African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 1-15)
www.abjournals.org

CASHEW SEEDLINGS NURSERY PRODUCTION IN UNIVERSITY OF ABUJA NIGERIA AND ITS RESPONSE TO DIFFERENT ORGANIC AMENDMENTS

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Cite this article:

Abanum N.B., Ede O.M., Olufemi A., Arinze O.V. (2022), Cashew Seedlings Nursery Production in University of Abuja Nigeria and its Response to Different Organic Amendments. African Journal of Agriculture and Food Science 5(2), 1-15. DOI: 10.52589/AJAFS-YXT9XB3S.

Manuscript History

Received: 30 March 2022

Accepted: 20 April 2022

Published: 28 April 2022

ABSTRACT: *Organic waste materials are embedded with plant nutrients augmented to contain nutrients used for plant use and raising cashew seedlings in the nursery. This study aims to observe the effect of organic materials as soil amendments in the growing of cashew seedlings. The treatments consisted of two cashew nut types (Jumbo and Medium size) and three organic materials: Cocoa pod husk-Biochar, Rice husk, Maize barn, and a control. These planting materials were arranged as Jumbo Nut-Control, Medium Nut-Control, Jumbo nut+Biochar, Medium nut+Biochar, Jumbo nut+Maize Bran, Medium nut+Maize Bran, Jumbo nut+Rice Husk, Medium nut+Rice Husk, Jumbo nut+Biochar+Maize Bran+Rice Husk and Medium nut+Biochar+Maize Bran+Rice Husk laid in a Complete Randomized Design with three replications. The seedlings were raised with a 10kg topsoil mix with 9.0g (5t/ha) of organic materials and control. Data collected include plant height, stem girth, numbers of leaves, leaf area, fresh and dry offshoot weight, root weight, and taproot length, analyzed with SAS statistical package and Mean separation using Tukey's Studentized Range Test at (P≤0.05). The pre-and post-soil were analyzed for chemical properties. The result showed that the organic amendments improved the chemical properties of the soil. Although these nutrient amendments improved crop productivity, their effectiveness was pronounced in the medium cashew nut. At termination, the control treatments had the least fresh and dry shoot, root weight and shortest Root length when compared to other treatments. Conclusively, Cocoa pod husk-Biochar, Rice Husk and Maize Barn should be considered in cashew nursery and field trial upon transplanting.*

KEYWORDS: Amendments, Biochar, Cashew nuts, Nursery, Maize Bran and Rice husk.

Article DOI: 10.52589/AJAFS-YXT9XB3S
DOI URL: https://doi.org/10.52589/AJAFS-YXT9XB3S

INTRODUCTION

The use of organic sources from plant by-products is becoming proper for farmers in the Federal Capital Territory (FCT) of Nigeria. Bala *et al.*, (2011) stated that the use of these sources is limited because of some socio-economic reasons. However, Lekasi, (2003) reported that some of these resources are mostly considered to be waste or used as mulching materials. In Nigeria, around 800,000 tons of cocoa pod husk are produced each year which are frequently wasted (Ayeni *et al*., 2008), but in most recent years it has been researched and converted into biochar (Biochar is a type of charcoal generated by pyrolysis, a process that involves heating at a high temperature in the absence of oxygen) which when added to poor soils has been used to boost the soil's cation exchange capacity and nutrient sorption (Gray *et al*., 2014); It's also used to promote soil microorganism activity (Ducey *et al*., 2013); and minimize plant nutrients loss from the soil according to Kameyama *et al*., (2012). Biochar has also been discovered to improve plant root growth (Prendergast-Miller *et al*., 2014). Rice husk is another waste material that can be recycled because millions of tons of it are produced each year and it constitutes about 20% of the total weight of the rice paddy (Stracke *et al*., 2018). These plant residues, if not properly disposed of, can pollute the environment as they are difficult to decompose as reported by Saidelles *et al*., (2012). Maize bran on the other hand is commonly used as livestock feed (Rose *et al*., 2010) but is a waste that may be used as organic fertilizer for growing crops. Several trials have been done with maize barn used in amending the soil or used as organic fertilizer with favourable results as stated by the following authors: Zhang *et al.*, (2019); Gharekhani *et al*., (2018); Olad *et al*., (2018). The Cashew (*Anacardium occidentale*), a tropical evergreen tree (Zepka *et al.*, 2009) is a commercial crop that is grown in almost every state in Nigeria, especially in Federal Capital Territory (FCT) Abuja and raised majorly for its nuts and pseudo-apple. It's a nut with different sizes: Jumbo, Extra-large, Large, Medium, Small, and Madras are the six different sizes of cashew nuts that can be found in Nigeria (Adeigbe *et al*., 2016). When cultivating cashew seedlings for plantation establishment, it was suggested that larger nut sizes be preferred over smaller nut sizes (Asogwa *et al*., 2008). A successful cashew field establishment begins in the nursery. Yeboah *et al.*, (2020) in their works stated that cashew is commonly grown from seed. Cashew orchards can be established by nursing seedlings in the nursery for 2 to 3 months before transplanting them to the field (Hammed *et al*., 2012). However, in-situ sowing of cashew seeds is comparably recommendable (Adeyemi and Nduka, 2019) when special management practice is put in place. In the nursery, topsoil is a traditional growth medium for seedling production (Marjenah, *et al*., 2016) as the growth and development of seedlings or crops is determined by soil characteristics and innate nutrition (Chintala *et al*., 2012). The nutritional status of the medium in which seedlings grow plays a role in their survival after transplanting as poor seedling nutrition during the early stages can cause growth and developmental problems, as well as a poor seedling establishment on the field, delayed growth, and a lower survival rate (Nduka *et al.*, 2015). Amendment of soil with organic matter or fertilizer which is cheaper than inorganic chemical fertilizers (Valkila, 2009) and most times regarded as waste polluting the environment has been known to enhance soil nutrients for optimum plant use.

