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Original Article

Growth Performance of Sterculia setigera (Del.) to Different Organic Manures

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ABSTRACT

A nursery experiment was conducted to evaluate the effect of organic manures on the growth and development of Sterculia setigera (Del.). One hundred and sixty viable seeds were collected from Sterculia setigera tree around Federal College of Wildlife Management Estate, New Bussa, Nigeria. Each soil treatment of 40 kg was thoroughly mixed with 1 kg of each of different organic manure and filled into ten polypots. Ten seeds of S. setigera were sown in each polypot and later thinned to three after sprouting. The experiment was laid in a Completely Randomized Design with four treatments consisting of poultry droppings (T1), cow dung (T2), goat droppings (T3) and top soil only (T4) as control. The experiment was replicated four times. The polypots were watered twice daily and data taken fortnightly for three months. The parameters measured included germination rate, seedling height, number of leaves, and collar girth. Results were analysed using one-way ANOVA. Results showed that the overall performance of S. setigera seedlings were not significantly affected by organic manures at $p \leq 0.05$. Soil treated with poultry droppings had highest germination rate (86%) and seedling height of 18.6 cm. Poultry droppings had the highest mean number of leaves (12) and highest mean collar girth of 3 cm with cow dung. Goat droppings and top soil bot had mean value of 2 cm of collar girth. Goat droppings did not perform optimally as it had the lowest mean germination rate (53%) and leaf count (8.4). The use of organic manure to improve growth performance of seedlings should be encouraged though, using poultry and cow-dung for S. setigera may be better than others.

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INTRODUCTION

Production of tree seedlings in the nursery depends largely among other factors, on the fertility of the nursery soil (Aiyeloja and Azeez, 2010). Timber seedlings have varied needs for nutrients and the demand for a particular element or nutrient affects the growth requirements of the species in question (Kraiser *et al.*, 2011). A healthy seedling must be supplied with all the nutrients in the proper proportion for efficient growth and development (Craven *et al.*, 2006). Soil amendments of forest nursery usually with organic matter has been reported to promote seedling quality (Afa *et al*., 2011) and this may lead to production of high-quality planting stock.

Although many studies had been carried out by different authors to assess the effect of inorganic and organic fertilizers on the growth and development of different kinds of tree seedlings in the nursery, unfortunately little is known on the nutritional requirement of *S. setigera* in terms of the type of fertilizer that is most suitable and adequate for raising its seedlings in the nursery (Aiyeloja and Azeez, 2010). Therefore, this study was carried out to examine the performance of *S. setigera* seed under different organic manure and to determine which of the organic manure is most suitable for the growth and development of *S. setigera*.

MATERIALS AND METHODS

Study Area

The study was carried out at the Federal College of Wildlife Management, New Bussa, Nigeria. It is located on latitude 7^0 and 31^1 N and longitude 4^0 and 3^1 E. It is situated in the Guinea savanna area of the Kanji Lake Basin, New Bussa, Niger State, Nigeria.

Method of Data Collection

One hundred and sixty (160) viable seeds of *S. setigera* were collected from mature tree in the Federal College of Wildlife Management (FCWM), New Bussa, Nigeria, Organic manures (poultry droppings - T_1; cow dung - T_2; and goat droppings - T_3) were collected from the Research and Teaching Farm of the College. Topsoil (control T_4) was collected from the floor of the natural forest around the College. The topsoil was analysed to determine its physical and chemical properties (*Table 1*). Forty (40) kilograms of topsoil was thoroughly mixed with 1 kg of each of the organic manure and replicated four times. Ten seeds of *S. setigera* were planted in each polypot which was later thinned to three and watered twice daily. Data on the growth and development were taken fortnightly (2 weeks interval) for a period of three months.

The parameters measured for the ten plants in each polypot were germination rate, seedling height, number of leaves and collar girth. Germination rate was determined by physical counting, seedlings heights were measured from ground level in pot to the shoot tip using ruler (cm), collar girth of the stems were measured at the plant - soil base level using analog veneer caliper (cm) while the number of leaves produced by seedlings were done by visual count. The experiment was laid in a Completely Randomized Design (CRD). Results obtained were analysed using one-way ANOVA and significant mean difference were separated at $p \leq 0.05$.

