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The Effect of Three Pre-Germination Treatments on the Germination and Early Growth Studies of *Tectona Grandis* (Teak) For Rural Afforestation.

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Keyword:
Germination, Pre-Germination, Rural Afforestation, Tactona grandis, Treatments.

Abstract

Decreasing natural timber resources have resulted in increasing interest in forest plantations as an efficient timber source and a means to reduce pressure on natural forests. At present, teak ranks among the top five tropical hardwood species in terms of plantation area established worldwide. Forest production and sustainability has been a great problem in Nigeria due to deforestation and degradation. Seed dormancy is one of the major problems of afforestation of Teak germination due to it stony impermeable endocarp. Therefore this study was undertaken to determine the effect of three different pre germination treatments on the germination and early growth studies on *Tectona grandis.* The study was conducted at the Department of Forestry and Wildlife Management Nursery, Federal University Wukari located in Taraba state of Nigeria. Seed lots collected from Federal College of Forestry Jos, Nigeria were subjected to three treatments: alternate soaking and drying for two weeks, socking in water for two weeks, and scarification by fire. They were then planted in Poly pots of size 18 x 25cm filled with two potting mixtures and two plots for each treatment. Each plot

had 12 poly post planted with 2 seeds. The treatments lay in a complete randomize block design (CRBD) and were placed under the shade and watered in the early morning hours every day. After the germination process at two leaves stage the seedlings were thinned for early growth studies. Data collected among others include germination count / percentage, leaf count, seedling diameter and height using veneer caliper, meter rule and physical counting. The data generated were subjected to two way analysis of variance ANOVA using SPSS software package. Statistical tools such as mean, percentages, bar charts and pie charts were also used. Results showed that alternating soaking and drying for 14days enhanced fast germination of teak seed, height and number of leaves of the seedling and seedling diameter. Scarification by fire also had a significant effect on the germination of teak seed, seedling height, number of leaves and seedling diameter while soaking in water for 14days did not have significant effect on the germination of teak. From this result it implies that alternating soaking and drying for two weeks is the best pre-germination treatment recommended to enhance germination of *Tactona grandis*..

Introduction

As a result of significant increases in the demand for wood, the Nigerian wood market is undergoing rapid changes, putting considerable and increasing pressure on the countrie's remaining natural forest. In Nigeria, Hence, decreasing natural timber resources have resulted in increasing interest in forest plantations using fast growing exotic species as an efficient timber source and a means to reduce pressure on natural forests. The contribution of plantations to global forest cover in 2006 was 3.8% of the total area of forests

(FAO 2006). Without significant investment in promoting sustainable forest management (SFM), it must be expected that, increasing demand for wood will lead to further degradation and fragmentation of forest and even desertification. To successfully change this situation, Nigerian wood demand must be met through sustainable forest regeneration from both natural forest and plantation management (FAO 2007). To meet the ever increasing wood requirement of the society, forest plantations has to be put in place. This has gained acceptance since the beginning of the industrial revolution. (Pankaj 2016)). Teak growth and production show considerable variability depending on stand age, site characteristics, density regimes, and rotation length both within and across different vegetation zones of Nigeria. At present, teak ranks among the top five tropical hardwood species in terms of plantation area established worldwide (Pankaj 2016). Teak has a very wide range of uses including flooring decking, framing, electric poles among other uses including construction, furniture, railway sleepers vehicles building, musical instruments this is because of it durability and its very resistant to termite attacks. (kannan et al., 2008, Rathnathkumar *et al*.,2009) Teak is one of the most important tropical hardwood species in the international market of high-quality timber extracted from both natural forest and Plantations. (Daniel *et al.,* 2010*)*

Tectona grandis is native to south and Southeast Asia, mainly India, Indonesia, Malaysia, and Burma, but has acclimatized and cultivated in many countries, including Nigeria. According to Omokhua *et al* (2015), Teak was introduce to Nigeria in 1902. The word Teak comes from the Malayalam word thekku. This tree is mentioned in the seventh-century literature of Tamil popularly known as the Tevaram. It grows best in fertile, well-drained soil and warm, tropical climates where it receives plenty of sunshine. The species depends on pollination by insects -- mainly bees.

