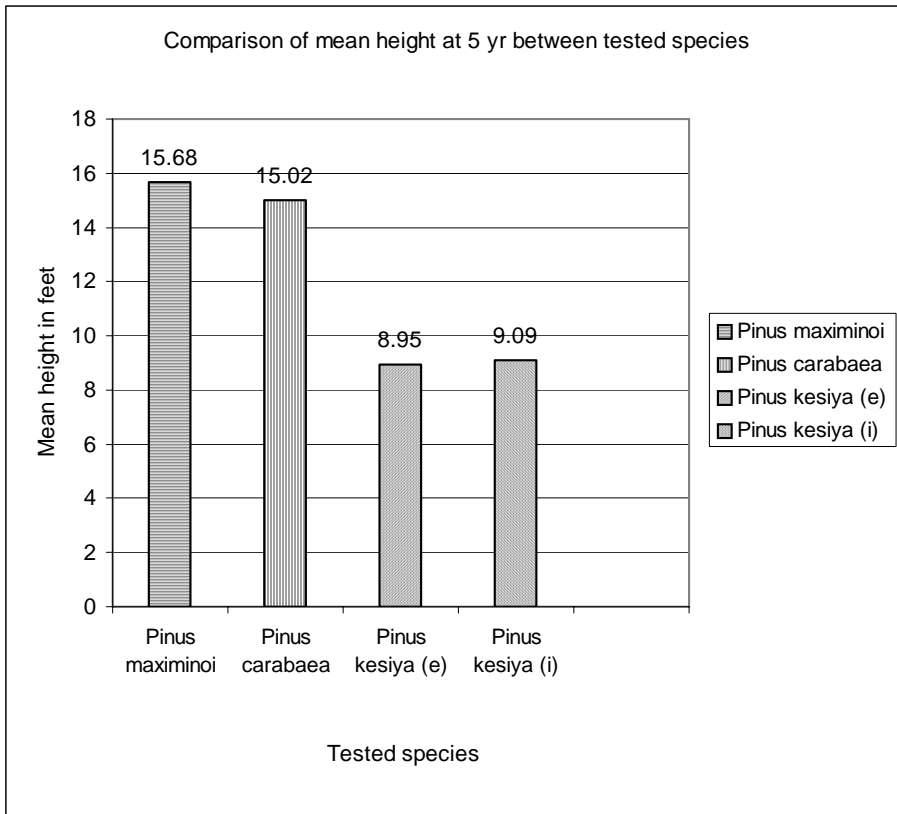


Figure 4



The average girths of different species and different seedling ages at the age of five years are shown in Table (7), Figure (5) and Figure (6).

**Table (7) Average girths at 5 years old**

Seedling ages (months)	Species				Sum of Seedling age	Mean survival % of seedling age
	Spp 1	Spp 2	Spp 3	Spp 4		
5 months	19.8	19.4	17.8	18.8	75.8	3.79
6 months	49.9	44.3	45.5	53	192.7	9.635
7 months	46.3	45.5	46.3	44	182.1	9.105
Sum of Species	116	109.2	109.6	115.8		
Mean girth of species	7.73	7.28	7.31	7.72		

L.S.D of Species = 2.26

L.S.D of Seedling Age = 1.96

The average girths of four pinus species are not significantly different as in Table (8)

**Table (8) ANOVA Table of Average girth at 5 year old**

Source of Variation	SS	df	MS	F	F crit
Species	2.82	3	0.94	0.1	2.82
Seedling age	417.96	2	208.98	22.9	3.2
Species, seedling age	8.02	6	1.34	0.14	2.31
Treatment	428.81	11	38.98236	4.13933	2.014048
Block	29.28	4	7.318917	0.777157	2.583668
Error	414.37	44	9.417553		
Total	872.454	59			

The six month old seedlings give the best result in mean girth (9.6") followed by seven month old seedlings (9.1") respectively. In species wise, *pinus maximinoi* and *Pinus kesiya* (*I*) give about same girth (7.7") which slightly better than the other two species.

Figure 5.