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RESULTS AND DISCUSSION

Physical and Chemical Characteristics of the Soil Used

Table 1 shows the analyzed physical and chemical characteristics of top soil collected from the floor of the natural forest around the College.

Table 1: Physical and chemical characteristics of soil used

Parameters	Value
Sand (g/kg)	553.40
Silt (g/kg)	136.65
Clay (g/kg)	310.00
Textural Class	Sandy loam
pH	6.60
Organic matter (%)	2.56
Na (ppm)	8.15
K (ppm)	5.70
Fe (ppm)	58.25
Zn (ppm)	0.85
Mg (ppm)	68.75

Germination Rate

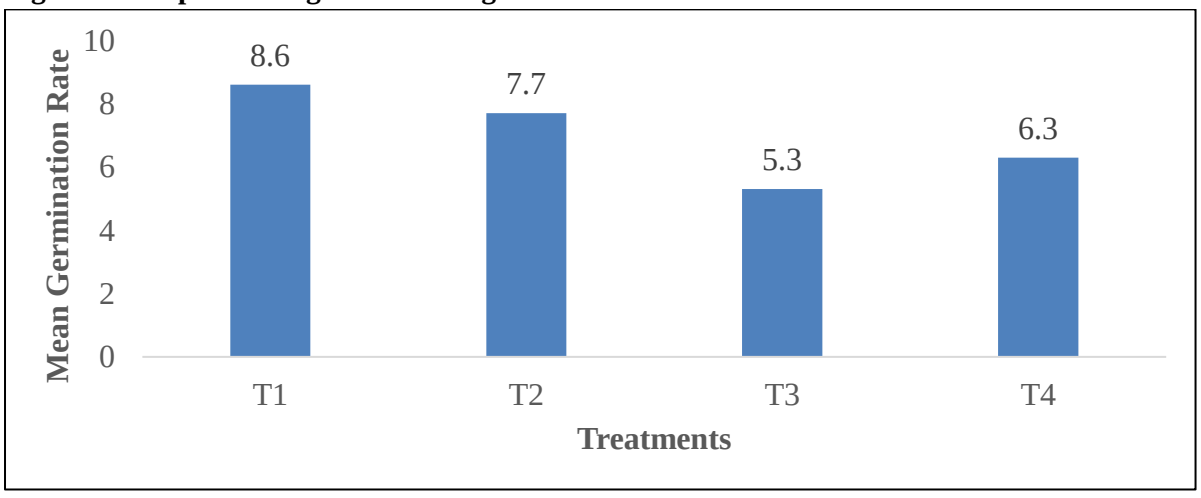
The germination rate of *S. setigera* seedlings were not significantly affected by the organic manure (*Table 2*). The F-cal 1.63 is less than F-tab 3.49, which means the germination rate of the plant is not significantly affected by the various organic manures used. The mean germination rate ranged from 5.3 to 8.6 as seen in *Figure 1*. After three months (12 weeks) of the study, the results obtained from poultry droppings (T_1) showed that it had the highest germination rate of 8.6 followed by cow dung T_2 (7.7). The control (T_4) obtained a mean germination rate of 6.3 while goat droppings (T_3) did not perform optimally. It obtained the lowest mean germination rate of 5.3. Among the various organic manures used, T_1 was observed to be the most suitable as *S. setigera* seeds sprouted faster when it was applied.

Table 2: Analysis of Variance for Germination Rate of *S. setigera*

Source of variation	Df	Sum of square	Mean of square	F-cal	F-tab	Decision
Treatment	3	1.32	0.44	1.63	3.49	Ns
Error	12	3.22	0.27			
Total	15	4.54				

ns= not significant at 5% probability

Figure 1: Graph showing variation in germination rate in relation to treatments



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At the end of the experiment (12 weeks), the height of *Sterculia setigera* was considerably increased with the application of poultry manure (18.6 cm) compared to the application of other organic manures (*Figure 2*). This result is similar to the findings of Imoro *et al.* (2012) who reported a trend of increases in seedling length with increasing proportion of poultry dung in the soil. Akanbi *et al*, (2013) in his work on the growth response of cashew seedlings to applied organic fertilizers of animal and plant origin on a degraded soil in Ibadan, South-West, Nigeria also reported that organic fertilizers significantly increased plant heights but with poultry droppings recording the highest values compared to others.