Botanically *Tectona grandis* is a large, deciduous tree reaching over 30m in height in favorable conditions, open crown with many small branches, the bole is often buttressed and may be fluted, up to 15m long below the first branches. Back is brown, distinctly fibrous with shallow, longitudinal fissures. The root system is superficial, often no deeper than 50cm, but roots may extend laterally up to 15m from the stem, small fragrant white flowers and papery leaves that are often hairy on the lower surface, the species is highly prized and cultivated as plantation trees in tropical and subtropical regions

Teak is considered as one of the finest and most economical valuable timber species in the tropics, exhibiting desirable technical and decorative properties. The species has both physical and aesthetic qualities. (Folana *et, al.,* 2008) .Teak belongs to the family Lamiaceaein older classifications in Verbenaceae. Sometimes it is included in the subfamily Prostantheroideae. Tectona as a genus has three species which are T.grandis, *T. hamiltoniana, and T. philippinensis*. Teak, through an exotic species, is widely cultivated throughout the world because of its durability and multipurpose benefits (Nwoboshi, 1985; Bhat and Hwon, 2004).

Forest production and sustainability has been a great problem in Nigeria due to deforestation and degradation (Ogunwale 2015). There is a problem of distribution of forest resources coupled with increasing demand for wood and other forest resources due to increase in population. Over exploitation has been in a faster rate which can lead to total destruction of forest resources. One of the ways of overcoming this problem is plantation establishment using fast growing species with good wood quality such as *Tectona grandis.* However, Seed dormancy is often a nuisance to nursery operators and *Tectona grandis* is not an exception to this problem, due to it stony impermeable endocarp (Unikrisham and Rejeer, 1990). However the causes of seed dormancy and methods of breaking it are of both physiological and practical importance. Any primary dormancy present within the seed can be overcome from the interaction of the seed with it environment. According to Hudson *et al*., (2007) these dormancy conditions can be broken using several methods like physical scarification, chemical scarification, biological scarification mechanical scarification soaking in water and several other pre treatment methods depending on the type of seed involve. This study therefore was set to find out the best pre-germination treatment for *Tectona grandis* for plantation establishment in Nigeria.

MATERIALS AND METHODS

The study area

The study was conducted at the Department of Forestry and Wildlife Management Nursery, Federal University wukari located in Taraba State. Taraba state has an estimated land area of about 59,400qkm carrying a population of 2,688,944 (NPC 2016). Taraba state lies between latitude 6^{o} 25^{-}

^{1}N and 9^{0}30N and between longitude 9^{0}30E and 11^{0}45E. Taraba state has two climatic seasons, the wet season occurs between April - October and the dry season within November-March. (Schwatzl 1992).

Taraba state consists of undulating land scope dotted with a few mountainous features in Mambilla plateau. It is a home of biodiversity, with five vegetation zones which are the savannah woodland, Sudan- Guinea Savannah, rainforest, mountain forest and the guinea savannah. Wukari, where the Federal University is situated lies within latitude 7^{0}51m and longitude 9^{0}47E The mean annual maximum temperature varies from 30^{0}-39.4^{0}c (Adebayo 1999) (NPC 2006)

The materials used for this study were Teak seeds, poly pots, top soil, river sand and the experiment was conducted in different phases. At the first phase healthy seed were selected, divided into four sub-seeds lots and measured using electronic weighing balance, and each were subjected to three different pre germination treatments with 1 sub-seed lot as control. The second phase was the application of different pre-germination techniques on the seeds of *Techtona grandis,* while the third phase was the measurement of early growth rate of *Techtona grandis*.

Tectona grandis seeds were collected from the ground floor of mother trees at the Federal College of Forestry Jos Plateau State. The seeds collected were put into a sack and were stored in a dry room temperature for a period of 3 months.

Top soil was collected from the from the *Gmilina aboria* plantation of the Department of Forestry and Wildlife Management, Federal University Wukari, it was kept under the shad for air drying and was later filtered using 2mm sieve to remove visible leaves, roots and stones.

Cow dung was collected from the cattle unite of the Department of Animal Health and Production, Federal University wukari and kept under the shad for air drying and was filtered with 2mm sieve to remove large particles. River sand was also collected and filtered

Seeds with no visible signs of infection were selected and divided into four sub-seed lots. Each seed lot was weighed using a weighing beam, the seeds were subjected to three different pre germination treatments. The different treatments were as follows

To (Control) seed weighing 25g with no visible infections were selected and sown without any treatments directly to poly pots filled with top soil and poly pot filled with potting mixture. And were labeled pot zero (T_0).

T_1 (Treatment One) alternating soaking and drying. *Techtona grandis* seeds weighing 25g were subjected to an alternating soaking and drying for two weeks. Seeds were soaked in water in the night hours and dried in the day time for the period of 14days before being sown into pots.

T_2 (Treatment Two) soaking in water only. Teak seeds weighing 25g were soaked steadily in water for 14days (2weeks)

T_3 (Treatment three) scarification by fire. Teak seed weighing 25g were place under heat for the period of 3minuts using dry leaves from *Anacadium occidentalis* (cashew). The fire was set and the seeds were placed on the leaves while burning and was turned evenly at little interval in form of frying to avoid excessive burning after which the seeds where socked in water for one day befores sowing into pots.

