GROWTH RESPONSE OF *Sterculia setigera* DEL. TO DIFFERENT TYPES OF FERTILIZERS AND WATERING REGIMES IN THE NURSERY

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ABSTRACT
Growth response of Sterculia setigera to NPK (15:15:15) and Urea (46:0:0) at different levels of application and watering regimes were examined. A total of 160 seeds of Sterculia setigera were sown. After germination, 72 seedlings of good health and vigour were selected for the study. The fertilizers were applied at four different levels. 0.00g, 0.67g, 1.33g and 2.0g of NPK fertilizer and 0.00kg, 0.22kg, 0.44kg and 0.66kg of Urea with three replicates each. The second treatment was watering regimes; this was applied at three different levels, e.g. daily watering, watering at three days interval and watering at five days internal. The growth parameters which include total height, collar diameter, and number of leaves were measured for a period of twelve weeks. Biomass production was also evaluated. Assessment of the growth parameters reveals that when 0.20g of NPK and 0.66kg of Urea were applied under daily watering regime, the highest mean height of 23.82 and 24.39 cm were recorded. The highest mean diameter growth (collar) of 0.32 and 0.44cm were equally observed when 0.20g of NPK and 0.66kg of Urea fertilizer were applied under daily watering regime. Also, the highest mean number of leaves was produced (6.12 and 6.72) when 0.20g of NPK and 0.66kg of Urea were applied. Biomass analysis from the study also indicates that 0.2g NPK and 0.66kg Urea gave the highest dry matter yield. Therefore, for optima production of Sterculia setigera in the nursery, 0.20g of NPK, 0.66kg of Urea and daily watering regime are recommended.

Key words: Growth response, *Sterculia setigera*, fertilizer application, water regimes.

INTRODUCTION
Sterculia setigera is a member of the family Sterculiaceae. It is an indigenous soft wood tree species of a wider ecological adaptation, even though it is widely spread in Savanna areas of the tropical West Africa (Irvine, 1991). The distribution covers Nigeria, Cameroon, Senegal, Ghana and Cote devoir. In Nigeria, the species is found in all the Savanna areas of Oyo, Osun, Ondo and Ekiti, so also in Jigawa , Pleateau, Taraba, Kaduna, Kano and Sokoto state in the Northern guinea and Sudan Savanna area (Bada and Adeyoju, 1992)

The economic importance of the species includes carving, mat making, fuel wood and medical uses (Abbiw 1990). The species is of high economic value as it has a long fibre which makes it a close substitute to long fibre pine used for pulp and paper (RMRDC, 1997). The species has suffer a neglect in terms of harnessing its full economic potentials for pulp and paper making in our local industries because plantation establishment of the species is still at infant stage in Nigeria (Ogunwusi, 1997) Therefore intensive plantation establishment of this indigenous tree species will help in boosting the supply of raw material to the concerned industries and also go a long way at salvaging the nation the huge amount of money that might be spent annually on the importation of the exotic species for pulp and paper production.

However, plantation establishment depend much on the supply of high vigour seedlings from nursery. Zeki (1995), reported that establishment of healthy trees in plantation and their management during the first phase (years) to achieve fast and early commencement of vegetative growth, have been found to be a very critical step in the life of all commercially grown species. Production of tree seedlings in the nursery depends largely among other factors, on the fertility of the nursery soil. Oni (2002) observed that soil is not uniform and a lot of variation could be observed within an area as small as one hectare. Thus a good soil that would support the plant growth should have adequate nutrient and water status. Fertilizers have been used to improve the nutrient status of the soil and also to accelerate seedlings growth in the nursery, in order to cut down the period required to obtain seedlings of transplantable size. Thus, the importance of organic and inorganic fertilizers in promoting the growth of both agricultural and forest crops cannot be over emphasized. Water plays important roles in the physiological activities of tree plants at both nursery and plantation stages. It dissolves the soil nutrients and helps in transportation of such nutrients from the soil to the other part of the plant. Water constitutes one of the basic requirements for plant growth (Dyck *et al* 1994).

