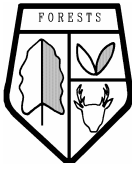


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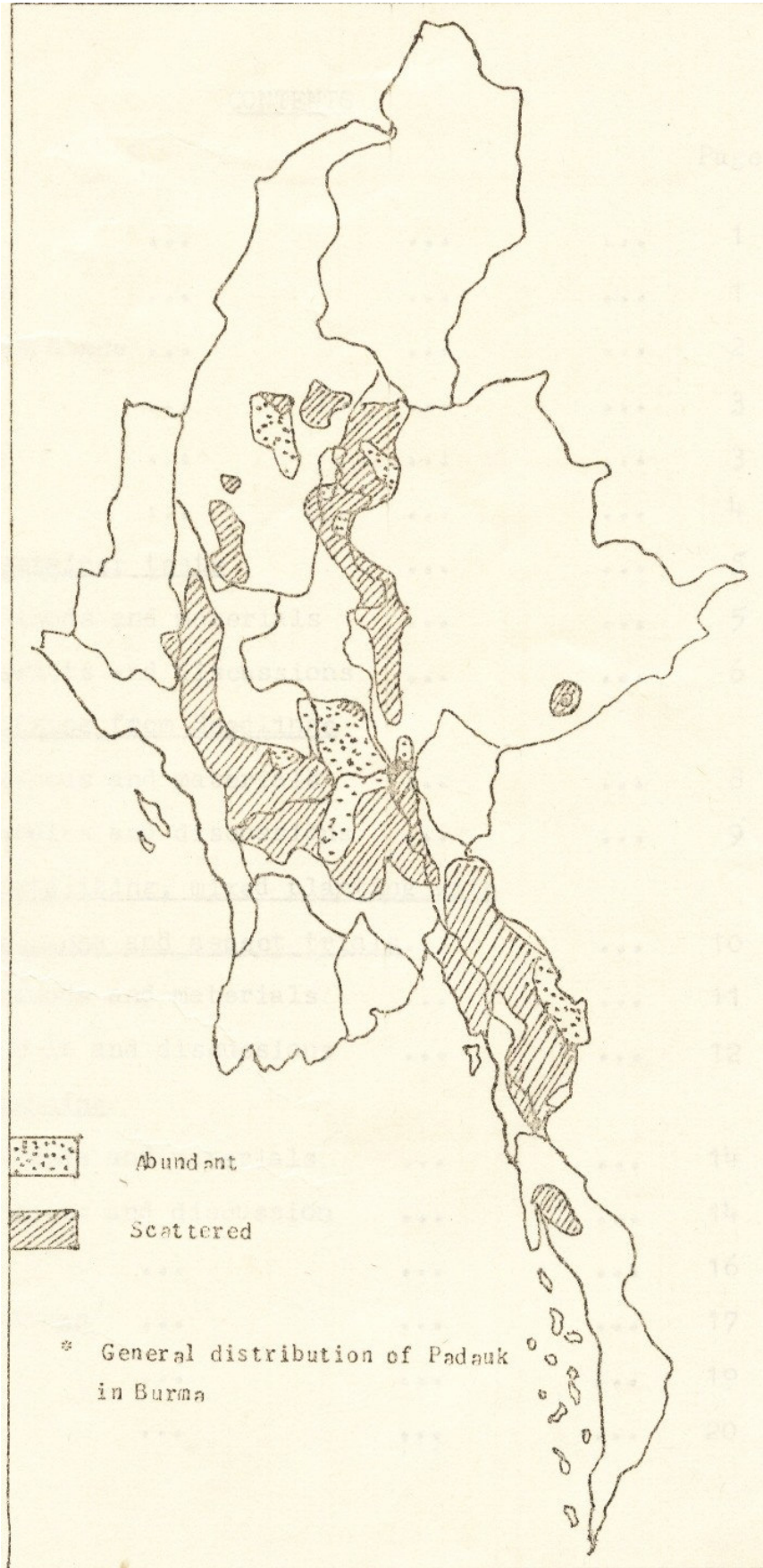


**Government of Union of Myanmar
Ministry of Forestry
Forest Department**



Treatment Response of Planted Padauk

By
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February, 1981



Acknowledgements

My humble thanks to U Htun Lynn, Statistics and Biometric Section, Forest Research Institute, for his full time co-operation in this piece of work both in the field and his expertise advice.