Poly pots of size 18 x 25cm were filled with potting mixture of cow dung, top soil and river sand at a ratio of 1:2:1 respectively, tops soil was labeled (ST) the potting mixture was labeled (SM), the filled poly pots were kept under a shad in the nursery. Each plot with a total number of 12 poly pots were laid in a complete randomized block design CRBD, each poly pot were sown with 2 seeds from $T_1 - T_3$ and their replications (Table 1).

Data collection

Data collected were on germination percentage and early growth studies of the seedlings, total germination was obtained by visual counting of the number of germinated seedlings from the first day of seedling emergence up to three weeks and percentage germination was expressed as follows.

Mean germination percentage = $x/y \times 100$

Where x = total no of germinated seed per treatment.

Y= total no of seeds sown per treatment. (Omokhua *et al* 2015)

At 2-leave stage after germination, the seedlings were thinned leaving only one seedling per poly pot. The thinned seedlings were transplanted to poly pots with the same treatment for early growth studies.

After the thinning and transplanting, the following parameters were assessed at 2weeks interval for the period of 3 months. Seedling height, number of leaves and girth/ diameter

The height measurement was taken from collar to the tip of the apical bud using a meter rule, calibrated in centimeter.

Seedling steam collar diameter was measured using a veneer caliper, calibrated in millimeter and was later converted to centimeter. Numbers of leaves were determined by visual counting. The data generated were subjected to two way analysis of variance ANOVA using SPSS software package.

RESULTS AND DISCUSSIONS

Germination Percentage.

The Germination of *Tectona grandis* seeds using three different pretreatment were monitored daily till there was no further germination of seed, this took a period of 25days.

The percentage germination of various treated seeds of *Tectona grandis* is shown in Table 2.

Treatment one (T1) under pot one and pot two $\mathbf{p_1}$ had a percentage germination of 23% while $\mathbf{p_2}$ had 22%. Treatment two pre treated with soaking only for 14 days under pot one and pot 2 had percentage germination of 16% and 15% for $\mathbf{p_1}$ and $\mathbf{p_2}$ respectively. Treatment three T_3 for scarification with fire under $\mathbf{p_1}$ and $\mathbf{p_2}$ had germination percentage of 16% and 18% for $\mathbf{p_1}$ and $\mathbf{p_2}$ respectively. Treatment one $\mathbf{T_1}$ had the mean germination percentage value of 93.75%, $\mathbf{T_2}$ had the least of 64.58% of germination and $\mathbf{T_3}$ had a germination value of 70.83% while there was no germination recorded from control throughout the period of this experiment.

The result shows that pre-germination treatment had a significant effect on the germination of *Tectona grandis.* Seeds treated by alternating soaking and drying for 14days had the highest germination percentage followed by seeds pre-treated with scarification by fire and soaking with water only for 14 days had the lest germination percentage .as shown in Table 2.

Early Growth Rate Characteristics of *Tectona grandis.*

After germination, the seedlings were thinned at two leaf stage and the polypots with no germination were replace with the thinned seedlings and

were then used for early growth studies. The parameters taken were seedling height (cm), Leaf count and diameter (cm) at 2weeks interval for 10 weeks. The result obtained were subjected to statistical analysis as indicated ealier.

Height

The result for the mean total height of Teak seedlings for the three different treatments**T_1, T_2 T_3** under two potting mixture **p_1** (Top soil) and **p_2** (soil mixture) for alternating soaking and drying, soaking only and scarification by fire respectively reveals that treatments one (**T_1)** had the highest mean height obtained from plot two P_2 with total height of 10.45cm, the second higher height was obtained from treatment two (T_2) in plot (P_2) with 10.28cm and the lowest height was recorded from treatment three (T_3) in P_2 with 9.03cm while T_1P_2 and T_2P_1 had heights of 9.84 and 9.39cm respectively (figures 3).

Leaf count

The number of leaves at the end of the experiment for T_1 T_2 and**T_3** alternating soaking and drying, soaking only and scarification fire respective were obtain **T_1**P_1had the heights leave number of 10, treatment three (T3) T_1&P_2 and T1 p_2 had the second highest leaver number of 9 the lowers leave number was obtain from treatment two T_1&T_2 with leave number of 8 (Fig 4).

Diameter

At the end of the experiment the mean seedling diameter of teak obtain from **T_1, T_2** and **T_3** for alternating soaking and drying, soaking only and scarification by fire under pot one **(P1)** and pot two **(T2)** shows that treatment one **(T_1)** had the highest seedling diameter of 0.36cm for **p_2** and 0.34cm for **p_2** treatment two **(T2)** recoded the lowest diameter of 0.28cm and 0.23cm for **P_2** and **P_1** respectively while treatment **(T_3)** recoded 0.32 and 0.31 respectively. (Fig 5).