Various research efforts have been made on the nutritional need of tree plant like *Terminalia ivorensis* (Aluko 1983 and 1987), *Pinus Caribbean* (Kadeba and Ajayi, 1986) *Eucalyptus sp* (Fagbenro *et al*, 1987) and various other tree species. However, there is dearth of information specifically on the nutritional requirement of *Sterculia setigera* in terms of the type of fertilizer that is most suitable and the watering regime that is most adequate for raising its seedlings in the nursery. Considering the social economic of this species, ranging from pulp and paper production, mat making, domestic use as fire wood and medical uses, hence the need for this study .The study was therefore carried out to determine the response of the species to different types of fertilizer ,the species response to different water regimes and to ascertain the appropriate or best combinations among the fertilizer types and watering regimes, required for the optimum growth of the seedlings under nursery investigation.

Experimental Site

The experiment was carried out at the West African Hardwood Improvement Project (WAHIP) nursery of the Forestry Research Institute of Nigeria (FRIN) Jericho, Ibadan. The institute is located on Latitude 7^{o} 26^{1} N and Longitude 3^{o} 54^{1} E of the equator.

MATERIALS AND METHODS

Materials used for the study include; seeds of *Sterculia setigera* which were sourced from FRIN gene bank. Other materials are Sterilized River sand, germination trays, top soil humidified propagator, NPK and Urea fertilizer, watering can, meter rule, vernier Caliper, sensitive electronic weighing balance, polythene bags, electronic oven and stationeries.

Textural class: the major nutrients composition of the potting media.

The top soil used as potting media was analyzed at the Rotas soil laboratory limited, Ring road, Ibadan. Table 1 contains the result of physical analysis of the top soil as well as its nutrient status before the commencement of the experiment. The physical analysis of the top soil shows its textural class to be sandy loam, while, Table 2 the nutrients analysis showed the nitrogen content of the top soil to be very low and pH slightly acidic. 160 seeds of *Sterculia setigera* obtained from the Forestry Research Institute of Nigeria were sown in the seed trays containing sterilized river sand. These were kept under humidified propagator to facilitate germination. After germination, 72 seedlings of good health and vigour were selected. These were transplanted into medium sized polypots (14cm x 10cm x 10cm) which have been filled with top soil. The transplanting was done at three leaf stage.

The first treatment applied were the types of fertilizer, namely NPK and urea. Each of these was applied at 4 different levels. The levels of application are as follows:
NPK (15:15:15) q_0 -0.00kg, q_1 - 0.67g, q_2 - 1.33g ,q_3 - 2.0g (each per 2kg of soil)
Urea (46:0:0) q_o- 0.00kg, q_1- 0.22kg ,q_2- 0.44 kg, q_3 - 0.66 kg (each per 2kg of soil)

The second treatment applied was watering regimes. The applications are daily watering, watering at three days interval and watering at 5 days interval.

Biomass determination: The seedlings of *Sterculia* spp planted were uprooted after the twelfth week. Seedlings were lowered in the bowl of water for easy removal of soil particles attached to the root. The uprooted seedlings were separated into root, leaf and stem and the fresh weight were taken. These were then put into labeled envelope and oven dry for 48 hours at 80^{o}c. The samples were allowed to cool down and the dry weight were taken on electronic weighing balance

Experimental Design

The experiment was conducted using 3x3x3 factorial in CRD with 3 replicate.
Table 3 showed the experimental layout.

Table 3: experimental layout

	F1 Q_o q_1 q_2 q_3	**F2** Q_o q_1 q_2 q_3
W^o	W_oq_o W_oq_1 W_oq_2 W_oq_3	W_oq_o W_oq_1 W_oq_2 W_oq_3
W^1	W_1q_o W_1q_1 W_1q_2 W_1q_3	W_1q_o W_1q_1 W_1q_2 W_1q_3
W^2	W_2q_o W_2q_1 W_2q_2 W_2q_3	W_2q_o W_2q_1 W_2q_2 W_2q_3

