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GROWTH POTENTIALS OF *Tectona grandis* LINN AS INFLUENCED BY SEED SOURCES AND DIFFERENT SOIL TYPES

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Abstract
The forest has been very useful to man as he obtains food, shelter, revenue, energy and myriad of environmental services from it. However, increase in demand for forest product as a result of overpopulation couple with urbanization has resulted in over exploitation and extinction of some forest trees. Therefore, there is an urgent need of supplying improved seeds for afforestation and forest regeneration in various forestry establishments. Nursery experiment was carried out to investigate the effect of provenance and soil type on the growth of Tectona grandis. Seeds were collected from different locations in three different states namely: Ekiti, Osun and Oyo State. Seeds were collected from Ado-Ekiti, Ekiti State; Iwo, Osun State and Ibadan, Oyo State. The seeds were pre-treated by soaking in the stream for two weeks before planting. The seeds were sown by broadcasting on a germination bed in the nursery. After germination, seedlings were transplanted into polythene pots containing the different soil types (Loamy, Sandy and Clay soil). The parameters assessed included total height, stem diameter and leaf production. T. grandis seeds collected from Oyo State and grown on loamy soil (T6) gave the best result in both total height and stem diameter (10.22cm and 0.20cm respectively) while Teak seeds collected from Oyo State and raised on sandy soil gave the best result for leaf count (8.17). The seeds collected from Oyo State performed better on sandy soil, best on loamy soil and less on clay soil. Seeds collected from Ekiti performed well in total height on loamy soil (9.48cm), in stem diameter on sandy soil (0.17cm) and in number of leaves both in sandy and clay soil (7.25). The seeds collected from Osun State performed well in total height and stem diameter on loamy soil (9.97cm and 0.19cm respectively) and had the same value for number of leaves in the three soil samples (7.08). Based on the findings of this work, it is hereby recommended that Tectona grandis seedlings should be raised using loamy soil at nursery stage. Also seeds of T. grandis should be collected from a location of similar geographical properties.

Key Words: *Tectona grandis, Provenance, Soil, Growth, Seed*

Introduction

Forestry has been defined as the science, which studies the skillful management of all natural resources occurring in association with forest lands for greater human benefit (Watkins, 1998). The forest has been very useful to man as he obtains food, shelter, revenue, energy etc. from it, (Ball, 2001). However, increase in demand for forest products has

resulted in over exploitation and extinction of some forest trees (FAO, 2001). Therefore, there is an urgent need of supplying improved seeds for afforestation and forest regeneration in various forestry establishments.

Forestry is on the threshold of genetic revolution such as was experienced in agriculture centuries or even millennia ago. Until very recently, foresters were working with wild species whereas, many of our agricultural crops had been subjected to deliberate process of selection since Neolithic times (Bradley *et al.,* 1967).

One of the ways of improving genetic quality of trees is to choose seeds from the appropriate provenance. Provenance can be defined as the source of a genetic material (Mac Cay, 2000). In the past, foresters dealing with exotic species have tended to play safe and use provenances known to be reasonably successful over a wide range of conditions. But it is known that very considerable economic advantages may result from the critical provenances on particular sites (Turnbull, 2003).

In the late eighteenth and early nineteenth centuries, many foresters and amateur geologist became interested in the reason for the distribution of different types of soil. They came to the general conclusion that there was a direct and fairly simple relationship between the character of the soil and the nature of the underlying soil parent material. They found chalky soils on chalk; sandy soils on sandstone, clayey soils on shale and organic soils on peat and so, they devised soil classifications which were based on the nature of the rock beneath it (Yeates and Darrah, 1991).

Soils vary enormously in their physical and chemical properties owing to the nature of the parental material. Differences in the lithological characteristics of the parent rock are of salient importance for two main reasons. Firstly, rock differ enormously in the amount of soluble plant nutrient that they liberate on weathering. Secondly, the residue of weathering can vary between almost 100% clay and almost 100% quartz. Although; most rocks yield a residue which contains a certain amount of clay particles and are exceedingly small with a diameter of less than 0.002mm. Quartz grains on the other hand are nearly all much larger in size, those with a diameter between 0.002mm and 0.02mm being referred to as silt and those with above 0.02mm as sand. It is clear that the larger the percentage of clay particles in weathered material, the slower will be the rate at which water will percolate through it. On the other hand, very sandy materials will allow water to flow through them almost unimpeded. Soil textures are classified as sandy, silt, clayey and loamy, according to the proportions of the different types of particle present.

