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Fertilizer Experiment in Young Teak Plantation

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သက်နုကျွန်းစိုက်ခင်းများတွင် ခမ်းသပ်မြေဩဇာကျွေးခြင်း

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Fertilizers Experiment in Young Teak Plantation

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Abstracts

Fertilization experiments with different levels of nitrogen and phesphorus were conducted to observe the response of teak, antation. With appropriate proportion of fertilizers, teak responds significantly at the early age. Using urea alone shows a quartic effects and thus optimum proportion of fertilizers use in first year planting are indicated in this paper.

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1. Introduction

Teak plantation has become a major operation in Burma. A total of 20,150 acres of teak plantation is to be planted in 1981-82 all over the country. It is planned to increase up to 28,000 acres in 1985-86. The expansion of teak plantation in the country calls for a better technique for full success in the formation of plantadtion. Even though there acre reasonal success in the establishment of plantation in the past, the foresters encounted many problems especially in getting sufficient labour for various phases of operations. Wotably, weeding operation is the major problem among the operations in the establishment of plantation.

Experiment on the elimination of weeds by application of chemicals has been taken up by the Forest Research Institute, but a concrete result has yet to be waited for a few years. In the mean time an indirect way of wuppressing the weeds by raising teak as fast as possible at the early stage seems possible. The object of this experiment is aimed at growing teak as fast as possible in the first and second year to outgrow the weeds and for make teak grow faster. Hence, a minimal weeding frequency may solve the labour problems.

2. Literature review

The experiment on application of fertilizers on teak has been reported by many researchers. Howener, fertilization test with the application of different proportion of fertilizers on teak has not been reported as yet.

Bhatagar (1969) studied on nutritional requirement of teak seedlings and reported that teak seedling respond to NPK in the form of height and weight compare to untreated seedlings.

Coster (1933) has demonstrated that on extremely poor soil, teak reacted favorably to manuring while on poor soils, effect is small and also mentioned that application of super-phosphate in extremely poor soil is beneficial.

Fernando (1966) reported that teak seedlings in Ceylon nursery showing deficiency symptoms were treated with N,P, and K fertilizers and it responded well to the application of N.

Teak manorial experiments in Nilumbur (1955) conducted by Forest Research Institute, Dehra Dun showed that application of 4 oz of super-phosphate per plant promotes more rapid growth, but also mentioned that further investigations are required to show whether weeding cost can be reduced to counter balance the cost of application of fertilizer.

Another test by the forest Department of India (1964) indicated that the fertilization boosts up the growth of teak plantation and also mentioned that fertilization should be integrarted with plantation programme on a rational basis.

Hedegarth (1971) working on teak seedlings reported that teak seedlings react positively to Ca and NPK fertilizers and also a combination of both.

Krishna (1972) described an experiment in fertilization with six fertilizers treatments and control in a first year teak plantation. He indicated that balanced fertilizers like NPK

resulted in better height growth at the end of the first year growing season up to 15% over the control.

Sdukkam (1962) described the effect of fertilizers treatment that N, NP, NK, NPK are significant to control and are more beneficial than P, K, and PK and treatments over the control.

Sumantakul (1971) reported that the application of NPK fertilizers to teak nursery seedlings has a positive reaction to the treatment. He also mentioned that one dose of N and one dose of NP mixture is more beneficial than the application of K and mixture of N, P, and K. His discussion also stated that a disturbance in nutrient balance in the experiment soil which is relatively rich in K was noted and that adding more K has no response in the increase of growth.

3. Materials and Methods

As a preliminary study, a comparative growth study of teak seedlings was conducted in the green house in modified Hoagland's solution using 500 ml erlenmyer flasks. The experiment conducted has 4 treatments with 10 replications: the first treatment was a complete nutrient solution, the second without N source, the third without P source, and the fourth without K source. The height growth of the seedlings were
Measured after two months. Then, the actual field experiment was carried out in South Toungoo Forest Division.

12 soil samples where fertilization trial took place were collected for both pnysical and chemical analysis.