Where:
F_1 = NPK 15:15:15, F_2 = Urea 46:0:0
q_o = Zero level of fertilizer application (control), $q_{1=}$ 1st level of fertilizer application
q_2 = 2nd level of fertilizer application, q_3 = 3rd level of fertilizer application
W_o = 1st watering regime (normal daily watering), W_1 =2nd watering regime (3 days interval), W_2 = 3rd watering regime (5 days interval), Normal daily watering (W_o) also serves as a control experiment.
The statistical model used is
Yijk = N+ Fi + Qj + Qij + Wk + Fwik + QWjk + FQWijk + Eijk
Where :
Yijk = individual measurement of the experimental unit
N = general mean.
Fi= effect of factor F where i= 1,2----- i
Qj = effect of factor Q where j =.1,2 ---- j
Wk = effect of factor W where k = 1,2 ----k
(fw)ik = interaction effect of f and w
(Qw)jk = interaction effect of Q and w
(fQw)ijk = interaction effect of f, Q and w
Eijk = error associated with the individual measurement
The fertilizer were thoroughly mixed with soil and allowed to dissolve before transplanting
Three watering regimes were applied to each block which was replicated 3 times. The watering regimes that were used are W_o : daily watering , W_1 :Watering once in 3 days, W_2 :Watering once in 5 days .

Collection Of Data

The following parameters were assessed fortnightly.

- **Shoot height**: this was measured in centimeters from the surface of the potting mixture to the terminal bud of the seedlings using a graduated ruler.
- **Number of leaves**: Total numbers of leaves per seedlings were visually counted.
- **Collar diameter**: this was measured using a venire caliper graduated in millimeters
- **Leaf area**: fully matured leaves plucked from the seedlings were traced on a graph sheet graduated in square centimeter and the area was determined by counting the number of complete squares in the area covered by the leaf.

Growth Parameter

The growth parameters of the seedlings of *Sterculia setigera* investigated in this study are total height colar diameter and leaf number.

Total Heights

The total heights of *Sterculia setigera* seedling were not significantly affected by the type of fertilizer used, the interactions between fertilizer type and watering regimes, as well as interaction between the fertilizer levels and watering regimes. However, fertilizer levels, watering regimes and interaction between fertilizer type and level of application as well as interaction between fertilizer type, level of applications and watering regimes had a marked effect on the total height of the seedling (Table 4). Though not significant different, when urea was used, the mean total height was 24.39c, compared to 23.8cm obtained when NPK was used. In term of fertilizer levels, the highest mean height of 26.83cm was recorded when q3(2.0g NPK and 0.66kg urea) of the fertilizers was applied, followed by 24.23cm, 2.05 cm and 22.32cm obtained when 1.33g 0.44kg 0.67g, 0.22kg and 0.00kg, 0.00kg of the fertilizer were applied respectively. Under varying moisture conditions, seedling that are watered daily gave the highest mean height of 26.68cm, followed by 24.10cm and 21.55cm obtained when watering was done once in 3 days and 5 days respectively. The graphical illustrations of the growth rate of seedlings for the period of 12-weeks were shown in figure 1, 2 and 3. in Figure 1, the initial height of seedling raised with urea was higher but, at the sixth week to the end of the twelveth week the difference was not marked. In 2, though all the fertilizer levels enhanced the height of the seedling, the influence was much felt on seedling raised with 2.0g 0.66kg of the fertilizer. The total height growth rate as shown in figure 3, showed that daily watering enhanced the growth of the seedling most.

Collar Diameter

Analysis of variance computed in table 4 showed that both NPK and urea had significant effect on the colar diameter of the seedlings. Also, the colar diameter of the seedling differed significantly ($p<0.01$) with variations in fertilizer levels, watering regimes and their interactions. However, the interactions between the fertilizer type, levels of application as well as the three watering regimes does not significantly influence colar diameters of the seedlings. Between the two fertilizers used, seedlings raised with urea have better diameter growth with the mean value of 0.44cm per seedling (Table 2, fig 4). When the fertilizer level was varied, the best diameter growth (0.42cm) was observed in seedlings raised with 2.0g, 0.66kg of the fertilizer, followed by 0.38cm, 0.36cm and 0.35cm obtained when 1.33g, 0.44, 0.67g, 0.22kg, and 2.0g 0.66kg of the fertilizer was applied per pot (table 5 , figure 5). However, the last three values were not significantly different (at 5% probability level). In terms of watering regimes, seedlings watered daily had the best diameter growth with mean value of 0.39cm, followed by 0.37cm and 0.35cm obtained when watering was done once in