Tectona grandis belongs to the family Verbaneceae. It can be found in the rain forest region but widely cultivated in the drier area of the rain forest. The stem is usually fluted and sometimes with slight buttresses. The back is grey to brownish colour; it is fibrous with shallow longitudinal fissures. The leaf is about 10-24 inches long by nine to fifteen inches wide. It is ovate to broadly elliptic, blunt or shortly accumulated at the apex, tapering gradually to the ends of the branches. It is about one-third inches across with six calyx, corolla and stamen, but all may vary between five and seven corolla tube with a forted stigma (Luke, 1983). The tree usually flowers between April and August. The fruit is more or less

glabrious, about three quarter inches in diameter with hard cover of stellate hairs calyx and falling off with it. The wood is highly durable and its durability makes it useful for many purposes. It is used for ship construction, house building, poles, furniture, cabinet works etc. (Dnyanaseagar and Kothekar, 1982).

Therefore, genetically, superior off-springs from different provenances are bound to show visible effect of the environment, so, this experiment gives the opportunity to choose the best environment for a particular seed source.

Materials and Methods

Study Area

The experiment was carried out at the Federal College of Forestry premises, Jericho, Ibadan. The College is located on the latitude 07º23' 18"N to 07º 23' 40"N and longitude 03º 36' 20"E to 03º32' 41"E (Fig. 1). The climate of the study area is the West African monsoon with dry and wet seasons. The dry season is usually from November through March and is characterized by dry cold wind of harmattan. The wet season usually starts from April to October with occasional strong winds and thunderstorms. Mean annual rainfall is about 1548.9mm, falling within approximately 90 days. The mean maximum temperature is 31.9°C, minimum 24.2°C while the mean daily relative humidity is about 71.9% (FRIN, 2015).

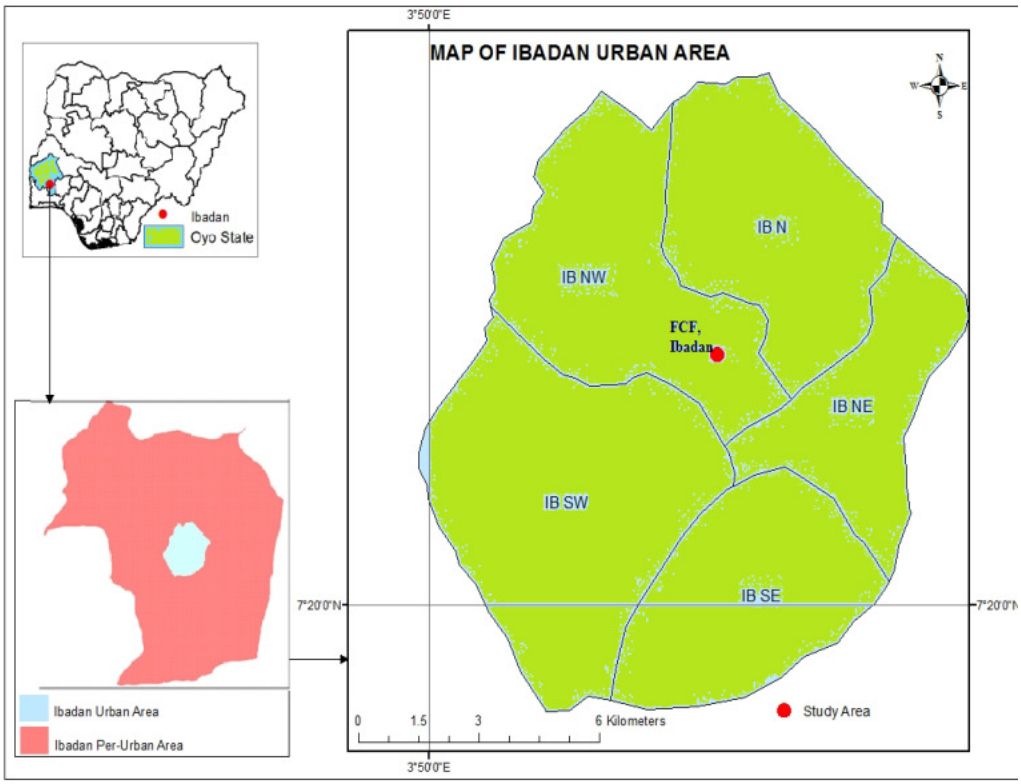

Fig. 1: Map of Ibadan showing the Study Area

Sowing of Seeds and Parameter Assessment

The seeds were pre-treated before planting. Pre-treatment was done by soaking the seeds in a running stream situated at Forestry Research Institute of Nigeria (FRIN) for two weeks. The seeds were broadcasted on a germination bed at the Federal College of Forestry nursery and after two weeks of germination, the seedlings were transplanted into polythene pots containing the different soil types. The following parameters were assessed namely; plant height, leaf production, stem diameter. Readings of the growth performance was taken once in a week.