Teak seeds from South Toungoo Forest Division were raised in the nursery bed in March. After the seeds germinated and had two pairs of leaves the seedlings were potted in the plastic containers, using forest soil, compost and sand at a ratio by volume of 2:1:1 as a medium. Uniform seedlings with a height of 10 inches were selected and planted out in the first week of June for the experiment No.0512 and in July for the experiment No.0511, in compartment No.220 of kabaung reserved forest.

3.1 Experimental design and application of fertilizers.

Experiment No. 0511

In the first experiment a factorial design was adopted with the following factors studied.

1. Sites - slope, ridge
2. Spacing - (7' x 7'), (8' x 8'), (9' x 9'), (10' x 10')
3. Species - Teak
4. Treatment - (1) A mixture of ½ oz Urea and ½ oz superphosphate/tree.

The plot size was an 80 feet x 80 feet plot.

Fertilizers were applied two months after planting. Two slit openings opposite to each other were cug 6 inches deep with show at distances of 8 to 10 inches from the teak plant. Fertilizers were fed into the slit and care was taken not to spill the fertilizers out side the slit.

Experiment No. 0512

In the second experiment a randomized block design was adopted with three replications and the following factors studied.

1. **Treatment (9)**
   Control NoPo
   1 oz Urea/tree (N1)
   2 oz Urea/tree (N2)
   1 oz super-phosphate/tree (P1)
   2 oz super-phosphate/tree (P2)
   1 oz urea + 1 oz super-phosphate/tree (N1P1)
   2 oz urea + 2 oz super-phosphate/tree (N2P2)
   1 oz urea + 2 oz super-phosphate/tree (N1P2)
   2 oz urea + 1 oz super-phosphate/tree (N2P1)

2. **Species – Teak.**

The plot size used was asquare chain (66 feet x 66 feet) with 49 trees per plot, spaced at 9 feet x 9 feet. Fertilizers were applied after one month of planting and the height of the teak were measured after 6 months of planting.

Two slit openings for either 1 oz of Urea or 1 oz of super-phosphate and 4 slit openings or either 2 oz of Urea or 2 oz of super-phosphate were dug 6' deep with shovels at a distance of 8 of 10 inches away from the teak plant. Fertilizers were then fed into the openings and care taken not to spill the fertilizers out side the opens.

At the time of measurement of height soil sample and plant itssue from the tested plot were collected for chemical analysis.