The rising advocacy for organic farming for healthy living, environmental improvement, reduction of fertilizer cost and seedling improvement has brought about the utilization of agricultural or industrial organic waste sources such as cocoa pod husk-biochar, rice husk, and maize bran, as organic amendments to support topsoil in meeting nutrient requirement demands of young cashew seedling in the nursery. Therefore, this experiment aims to evaluate:

Article DOI: 10.52589/AJAFS-YXT9XB3S
DOI URL: https://doi.org/10.52589/AJAFS-YXT9XB3S

- The responses of organic amendments (Cocoa pod husk-Biochar, Maize bran, and Rice husk) to two cashew nut sizes morphological growth.
- The responses of organic amendments application (Cocoa Husk-Biochar, Maize bran, Rice husk) on the soil's chemical and physical properties and
- To evaluate among these organic amendments (Cocoa Husk-Biochar, Maize bran, Rice husk) the most suitable for Cashew seedling growth.

MATERIALS AND METHOD

Location of study

The experiment was conducted at the screen house of the Faculty of Agriculture, University of Abuja, Federal Capital Territory (FCT). FCT is in the Guinea Savanna Agro-ecological Zone of Nigeria on a coordinate of Lat 8.9807°N, Long 7.1805°E between August 2021 and December 2021.

Pre-planting soil sampling and analysis

Topsoil was collected at 10-15cm depth from the University of Abuja Research farm. Samples of the topsoil were bulked together and mixed, air dried, crushed and sieved through a mesh of 2mm. The sieved sample was taken to the University of Ibadan (UI) Oyo state Nigeria agronomy lab for routine analysis.

Planting materials

Two improved Cashew varieties: Jumbo size nuts (≥ 16g) and Medium size (>1 2 ≤ 16g) Cashew nuts were obtained from Ochaja Sub-Station of Cocoa Research Institute of Nigeria (CRIN) situated at Ochaja- Kogi state. The organic materials used for the experiment were Cocoa pod husk which was burned in zero oxygen to produce a black charcoal material called Biochar. Rice husk and Maize bran were obtained from a miller processing house at the main market situated at Gwagwalada Local Government of Federal Capital Territory Abuja, and control where the soil was not mixed with any of the nutrient supplements mentioned above.

Nursery establishment

30 perforated polythene bags of 6×9 inches size was used to raise the seedlings to ensure good drainage. Each of the 10kg topsoil collected was mixed with each of the different organic amendments at the rate of 5ton/ha (9g per seedling). Watering to 70% field capacity was done a day prior to nuts sowing. Two nuts per bag were sown at a depth of 5cm. These were later thinned to one seedling per bag upon seedling germination.

