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Effects of Pulverized Compost Materials and Composting Durations on Early Growth of Savannah Mahogany *Khaya senegalensis* (Desr.) A. Juss in a Semi-Arid Ecosystem of Nigeria

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Abstract

The study was carried out in the Nursery of the Department of Forestry and Wildlife, University of Maiduguri, Nigeria, to assess the effects of pulverized compost materials (PCM) and composting durations on the early growth of *Khaya senegalensis* in Maiduguri, Nigeria. Leaves of *Azadirachta indica*, *Gmelina arborea*, *Eucalyptus camaldulensis* and *Arachis hypogea* were collected within the premises of University of Maiduguri. The leaves were sundried and pulverized before buried for 30, 60, and 90 days at the depth of 45cm and grouped into (M1-M5). Viable seeds sown at 3cm depth. Eighteen polythene pots arranged randomly in three replications were used for the experiment. Data were taken four weeks after sowing on stem diameter, stem height and number of leaves on weekly basis for the period of eight weeks, while root length and biomass were determined at the end of the experiment. The data collected were subjected to analysis of variance (ANOVA) using Statistix (8.0) DMRT was applied for mean separation. The result obtained from the analysis of variance revealed that PCM_5 (pulverized leaves of *G arborea*, *E camaldulensis* and *A hypogea*) at eight WAS produced the highest value (2.54mm) while PCM_1 (pulverized leaves of *A indica*, *G arborea*, *E camaldulensis* and *A Hypogea*) at five WAS had the least stem diameter value (0.88mm). T_3 (90 days composting) had the highest stem value (2.14mm) which was significantly different (P=0.05) from T_1 (30 days composting) and T_2 (60 days composting). The result obtained for stem height showed that PCM_5 (pulverized leaves of *G arborea*, *E camaldulensis* and *A hypogea*) at 12 WAS had the highest value (13.94cm) while PCM_1 (pulverized leaves of *A indica*, *G arborea*, *E camaldulensis* and *A hypogea*) at five WAS had the least stem height value (3.99cm).

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It was also observed from the result obtained on composting durations for stem height that T_3 at 12 WAS had the highest value (12.18cm) while T_2 at five WAS had the least value (4.21cm). The result obtained for number of leaves showed that PCM_5 at 12 WAS had the highest value (9.67) while PCM_1 at five WAS had the least value (2.22). It was evident from the result obtained for number of leaves that T_3 at 12 WAS had the highest value (8.50) while T_1 and T_2 at five WAS had the least value (2.50). The result obtained for root length analysis showed that PCM_5 produced the highest root length value (9.28cm) while control had the least value (5.27cm). The result obtained for biomass showed that PCM_2 pulverized leaves of *A indica, G arborea and E camaldulensis*) produced highest weight value (0.56g) while PCM_3 pulverized leaves of *A indica, G arborea* and *A hypogea*) had the least value (0.28g). T_1 had the highest value which was not significantly different (P=0.05) from T_2 and T_3. Based on these findings, it was concluded that PCM_5 at 12 WAS showed effectiveness on stem diameter, stem height, number of leaves, root length and biomass which indicates its potentials as a good source of nutrients (compost) for seedling growth and development.

Key words: Early growth; compost; pulverize; biomass; semi-arid.