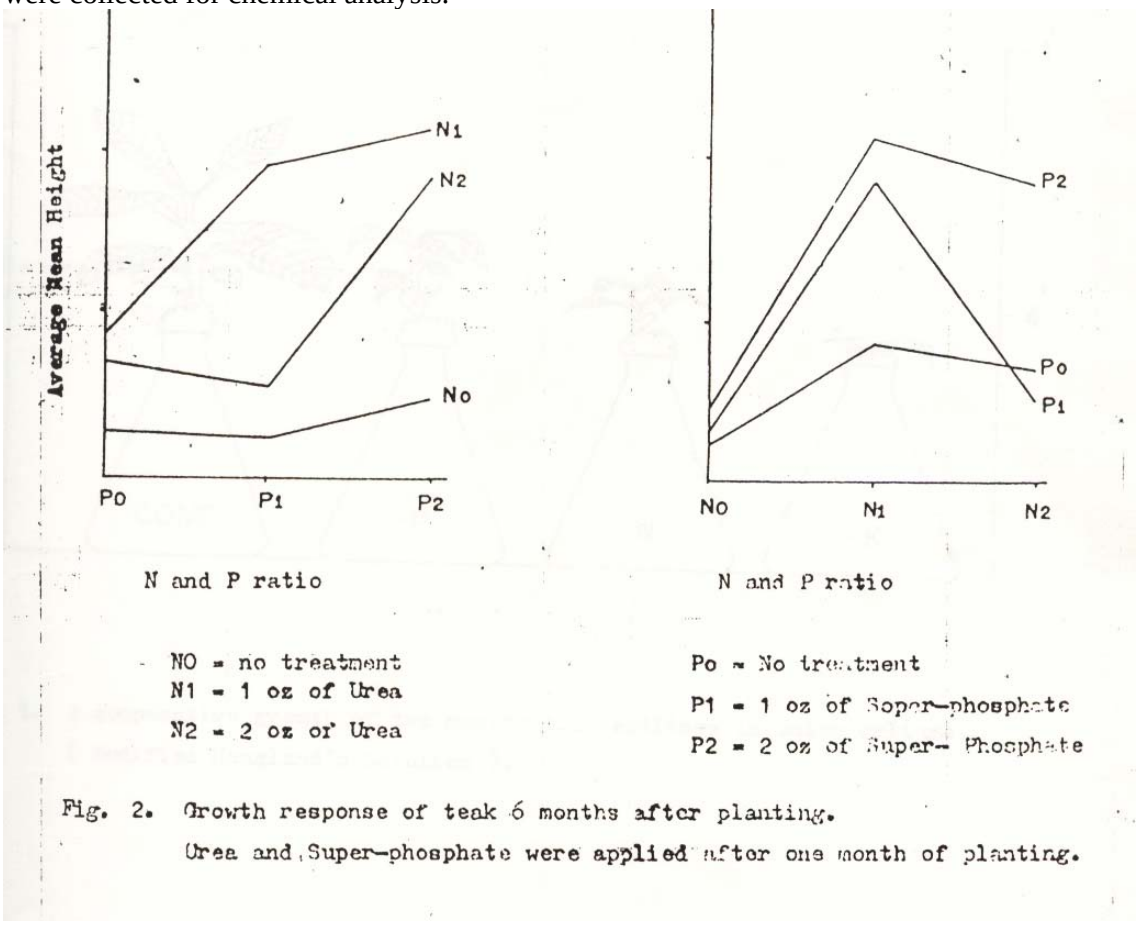


Fig. 2. Growth response of teak 6 months after planting.
Urea and Super-phosphate were applied after one month of planting.

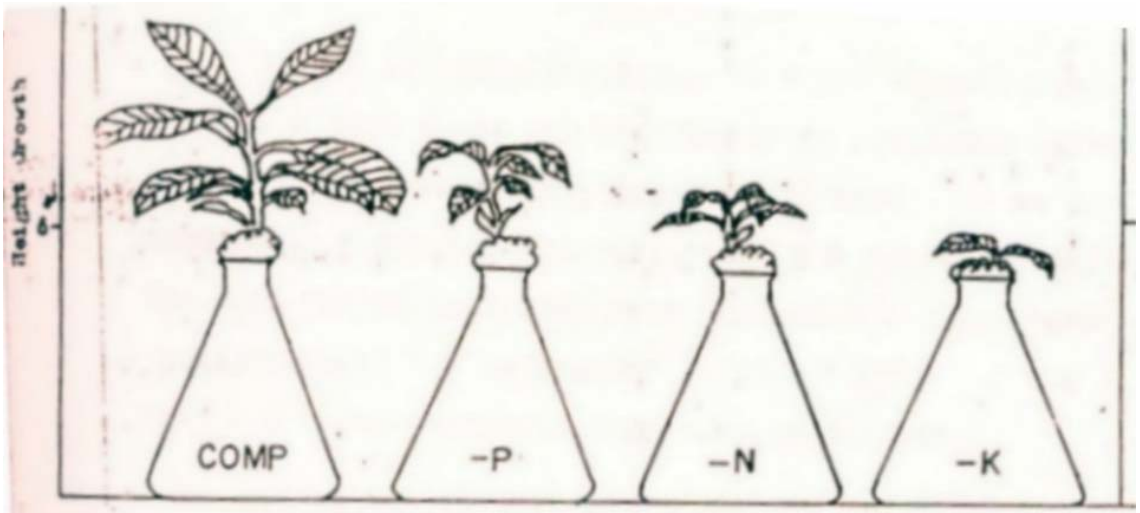


Fig. 1. A comparative growth of two months old seedlings in water culture. (Modified Hoagland's Solution).

4. Result and Discussion

A preliminary green house experiment. Conducted in water culture indicated that any major elements either N, P, or K deficient in a water culture medium resulted with the stunted growth of teak seedlings. Seedlings in a complete nutrient solution out grow 25% over rest of the seedling in the deficient medium (Fig.1).

A soil analysis conducted over the experimental areas indicated that there was a defiency in available nitrogen percent and also available phosphorus 16/acre. Where as exchangeable potassium was sufficient for plant growth (Table 3). The soil tested indicated that potassium was not necessary for application in the experiment. Wilde (1972). Hence only urea and super-phosphate were used in the trial.