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Abstracts

Padauk (Pterocarpus macrocarpus) plantation has taken a major role in man-made forestry of Burma recently. The most economical means to establish padauk plantation is investigated by using padauk cutting from seedlings, and portable and semi-durable containers. Fertilization treatment for better growth is compared between padauk/leucaena mixed plots and pure padauk plots. Plantation to produce sound straight log by pruning is also investigated.

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1. Introduction

Padauk (*Pterocarpus macrocarpus*) in Burma grown in the drier parts of the country mostly in Upper Mixed Deciduous Forests. It ranges from 24° latitude in the Bhamo, Mogok and Katha Forest Divisions Southward to isolated patches in Tanasserim and Mon states. On the east it is found in Southern Shan State and Kayah State and ranges westward as far as the Arakan and Pakkoku Forest Divisions. It grows abundantly in the Shwebo, Pyinmana, Mandalay, Meiktila, Yaw, Pakkoku, Prome and Thayet Forest Divisions.

Padauk is found in undulating hilly country at elevation up to 2500 feet and usually most abundant in the drier sites-the ridge top and upper slopes. It occurs in rainfall areas of under 35 inches to over 100 inches, but seems to thrive well with a rainfall of 50 to 60 inches, with minimum and maximum temperature of 45° and 110° degree F. It grows well on the more sandy soils especially in depression between tracts of semi-indaing forests.

Padauk is a member of the legume family and has a well developed root nodules even in young seedlings (Plate I, fig.1). This symbiosis with Rhizobium bacteria which extract atmospheric nitrogen, adds to the nitrogen supply available to the plant. This may explain at least in part the good growth of Padauk on the restrictive sites. At Moswe, in the North Pegu Yoma Padauk seedlings planted in mid-June has attained an average height of 35 inches in four months even rainfall was much below the average.

Economic Importance

Padauk fetches a very high price on the foreign market, and large volumes are being cut throughout the areas where it occurs in quantity. Logs seldom exceed 6 feet mid-girth, many are smaller. To replace the removal, replacement trees in terms of plantation becomes necessary and development of technique for the production of quality timber must be carried out.

Plate I.



Fig 1. A well-developed root nodules on 3 month old padauk seedlings.



Fig 2. A worker carrying 50 padauk seedlings in portable and semi-durable plastic tubes.

Background

Andaman Padauk (*Pterocarpus dalbergoides*) was found to have very few trees with straight non-branchy boles. Padauk with straight boles do occur in the forest of Burma. However in planted Padauk, straight seedlings and branchy ones can often be found side by side.

In fifty-year old planted Padauk in Gwethe reserve, compartment 38, North Taungoo Forest Division, with an average height of 101 feet, more than 50 percent of the trees were strongly forked. In many of these trees only one 10-foot log could be obtained (Table 1). The trees were planted close together in 1929, and the first thinning was delayed until 1956. Apparently close spacing and little influence toward control of forking. (Refer Plate II, fig. 1-4).

Regeneration

Natural regeneration of Padauk is rather poor. This may be due in part to the tough fibrous outer covering of the fruit and the hard shell of the seed. Germination of Padauk seed is only 40-50 percent.

At planting time, some seedlings will be forked and heavily branched, others will have straight clean stems. Some very preliminary tests indicate that planting only the straight seedlings will result in a higher percentage than if forked seedlings are also included. However about spacing (6' x 6') in the first year produced branches heavily in the second year. Therefore, until tree improvement for padauk is well developed, trials to improve the bole of planted Padauk become important.

Plate II.



Fig 1. A forked Padauk tree with some straight clean bole of padauk plantation in Gwethe Reserve.



Fig 2. A double forks on the same Padauk tree in Padauk plantation, Gwethe Reserve Compartment 38, North Taungoo Forest Division.