1. Introduction

Compost has been variously defined as a stable aerobically decomposed organic matter that results from a controlled decomposition process or simply as a stable aerobically decomposed organic matter [1, 2] Hence, any decaying plant material that is added to soil to improve its quality is known as compost [3]. Compost is a mixture of organic matter that has decayed or has been digested by micro-organisms that is used to improve soil structure and provides nutrients. It is usually dark brown in color and has an earthy appearance [4]. Composting refers to the biodegradation process of a mixture of organic substrate by bacteria, and fungi mainly actinomycetes [5]. However, composting differs from other decomposition systems due to control in temperature and rate of decomposition [6] Compost application result in a range of environmental benefits which include improved soil health, water savings, reduction in the use of synthetic fertilizer and improved crop performances [7] The positive effects of compost on plant growth are due to its inherent capacity for nutrient supply, improve soil structure and increase soil water content [8] By supplying nutrients particularly N P K and organic matter, compost can improve plant nutrients uptake [9] (Walker and Bernal, 2008). In his work [10] reported that compost application increases plant growth and nitrogen mineralization rate, though high rates are required to meet the crop nitrogen needs. Pulverization refers to the process of reducing any substance to fragments or powdery form especially through crushing (manually or mechanically), this process reduces waiting time of composting and enhance early onset of microbial activities. Tree seedling growth and survival need to be given priority with regards to nutrient requirement, hence this research work is aimed at addressing the problems of tree seedling poor growth, development and survival. In a developing country like Nigeria, there is an exponential increase in the exploitation of the forests as demand for food, medicinal plants, timber and non-timber forest products increase with the increasing population. The critical problems of tree seedling growth and the need to reduce the waiting time for compost preparation has become necessary through pulverization of the main ingredients of the organic material particularly the foliar component. In addition, there are few literatures on the use of mixture of pulverized foliar compost for nursery seedling production and studies on the effect on early growth of *Khaya senegalensis.* Hence this research is aimed at exploring a method through which

seedlings growth of *K. senegalensis* can be enhanced through the use of pulverized foliar compost and the inherent capacity to reduce the waiting time for other productive activities on the field. The main objective of this research is to determine the effects of different mixtures of pulverized foliar compost on the early nursery growth of *K. senegalensis* and the effects of pulverized compost materials and composting durations on the early growth of *K. senegalensis.* In addition, the outcome will help future planners of plantation establishment, managers of afforestation projects and enriching literature for future reference.

2. Materials and Methods

2.1 Study area

The experiment was conducted in the Nursery of the Department of Forestry and Wildlife, University of Maiduguri from December 2017 to June 2018. Maiduguri lies within latitude 11^{o} 50'and12^{o} 05'N and longitude 13^{o}.50'and 12^{o}.20' E. of the equator. Maiduguri, the capital of Borno State occupies a total landmass of 137.36 Km^2 while the city is estimated to have a population of 1,907,600, as of 2007 [11]. Its residents are mostly Kanuri, Hausa, Shuwa, Babur/Bura, Marghi, Fulani and other ethnic groups.

2.2 Climate and Vegetation

The climate of Maiduguri is typically of dry tropical climate with distinct wet and dry season. Temperature ranges from 14.4^{o}C to 41.1^{o}C and rarely below 11.1^{o}C to 43.3^{o}C [12]. The area has an annual rainfall range of 500-700mm per annum [13] Nigerian Metrological Agency (NIMET, 2008). Maiduguri lies in the semi-arid ecological zone characterized by scattered trees and vast grassland: the grasses are seasonal they disappear during the dry season i.e. the leaf area index, an important structural property of vegetation is less than one (LAI<1) which is responsible for lack of vegetation cover mostly during the dry season and hence the negative effect on primary production [14]

2.3 Collection of Compost Sample Materials

Dried leaves of *Azadirachta indica, Gmelina arborea,Eucalyptus camaldulensis* and *Arachis hypogea* were collected within the premises of the University of Maiduguri. The collected leaves were further sundried to aid pulverization using a motorized disk refiner. One kilogram (kg) of each pulverized composting materials was used to form the materials (M_1-M_5) and the control experiment M_0. The pulverized materials were poured into polythene sacks and buried at a depth of 45cm for composting.

2.4 Procedure for Composting

Pit composting was adopted in line with Kuo (2004) procedure [15]. The pulverized foliar materials were buried at 45cm depth in December 2017-March 2018 for 30 days, 60 days and 90 days respectively. Systematically, 90-day sample was buried first followed by 60-day sample and lastly by 30-day sample. The composts were turned and added two liters of water every 15 days throughout the composting durations. At the end of the composting period, all the pulverized composts were ready and were filled into the polypots which were used to

raise the seedlings of *K senegalensis* for the experiment.