Experimental Layout

Table 1: The experiment was laid in a completely randomized design (CRD). There are nine (9) treatments and three (3) replicates

R1	R2	R3
a1b1	a2b2	a3b3
a1b2	a2b3	a2b1
a1b3	a2b1	a2b2
a2b1	a3b2	a2b3
a2b2	a3b3	a1b1
a2b3	a3b1	a1b2
a3b1	a1b2	a1b3
a3b2	a1b3	a3b2
a3b3	a1b1	a3b1

Where;
T1 = a1b1 = Sandy – Ekiti, T2 = a1b2 = Sandy – Osun, T3 = a1b3 = Sandy – Oyo, T4 = a2b1 = Loamy – Ekiti, T5 = a2b2 = Loamy – Osun, T6 = a2b3 = Loamy – Oyo, T7 = a3b1 = Clay – Ekiti, T8 = a3b2 = Clay – Osun, T9 = a3b3 = Clay – Oyo.

Method of Data Analysis

The data collected were analyzed using ANOVA. The mean values were separated using Duncan multiple ranged test (DMRT).

Results and Discussion

Tables 2, 3 and 4 show the percentage composition of carbon and nitrogen in the soil samples from Ekiti, Osun and Oyo States respectively. Table 5 shows the mean value for the total height measured across the treatment used, T6 had the highest mean stem height of 10.22cm, followed by T5 with 9.97 and T4 with 9.48. T2 had 7.82cm which is the lowest. The three provenances showed the highest stem height on Loamy soil (T4, T5 and T6). This is in correlation with the work of Palm, (2001) who stated that: in most tropical soils, the growth and production of trees is limited by the availability of one or several nutrients, such as Nitrogen in sandy savanna soils.

Table 2: Percentage composition of carbon and nitrogen in the soil collected from Ekiti State

Sample	%Carbon	%Nitrogen	%Sand	%Clay	%Slit
Sandy soil	1.40	0.15	13.10	3.10	75.10
Clay soil	1.02	0.11	41.46	32.80	48.11
Loamy soil	3.51	0.70	12.46	4.91	83.12

Table 3: Percentage composition of carbon and nitrogen in the soil collected from Osun State

Sample	%Carbon	%Nitrogen	%Sand	%Clay	%Slit
Sandy soil	1.30	0.11	12.7	4.10	91.89
Clay soil	1.40	0.22	22.50	35.77	55.76
Loamy soil	4.55	0.52	13.33	3.55	78.93

Table 4: Percentage composition of carbon and nitrogen in the soil collected from Oyo State

Sample	%Carbon	%Nitrogen	%Sand	%Clay	%Slit
Sandy soil	1.20	0.10	11.8	5.08	83.92
Clay soil	1.00	0.10	31.44	24.72	43.84
Loamy soil	5.49	0.47	11.44	5.72	82.84

Table 5: Mean values for Total Height of *Tectona grandis* seedlings from differenton different soil types

Treatments	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Total mean
T1*	6.00	6.23	6.50	8.67	10.47	10.47	11.00	11.23	8.82
T2	4.50	4.70	4.90	7.67	9.23	10.20	10.53	10.83	7.82
T3	7.37	7.57	7.73	8.93	10.17	9.27	9.60	9.97	8.83
T4	6.50	6.70	6.90	9.20	11.40	11.47	11.70	12.00	9.48
T5	7.60	7.77	8.03	9.37	11.73	11.47	11.70	12.07	9.97
T6	7.70	7.90	8.07	9.27	11.40	12.23	12.50	12.67	10.22
T7	6.60	6.93	7.17	9.37	9.97	11.07	11.40	11.77	9.28
T8	6.83	7.10	7.37	8.40	8.63	9.00	9.27	9.67	8.28
T9	6.30	6.53	6.77	8.83	9.87	9.80	10.10	10.50	8.59

Grand mean = 9.03; *See footnote to Table 1; Wk = Week

Table 6: Analysis of Variance for Total Height of *Tectona grandis* seedlings from differenton different soil types

Source of variation	DF	SS	MS	VR	Fpr.
Treatments	8	116.552	14.569	10.59	<.001*
Soil type	7	721.749	103.107	74.96	<.001*
Treatments soil type	56	67.308	1.202	0.87	0.714NS
Residual	144	198.080	1.376		
Total	215	1103.690			

Where * = Significant at 5% level of significance, NS = not significant at 5% level of significance, DMRT = 0.67, Standard Error (S.E) = 1.17

Table 6 shows the analysis of variance for the total height. The results shows that there are significant variation among the treatments and also among the soil types while there are no significant variation in the interaction between the treatment and the soil type. Table 7 shows the highest mean stem diameter to be 0.20cm which was observed in T6, followed by T5 which had the mean of 0.19cm with T1 and T3 which had 0.17cm. The lowest mean stem diameter was observed in T7 which had

0.13cm. This could be due to the fact that the soil used as T6 (loamy) had the highest value of Nitrogen (0.472) which is considered as one of the most important nutrient for plant development. Nitrogen is important for proper stem growth; this includes both lateral and diameter growth (Oguike and Mbagwu, 2009; Turnbull, 2003).