Treatments and experimental design

The experiment is a factorial (2 x 3 x 3) experiment, with 10 treatments combinations arranged and laid in a completely randomized design (CRD) with three replications. These combinations include: (1) Jumbo nut Control (JC), (2) Medium nut Control (MC), (3) Jumbo nut + Cocoa pod husk-Biochar (JB), (4) Medium nut + Cocoa pod husk-Biochar (MB), (5) Jumbo nut + Rice husk (JRH), (6) Medium nut + Rice husk (MRH), (7) Jumbo nut + Maize bran (JMB), (8)

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Medium nut + Maize bran (MMB), (9) Jumbo nut + Cocoa pod husk-biochar + Rice husk + Maize bran (JBMRH) and (10) Medium nut + Cocoa pod husk biochar + Rice husk + Maize bran (MBMRH)

Data collection

The growth parameters observed were plant height, stem girth, number of leaves and leaf area at two weeks intervals from 4 weeks after sowing (WAS). Plant height was measured from ground level to the base using a measuring rule. The number of leaves was manually counted, stem diameter was taken with the aid of a calibrated vernier calliper, while leaf area of cashew was determined using the regression equation as described by Remison and Lucas (1982). The equation is given as

$$Y = L \times W \times \text{Correction factor } (0.25) \quad \text{i}$$

Where Y = area of the leaf,

L = length of the midrib of the central lobe.

W = width of leaf.

At the termination of the experiment, a soil sample was collected from each of the amended treatments to analyze for the chemical properties and a destructive sampling was done where data on fresh shoot weight, dry shoot weight, fresh root weight, dry root weight and taproot length were collected and recorded.

Statistical analysis

Data collected were analyzed using SAS (2011) Statistical computer package and descriptive analysis with means separated using Tukey's Studentized Range (HSD) Test at a probability level of 5%.

RESULT AND DISCUSSION

The result of the topsoil routine analysis and cashew soil critical level is shown in table 1. Revealed soil is slightly acidic (pH 5.4), the organic carbon is very low (5.55g/kg), The Total Nitrogen (N) was (0.01g/kg); this is lower than 0.10% being the critical level of cashew soil requirement according to Egbe, N.E *et al*., (1989), which shows a great need for manure/fertilizer supplement. The available Phosphorous (6.20 mg/kg) is sufficient for cashew growth. For the exchangeable cations CEC, the value of 2.60cmol/kg is very low because of the small amount of organic carbon (5.55g/kg) content present in the pre-soil sample and collaborate with Perez-Esteban *et al*., (2014) in their work reported that poor organic matter present in soil has a negative effect on CEC content. Potassium (K) (0.45cmol/kg) is very accurate for cashew production and it's in accordance with Folorunso *et al*., (2000) who reported that K of 0.3% is ideal for most crop growth. Magnesium (Mg) (2.15cmol/kg) is moderately available in the soil, while Calcium (Ca) (1.37cmol/kg) content is very low when compared to the 0.8% recommendation for cashew soil (Egbe, N.E *et al*., 1989).

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The chemical composition of the different organic amendments used in the experiment is shown in Table 2. Cocoa pod husk- Biochar had the highest total organic carbon (8.61%). Further in table 2 was the chemical composition of Rice husk and Maize bran. From the results, rice husk values were low thus, an insufficient amount of Nitrogen (N), Magnesium (Mg), Sodium (Na), Copper (Cu) and Zinc (Zn) was observed. This was consistent with the work of Dhaneswara *et al*., (2020), who reported that rice husk has a poor nutrient composition as shown in Table 2. Table 2 also shows that the Maize bran total nitrogen has the highest mean value of 2.57% compared to Rice husk with has no value. However, Carbon concentration was the lowest having 3.5 % compared to 8.61 and 6.43 as observed from the Cocoa pod husk-Biochar and Rice husk respectively in table 2.

Tables 4, 5, 6 and 7 presented the ANOVA summary, the mean and the coefficient of variation of the ten treatments measured. There existed no significant ($P \leq 0.05$) variation among the Ten treatments for each growth measurement with respect to the plant height (Table 3) from 4 to 12 weeks after sowing. The least coefficient of variation (12.93%) occurred in Plant height (Ph) @ 12WAS while the highest (23.44%) was observed in (Ph) @ 6WAS (Table 3). The increase in plant height from 4 to 12 weeks after sowing did not follow a unique pattern. However, Among the two varieties used, the application of soil amendments having Rice husk (RH) had the tallest plant height (35.70cm). The medium cashew nut at 12 weeks after planting recorded the lowest value (24.50cm) plant height rate (Table 3). This could be because of the slow nutrient release capacity of most organic fertilizers or amendments which according to Miller and Miller (2000) acknowledged that the effect of organic fertilizer or amendment application to agricultural soils may not be immediately apparent, but that while its presence improves immediate soil characteristics, nutrients are progressively released into the soil.

Table 4 shows a similarity to that presented in Table 3 and suggests that the use of different cashew nut sizes (Jumbo and Medium nut sizes) and the organic soil amendments did not influence the number of leaves of the cashew seedling and support the findings reported by Nduka *et al*., (2014) who reported that coffee husk used as soil amendment does not produce any comparable influence on the leaves production of cashew seedlings. Furthermore, in table 4, the Jumbo nut cashew variety produced more leaves (23.00) compared to the medium nut variety (16.00) having a combination of biochar, Rice husk and maize barn used in planting. On the other hand, the coefficient of variation was 19.29 @ 4 weeks after sowing (WAS), it reduces @ 6 WAS and gradually increases across the board till termination of the experiment.