2.5 Design of Experiment

Pulverized leaves of selected species for the experiment were formed into six mixed materials (M0, M1, M2, M3, M4, M5) and buried for composting in 45cm depth pit for 30, 60 and 90 days. The mixed materials are as follow: M0 (no compost), M_1 (Ai+Ga+Ec+Ah), M_2 (Ai+Ga+Ec), M_3 (Ai+Ga+Ah), M_4 (Ai+Ec+Ah), and M_5 (Ga+Ec+Ah). Where: Ai=*Azadirachta indica* . Ga=*Gmelina arborea*. Ec=*Eucaluptus camaldulensis*. Ah=*Arachis hypogea*. The experiment comprised 15 compost pits of 45cm depth that was used for composting of 5 different composting mixed materials (M1, M2, M3, M4 and M5). The experiment was arranged in 6x3 factorial in Randomized Complete Block Design (RCBD) with three replicates i.e. six composting materials with control and three composting durations of 30, 60 and 90 days.

2.6 Seed Collection, Treatment and Sowing

The seeds were collected fresh from the mother tree within the premises of University of Maiduguri and sorted. The good ones were sown directly into the polypots. 13cm x25cm of diameter and height of polythene pots were used, they were watered twice a day (morning and evening) throughout the period of the research

2.7 Data Collection

Data on seedling growth parameters were collected for eight weeks starting from 29th April 2018 to 24th June 2018. Stem diameter (mm), stem height (cm) and number of leaves were collected and recorded on weekly bases, while root length (cm) and biomass (g) were measured and recorded at the end of the experiment.

2.7.1 Stem height (cm) and diameter(mm) measurement

The stem heights were measured using graduated meter rule from the root collar to apical bud and recorded in cm for the period of eight weeks as described by Saka and his colleagues (2016) [16]. The stem diameter was measured using digital veneer caliper. The measurement was carried out on weekly basis and recorded in mm for the period of eight weeks as described by [16].

2.7.2 Number of leaves and root length measurements

Fully expanded green leaves of the plants were physically counted and recorded on weekly basis for the period of eight weeks as described by [16]. The taproot length was measured using graduated ruler in centimeter after removing the sample plants from the polythene pot and washed to get rid of the soil the measurement was then taken.

2.7.3 Biomass estimation (g)

The sample plants were removed from the pots and the root soil was washed off before drying in an oven. They were measured in grams before inserting into the oven for drying at 75^{o}C for 48hrs [17] and measured for six

consecutive readings until there were three constant weight measures.

2.8 Data Analysis

The data obtained from the nursery were subjected to two-way analysis of variance (ANOVA) at $P<0.05$ using Statistix 8.0 analytical tool. Where significant difference exists among the means, Duncan Multiple Range Test (DMRT) was applied to separate the mean values.