3 and 5 days respectively (Table2). Meanwhile, the watering regimes on the colar diameter was not distract until the sixth week (Fig 6)

Number Of Leaves

Leaf production varied significantly ($p<0.01$) with difference in fertilizer and their level of application as well as watering regimes. Also the interactions between different levels of fertilizer application and watering regimes and, interactions between fertilizer types, level of application and watering regimes had significant effect on leaf production per seedling of *Sterculia setigera* (Table 4)

Table 4: Analysis of variance of the growth parameter of the seedlings of *Sterculia setigera*

Sources of variation	Degree of freedom	Means of squares	F ratio	Significant level
Total height				
Fertilizer type (FT)	1	35.0208	0.9750	ns
Fertilizer level (FL)	3	422.9816	11.7764	**
Watering regime (WR)	2	949.6792	26.4403	**
FT x FL	3	198.4663	5.5256	**
FT x WR	2	43.6002	1.2139	ns
FL x WR	6	59.0303	1.6435	ns
FT x FL x WR	6	173.3208	4.8255	**
Error	48	35.9179		
Total	71			
COLAR DIAMETER				
Fertilizer type (FT)	1	1.5672	83.6269	**
Fertilizer level (FL)	3	0.0914	4.8759	**
Watering regime (WR)	2	0.1004	5.3558	**
FT x FL	3	0.0667	3.5576	**
FT x WR	2	0.1241	6.6239	**
FL x WR	6	0.0729	3.8912	**
FT x FL x WR	6	0.0131	0.6968	ns
Error	48	0.0187		
Total	71			
LEAF NUMBER				
Fertilizer type (FT)	1	39.1204	9.9930	**
Fertilizer level (FL)	3	85.3889	21.8120	**
Watering regime (WR)	2	73.2153	18.7024	**
FT x FL	3	9.2994	2.3755	*
FT x WR	2	5.8495	1.4942	**
FL x WR	6	22.4005	5.7221	**
FT x FL x WR	6	11.0100	2.8124	ns
Error	48	3.9148		
Total	71			

*= significant at 5% probability level
**= significant 1% probability level
ns = not significant

Like in total height and colar diameter, seedlings with urea had higher mean number of leaves per seedling (6.72) (Table 2). This difference became more pronounced in the fourth week to the end of the twelveth week (Fig 7). When the fertilizer levels was varied, the

highest mean number of 7.66 leaves was produced per seedling raised with 2.0g 0.66kg of the fertilizer, followed by 6.46 and 5.81 and leaves per seedling raised with 1.33g, 0.44kg, and 0.67g, 0.22kg of the fertilizer respectively. The least number of 5.74 was obtained on seedlings, raised with 0.67g, 0.22kg (Table 5).

Table 5: Mean values of the growth parameter of the seedlings of *Sterculia setigera*

	Mean values		
Variables	Total height (cm)	Colar diameter (cm)	Leaf number
Fertilizer type			
NPK	23.82 a	0.32 a	6.12a
Urea	24.39 a	0.44b	6.72b
Fertilizer level			
q_o	22.32a	0.35a	5.74 a
q_1	23.05 ab	0.36a	5.81 a
q_2	24.23 b	0.38a	6.46 b
q_3	26.83c	0.42b	7.66c
Watering regimes			
Daily			
Once in 3 days	26.68a	0.39a	6.90 a
Once in 5 days	24.10b	0.37b	6.76 a
	21.55c	0.36 b	5.60 b

Note: Means with the same letter under the same column are not significant different from each other.

However, while leaf was more pronounced in seedlings raised with 2.0g, 0.66kg of the fertilizer throughout the 12 weeks of assessment, it was not significant among seedlings raised with 0.00kg , 0.00kg, 0.67g, 0.22kg, and 2.0g, 0.66kg of the fertilizer because more significant (fig 8). Under different watering regimes, there was no significant difference in leaf number per seedling watered daily and once in 3-days despite the highest mean value of 6.90 obtained when watering was done once in 5-day. However, the rate of the leaf production per seedling was not marked until the fourth week when seedlings were watered daily and once in 3 days became distinct from those watered once in 5 days (Fig 5).