Table 5 presents the response in organic amendments growth parameters of cashew seedlings girth with respect to each of the ten treatments showing the absence of vegetative parameters for 4 and 6 weeks. This is not surprising because the vernier calliper was recording 0.01consistencely hence the authors excluded it (Table 5). However, the nuts sizes and the different growth mediums used did not significantly influence all the measures with respect to the time but the combination of biochar, rice husk and maize barn had the highest stem girth of 1.40 (Jumbo nuts) and 1.27 cm (Medium nuts) respectively. Although not significantly enhanced, the results obtained in Table 5 agree with Awodun *et al*., (2015) who reported that organic fertilizers can improve the stem girth of cashew seedlings.

The use of medium size cashew nuts and the application of cocoa pod husk biochar had a significant enlarge leaf area values @ 4 and 6 weeks after sowing (34.13 and 58.48 cm2) and @ 4 weeks with the highest coefficient of variation compared to the other treatments imposed (Table 6). Furthermore, in table 6, the results indicate that medium cashew nuts used in this

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study with the application of biochar produce the highest values across the weeks of measurements (@ 4 Weeks after planting (WAS)- 34.13cm^2, @6 WAS-58.48cm^2, @ 8WAS-66.98cm^2, @10WAS-74.74cm^2 and @ 12 WAS- 99.07cm^2 respectively when compared to the other treatments. A similar observation was reported by Ugwu *et al*., (2020) who observed a notable difference in the size of the leave (leaf area) at the early stages of seedlings' growth with the application of organic soil amendment (Table 6).

At the termination of the experiment (3 months after sowing), the results of post soil analysis were shown in Table 7. It was observed that soil amendment combination with Jumbo nut sown had a lesser value of N compared to their medium cashew nut counterpart. This agrees with the findings of Hammed *et al*., (2011) that jumbo seedlings exhibit higher nutrient uptake than medium seedlings. However, the addition of biochar organic amendments into the topsoil improved the soil and agrees with the findings of Wang *et al*., (2019) that organic fertilizers can improve the nutrient condition of the soil. It was also observed that the acidity of the soil was reduced due to the addition of the different organic materials (Cocoa pod husk-Biochar, Rice husk and Maize barn) used in this study. This correlates with Liu *et al*., (2021) whose report stated that the application of organic fertilizer has the capacity of reducing the soil acidity contents. It was observed in this study (fig 1) that the fresh root weight had a positive link with the dry root weight on the two nut sizes grown under the control plots that received zero manure application. However, the use of cocoa pod husk-Biochar and Rice husk significantly increase these values for root weight (Fig1). This could be because of rich nutrients embedded in the organic amendments which were available for the cashew seedlings to uptake (Badar *et al*., 2015). Ahanger *et al*., 2021 also reported high dry matter content on tomatoes grown with organic fertilizers amendment. Figure 2 shows the fresh and dry weight of the different cashew nuts seedlings like that of root weight presented in Table 1. In correlation with these findings, Aziz *et al*., (2010) also observed higher fresh shoot and dry shoot weight of maize where organic fertilizers were applied. The application of the different organic amendments (Cocoa pod husk-Biochar, Rice husk, Maize barn) improved the length of the taproot (Fig 3) and corresponds with the findings of Moyin-Jesu, (2007) who observed an increase in taproot length of okra amended with organic fertilizer.

CONCLUSION

Our research considered two cashew nut sizes: Jumbo (≥ 16g) and Medium (>1 2 ≤ 16g) cashew nuts and three organic materials (Cocoa pod husk Biochar, Rice Husk and Maize Barn) both of which affected the expression of the soil chemical traits and seedling vegetative characteristics distinguished. The results from this study clearly showed that the 3 organic materials (Cocoa pod husk Biochar, Rice Husk and Maize Barn) improved physicochemical properties, which is attributed to soil nutrient availability embedded in these organic amendments. They actively improved the morphological development of the cashew seedling. Thus, will serve as a good head start on transplanting the success rate of the seedling in the field. However, the combination of these three organic materials under the medium cashew nuts had the fattest stem girth, Cocoa pod husk-Biochar applied to the medium nuts was also significantly taller. While Biochar organic amendments significantly produce the highest number of leaves of the medium cashew seedlings. Fresh shoot weight, dry shoot weight, fresh root weight, dry root weight and taproot length of the cashew seedlings were notably improved by the addition of these organic amendments. This response is an indication of the effectiveness

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of these materials in the enhancement of crop productivity. In general, they responded positively to the organic amendments applied with medium cashew nuts seedlings identified to be of the highest value measurement. It's worthy to state here that these organic materials when used as part of soil management materials will change the term waste to a profitably and affordable manure that will not only guarantees better vegetative cashew seedling growth but enhance soil life improvement. Generally, cashew seedlings of the jumbo and medium nut types responded positively to the organic amendments applied. Further research is necessary to explore the effectiveness of these amendments after transplanting on the field. It should also be investigated to know the impact on soil biomass, texture and on other fruit crops of economic importance.