3. Results and Discussion

3.1 Stem Diameter

From the result obtained, it showed that at five WAS, the control had no significant difference with PCM_1-PCM_5 likewise in six WAS. However, at seven WAS control showed no significant difference with the pulverized compost (PCM_2-PCM_5) except with PCM_1. Equally same trend was observed in seven WAS, eight WAS and nine WAS that there was no significant difference between control and PCM_{2-5} except with PCM_1. At ten WAS, there was a significant difference between control and PCM_3 and PCM_5. However, there was no significant difference between PCM_1, PCM_2, PCM_4 and the control. The result obtained at 11 WAS showed no significant difference between control and other treatments (PCM_1-PCM_4) except with PCM_5. It was observed from the result obtained at 12 WAS that there was significant difference between control and PCM_1-PCM_5. However, PCM_5 had the highest value which was significantly different from other treatments (Table 1.0). It was observed from the results that control experiment was performing better than the other treatments in the earlier weeks of data collection (5, 6, 7, 8, and 9 WAS). This trend however, changed at weeks 10, 11 and 12. This result is supported by the findings of [18] that available essential nutrients in the growth media resulted in increased seedling growth. Similarly, [19] reported in his work that compost application caused increased in diameter and plant height and the average values recorded are greater than the control. The increase in plant growth could be as a result of more nitrogen availability as composts contain the main nutrients especially high level of nitrogen, which is available to plants after decomposition. The results obtained for composting durations of 30, 60 and 90 days showed that there was no significant difference at five, six, seven, eight, nine, ten and eleven WAS except at 12 WAS where T_3 (90 days composting) had the highest value (2.14mm) which was significantly different from T_1 and T_2 (30 and 60 days composting). This result may be due to the fact that the release of nutrients from organic matter is slow, this is because the breakdown of organic matter by soil microbes is a slow process over a period of time. That is why the values obtained at 90 days composting (T_3) were higher that T_1 and T_2, although they were mostly not significantly different. The result of this findings (composting duration) is synonymous with the findings of [20] that, coarse-textured compost has little effects on soil properties and plant growth. However, medium and fine-textured composts, Nitrogen and Phosphorus availability increased over composting time while plant growth was maximum. Similarly, [21] reported that slow decomposition of organic matter is more effective in increasing soil organic matter content of the soil which plays a key role in soil fertility by retaining nutrients over a long period of time.

Table 1: Effects of pulverized compost materials and composting durations on stem diameter (mm) of *K senegalensis*

Pulverized Compost Materials (PCM)	**Weeks After Sowing (WAS)**							
	5	6	7	8	9	10	11	12
1	0.88b	0.92b	1.11b	1.22b	1.33b	1.40b	1.51b	1.78d
2	1.24a	1.30a	1.39ab	1.49ab	1.58ab	1.66ab	1.83ab	2.16c
3	1.30a	1.36a	1.48a	1.60a	1.69a	1.77a	1.86a	2.29b
4	1.14ab	1.21ab	1.34ab	1.46ab	1.53ab	1.64ab	1.76ab	2.34b
5	1.22a	1.30a	1.41a	1.54a	1.66a	1.74a	1.87a	2.54a
Control	1.14ab	1.32a	1.49a	1.67a	1.78a	1.41b	1.57ab	1.02e
SE±	0.09	0.10	0.09	0.09	0.10	0.11	0.12	0.03
Composting Durations								
30 days	1.15a	1.25a	1.38a	1.51a	1.61a	1.62a	1.70a	1.89c
60 days	1.07a	1.15a	1.32a	1.45a	1.56a	1.61a	1.77a	2.03b
90 days	1.24a	1.31a	1.42a	1.53a	1.62a	1.58a	1.72a	2.14a
SE±	0.07	0.17	0.07	0.07	0.07	0.08	0.08	0.02
PCM x T	Ns	Ns	Ns	Ns	Ns	Ns	Ns	**

*Means followed by the same letter(s) in the same column are statistically not significant using Duncan's Multiple Range Test (DMRT) **=Significant at 1% probability level, Ns= not significant. T1=30 days composting duration, T2=60 days composting duration, T3=90 days composting duration. WAS=weeks after sowing*

3.2 Stem Height (cm)

The result obtained for stem height at five WAS indicated that PCM_5 had the highest value (4.93cm) which was not significantly (P=0.05) different from other materials and the control, PCM_1 had the least stem height value (3.99cm). It was equally observed from the results obtained that there was no significant difference at six, seven, eight and nine WAS between treatments and control. At ten WAS, PCM_2 had the highest value (7.68cm) which is not significantly different from PCM_1 (6.51cm) PCM_3, (6,81cm), PCM_4 (7.60cm) and PCM_5 (7.57cm), while control had the least value (4.89cm) which was not significantly different from PCM_1 (6.51cm). At 11 WAS, the result obtained showed that PCM_2 had the highest value (10.40cm) which was not significantly different from PCM_4 (9.79cm) and PCM_5 (9.62cm). Similarly, the result revealed no significant difference between PCM_1 (8.31cm), PCM_3 (8.39cm), PCM_4 and PCM_5. Control had the least value (5.41cm) which is significantly different from all the other treatments. It is evident from the result obtained at 12 WAS that PCM_5 had the highest value (13.94cm) which was significantly different from other treatments, while control had the least value (5.18cm) which was also significantly different from the other treatments. Although there was no