Biomass Production

The biomass production in the seedling of *Sterculia setigera* evaluated in this study are leaf dry weight, stem dry weight, root dry weight and total biomass.

Leaf Dry Weight (LDW)

The types of fertilizer used, level of application as well as the watering regimes significantly affect ($p < 0.01$) the dry weight of the leaves of *Sterculia setigera*. Also significant are the interactions between fertilizer types and their levels, fertilizer types and watering regimes, level of fertilizer application and watering regimes, as well as the interaction between the type of fertilizer used, level of application and the watering regimes (Table 5 and 6)

The mean values in Table 7 showed that seedlings raised with urea produced higher leaf dry weight of 1.91g per seedling compared to 1.10g produced when NPK was applied. With varying level of fertilizer applications, seedlings raised with 2.0g, 0.66kg of the fertilizer had the highest mean LDW value of 2.85g, followed by seedling raised with 1.33g, 0.44kg, and 0.67g, 0.22kg of the lowest mean value of 0.55g was obtained per seedling raised with 0.00kg, 0.00kg of the fertilizer.

The graphical illustration in figure 10 showed that the responded positively to leave dry weight, but the difference between the two fertilizers was not marked except in seedling raised with 2.0g, 0.66kg of the fertilizer where the leaf dry weight of per seedling raised with urea was more than doubled those raised with 2.0g, 0.66kg of NPK fertilizer.

Stem Dry Weight (SDW)

The stem dry weight of *Sterculia setigera* seedling were significant influenced ($p<0.01$) by the fertilizer type, level of application and watering regimes. Similarly, the interactions between the fertilizer types and their level of fertilizer type and watering regimes , as well as the interactions between fertilizer type, level of applications and watering regimes had significant effect ($p<0.01$) on the stem dry weight per seedling (table 6)

Meanwhile, the seedlings raised with urea had higher stem dry weight with mean value of 1.04g per seedlings. Also, there was variation among seedlings raised with different levels of the fertilizer (Table 7). The highest means of 1.10g was obtained where q_3 of the fertilizer per applied. This was closely followed by 0.86g and 0.78g per seedling raised with 1.33g, 0.44kg and 0.67g, 0.22kg of the fertilizers respectively. The least value, 0.68g was obtained per seedling raised with 0.00kg, 0.00kg of applied urea enhanced stem dry weight more than NPK particularly when 2.0g, 0.66kg of the fertilizer was applied (fig 11)

Meanwhile, when the watering regime was varied, seedlings watered daily had the highest stem dry weight of 1.23g. The value was significant when compared with the mean stem dry weight of 0.67g per seedling watered once in 3 and 5 day (Table 7)

Stem Dry Weight (SDW)

The stem dry weight of *Sterculia setigera* seedling were significant influenced ($p<0.01$) by the fertilizer type, level of application and watering regimes. Similarly, the interactions between the fertilizer types and their level of fertilizer type and watering regimes , as well as the interactions between fertilizer type, level of applications and watering regimes had significant effect ($p<0.01$) on the stem dry weight per seedling (table 6). Meanwhile, the seedlings raised with urea had higher stem dry weight with mean value of 1.04g per seedlings. Also, there were variations among seedlings raised with different levels of the fertilizer (Table 7). The highest means of 1.10g was obtained where q_3 of the fertilizer per applied. This was closely followed by 0.86g and 0.78g per seedling raised with 1.33g, 0.44kg and 0.67g, 0.22kg of the fertilizers respectively. The least value, 0.68g was obtained per seedling raised with 0.00kg, 0.00kg of applied urea enhanced stem dry weight more than NPK particularly when 2.0g, 0.66kg of the fertilizer was applied (fig 11)

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Table 6: Analysis of biomass production in seedling of *Sterculia setigera*

Sources of variation	Degree of freedom	Means of squares	F ratio	Significant level
LEAF DRY WEIGHT				
Fertilizer type (FT)	1	11.9479	523.552	**
Fertilizer level (FL)	3	17.2921	757.732	**
Watering regime (WR)	2	22.9734	1006.684	**
FT x FL	3	22.4058	981.812	**
FT x WR	2	4.0074	175.604	**
FL x WR	6	6.4067	280.739	**