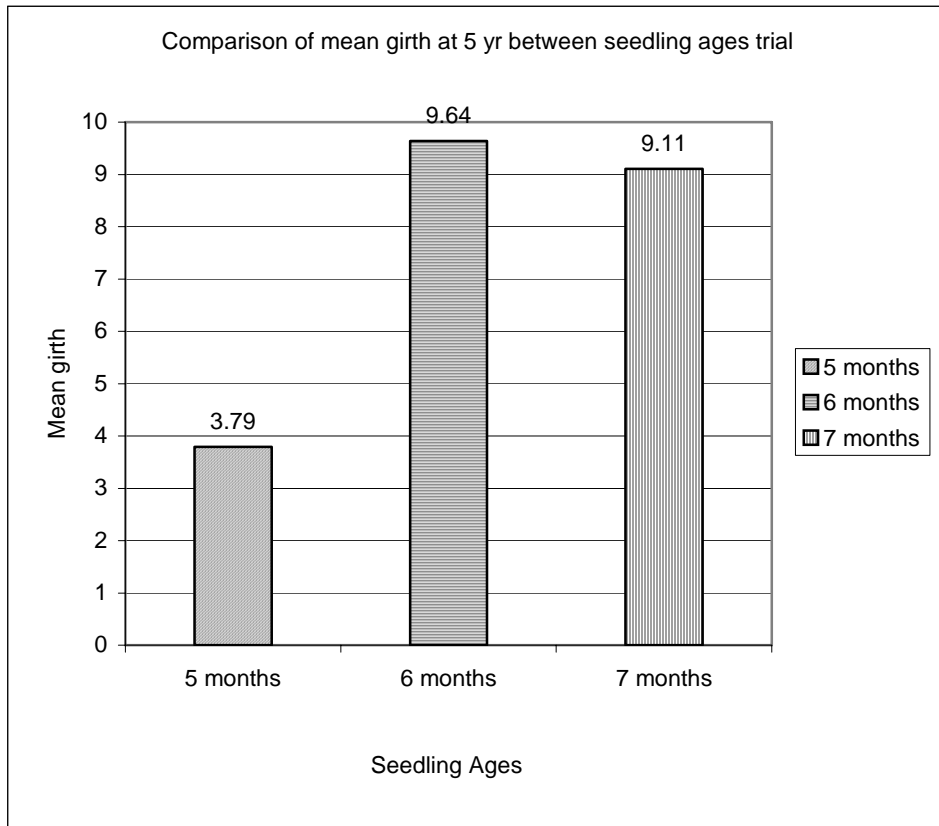
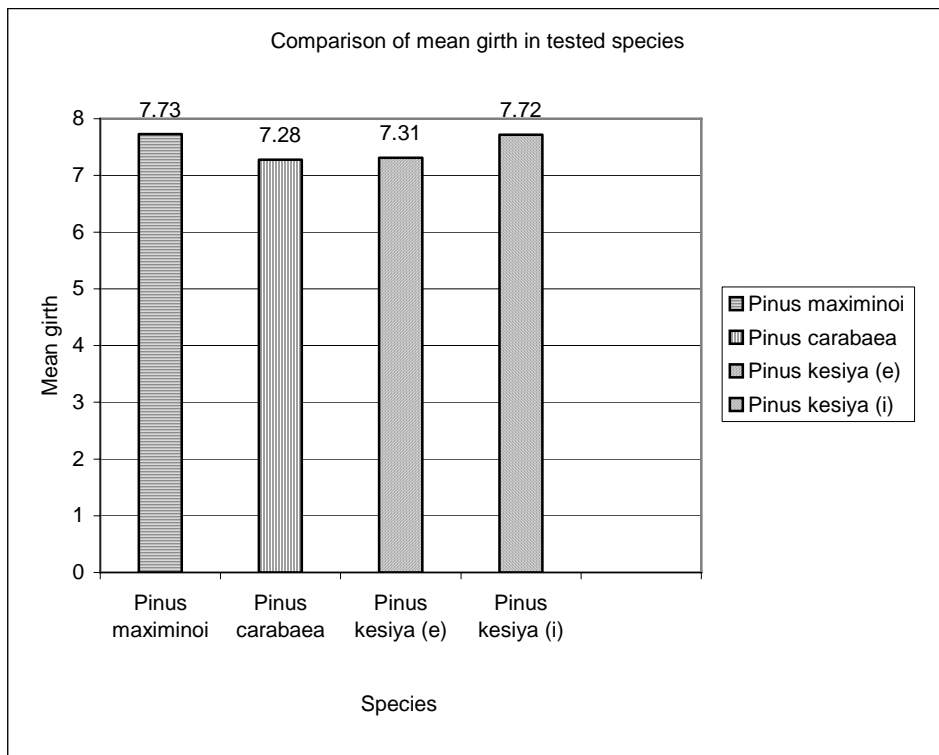


Figure 6.