The effect of pre- treatment and potting mixture on the growth rate of *Tectona grandis*

The growth rate characteristics (Number of Leaves, Diameter and Tree Height) of teak tree was subjected to a two way ANOVA having three levels of treatment (Alternating Soaking and Drying for 14 days, Only Soaking for

14 days and scarification by fire) and two levels of potting mixture (Soil Mixture and Top Soil.

The two-way ANOVA shown in Table 4 revealed a significant multivariate main effect for treatments, Wilks' $\lambda = .934$, F (6, 704) = 4.05, $p = .001$, partial eta squared = .033. Power to detect the effect was .975; and potting mixture (plots), Wilks' $\lambda = .967$, F (3, 352) = 4.03, $p = .008$, partial eta squared = .033. Power to detect the effect was .839.The interaction between treatments and potting mixture was not statistically significant, Wilks' $\lambda = .989$, F (6, 704) = .66, $p = .68$, partial eta squared = .006. Power to detect the effect was .266.

Given the significance of the overall test, the univariate main effects were examined, at adjusted alpha level of .008 (.05/6), to see if the independent variables have a significant impact on the dependent variables considered separately. Significant univariate main effects for treatments were obtained for tree diameter, F (2,354) = 4.95, $p = .008$, partial eta square =.027, power = .808; and number of leaves, F (2,354) = 10.45, $p<.001$, partial eta square = .056, power = .988. The main effects for treatments on tree height were not significant. The univariate main effects for potting mixture on all the dependent variables were not significant.

The group variances on tree diameter are not significantly different, so Sheffé post hoc test was selected to compare the means. For the number of leaves, the group variances are significantly different, so Tamhen post hoc test was selected. The pair wise comparisons suggested that the mean diameter for seeds treated by alternating soaking and drying for 14 days (M = 0.351) were marginally significantly higher than for the seeds treated by only soaking for 14 days (M = 0.294) and seeds treated by scarification (M = 0.313). There is no significant different on the mean tree diameter between the seeds treated by only soaking for 14 days and seeds treated by scarification. The post hoc test for number of leaves indicated that the mean number of leaves for seeds treated by alternating soaking and drying for 14 days (M = 9.9) was significantly higher this is in agreement with Offiong *et al* (2010) research on seed treatment. it was observed that seeds soaked in water and alternating drying significantly affected important morphological parameters and biomass production such as seedling height, stem collar diameter, number of leaves, than for the seeds treated by only soaking for 14 days (M = 8.2) and seeds treated by scarification (M = 9.2). There is no significant different on

the mean number of leaves between the seeds treated by only soaking for 14 days and seeds treated by scarification.

Specifically, the results suggest that alternating soaking and drying for 14 days is the best pre-germination treatment, among all the treatments considered, that will enhance germination and early growth of teak. There is no difference in the effect of the two different potting mixtures analyzed – top soil and soil mixture, on the growth rate characteristics of teak.

CONCLUSION

The seed dormancy in *Tactona grandis* is as a result of its inability to absorb water due to it stony impermeable endocarp which affect the seed germination results obtained in this experiment emphasize the necessity of pre- treating *Tactona grandis* seeds before sowing by using different pre-treatment in other to enhance its germination and early growth. Alternating soaking and drying 14day enhanced fast germination of the seed, height and number of leaves of the seedling and seedling diameter. Scarification by fire also had a significant effect on the germination of teak seed, seedling height, number of leaves and seedling diameter while soaking in water for 14days did not have much effect on the germination of teak.

RECOMMENDATIONS

1. Alternating soaking and drying of seeds for 14 days is being recommended to enhance germination of *Tactona grandis*. It is hoped that the result obtain from this study will provide useful information on a large scale afforestation and enhance practical nursery techniques of farmer and foresters.
2. This research has revealed that Scarification with fire can enhance the germination of *Tectona grandis* if carefully handled .
3. Further research needs to be conducted on the growth rate of *Tectona grandis* as the time limitation for these studies did not give enough room to monitor the variation in growth rate as affected by the various pre-treatment
4. Training should be given to farmers on various nursery practices such as propagation techniques that could be used to enhance afforestation of valuable hard wood such as *Tectona grandis*.