Fig 3. A patch of straight clean bole of Padauk plantation Gwethe Reserve, Compartment 38, North Taungoo Forest Division.



Fig 4. 7 months old coppice shoot with lateral branches in Moswe Reserve, Compartment 72, Yemathin Forest Division.

Branching characteristics of Padauk in artificial regeneration.

Table 1. Growth of Padauk and Teak in a 50-year-old plantation spaced closely when planted in 1929, and with about 50 percent of the Padauk forked after three thinnings.

| Species | Height* | | | Girth** | | | Fork height above ground | | |
|---------|---------|------|------|---------|------|------|--------------------------|------|------|
| | Ave. | Max. | Min. | Ave. | Max. | Min. | Ave. | Max. | Min. |
| Padauk | | | | | | | | | |
| No fork | 101 | 120 | 78 | 45 | 57 | 39 | - | - | - |
| Forked | 101 | 115 | 75 | 55 | 59 | 48 | 13 | 15 | 10 |
| Teak | 96 | 110 | 80 | 45 | 55 | 40 | - | - | - |

* Height in feet.

** Girth Breast Height in inches.

2. Objectives

The objectives of the trials has two fold:

- (1) to develop the most economical and suitable methods in the establishment of Padauk plantation;
- (2) to determine the effects of pruning by several methods in a two-year old Padauk plantation.

Study 1

Container Tests

Methods And Materials

The following 4 sizes of containers were tested to determine the development of seedlings.

| Code No. | Size (inches) | | Volume |
|---------------------|------------------|--------|--------|
| | Orifice Diameter | Length | Ratio |
| 01 PT | 1.0 | 4.0 | 0.056 |
| 02 PT | 1.5 | 4.5 | 0.167 |
| 03 PT | 2.0 | 3.5 | 0.2 |
| 04 PT (Plastic bag) | 2.5 | 6.0 | 1.0 |

PT = Portable and semi-durable plastic tubes.

50 containers of each size were filled with forest top soil without any mixture. The seeds of 4 species, Thinwin (*milletia pendula*), Sit (*Albizzia procera*), Yinma (*Chukrasia tabularis*) and Padauk (*Pterocarpus macrocarpus*) were germinated in the river sand box and transferred to the containers after the germinated seeds produced a pair of leaves. Two species Sit and Thinwin were kept under partial shade while the other two species, Yinma, and Padauk were kept under shade. Measurement of height for each species were recorded weekly.

100 Padauk seedlings were raised in container 01 consisted of two part forest top soil, one part of river sand and one part compost as a medium. The seedlings were transplant in the

field after they attained a height of 4-6 inches. The survival and height of planted seedlings were recorded after 7 months of planting.

Results and Discussions

Table (2)- Significance table (t-statistic) for the difference in average height growth.

| Species Type of container | Padauk | Yinma | Sit | Thinwin |
|--------------------------------------|---------------|--------------|------------|----------------|
| 01 vs 02 | 0.96 | 5.94** | 1.705 | 2.154* |
| 01 vs 03 | 1.853 | 0.085 | 0.723 | 5.883** |
| 01 vs 04 | 1.9343 | 6.179** | 0.156 | 2.883** |
| 02 vs 03 | 2.9587** | 4.836** | 2.369* | 0.965 |
| 02 vs 04 | 1.229 | 2.406* | 3.872** | 1.311 |
| 03 vs 04 | 4.1311** | 5.692** | 0.341 | 2.122** |

* Significance at the 5% level.

** Significance at the 1% level.

From the above Table (2) it could be expressed that there were difference in height growth between each container used. However, container 01 and 03 did not showed significance difference between each other, particularly for Padauk, Yinma and Sit, except for Thinwin. It could also be mentioned that container 03 was not suitable to use for the test species, simply because most of the test species were leguminous species which had a long tap root.