significant difference between PCM_1 (12.06cm) and PCM_3 (11.54cm). The result obtained at 12 WAS also revealed that there was no significant difference between PCM_2 (10.83cm) and PCM_3 (11.54cm). This showed that at the initial stage (5-9 WAS), the nutrient released through microbial activities was very slow compared to unamend medium (control). Subsequently from 10 WAS, the nutrient was available to the sample plant up to 12 WAS, while control might have exhausted the nutrient available for the sample plant since there was no addition of compost in the control. This finding is supported by the findings of [22] that the incorporation of foliar compost in to the soil medium significantly increased the mean height of the Asontem variety. Amanullah and his colleagues (2010) [23] further stated that the increase in stem height due to application of compost could be as a result of nutrient mineralization and their availability for plant used. [24] reported a similar result in his work that the urban waste application contributes to the increase in the height growth of *Zea mady*s plants at six and eight WAS. The finding is contrary to the result observed by [16) that highest stem height was recorded on control experiment. This may perhaps be as a result of the differences in the tree species used for the experiment and indeed the pulverized compost materials used. The result obtained on composting durations showed no significant difference at five, six, seven, eight, nine, ten and 11 WAS, while at 12 WAS, 90 days composting durations (T_3) had the highest value (12.18cm) which was significantly different from T_1 (9.87cm) and T_2 (11.16cm). (Table 2.0). This indicates that 90 days pulverized composting provides nutrient available effective for plant growth, it might be due to slow activities of microorganisms on composting materials which achieved optimally at 90 days composting. This could also be attributed to the durations of composting which determine the effectiveness of microbial activities.

Table 2: Effects of pulverized compost materials and composting durations on stem height (cm) of *K. senegalensis.*

Pulverized compost materials	**Weeks After Sowing (WAS)** 5	6	7	8	9	10	11	12
1	3.99a	4.10a	4.83a	5.06a	5.47a	6.51ab	8.31b	12.06c
2	4.84a	4.99a	5.26a	6.53a	6.04a	7.68a	10.40a	10.83d
3	4.57a	4.68a	4.81a	5.41a	5.91a	6.81a	8.39b	11.54cd
4	4.30a	5.19a	5.36a	5.81a	6.49a	7.60a	9.79ab	12.83b
5	4.93a	5.07a	5.22a	5.72a	6.52a	7.57a	9.62ab	13.94a
Control	4.04a	4.43a	4.71a	5.08a	5.23a	4.89b	5.41c	5.18e
SE±	0.62	0.60	0.58	0.53	0.58	0.57	0.62	0.27
Composting Duration								
30 days	4.37a	4.57a	4.77a	5.27a	5.82a	6.67a	8.25a	9.87c
60 days	4.21a	4.78a	5.23a	5.73a	6.07a	7.19a	8.92a	11.16b
90 days	4.76a	4.88a	5.09a	5.81a	5.94a	6.67a	8.79a	12.18a
SE±	0.44	0.43	0.41	0.37	0.41	0.40	0.44	0.19
Interaction M x T	NS	NS	NS	NS	NS	NS	*	**

*Means followed by the same letter(s) in the same column are statistically not significant using Duncan's Multiple Range Test (DMRT) **=Significant at 1% probability level, *= Significant only at 5% probability level, Ns= not significant. T_1=30 days composting duration, T_2=60 days composting duration, T_3=90 days composting duration*