TABLES AND FIGURE

Table 1 Experimental Lay Out

Potting mixture		P_1	P_2
Treatment	T_1	T_1P_1	T_1P_2
	T_2	T_2P_1	T_2P_2
	T_3	T_3P_1	T_3P_2

T1 Treatment one (alternating soaking and drying) T2 Treatment two (soaking in water only)
T3 Treatment three (scarification by fire) P1 Pot one (Top soil)
P2 Pot two (potting mixture of river sand top soil and cow dung)

Table 2 Effectiveness of Pre- Germination Treatment on the Seed of *Tectona grandis*

Potting Mixture	Pre germination treatment	Number of seeds treated and sown	Number of seed Germinated	Germination Percentage (%)
Plot 1	T_0	24	0	0%
	T_1	24	23	95.83%
	T_2	24	15	62.5%
	T_3	24	16	66.67%
Plot 2	T_1	24	22	91.67%
	T_2	24	16	66.67%
	T_3	24	18	75%

Table 3 Treatment on Growth Rate Parameters

TREATMENTS	PERIOD (WEEKS)	NUMBER OF LEAVES		HEIGHT		DIAMETER	
		Plot 1	Plot 2	Plot 1	Plot2	Plot1	Plot2
ALTERNATING SOAKING AND DRYING	1	5.33	5.5	5	4.67	0.19	0.19
	2	8	8.167	8.9	8.33	0.25	0.28
	3	11.17	10.42	12.75	10.16	0.34	0.35
	4	12.83	10.83	14.50	13.41	0.43	0.46
	5	14.50	12.67	16.08	12.75	0.52	0.52
SOAKING ONLY	1	4.33	4.00	4.16	3.41	0.12	0.13

	2	7.67	7.17	7.25	6.91	0.02	0.24
	3	9.67	10.00	10.08	8.66	0.25	0.28
	4	9.00	9.00	11.25	10.16	0.33	0.33
	5	10.83	11.00	14.25	12.08	0.44	0.43
SCARIFICATION BY FIRE	1	4.83	5.00	5.25	4.00	0.13	0.13
	2	8.17	8.17	6.83	6.00	0.21	0.22
	3	9.50	9.83	10.75	10.00	0.33	0.36
	4	11.17	10.17	12.91	11.66	0.40	0.38
	5	13.17	13.17	14.66	13.50	0.48	0.52

Table 4 Result of analysis of variance for the effect of T1, T2 &T3 on germination and early growth rate of *Tectona grandis*

Treatment	Germination (%)	Height (CM)	Diameter (CM)	No. of leaves
T1	93.75%	8.7	0.35	9
T2	64.58%	7.8	0.20	8
T3	70.83%	9.7	0.31	9

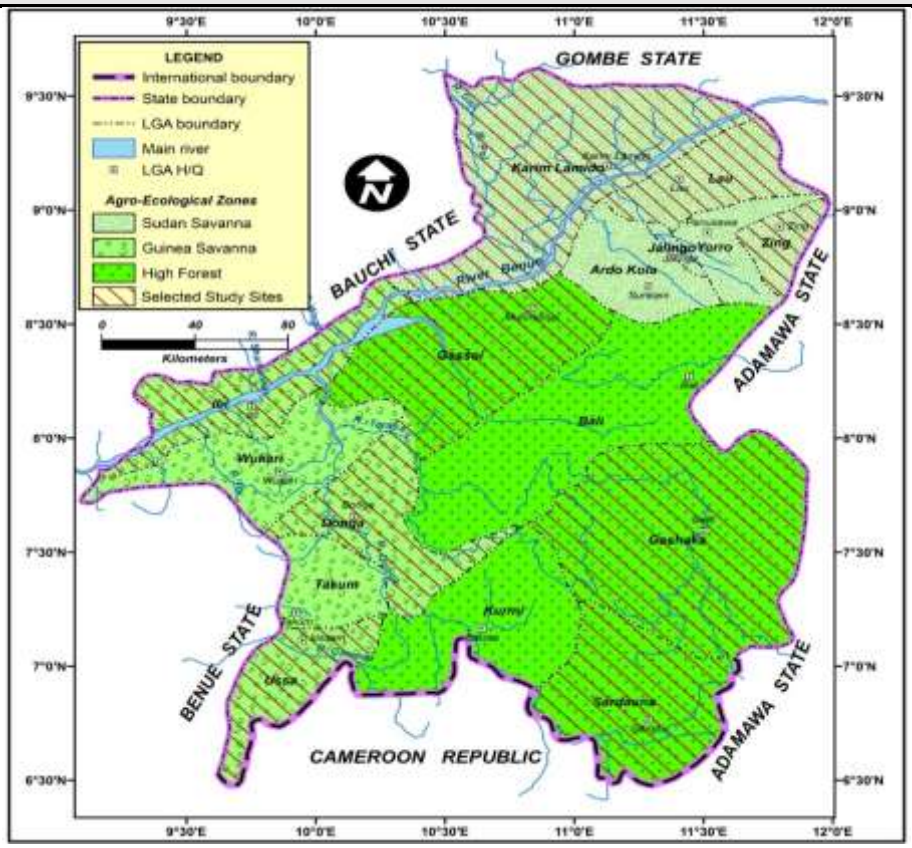

Fig 1 Map of Taraba showing Wukari Local Government Area.