The following data are result of experiment No. 0511.

Table 1. Average mean height of treated and non-treated teak over 4 replicates

Site \ Treatment	Control	Fertilizer	Total
Slote	10.8947 8.9107 7.7143 4.3182	17.7250 9.5256 8.4444 6.3548	73.8877
Ridge	8.6552 5.4407 2.8235 2.5926	13.0961 9.5909 9.3750 4.2143	55.7883
Total	51.3499	78.3261	129.676

Table 2. Analysis of variance of the Data in Table. 1.

Source of Variation	d. f.	Sum of squares	Mean Squares	F-ratio
Treatment (Fertil:)	1	45.4822	45.4822	3.3779
Site	1	20.4743	20.4743	1.5206
Fert x Site	1	2.6834	2.6834	0.1993
Error	12	161.5765	13.4647	
Total	15	230.2164		

Data in table 1 shown a marked difference in total height growth of teak between treated and non-treated teak, and also site effect between slope and ridge. However, analysis of variance of the data (Table 2) did not show much significant differences between each other.

The result indicated that dosage of application of fertilizers was not up to the optimum condition for teak growth, once only ½ oz of Urea and ½ oz of super-phosphate were used in the test. Hence, a higher dosage of fertilizers were used in the second experiment.

The following data are result of experiment No. 0512.

Table 3. Analysis of variance of experiment No.0512.

Source of variance	Sum of squares	d. f.	m. s.	F. ratio
Replicate	2.1184	2	1.0562	1.3766
Treatment	13.7164	8	1.7145	2.2284
Due to (a)N	7.7959	2	3.8979	5.0661
Due to (b)P	3.5743	2	1.7872	2.3228
(a) x (b)	2.3464	4	0.5866	0.7624
Error	12.3106	16	0.7694	0.7624
Total	28.1454	26		

* Significant at 5%.

Making use of the F test it is seen that the treatment mean square is lesser than the error mean square, F-1.7146/ 0.7649 = 2.2284, F.05 (8, kdf) = 2.59. Partitioning of the treatment sum of squares into its component parts indicated that the variation among nitrogen fertilizers accounts for the major portion of the treatment sum of square. Hence the effect of nitrogen is significant at 5% probability level and linear partitioning indicated the quartic effect in the applicate of N (Fig.2). Since the amounts of N and P were in arithmetic progression, it would be appropriate to choose the linear and quadratic components of the regression on amount of dressing as the individual components of the main effects. Table 4 gives an analysis of variance of the 8 d.f. among the treatment totals into 8 single component.

Table 4. Subdivision of the treatment s.s

d.f	m.s	F ratio
N1 1	2.2691	2.9492
Nt 1	5.5266	7.1829
P1 1	3.4212	4.4466
Pt 1	0.1531	0.1990
N1P1 1	0.6222	0.8087
N1Pt 1	0.3701	0.4810
NtP1 1	0.3563	0.4631
NtPt 1	0.9980	1.2971

The linear effects of both fertilizers are not significant at 5% level. The quadratic effect of nitrogen is significant at 5% level. The average height totals (over three replicates are as follows:

	Po	P1	P2	Total
No	6.7258	6.6203	7.7378	20.7246
N1	8.5306	11.6867	12.3403	32.5546
N2	8.0982	7.5340	11.4833	27.1155
Total	23.3547	25.841	31.2021	80.3979

Instead of having no effect, phosphate has apparently given a steady increase in height with the second level of nitrogen, but a little curvature with first and third level nitrogen (Figure 2).

4.1 Comparison of storage stump, fertilization and non-treated teak

An attempt was made to compare height growth of teak between teak planted from storage stumps, fertilized teak and non-treated one.

Average mean height in feet of 7 months old teak are as follows:-

Control	Stump	Fertilization	Fertilization
2.2419	2.4624	3.8956	4.1134

Test was used to compare between these treatments with stump and the following gives t value for each comparison.