Acknowledgements: The authors acknowledge the technical support of Monday Elugbe the superintendents of Ochaja Sub Station of Cocoa Research Institute of Nigeria (CRIN) Ibadan, Nigeria for providing the Cashew nuts.

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Article DOI: 10.52589/AJAFS-YXT9XB3S
DOI URL: https://doi.org/10.52589/AJAFS-YXT9XB3S

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 1-15)

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APPENDIX

Table 1: Pre soil physical and chemical properties and values of Cashew soil critical level.

Parameters	Measured Values	Cashew soil critical levels
pH in (H_20)	5.4	
Organic Carbon (gkg^{-1})	5.55	
Total Nitrogen (gkg^{-1})	0.01	0.10
Available P ($mg\ kg^{-1}$)	6.20	3.37
Exchangeable Cations ($cmol\ kg^{-1}$)		
Ca	1.37	0.8
Mg	2.15	0.08
K	0.45	0.12
Na	0.14	
CEC	2.60	
Particle Size Distribution (%)		
Sand	35	
Silt	40	
Clay	25	
Textural Class	Silt loam	

Table 2: **Pre chemical composition of the organic materials**.

Parameters	Biochar (Cocoa Pod Husk)	Rice Husk	Maize Bran
pH	10.5	10.2	7.23
Total C %	8.61	6.43	3.5
Total N %	0.33	-	2.57
Total P%	7.96	0.2	0.33
K	0.86	0.25	0.82
Ca	3.95	0.25	0.35
Mg	2.06	-	0.18
Na	0.68	-	0.88
Cu	0.68	-	-
Zn	0.23	-	0.02

Article DOI: 10.52589/AJAFS-YXT9XB3S
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African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 1-15)

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Table 3: Mean performances of post soil chemical properties traits across different Manuring effect on Cashew seedling

Trt	pH	OC (g/kg)	AVP (mg/kg)	Al cmol/kg	T.N (g/kg)	Ca cmol/kg	Mg cmol/kg	K cmol/kg	Na cmol/kg
CJB	8.1	42.39	86.84	1.22	3.88	13.45	4.02	3.10	2.04
JBMRH	7.1	25.75	82.58	0.88	2.51	13.23	5.56	1.81	2.40
JMB	6.5	17.90	66.09	0.78	1.89	13.06	3.76	1.42	1.31
JRH	6.7	16.96	94.82	0.64	1.75	13.19	3.98	0.92	1.31
CMB	7.8	45.23	89.44	1.29	3.98	13.50	4.44	4.11	2.54
MBMRH	7.2	30.11	85.23	1.05	3.22	14.88	5.97	2.01	2.75
MMB	7.3	23.45	78.33	0.97	2.54	13.65	4.01	1.45	2.34
MRH	6.9	20.27	97.21	0.95	1.83	14.12	4.05	1.09	2.33

Key: Jumbo nut Control (JC), Medium nut Control (MC), Jumbo nut + Cocoa pod husk biochar (JB), Medium nut + Cocoa pod husk biochar (MB), Jumbo nut + Rice husk (JRH), Medium nut + Rice husk (MRH), Jumbo nut + Maize bran (JMB), Medium nut + Maize bran (MMB), Jumbo nut + Cocoa pod husk biochar + Rice husk + Maize bran (JBMRH) and Medium nut + Cocoa pod husk biochar + Rice husk + Maize bran (MBMRH)

Table 4: Effects of soil organic amendments on plant height of Cashew seedlings.