Source: Department of Geograhy, Taraba State University.

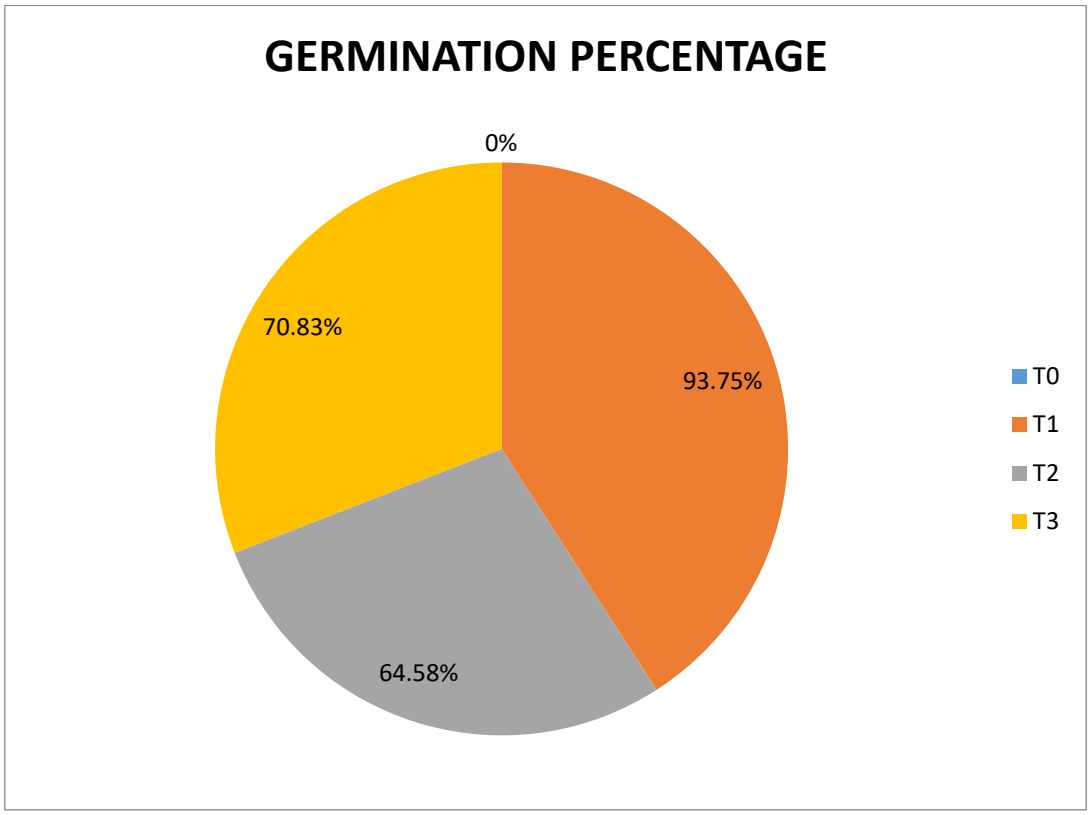

Figure 2: Percentage Germination for three Different Treatments.