Stump vs Control = 0.9768
Stump vs Fertilization N_1P_1 = 3.2374
Stump vs Fertilization N_1P_2 = 2.9636
($t_{11.05}$ = 2.20 and $t_{11.01}$ = 3.11

From the above t value it is evidence that fertilized teaks are significantly difference at 1% and 5% level. Where as non-treated teak has no significant difference over teak planted from stump.

Table 5. Chemical analysis of soil sample from Kabaung Reserve, South Toungoo Forest Division.

Sample No.	**PH**	**Average N%**	**Average P2O5 lb/acre**	**Exchangeable K mg/100 gm**
1	**2**	**3**	**4**	**5**
ATGN	5.6	0.0172	28	19.96
BTGN	5.7	0.0162	22	14.00
CTGN	6.0	0.0177	22	18.99
DTGN	5.8	0.0157	8	24.99
ETGN	5.9	0.0191	30	18.99
FTGN	6.7	0.0160	16	17.97
GTGN	6.1	0.0210	26	23.99
HTGN	5.9	0.0200	35	21.99
ITGN	6.3	0.0180	46	29.99
JTGN	6.15	0.180	26	22.97
KTGN	6.4	0.0160	16	16.96
LTGN	5.8	0.0169	25	37.99

4.2 Surface Soil and Teak Foliage Analysis

Surface soils and teak foliage from the tested plots were collected for chemical analysis. A graphical study of surface soil analysis illustrated the response of teak to fertilizers to a certain extent.