## **6. Conclusion and Recommendations**

1. It seem that seedlings of *Pinus* species of at least six month old are acceptable for the plantation establishment.
2. *Pinus maximinoides* and *Pinus kesiya* (i) can be recommended for plantation establishment in Shan State.

**Appendix I**

**Raw data of survival % affect on seedling ages and height in pine plantation**

Treatment Combination	Survival % by Block					Treatment Total
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	B <sub>5</sub>	
1.5	0	25	0	41.7	0	66.7
1.6	83.3	77.8	72.2	80.6	50	363.9
1.7	69.4	51.6	63.9	66.7	61.1	312.7
2.5	30.5	0	0	0	47.2	77.7
2.6	52.8	77.8	80.6	66.7	58.3	336.2
2.7	55.6	60.4	72.2	55.6	58.3	302.1
3.5	0	38.9	0	50	0	88.9
3.6	77.8	69.4	55.6	83.3	69.4	355.5
3.7	58.3	52.8	66.7	75	72.2	325
4.5	0	38.9	0	50	25	113.9
4.6	77.8	69.4	72	69.4	72	360.6
4.7	61.1	72.2	65	75	52.8	326.1
Overall Total	566.6	634.2	548.2	714	566.3	3029.3

**Raw data of Average height affect on seedling ages and height in pine plantation**

Treatment Combination	Survival % by Block					Treatment Total
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	B <sub>5</sub>	
1.5	0	21.3	0	21.3	0	42.6
1.6	19.4	18.4	21.3	18.6	18.9	96.6
1.7	20.5	18.5	19.9	17.5	19.6	96
2.5	20.4	0	0	0	17.9	38.3
2.6	17.2	19.9	17.9	18.9	18.7	92.6
2.7	19.1	18.9	18.9	19.1	18.4	94.4
3.5	0	9.9	0	11.5	0	21.4
3.6	11.1	10.8	10.5	10.8	12	55.2
3.7	11.8	11.2	11	11.6	12	57.6
4.5	0	11.7	0	0	10.9	22.6
4.6	12.3	11	11.3	10.7	11.3	56.6
4.7	10.3	10.2	14.3	10.9	11.5	57.2
Overall Total	142.1	161.8	125.1	150.9	151.2	731.1

**Raw data of Average girth effect on seedling ages and girth in pine plantation**

<b>Treatment Combination</b>	<b>Average girth by Block (in)</b>					<b>Treatment Total</b>
	<b>B<sub>1</sub></b>	<b>B<sub>2</sub></b>	<b>B<sub>3</sub></b>	<b>B<sub>4</sub></b>	<b>B<sub>5</sub></b>	
1.5	0	9.9	0	9.9	0	19.8
1.6	10.4	9.5	10.5	9	10.5	49.9
1.7	10.1	7.3	10.2	8.8	9.9	46.3
2.5	9.9	0	0	0	9.5	19.4
2.6	8.7	8.9	8.7	9.1	8.9	44.3
2.7	8.6	9.1	9.4	9.1	9.3	45.5
3.5	0	8.4	0	9.4	0	17.8
3.6	9.1	9	8.8	9	9.6	45.5
3.7	9.6	8.5	9	9.5	9.7	46.3
4.5	0	9	0	0	9.8	18.8
4.6	10.6	10.5	10.6	10.7	10.6	53
4.7	8.4	8.1	8.8	9.2	9.5	44
<b>Overall Total</b>	<b>85.4</b>	<b>98.2</b>	<b>76</b>	<b>93.7</b>	<b>97.3</b>	<b>450.6</b>



## References

1. C.F.I. (1973) Tropical Forestry Paper No(6), *Pinus carabaea* volume 1 compiled by A F A LAMB
2. C.F.I. (1973). Tropical Forestry Paper No (9), *Pinus kesiya* compiled by F.B. ARMITAGE & J BURLEY.
3. Ko Ko Gyi, Zaw Win (5). Kyi Win (1987). Investigation on the Suitability of some Tropical Pines for Plantation Establishment in the Shan State Area.
4. Mirov, (1967) The Genus Pinus