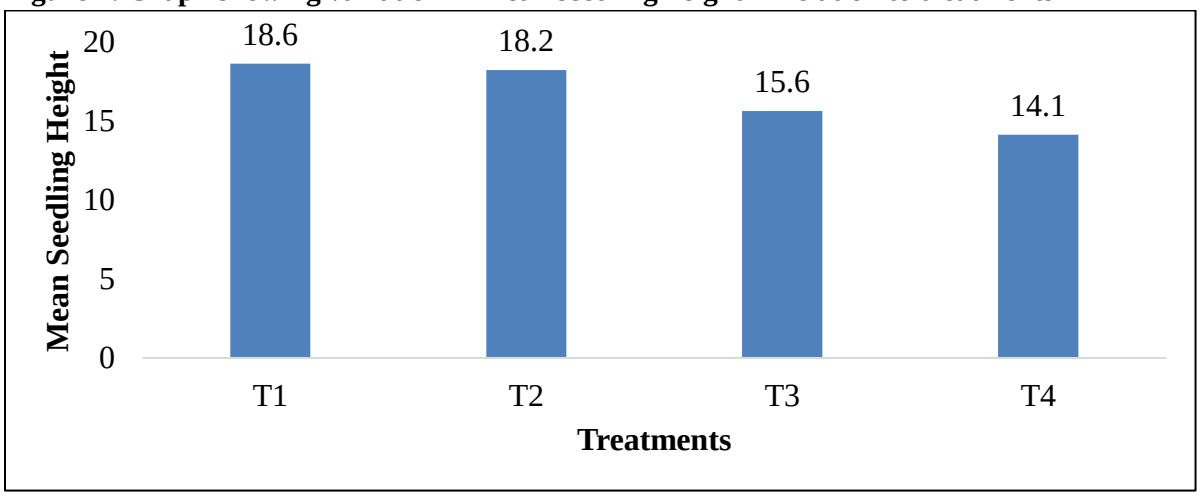
Cow dung (T_2) was also found to be a comparable alternative. A mean seedling height of 18.2 cm was observed at the end of the experiment. Goat droppings (T_3) had a mean seedling height of 15.6 cm while control (T_4) had the lowest mean seedling height of 14.1 cm (*Figure 2*). However, the seedling height of *S. setigera* seedlings were not significantly affected by the organic manures used (*Table 3*). This is evident in *Figure 2* with the mean seedling height readings close to each other, ranging from 14.1 cm to 18.6 cm. This conforms to the report of Aiyeloja and Azeez (2010) who noted that the total heights of *S. setigera* seedlings were not significantly affected by the type of fertilizer used. Yakubu *et al.* (2015) also obtained a similar result for *Vitellaria paradoxa*. The authors reported that there was no significant difference in seedling height growth of *V. paradoxa* at 5% level of probability when different fertilizers were used. Other authors obtained similar results, for example, Bechem *et al.* (2013) reported that fertilization of *Terminalia superba* resulted to shoot height increment but the difference was not significant for all the nutrient additions.

Table 3: Analysis of Variance for Seedling Height of *S. setigera*

Source of variation	df	Sum of square	Mean of square	F-cal	F-tab	Decision
Treatment	3	56.25	18.75	0.855	3.49	Ns
Error	12	263.33	21.94			
Total	15	319.58				

ns= not significant at 5% probability

Figure 2: Graph showing variation in mean seedling height in relation to treatments



Number of Leaves

The ANOVA result shows that the number of leaves of *S. setigera* seedlings after the experiment were not significantly affected by the organic manure used (*Table 4*). This result is in conformity with the work done by Yakubu *et al.* (2015) who also observed that there was no significant difference at 5% probability level by the fertilizers used in leaf production among treatments and control samples of *V. paradoxa.* Bechem *et al.* (2013) also noted that fertilization

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had no significant effect on number of leaves for *Entandrophragma angolensis.*

At the end of the experiment, it was revealed that poultry droppings (T_1) had the highest mean number of leaves (12), followed by cow dung T_2 (11.7) and control T_4 (9.6). The least was observed in goat droppings T_3 (8.4) (*Figure 3*). Among the various organic manures used poultry droppings T_1 was observed to be the most suitable for *S. setigera.* Cow dung (T_2) was also found to be an alternative to T_1. This finding supports the work done by Okunomo and Bosah (2007) who reported that the highest leaf number of *Acacia senegal* seedling was recorded under poultry droppings.