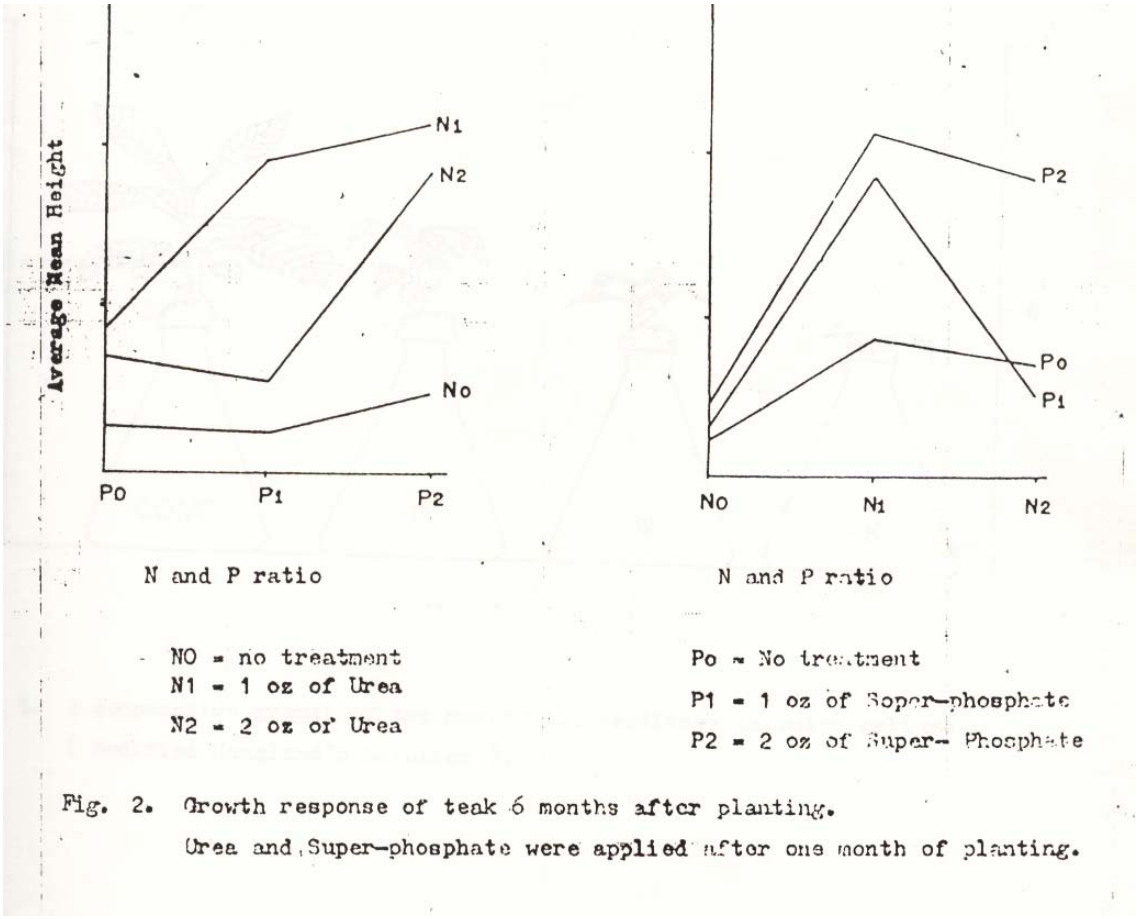


Fig. 2. Growth response of teak 6 months after planting.
Urea and Super-phosphate were applied after one month of planting.

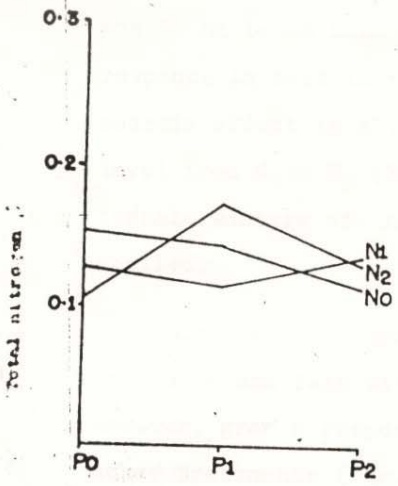


Fig 6.

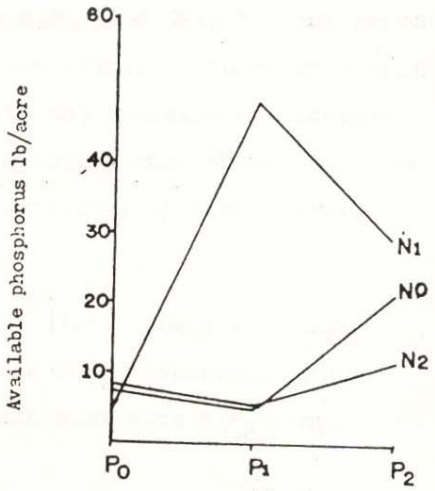


Fig.7

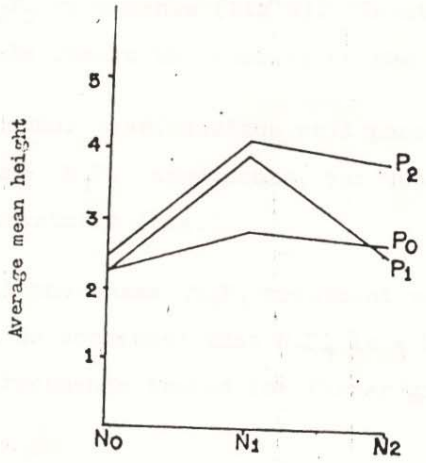


Fig. 8

No – no treatment
N1 – urea 1 oz
N2 – urea 2 oz
Po – no treatment
P1 – super-phosphate 1 oz
P2 – super-phosphate 2 oz

Fig.6 Surface soil analysis for total nitrogen.
Fig.7 Surface soil analysis for available phosphorus.
Fig.8 Response of teak growth to fertilization.

According to teak foliage analysis, nitrogen intake was found to be highest in the N_2 P_2 plot (Fig.3), but growth response is best in the N_1 P_2 plot (Fig.5). There is a clean quartic effect in all plots with the increase of nitrogen level from N_1 to N_2 (Fig.5), indicating that there could be certain wastage of nitrogen fertilizer if higher dosage is applied.

Intake of phosphorus level also is best with N_1P_1 treatment and fair with N1P2 treatments (Fig.4). However, growth response is again best with N_1P_2 compared to other treatments (Fig.5).

There is an increase in surface soil nitrogen with N_1P_1 and N_2P_2 treatments (Fig 6). In other treatments nitrogen levels remain the same as to the control.

In another case, surface soil phosphorus level rises with N_2P_2 and N_1P_1 treatments, but phosphprus level crops with NOP_2 treatment (Fig.7) .

In all the cases N_1P_1 treatment remains dominant and it may well be concluded that M1P1 is a better combination among the treatments tested for faster growth of teak.