The average mean height (inches) for the test species after 2 months were indicated as follows:

| Species Container | Padauk | Yinma | Sit | Thinwin |
|------------------------------|---------------|--------------|------------|----------------|
| 01 | 1.47 | 0.88 | 3.40 | 4.2 |
| 02 | 1.75 | 1.09 | 3.61 | 3.77 |
| 03 | 1.67 | 0.89 | 3.48 | 4.74 |
| 04 | 1.86 | 1.35 | 4.89 | 4.75 |
| Total | 1.996 | 1.18 | 4.01 | 4.42 |

Padauk and Yinma did not developed when compared to sit and Thinwin simply for the reason that the former two species were kept under shade in the course of test. The overall average mean height could be more, in case, nutrient were added to the test medium.

Following the above test Padauk seedlings raised in container 01 and planted in the field had a 86 percent survival with an average height growth of 1 feet 6 inches after 6 months of planting. This indicated that container 01 could be used for Padauk planting.

In the field a worker could carry seedlings in container 01 at least 10 times as much seedlings when compared to container 04. (Refer Plate I, fig. 2). On the other hand, the volume of medium used be reduced by 18 fold, and the planting time would also be considerably short.

Study 2

Cuttings from Seedlings

Methods and Materials

150-ten months old seedlings were selected for cuttings. Each seedlings was cut to a length of 3-4 inches consisting of 2-3 buds in each cutting. 6-10 cuttings were obtained from each seedling respectively. A total of 1000 cuttings were raised in the plastic bags consisted of 2 part forest top soil, one part river sand and one part compost by volume. After 6 months the cuttings were transplanted in the field with an average height of 1.5 feet. The survival and height were recorded after 6 months of planting.

Rite Gro (Indole Butyric acid) was used in a test on the rooting of Padauk cuttings. 45 moist cuttings were treated with rooting powder. 45 other cutting were not treated. The cutting were then placed in the containers consisting of forest top soil and were kept under shelter. A fine spray was used in misting-watering.

Observation was made daily to observe shoot development of the cuttings.

Results And Discussions

6 months after planting the survival percent of seedling cuttings was 80 with an average height of 32 inches. On the other hand the survival percent for most of seedlings transplant was 84 with an average height of 35 inches. In all the cases, no patching was done in the course of the test. The figures showed that there were not much differences in survival and height growth in both cases. It may also be stated that cuttings can also be propagated in the field similar to seedlings transplant. However, the fact still remains that cuttings might produced more branches because the apical shoot was disturbed. This remains a problem to be studied in future.

Cutting from seedlings treaded with IBA (Indole Butyric Acid) indicated the following information.

Table 3. Number of shoot development of cutting from Padauk seedlings after 4 weeks.

| Diameter (mm) | <4 | 4-6 | 7-12 | Total | % |
|----------------------|--------------|------------|-------------|--------------|----------|
| Treatment | | | | | |
| With IBA | 8 | 13 | 13 | 34 | 60.7 |
| Without IBA | 5 | 7 | 10 | 22 | 39.3 |
| Total | 13 | 20 | 23 | 56 | |
| % | 23.2 | 35.7 | 41.1 | | |

By using the standard normal variate z the observed differences at an appropriate level of significance hereby test the null hypothesis that there was no difference between shoot development. In comparing shoot development of size <4 and size 4-6 the corresponding z value was 1.8168 which might be concluded that the difference of size was significant at 5% level. Again, since the value of z for sizes 4-6 and 7 was only 0.2727 the hypothesis accepted at 5% level. For the comparison between treated and none treated cuttings, the z value was 2.6089 which was significant at 1% level.

The statistical analysis indicated the effect of IBA treatment and also the larger cuttings preferences.

In the experiment the treated cuttings developed shoots within 7 days, and ahead of the untreated cuttings.

The result also indicated the better chance of producing more propagules from a seed.

Study 3 Fertilizing, mixed planting with *Leucaena* and aspect trials of Padauk plantation.

Description of Localities of Trials

The location of the experiment plot was in the Yamethin Forest Division, Nagalaik reserve, Compartment 72.

Type of Forest

Most Upper Mixed Deciduous forests.

Altitude

450 feet above mean sea level.