Treatments	Plant Height (cm)				
	Week 4	Week 6	Week 8	Week 10	Week 12
JBMRH	7.67a	13.00a	16.83a	24.87a	29.63a
MBMRH	6.33a	11.73a	16.80a	25.03a	31.07a
JB	5.33a	14.00a	18.40a	22.90a	26.17a
MB	6.67a	16.43a	21.60a	26.37a	31.30a
JRH	7.60a	15.33a	20.20a	28.73a	35.70a
MC	6.33a	12.83a	19.83a	25.77a	30.77a
JC	7.37a	12.43a	20.17a	23.17a	27.97a
MMB	7.10a	15.50a	18.60a	20.40a	24.50a
MRH	7.27a	13.4a	19.63a	28.21a	31.23a
JMB	6.93a	12.90a	16.73a	21.40a	26.27a

Article DOI: 10.52589/AJAFS-YXT9XB3S
DOI URL: https://doi.org/10.52589/AJAFS-YXT9XB3S

Error Mean Square	1.87	10.39	13.38	35.48	13.85
Coefficient of variation	19.92	23.44	19.38	23.47	12.93

Key: Means with the same letter across columns are not significantly different; Jumbo Control (JC), Medium nut Control (MC), Jumbo nut + Cocoa pod husk biochar (JB), Medium nut + Cocoa pod husk biochar (MB), Jumbo nut + Rice husk (JRH), Medium nut + Rice husk (MRH), Jumbo nut + Maize bran (JMB), Medium nut + Maize bran (MMB), Jumbo nut + Cocoa pod husk biochar + Rice husk + Maize bran (JBMRH) and Medium nut + Cocoa pod husk biochar + Rice husk + Maize bran (MBMRH)

Table 5: Effect of organic amendments on the numbers of leaves of Cashew seedlings

Treatments	**No. of Leaves**				
	Week 4	**Week 6**	**Week 8**	**Week 10**	**Week 12**
JBMRH	4.33a	7.33a	10.00a	14.00a	16.00a
MBMRH	5.67a	7.00a	9.33a	13.67a	16.67a
JB	6.33a	8.00a	11.00a	17.67a	22.00a
MB	5.33a	7.66a	10.33a	14.67a	20.67a
JRH	5.67a	7.33a	9.67a	13.67a	18.67a
MC	5.67a	7.33a	10.00a	15.67a	17.67a
JC	5.50a	7.33a	9.67a	14.67a	17.00a
MMB	5.67a	7.00a	11.33a	14.67a	16.33a
MRH	5.00a	7.00a	9.67a	14.00a	20.00a
JMB	5.33a	8.33a	11.33a	20.00a	23.00a
Error Mean Square	1.1	1.42	2.77	6.43	10.82
Coefficient of variation	19.29	16.02	16.25	16.61	17.5

Key: Means with the same letter across columns are not significantly different; Jumbo nut Control (JC), Medium nut Control (MC), Jumbo nut + Cocoa pod husk biochar (JB), Medium nut + Cocoa pod husk biochar (MB), Jumbo nut + Rice husk (JRH), Medium nut + Rice husk (MRH), Jumbo nut + Maize bran (JMB), Medium nut + Maize bran (MMB), Jumbo nut + Cocoa pod husk-biochar + Rice husk + Maize bran (JBMRH) and Medium nut + Cocoa pod husk- biochar + Rice husk + Maize bran (MBMRH)

Article DOI: 10.52589/AJAFS-YXT9XB3S
DOI URL: https://doi.org/10.52589/AJAFS-YXT9XB3S

Table 6: Effect of organic amendments on the leaf area of Cashew seedlings.

Treatments	Leaf Area (cm^2)				
	Week 4	**Week 6**	**Week 8**	**Week 10**	**Week 12**
JBMRH	6.10b	19.90b	62.01a	57.88a	87.59a
MBMRH	22.07ab	28.83b	43.01a	53.30a	73.10a
JB	21.67ab	19.90b	40.79a	48.45a	88.17a
MB	34.13a	58.48a	66.98a	74.74a	99.07a
JRH	20.97ab	23.79b	37.45a	59.48a	82.99a
MC	26.11ab	34.60ab	64.95a	66.11a	80.25a
JC	21.93ab	33.64ab	44.71a	48.60a	67.79a
MMB	26.17ab	43.33ab	45.87a	61.06a	79.23a
MRH	17.77ab	21.14b	47.56a	58.97a	78.60a
JMB	30.43ab	45.77ab	49.97a	59.50a	78.65a
Error Mean Square	83.59	96.98	113.74	160.52	423.75
Coefficient of variation	40.24	29.9	21.19	21.54	25.33

Key: Means with the same letter across columns are not significantly different; Jumbo Control (JC), Medium Control (MC), Jumbo + Cocoa pod husk biochar (JB), Medium + Cocoa pod husk biochar (MB), Jumbo + Rice husk (JRH), Medium + Rice husk (MRH), Jumbo + Maize bran (JMB), Medium + Maize bran (MMB), Jumbo + Cocoa pod husk biochar + Rice husk + Maize bran (JBMRH) and Medium + Cocoa pod husk biochar + Rice husk + Maize bran (MBMRH)

Table 7: Effect of organic amendments on stem girth of Cashew seedlings.