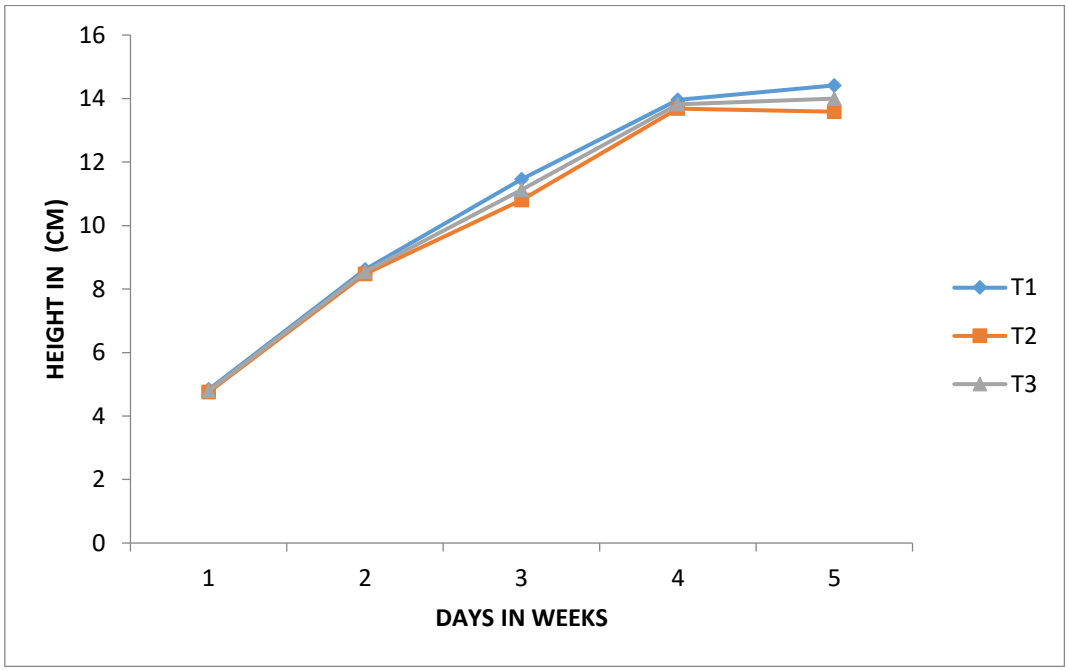

Fig3: The Effect of Different Treatment on the Height of *Tactona grandis*

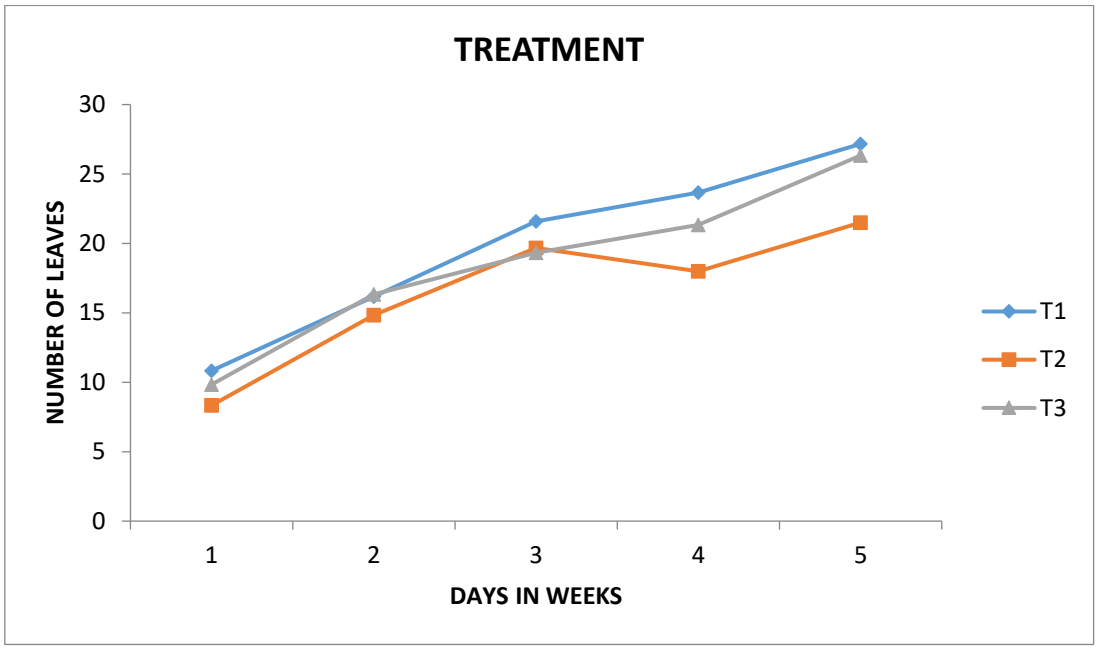

Fig4: The Effect of Different Treatment on the Number of Leaves of *Tactona grandi*