FT x FL x WR	6	9.2277	404.354	**
Error	48	0.0228		
Total	71			
STEM DRY WEIGHT				
Fertilizer type (FT)	1	2.4494	2013.224	**
Fertilizer level (FL)	3	0.5761	473.525	**
Watering regime (WR)	2	2.4902	2046.714	**
FT x FL	3	4.3754	3596.198	**
FT x WR	2	2.8948	2379.289	**
FL x WR	6	3.2777	2693.997	**
FT x FL x WR	6	3.0472	2504.578	**
Error	48	0.0012		
Total	71			
ROOT DRY WEIGHT				
Fertilizer type (FT)	1	22.1090	183.9897	**
Fertilizer level (FL)	3	10.1946	84.8385	**
Watering regime (WR)	2	4.7536	39.5593	**
FT x FL	3	15.8676	132.0488	*
FT x WR	2	6.8338	56.8704	**
FL x WR	6	4.9768	41.4168	**
FT x FL x WR	6	7.5664	62.9667	**
Error	48	0.1206		
Total	71			
TOTAL DRY BIOMASS				
Fertilizer type (FT)	1	69.7577	1898.457	**
Fertilizer level (FL)	3	150.7664	4348.043	**
Watering regime (WR)	2	27.1450	738.750	**
FT x FL	3	30.6825	835.024	*
FT x WR	2	41.0065	1115.993	**
FL x WR	6	6.8627	186.770	**
FT x FL x WR	6	13.4459	365.931	**
Error	48	0.036744		
Total	71			

** = significant at 1% probability level

Between the two fertilizer, seedling raised with urea had higher mean root dry weight of 2.09g compared with 0.98g obtained when NPK was used (Table 7). Among the four fertilizer levels seedlings raised with q_3 of fertilizers (0.20g NPK and 0.66kg Urea) had the highest mean root dry weight of 2.50g per seedling followed by 1.69g and 1.22g obtained per seedling raised with 1.33g 0.44kg and0.67g, 0.22kg of the fertilizer respectively

The least, 0.73g, root dry weight per seedling was obtained when 0.00kg, 0.00kg of the fertilizer was applied (Table 7). In Figure 12, the root weight per seedling raised with urea was visibly higher than those raised with NPK. It became most pronounced when 2.0g, 0.66kg of the fertilizer was compared. The variation in watering regimes also had significant effect on mean root dry weight of *Sterculia setigera*. Seedling watered once in 5 days had highest mean value of 1.86g per seedling though not significantly differentiated from 1.71g obtained when watering was done once in 3 days. The least mean value of 1.03g was obtained in seedling watered daily (Table 7)

Total Dry Biomass

In Table 4, analysis of variance showed that both fertilizer type and level of application as well as watering regimes had significant effect ($p<0.01$) on total dry biomass of the seedlings. Similarly, the interactions between fertilizer type and level of application, fertilizer type and watering regimes and, between fertilizer levels and watering regimes as well as the interactions between fertilizer type, level of application and watering regimes (Table 7). Between the two fertilizers, seedlings raised with urea had higher total dry biomass, 4.69g per seedlings compared with 2.72g per seedling raised with NPK. Among the four fertilizer level 2.0g 0.66kg of the fertilizer produced the highest mean total dry biomass of 7.83g per seedling followed by a distance 3.76g and 2.52g obtained when 1.33g, 0.44kg and 0.67g, 0.22kg of the fertilizer was applied respectively. The least, 0.96g TDB was obtained when 0.00kg, 0.00kg of the fertilizer was applied. The difference between the seedlings raised with urea and NPK was most pronounced when the fertilizers was compared (fig 13)

Under the three moisture conditions daily watering enhanced the total biomass most with the mean value of 4.83g per seedling followed by 3.56g and 2.72g obtained in per seedling watered once in 5 days and 3 days respectively (table 7)

Means values of the biomass production in the seedlings of *Sterculia setigera*

	Mean values			
Variables	Leaf dry weight (g)	Stem dry weight (g0	Root dry weight (g)	Total dry biomass (g)
Fertilizer type NPK Urea	 1.10a 1.91b	 0.67 a 1.04b	 0.98a 2.09b	 2.72a 4.69b
Fertilizer level q_o q_1 q_2 q_3	 0.55a 1.10b 1.51c 2.85d	 0.68a 0.78b 0.86c 1.10d	 0.73a 1.22b 1.69c 2.50d	 0.96a 2.25 b 3.76 c 7.83 d
Watering regimes Daily Once in 3 days Once in 5 days	 2.61 a 1.13b 0.76c	 1.23a 0.67b 0.67b	 1.03a 1.71b 1.86b	 4.83a 2.25b 3.56c

Note: Means with the same letter under the same column are not significant different from each other.