Treatments	Stem Girth (cm)		
	Week 8	**Week 10**	**Week 12**
JBMRH	0.60a	0.83a	1.40a
MBMRH	0.47a	0.77a	1.27a
JB	0.50a	0.70a	1.20a
MB	0.50a	0.70a	0.93a
JRH	0.26a	0.60a	0.83a
MC	0.43a	0.73a	0.97a
JC	0.33a	0.67a	0.87a
MMB	0.40a	0.73a	1.25a
MRH	0.53a	0.73a	1.18a
JMB	0.47a	0.70a	1.24a

Article DOI: 10.52589/AJAFS-YXT9XB3S
DOI URL: https://doi.org/10.52589/AJAFS-YXT9XB3S

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 1-15)

Error Mean Square	0.018	0.02	0.25
Coefficient of variation	29.54	20.15	45.37

Key: Means with the same letter across columns are not significantly different; Jumbo nut Control (JC), Medium nut Control (MC), Jumbo nut + Cocoa pod husk-biochar (JB), Medium nut + Cocoa pod husk-biochar (MB), Jumbo nut + Rice husk (JRH), Medium nut + Rice husk (MRH), Jumbo nut + Maize bran (JMB), Medium nut + Maize bran (MMB), Jumbo nut + Cocoa pod husk-biochar + Rice husk + Maize bran (JBMRH) and Medium nut + Cocoa pod husk-biochar + Rice husk + Maize bran (CMBMRH)

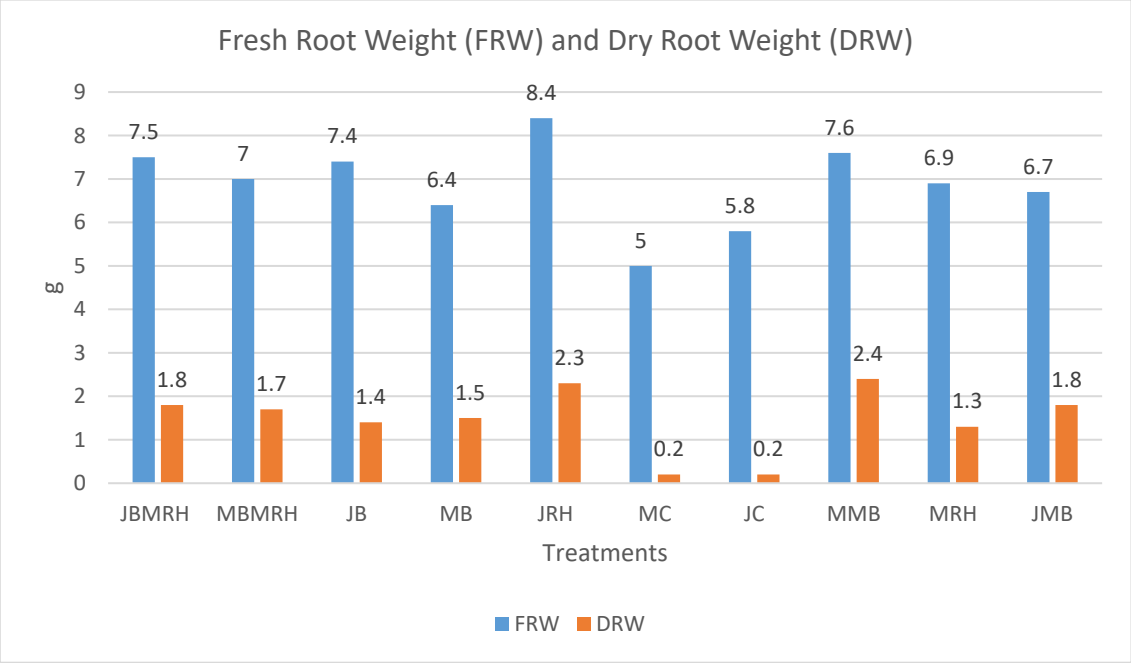

Figure 1: Fresh root weight and dry root weight of cashew seedlings from the treatments.