3.3 Number of Leaves

The result obtained from the ANOVA on number of leaves at five WAS showed that PCM_4 had the highest value (3.00) which was not significantly different at (P=0.05) from other treatments and the control, Table 3.0. At six WAS, the result obtained showed that control had the highest value (4.22) which was not significantly different at (P=0.05) from PCM_4 (3.44). It was equally observed from the result that there was no significant difference between PCM_2 (2.89), PCM_3 (3.11), PCM_4 (3.44) and PCM_5 (3.22). While PCM_1 had the least value (2.44) which was not significantly different from PCM_2 (2.89), PCM_3 (3.11) and PCM_5 (3.22). The result at seven WAS showed that control had the highest value (4.11) which was not significantly different from PCM_2 (3.00), PCM_3 (3.22) and PCM_5 (3.77), while PCM_1 had the least value (2.67) which was not significantly different from PCM_2 (3.00), PCM_3(3.22), PCM_4(2.77) and PCM_5(3.77). It was observed from the result at eight WAS that there was no significant difference at (P=0.05) between the treatments. However, PCM_2 and control have the highest value (4.33) and PCM_1 had the least value (3.67). It was also observed at nine and ten WAS that there was no significant difference between the treatments, but the control had the highest value (4.78) at nine WAS while PCM_2 had the highest value (4.67) at ten WAS. At 11 WAS, PCM_2 had the highest value (7.00) which was not significantly different from PCM_4 (5.89) and PCM_5 (6.00). Similarly, the result showed no significant difference between PCM_1 (5.22), PCM_3 (4.89), PCM_4 (5.89), PCM_5 (6.00) and the control (4.89). It was observed from the result at 12 WAS that PCM_5 had the higher value (9.67) which was significantly different from all the other treatments while control had the least value (5.33). However, the result showed that there was no significant difference between PCM_1 (7.67) and PCM_2 (8.22). This result implies that there was gradual release of nutrients to the sample plant at the initial weeks of data collection (5-10 WAS) as noticed in the performance of control compared to the treated plant. However, from 11-12 WAS the performance of the compost – applied plant was improved compared to control, this could be so due to the microbial activities that made nutrients from compost available for plant uptake. Addition of Pulverized Compost Materials had shown effectiveness on the number of leaves with regard to the control experiment especially at five, six, seven and eight WAS. The result of this study is supported by the findings of [16] that addition of supplement most especially compost to the potting mixture is necessary for tree vegetative growth and development at the early stage of growth. In contrast [25] reported that addition of either cow dung, poultry droppings or foliage to the potting mixture had no effect on the vegetative growth of *K. senegalensis* at the initial stage of growth. Similarly [20] reported that the highest number of leaves was observed on control experiment, while the seedlings treated with cow dung had the least number of leave. This could be so due to differences in composting materials used and the location of the experiment. The result obtained for composting durations showed that there was no significant difference between T_1, T_2 and T_3 at five, six, seven, eight, nine, and ten WAS. However, at 11 WAS, T_3 had the highest value (6.11) which was not significantly different from T_2 (5.89). In addition, T_1 had the least value (4.89) which was significantly different from T_2 and T_3. At 12 WAS, T_3 had the highest value (8.50) which was significantly different from T_1 (6.83) and T_2 (7.83). Similarly, the result showed that there was significant difference between PCM_1 and PCM_2 (Table 3.0). This implies that most essential nutrients in compost are in organic forms which are released gradually for plant utilization over a period of time (residual effect).

Table 3: Effects of Pulverized Compost Materials and Composting Durations on number of Leaves of *K. senegalensis*