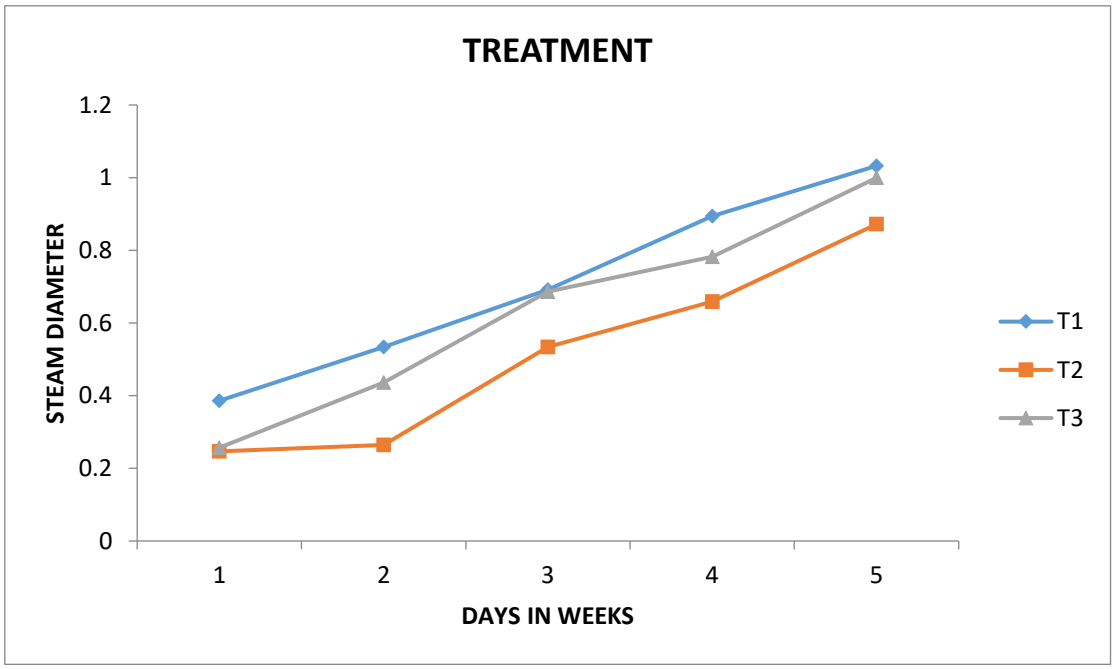

Fig **5: The Effect of Different Treatment on the Steam Diameter of *Tactona grandis***

REFERENCE

Adebayo, A.A. (1999). *Introd+uction* In Adebayo A.A. & Tukur A..L (Eds), *Adamawa State In Maps.* Yola: Department of Geography, F.U.T Yola and Paraclete Publishers Nigeria. p 3

Bhat and Hwan (2004) Mair, K, S.S AND SUMARDI, 2000, insect pest and diseases of major plantation species. In Nair, K.S.S Ed. Insect pest and diseases in Indonesian forest. An assessment of the major thrats, research efforts Bagor Indonesia, pp 15-38.

Daniel Verhaegen, Jesus Fofana Inza, A. Z´enor Logossa, Daniel Ofori. (2010). What is the genetic origin of teak (Tectona grandis L.) introduced in Africa and in Indonesia?. Tree Genetics &

FAO -Food And Agriculture Organization Of The United Nations. Faostat Forestry. Available at: <http://faostat.fao.org/site/381/default.aspx>. Last access: May 28, 2007.

FAO. 2006. Global forest resources Assessment 2005: Progress towards Sustainable Forest Management. FAO, Rome.

Folana I. J lidah Y.J., Diarrassouba; N'guetta S. P. A., Sangare, A. and Verhaegen, D, 2008 Genetic structure and conservation of TEAK (Tectona grandis) plantation cote d'Ivore, revealed by cite specific recombines (SSR). Tropical Conservation Science Vol.1 (3):

Hudson T.H Hartmann, Dale K. Kester, Fred T. Davies, Jr. Robert L Geneve. (2007) Plant propagation principles and practice Savant Edition page 185-195.

Kumtainable teak al .B. M., kumar 2005 sustainable teak plantation in the tropics: the question of nutrient management in k.m., Bhat K.KN. Nair K.vv bbhat, E.M, Muralidharan and J.K Sharma (eds). Quality timber product of teak from sustainable forest management KFRI peechi PP.179-187

N.P.C. (2006). National Population Commission. gov. ng. Retrieved 2017-10-10

Ogunwale, A.O Deforestation and greening the Nigerian Environment national institute of social and Economic Research (NISER Ibadan, N igeria international conference on African Development Issues (cu-ICADI) 2015; Renewable Energy Track.

Omokhua, Godwin E and Alex, A. 2015 Improvement on Teak (*Tectona Grandis* Lin F.) Germination for Large Scale Afforestation in Nigeria Department of Forestry and Wildlife Management, University of Port Harcourt, Port Harcourt, Nigeria http://www.sciencepub.net/nature

Pankaj kumar singh Am improved method of micro propagation of Teak (*Tectonic grandis* ciBTech journal of Biotechnology ISSN. 2319-3859(online) an open Access, online International journal available at http://www.cibtech. Org/cjb.htm 2016 vol .5 (1) January March pp.1-5/singh

Saka, M. G., Amadi, D.C. A and Olaniyi W.A 2016 effect of different soil potting JUSS mixture on the early growth of mahogany (khaya senegalensisa) A. J Futo journal series (FUTOJNLS) e-ISSN: 2476-8456 p- ISSN: 2467-8325 Volume-2, Issue-2, pp-35-42.www.futojnls.org

Schwetzl 1992 and cannel, 2003 www. onlinenigeria.come>linksRead print

Unikrishnon, K.and Rajeer, K.P (1990). On germination of Indian Teak (*Tectona grandis*). Indian forest, 116:992-993.