4.3 Economical Consideration

The following calculation depects the cost of fertilization in a 9 feet x 9 feet spaced teak plantation.

Cost of Urea/acre at the rate of 1 oz / tree	K	5.50
Cost of Super-phosphate/acre at the rate Of 1oz/tree	K	19.05
Labour charges per acre	K	13.00
Total	K	36.55

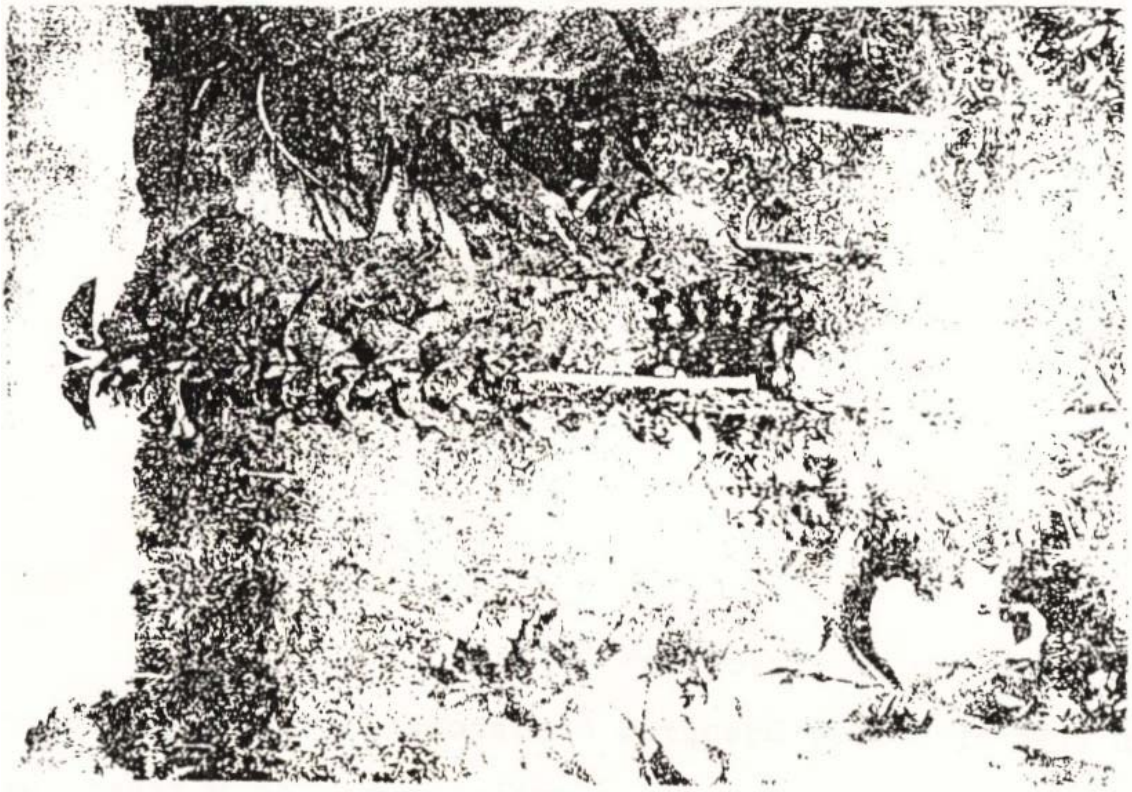
Weeding regime as fixed by the Forest Department is 3,2,2,1, which is 8weedings in a four year's time. The two sets of experiment conducted demonstrates that, teak treated with optimal proportion of mixed fertilizers has an average height of 4 feet after 6 months of planting. In the second year, fertilized teak grows up to an average height of 15 ft. It has been observed that the second year old fertilized teak needs only two weedings, the first operation in July and the second in November under Pegu Yoma conditions. After these two weedings it can be observed that only one wedding is required in the third growing season since the teak outgrows the weeds in the second year. It may be mentioned also that weeding for the third year should be in the middle of the raining season. No further weeding may be required in the following year. Thus weeding frequency may be reduced from 8 to 6 times in the establishment of a young plantation, saving the total weeding cost of K54/- at the current rate of K27/- per operation per acre.