Table 7: Mean value for stem diameter of *Tectona grandis* seedlings from differenton different Soil Types

Treatments	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Total Mean
T1*	0.13	0.15	0.17	0.17	0.18	0.18	0.19	0.20	0.17
T2	0.11	0.13	0.15	0.15	0.15	0.16	0.16	0.17	0.15
T3	0.13	0.15	0.16	0.17	0.17	0.18	0.18	0.20	0.17
T4	0.11	0.12	0.13	0.14	0.15	0.15	0.16	0.17	0.14
T5	0.15	0.17	0.18	0.19	0.19	0.20	0.21	0.21	0.19
T6	0.16	0.18	0.19	0.20	0.21	0.21	0.22	0.23	0.20
T7	0.09	0.11	0.11	0.13	0.13	0.14	0.15	0.16	0.13
T8	0.11	0.12	0.14	0.15	0.15	0.16	0.16	0.17	0.15
T9	0.10	0.12	0.14	0.15	0.14	0.15	0.16	0.17	0.14

Grand mean = 0.159; *See footnote to Table 1

Table 8: Analysis of Variance for Stem diameter of *Tectona grandis* Seedlings from differenton different Soil Types

Source of variation	DF	SS	MS	VR	Fpr.
Treatments	8	0.1142417	0.0142802	15.34	<.001*
Soil type	7	0.0851981	0.0121712	13.07	<.001*
Treatments soil type	56	0.0018769	0.0000335	0.04	1.000NS
Residual	144	0.1340667	0.0009310		
Total	215	0.3353833			

DMRT = 0.02; S.E = 0.03

Table 8 shows the analysis of variance for stem diameter, there are significance different among the treatment and also among the soil type, however there are no significant different in the interaction. Table 9 shows that T3 had the highest mean leaf number of 8.17, followed by T6 and T9 with 7.42, while the lowest mean leaf count was observed in T4 which had 6.75. The Oyo State provenance had the highest leaf number on sandy soil (T3) 8.17. Sandy soils are well aerated soils which have no capacity of holding water. The roots have more space to extend their tendrils in order to absorb water and nutrient (Bergsma, 1992). Table 10 shows the analysis of variance for leaf production, again there are significant difference among the treatment and soil type while there are no significant difference in their interaction.

Table 9: Mean value for leaf production of *Tectona grandis* seedlings from differenton different soil types

Treatments	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Total mean
T1	2.67	4.00	6.00	7.33	7.33	8.67	10.00	12.00	7.25
T2	3.33	4.00	6.00	6.00	6.67	8.67	10.00	12.00	7.08
T3	3.33	4.67	6.67	8.67	8.67	10.00	10.67	12.67	8.17
T4	2.67	3.33	5.33	7.33	6.33	8.33	9.67	11.00	6.75
T5	3.33	4.00	5.33	6.67	6.67	8.67	10.00	12.00	7.08
T6	4.00	4.67	6.67	8.00	7.00	8.33	9.67	11.00	7.42
T7	4.00	4.00	6.00	6.00	7.33	9.33	10.00	11.33	7.25
T8	3.33	4.00	6.00	6.00	7.33	9.33	10.00	11.33	7.25
T9	3.33	4.00	6.00	7.33	7.67	9.67	9.67	11.67	7.42

Grand mean = 7.278

Table 10: Analysis of Variance for Leaf production of *Tectona grandis* Seedlings from differenton different Soil Types

Source of variation	DF	SS	MS	VR	F p.r
Treatments	8	29.333	3.667	3.38	0.001*
Soil type	7	1519.481	217.069	200.37	<.001*
Treatments soil type	56	34.519	0.616	0.57	0.991NS
Residual	144	156.000	1.083		
Total	215	1739.333			

DMRT = 0.60, S.E = 1.04

Conclusion

In summary, *Tectona grandis* seeds collected from Oyo State and grown on loamy soil (T6) have given the best result in both stem height and stem diameter (10.22cm and 0.20cm respectively) while Teak seeds collected from Oyo State and raised on sandy soil gave the best result for leaf count (8.17). The overall analysis of variance shows that there are significant difference among the treatments and soil types for all the parameters measured. The seeds collected from Oyo State performed better on sandy soil, best on loamy soil and less on clay soil. From the soil analysis, clay soil had the lowest value of nitrogen and carbon; this could have resulted in the low performance of Teak on it. Based on the findings of this work, it is hereby recommended that seedlings should be raised using loamy soil at nursery stage. Also seeds to be raised should be collected from Oyo State or a location of similar geographical properties.

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