Temperature

Maximum 106° F. Minimum 49° F.

Rainfall

Average annual rainfall was 42-89 inches.

Rock and Soil

The prevailing types of soil and rocks being the loose coarse reddish brown gritty sand-stones, and yellowish sand-stone, with bed of gravel. Soil analysis indicate the acidity of soil (p^H 6) and deficiency in phosphate.

Aspect and Slope

A ridge from North to South having one of the slopes at eastern aspects and another slopes at western aspect. The slope is approximately 25 percent.

Methods and Materials

The experimental was a split plot design. Three main plots were selected in the experiment. The first plot had an eastern aspect, the second plot was on the ridge and the third plot had a western aspect. In each plot there were 4 sub-plots. The sub-plots measured 33 feet x 33 feet. With trees spaced at 6 feet x 6 feet. Treatment of the sub-plots was as follow, with four replication.

- (A) No treatment
- (B) Padauk mixed with *Leucaena*
- (C) Application of super-phosphate at the rate of 20 lb./acre.
- (D) Application of super-phosphate to (B) in the rate and timing of (C)

Results and Discussions

Statistical Analysis

Analysis of variance of average height for the experiment.

Table 4. Analysis of Variance.

| Sources of Variation | d. f | Sum of square | Mean Square Error | F-value |
|----------------------|-----------|----------------|-------------------|---------|
| Replications | 3 | 12.4377 | | |
| Site aspects | 2 | 0.2745 | 0.1372 | 0.3542 |
| Error (a) | 6 | 2.3248 | 0.3875 | |
| Treatment | 3 | 5.5709 | 1.8569 | 3.7484* |
| Treatment x site | 6 | 5.3436 | 0.8906 | 1.7977 |
| Error (b) | 27 | 13.3745 | 0.4954 | |
| Total | 47 | 39.3260 | | |

The mean square for the site aspects, which above that for error (a) does not approach the 5% level. Treatment effects are significant at 5% level as compared with error (b). for the comparison, standard error of difference between two treatment means is

$$\sqrt{\frac{2(0.4954)}{4 \times 3}} = 0.2893$$

With 27 degree of freedom. The following are the treatment means.

| <u>Treatment</u> | <u>Treatment Mean (feet)</u> | | | | |
|------------------|------------------------------|------|------|------|-------|
| | A | B | C | D | Total |
| | 7.65 | 7.40 | 8.32 | 7.89 | 7.82 |

Derivation of t tests from these figures by the ordinary rule are as follows:

| No. | Combination | t |
|-----|-------------|----------|
| 1 | A vs B | 0.8761 |
| 2 | A vs C | 2.3411* |
| 3 | A vs D | 0.8305 |
| 4 | B vs C | 3.2172** |
| 5 | B vs D | 1.7146 |
| 6 | C vs D | 1.5026 |

The 5% and 1% level of t with 27 degree of the freedom are 2.052 and 2.771 respectively.

From the above statistical analysis it indicated that super-phosphate had effect on Padauk development in the younger stage. There was no other treatment response at this early stage.

Study 4

Pruning

Methods and Materials

A two-year old plantation was selected for pruning trial. 25 trees which has approximate uniform height (6. 5-7 feet) were selected among the plantation for different treatment of pruning. Pruning was done in the dry season (Middle of March). 4 types of treatment were tested.

- (A) Lateral small branches were removed.
 - (B) One of the two equally strong stem was removed.
 - (C) Low forked treed were cut flush to the ground.
 - (D) No prunnings was done to trees having a clear stem.
- (Refer plate III).

After pruning, the cut surfaces were brushed with soluble tar. The trees were left for one year for observations.

Results and Discussions

Observation a year after pruning indicated that:

- (1) There was no decay at the point of cutting. A thin layer of callus and formed. No other damage was observed.
- (2) The growth rate of treated and non-treated trees did not differ. The average girth measured at 2 feet above ground was 0.64 feet in both the cases. The average height was 12.3 feet for the treated trees and 12.5 feet for untreated tree.
- (3) Trees cut flush to the ground produced as many as four to six shoots around the stool.
- (4) No new shoots develop where the cuts were made. The pruned trees looked clean and straight with out branches on the stem.