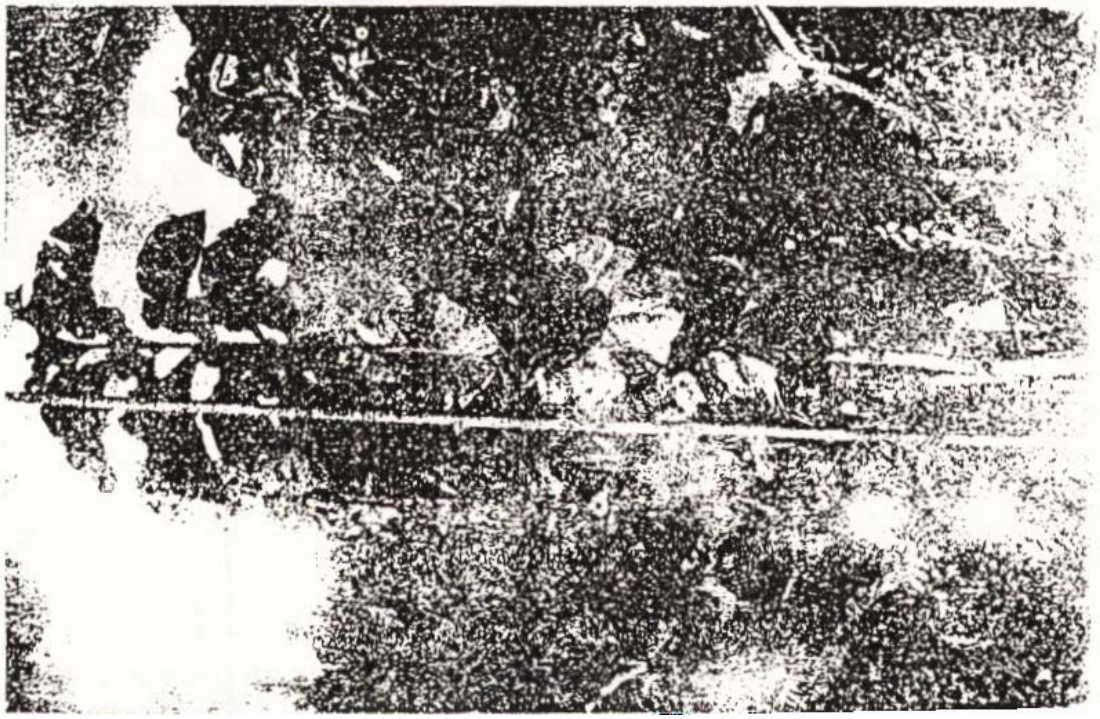
On the other hand the facts still remain to be considerea that the experiments conducted were with potted seedlings in the order to have uniformity. In a large scale plantation it may be difficult to carry and plant the seedlings in time unless there is proper infrastructure. According to the time and work studies, a labour can carry and plant 80 seedlings in plastic container normally used by the Forest Department in a flat configuration and 50 seedlings in a steep area in one day. A smaller plastic bags may also be used for raising teak seedlings, which means a reduction in load of work and expenses. However, adoption of this method for planting depends largely on the situation of the localities although it has many advantages to a highly successful plantation.

5. Conclusion

Although the present experiment was confined to the East Pegu Yoma conditions, a wide knowledge of the growth characteristics of teak is obtained through the experience. In the first place, it is learnt that there is a wide range of variation of teak growth as demonstrated by the height growth within plots, even in the same experiment plot. In addition, there is also a micro-site variation between plots. These two variations factors is difficult to eliminate since the first one on genotypic characters and the second phynotypic variation of the environment. However, the response of teak to fertilization, as demonstrated is encouraging and the result interpreted are value for application in the field.

Fig. 9. 7 months old teak in fertilized teak plot established from potted seedlings. Average height five feet





According to the findings form the present experiment, it may be concluded that fertilization with one ounce of Urea and one ounce of Super-phosphate may by considered to be suitable for application in the first year of planting.

As regarding the adoption of the method of planting used in this experiment, it depends, largely on the locality and fund available. No doubt, this method of planting, when properly executed, gives a better result in the establishment of plantation. The cost incurred may be a little higher than that of normal planting practices. Further research in this direction is indicated.

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