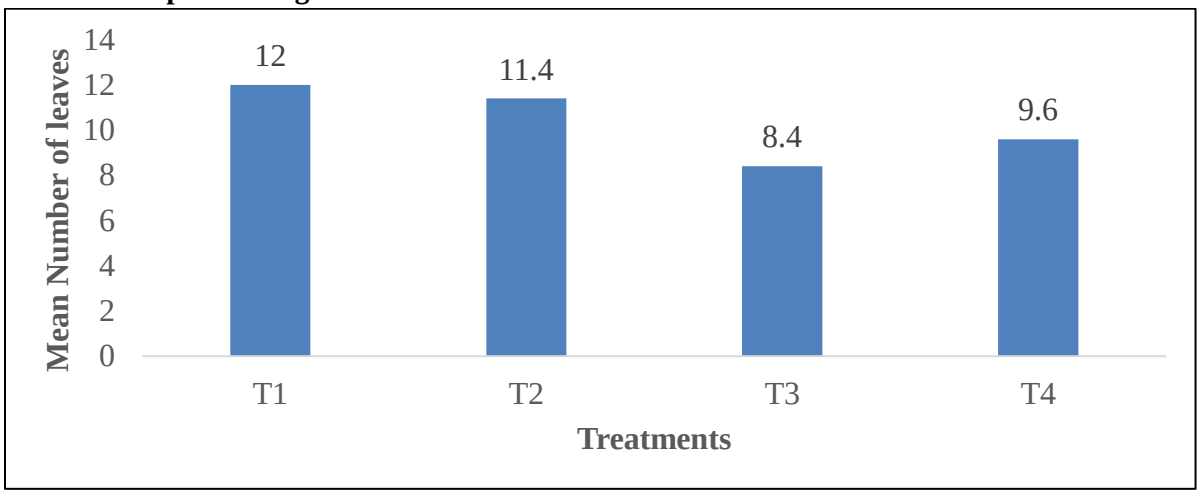
In their work on comparative effects of different fertilizer sources on the growth and nutrient content of Moringa (*M. oleifera*) seedlings in a greenhouse trial, Dania *et al*. (2014) reported increase in number of leaves of Moringa as a result of application of poultry droppings. While Akanbi *et al*. (2013) also reported a similar result that the application of poultry dropping manure and cow dung manure have positive effect on the number of leaves of cashew seedlings. According to Dania *et al* (2014) and Akanbi *et al*. (2013), this might be as a result of high nitrogen contents of the organic materials which contributed to leaf development compare to the control and this is in conformity with the work of Adejobi *et al*. (2011) which showed that organic manures increased plant height, number of leaves, stem diameters, etc.

Table 4: Analysis of Variance for number of leaves of *S. setigera*

Source of variation	df	Sum of square	Mean of square	F-cal	F-tab	Decision
Treatment	3	1.56	0.52	1.182	3.49	Ns
Error	12	5.23	0.44			
Total	15	6.79				

ns= not significant at 5% probability

Table 5: Graph showing variation in number of leaves in relation to treatments



The collar girth of *S. setigera* seedlings were not significantly affected by the organic manure used (*Table 5*). Bechem *et al.* (2013) also observed similar result, he noticed that *E. angolensis* did not show any significant gain (p = .57) in collar diameter following addition of nutrients at all concentrations. But it is apparent that the application organic manures especially the poultry droppings had positive effect on the collar girth increment.