Article DOI: 10.52589/AJAFS-YXT9XB3S
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African Journal of Agriculture and Food Science
ISSN: 2689-5331
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www.abjournals.org

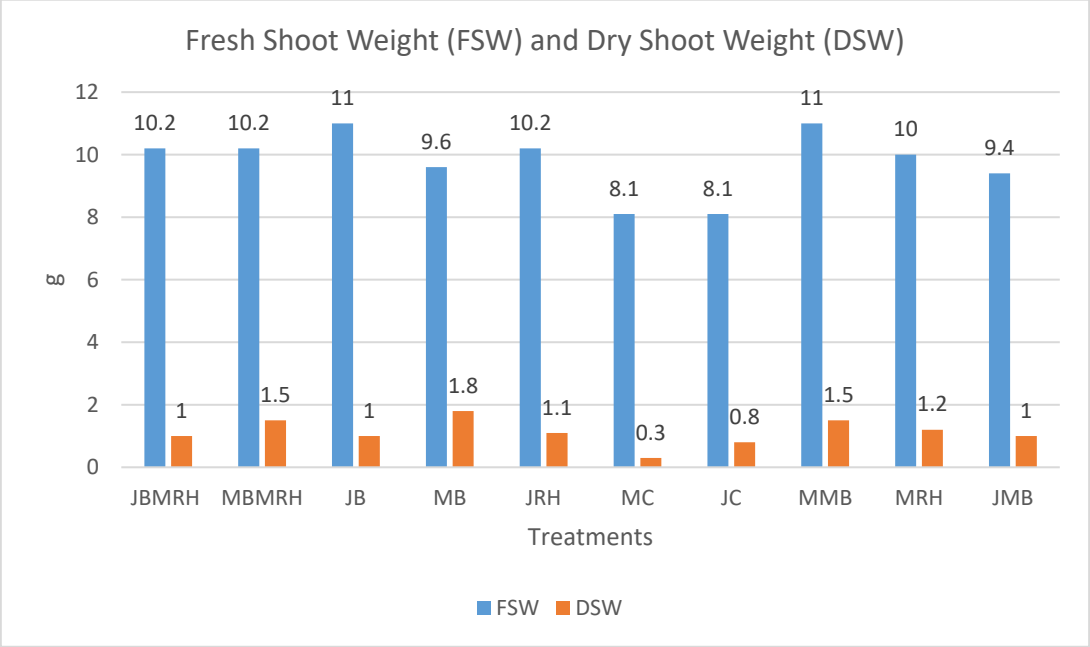

Figure 2: Fresh shoot weight and dry shoot weight of cashew seedlings from the treatments.

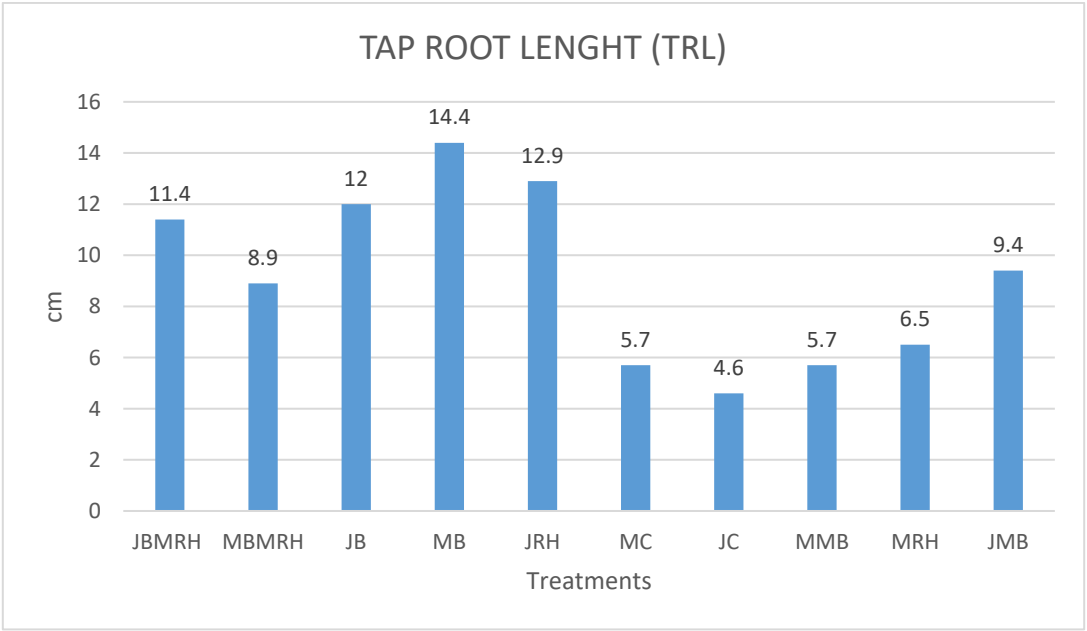

Figure 3: Taproot length of cashew seedlings from the treatments.

Article DOI: 10.52589/AJAFS-YXT9XB3S
DOI URL: https://doi.org/10.52589/AJAFS-YXT9XB3S