Correlation Analysis Of Growth Parameters And Biomass Production

The correlation analyses employed in this study to test the degree of relationship between the parameter investigated indicated that significant relationship existed between the growth parameters (total height , colar diameter and leaf number in one hand and between dry weight parameter (leaf, stem, root and total biomass) on the other hand. For example in Table 8 when the parameters was compared, it was discovered that the best relationship(40.5%) existed between the total height of the seedlings and their colar diameters as against 31.5% and 27.5% correlation that existed between total height and leaf number, and colar diameter and leaf number respectively

Similarly, when the biomass production parameters were compared, it was discovered that there were significant correlation among the parameters. When ranking was done, the correlation between root dry weight and total dry biomass ranked highest contributing 20.5% f the total, followed by 20.1% that existed between leaf dry weight and total biomass. The least correlation, 11.5% was observed between stem dry weight and leaf dry weight.

: Correlation analysis of the growth parameter of the seedlings of *Sterculia setigera*

Growth parameter	Total height	Colar diameter	Leaf number
Total height		0.45*	0.35*
Colar diameter	40.5%		
Leaf number	31.5%	27.5%	0.31*

* = significant at 5% probability level

Table 9: Correlation analysis of the biomass production in the seedlings of *Sterculia setigera.*

	Variables			
Variables	LF-DR-WT	ST-DR-WT	RT-DR-WT	T-DR-WT
LF-DR-WT		0.55*	0.93*	0.96*
ST-DR-WT	11.5%		0.63*	0.72*
RT-DR-WT	19.5%	13.2%		0.98*
T-DR-WT	20.1%	15.1%	20.5%	

CONCLUSION

It has been the aim of this study of determine the growth response of *Sterculia setigera* seedlings to NPK (15:15:15) and Urea (46:0:0) with varying levels of application and watering regimes. Bearing in mind that the success of any plantation establishment is to a great extent dependent on the availability of healthy and vigorously growing transplantable seedlings raised in suitable potting medium, this goal remained clear throughout this study.

The findings from this study showed that nursery seedlings of *Sterculia setigera* a seedlings responded positively to urea ad NPK fertilizer. Accordingly both fertilizer types enhanced the growth parameters and biomass production yields differently. Under varing fertilizer levels, the best growth parameter, total height (26.83cm) colar diameter (0.45cm) and leaf number (7.66) and their dry weight; leaf (2.85g), stem (1.10g), root (2.50g) and total biomass (7.83g) per seedling was observed when NPK and urea levels were raised to 0.20g and 0.66kg per pot respectively.

Between the two fertilizers, seedlings raised with urea performed better throughout the twelve weeks period of assessment especially, when seedlings raised with 0.20g of NPK and 0.66kg of urea fertilizers was compared.

Lastly, at varying watering regimes, *Sterculia setigera* seedlings performed best when watering was done daily.

RECOMMENDATIONS

Consequent upon the findings and conclusions drawn from this study, the following recommendations are made;

- Preference should be given to urea over NPK fertilizer in raising seedlings of *Sterculia setigera*
- 0.66kg of urea (46:0:0) should be applied for pot to ensure maximum growth and biomass production
- Where urea is not available, 0.20g of NPK should be applied instead.
- Watering of the seedlings of *Sterculia setigera* seedlings should be carried out daily.
- Further research on the appropriate level of NPK and urea for raising seedlings of *Sterculia setigera* should be encouraged. However, the application rate should be above 0.2g of NPK and 0.66kg of urea. This is with the aim the ascertaining of optimal level of these fertilizers for raising the seedlings of *Sterculia setigera.*

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