Figure 4 reveals that at the end of the 12 weeks of the experiment both poultry droppings (T_1) and cow dung (T_2) had the highest mean collar girth of 3 mm respectively. This was followed by goat droppings (T_3) and control (T_4) with a mean collar

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girth of 2 mm respectively. Among the various organic manures used poultry droppings (T_1) was observed to be the most suitable. Uddin *et al.* (2012), Akanbi *et a*l (2013) and Dania *et al* (2014) obtained similar results; they reported that the application of poultry droppings and cow dung had significant effect on the increment of collar diameter in *L. leucocephala,* cashew and moringa seedlings respectively. These works agree with the findings of Stoffella *et al.* (1997) who reported that organic manure can serve as soil amendment to improve soil nutrient status and the growth and development of plants.

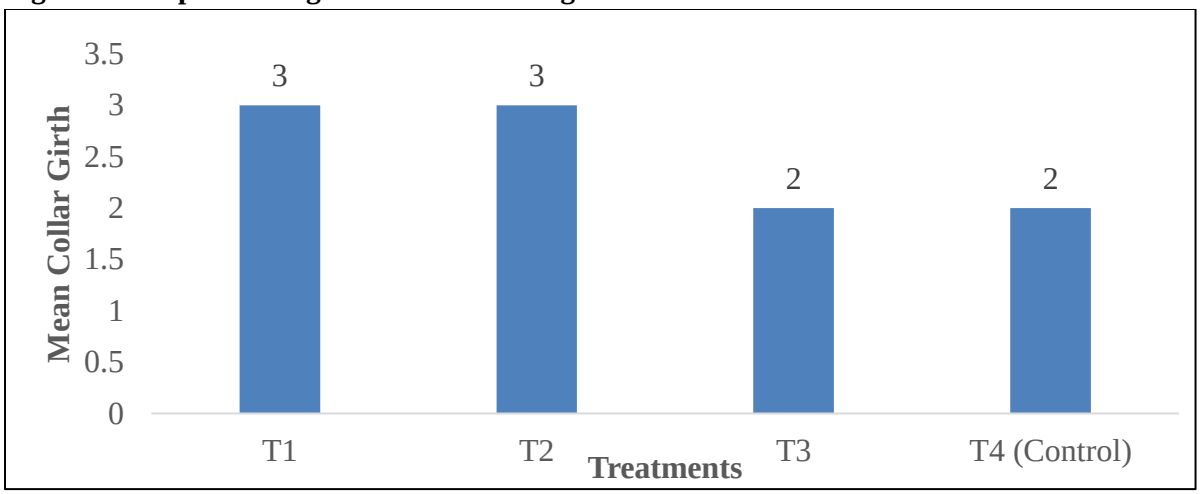
Study by Okunomo and Bosah (2007) reported that poultry droppings have the highest performance on *Acacia senegal* with a mean value of 0.95 cm. However, he noticed no significant difference in collar girths among various treatments.

Table 6: Analysis of Variance for Collar Girth of Sterculia setigera

Source of variation	df	Sum of square	Mean of square	F-cal	F-tab	Decision
Treatment	3	0.04	0.013	2.60	3.49	Ns
Error	12	0.06	0.005			
Total	15	0.1				

ns= not significant at 5% probability

Figure 3: Graph showing variation in collar girth in relation to treatments



CONCLUSION

This study has revealed the result of different organic manure applied to *Sterculia setigera*. The result of the investigation shows that there was no significant different in the germination rate, shoot height, leaf count and collar diameter. However, T_1 (poultry droppings) was considered as the most appropriate organic manure to use. This is because of the relative high value recorded in the germination rate, shoot height, leaf count and collar diameter when T_1 was used. T_2 (cow dung) was considered to be a comparable alternative as it also recorded fairly highly. T_3 (goat droppings) was observed to have the least effect on *Sterculia setigera.* The poor performance of T_3 (goat droppings) may probably be due to its low mineralisation which make its availability to the roots of the plant difficult.

RECOMMENDATIONS

Based on the findings of this study, it is therefore recommended that poultry dropping which has shown to be very promising should be incorporated as organic amendments to the soil for the growth of *Sterculia setigera* in the nursery. Government and non-governmental organizations should fund independent studies on *S. setigera* as the available literature for this species are not only limited but shallow.

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