Pulverized	**Weeks After Sowing (WAS)**							
Composting Materials	5	6	7	8	9	10	11	12
1	2.22a	2.44c	2.67b	3.67a	4.00a	3.89a	5.22b	7.67c
2	2.55a	2.89bc	3.00ab	4.33a	4.44a	4.67a	7.00a	8.22bc
3	2.33a	3.11bc	3.22ab	3.89a	4.67a	4.56a	4.89b	6.78d
4	3.00a	3.44ab	2.77b	4.11a	4.44a	3.89a	5.89ab	8.67b
5	2.67a	3.22bc	3.77ab	4.00a	4.22a	3.89a	6.00ab	9.67a
Control	2.56a	4.22a	4.11a	4.33a	4.78a	4.22a	4.89b	5.33e
SE±	0.32	0.34	0.46	0.31	0.29	0.42	0.47	0.29
Composting Duration								
30 days	2.50a	3.39a	3.06a	3.89a	4.22a	3.83a	4.89b	6.83c
60 days	2.50a	3.17a	3.22a	4.00a	4.56a	4.39a	5.89a	7.83b
90 days	2.66a	3.11a	3.50a	4.28a	4.50a	4.33a	6.17a	8.50a
SE±	0.22	0.24	0.32	0.22	0.21	0.30	0.33	0.20
Interaction								
M x T	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in the same column are statistically not significant using Duncan's Multiple Range Test (DMRT), Ns= not significant. T_1=30 days composting duration, T_2=60 days composting duration, T_3=90 days composting duration

3.4 Root Length and Biomass

It was observed from the result of analysis that PCM_4 had the highest root length value (9.29cm) which was not significantly (P=0.05) different from PCM_2 (8.40cm) PCM_3 (8.08cm) and PCM_5 (9.28cm). It was also observed from the results that there was no significant difference (P=0.05) between PCM_1 (6.19cm), PCM_3 (8.08cm) and control (5.27cm). This result could be as a result of addition of compost that stimulates the growth of the root which was absent in the control as shown in Table 4.4. Similar result was obtained from the findings of [26] that there was significant difference observed from compost treatments with regards to root length at P=0.05. Similarly, most of the results obtained were higher than the control which signifies the effects of compost on the development of root length. The result of the composting durations showed that T_3 had the highest value (7.76cm) while T_1 (7.74cm) and T_2 (7.74cm) had the least values. However, there was no significant different (P=0.05) between T_3 and the other composting durations (T_1 and T_2). The result obtained for biomass indicated that PCM_2 had the highest value (0.56g) which was not significantly (P=0.05) different from PCM_1 (0.43g), PCM_4 (0.37g) and PCM_5 (0.47g). Equally observed from the result was that control had the least value (0.33) which was not significantly different from PCM_1 (0.43g), PCM_3 (0.28g), PCM_4 (0.37g) and PCM_5 (0.47g). It was

also observed from the result that T_1 had the highest value (0.43g) which was not significantly (P=0.05) different from T_2 (0.39g) and T_3 (0.39g). (Table 4.0). Similarly, most of the values obtained from the result of the analyses for biomass were higher than the control. This indicates the significant effect of pulverized compost materials on the sample plant. The result of this finding on biomass is in conformity with that of [27] Compost application to soil medium increases biomass as compared to control.

Table 4: Effects of Pulverized Compost Materials and Composting Durations on Root length and Biomass of *K. senegalensis*

Pulverized Compost Materials (PCM)	Root length (cm)	Biomass (g)
1	6.19bc	0.43ab
2	8.40ab	0.56a
3	8.08abc	0.28b
4	9.29a	0.37ab
5	9.28a	0.47ab
Control	5.27c	0.33b
SE±	0.99	0.07
Composting durations (Days)		
30	7.74a	0.43a
60	7.74a	0.39a
90	7.76a	0.39a
SE±	0.70	0.05
Interaction		
MxT	NS	NS

Means followed by the same letter(s) in the same column are statistically not significant using Duncan's Multiple Range Test (DMRT), Ns= not significant. T_1=30 days composting duration, T_2=60 days composting duration, T_3=90 days composting duration

4. Conclusion

Based on the findings of this research, PCM_5 at twelve WAS showed significant effects on stem diameter, stem height, number of leaves, root length and biomass which indicates its potentials as an effective nursery compost for seedlings of *K. senegalensis* in terms of growth and development. It is suggested: (1) that foliar materials can undergo pulverization before composting since pulverization reduces bulkiness of composting materials, space and waiting time for nutrient breakdown. (2) It is also recommended that 90 days composting of pulverized foliar materials is effective and provides significant early growth in the experimental tree seedlings.

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