From the above test it was observed that a second or third pruning would be required to obtained a clear 18 foot logs. A second pruning might have to be done in the following year because at the first pruning the apical crown at 6.5 feet had three or four branches. It was not advisable to cut the tree flush to the ground; only more unwanted shoots would be developed. Such tree shoot be left for thinning.

Plate III.



Fig 1. Small lateral branches are removed. The white ribbon indicates the position of cutting.



Fig 2. One of the two equally strong stems is removed. The white label indicates the removed stem.



Fig 3. Low fork tree is cut flush to the ground. The ribbon indicates the position of cutting.



Fig 4. A straight stem is left uncut.

4 types of pruning to a 2-years old Padauk plantation.

Plate IV.



2 years old padauk plantation in Moswe Reserve, Compartment 72, Yemethin Forest Division. Average height, 7.82 feet.

3. Conclusion

The preliminary findings present in the paper may solve the problems anticipated in the establishment of Padauk plantation. However, refine techniques still remain to be developed for further application in the field.

For example, if the seedlings raised one year ahead in the nursery bed, and the treated cuttings obtained are directly transplant in the field produce good result, the cheapest means of planting will be obtained. On the other hand, if the seedlings from the portable tube is used together with fertilization produce the same result this will also be a cheaper means of planting.

Overall, more research work still lie ahead and a sound research approach may provide further information for the establishment of economical man-made forests.

Appendix I

Estimates of Seed Demand and Cost Per Acre.

| | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|--------------------------|
| 1. Species | ... | ... | ... | ... | ... | ... | Padauk |
| 2. Plant per acre | | | | | | | |
| (a) Number planted | ... | ... | ... | ... | ... | ... | 540 (9' x 9') |
| (b) Add field replacements at 20% | ... | ... | ... | ... | ... | ... | <u>108</u> |
| (c) Total required plantable plants | ... | ... | ... | ... | ... | ... | 648 |
| (d) Add losses and culls at 25% | ... | ... | ... | ... | ... | ... | <u>216</u> |
| (e) Total required germinated seed | ... | ... | ... | ... | ... | ... | 864 |
| Ditto rounded up | ... | ... | ... | ... | ... | ... | 900 |
| 3. Estimated number of seeds required at 45% germination | ... | ... | ... | ... | ... | ... | 2000 or 0.1848 kg. |
| 4. Pods required per acre (100 pods produced 60 seds) | ... | ... | ... | ... | ... | ... | 3333 |
| 5. Total required pod baskets (200 pods/pyi) | ... | ... | ... | ... | ... | ... | 1.0417 |
| 6. Cost of pod/basket at K. 20/- | ... | ... | ... | ... | ... | ... | k.20.83 |
| 7. Cost of seed extraction at K.1 / 100 | ... | ... | ... | ... | ... | ... | <u>K.20.00</u> |
| Total cost for Pod and Seed extraction per acre | ... | ... | ... | ... | ... | ... | <u>K. 40.83</u> |

Appendix II

Measurement

Weight

| | |
|------|--------------------------|
| g | gram (s) |
| kg | kilogram (s) |
| ton | Metric ton |
| oz | ounce = 28.49 gm |
| lb | pound = 16 oz = 0.454 kg |
| viss | 20.9 kg (paddy) |

Length

| | |
|------|------------------------------------|
| mm | millimeter (s) |
| cm | centimeter (s) |
| m | meter (s) |
| km | kilometer (s) |
| inch | 25.4 mm |
| ft | foot (feet) = 12 inches = 30.48 cm |
| mile | 5,280 feet = 1.609 km |

Area

| | |
|----------|------------------------------------|
| sq. cm | square centimeter (s) |
| sq. m | square meter (s) |
| sq. km | square kilometer (s) = 100 ha |
| ac | acre (s) = 4, 047 sq. m |
| sq. mile | square mile = 2.59 sq. km = 640 ac |
| ha | hectare |

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