ZIBELINE INTERNATIONAL™ PUBLISHING
ISSN: 2710-6012 (Online)
CODEN: JWBMAO

Journal of Wastes and Biomass Management (JWBM)

DOI: http://doi.org/10.26480/jwbm.02.2024.84.87

RESEARCH ARTICLE

EFFECT OF ORGANIC FERTILIZER DERIVED FROM FOOD MARKET WASTE ON CASHEW SEEDLINGS GROWTH IN THE NURSERY

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ARTICLE DETAILS

Article History:

Received 27 April 2024
Revised 01 June 2024
Accepted 04 July 2024
Available online 08 July 2024

ABSTRACT

The shift towards effective organic waste management and organic fertilizers is gaining attention due to concerns about environmental sustainability and raising healthy crops respectively. This study evaluates the effect of a processed market source waste: Aleshinloye Grade B Organic Fertilizer (AOF) on cashew seedlings growth in the nursery. A 3-month nursery trial was established at the Cocoa Research Institute of Nigeria's nursery Ibadan, Nigeria. The experiment is a 2 factorial experiment with fertilizer rate (200t/ha and 100t/ha) and application method (Top-dressing and Soil-mixed). The treatments arranged in a Complete Randomized Design are Top-dressed AOF at 200t/ha (T1TD), Soil-mixed AOF at 200t/ha (T1M), Top-dressed AOF at 100t/ha (T2TD), Soil-mixed AOF 100t/ha (T2M) and the control treatment (NF) with no fertilizer. Morphological and destructive samples data collected were subjected to Analysis of Variance (ANOVA) and treatment means were separated using Least Significant Difference (LSD) at a 0.05% probability. Results showed that T1M improved cashew seedling number of leaves at 3 months after sowing while other morphological traits and destructive samples were not significant when the fertilizer treatments were compared with NF. Either of the two application rates and methods of application did not improve cashew seedling growth in the nursery. However, notable improvement was only observed in the number of leaves when 200t/ha of AOF was applied as topsoil-mixed. For notable improvement in cashew seedlings, it is therefore recommended that the period of observation be extended as organic fertilizers slowly release their nutrients in the soil.

KEYWORDS

Cashew Seedlings, Organic Fertilizer, Nursery, Growth, Aleshinloye

1. INTRODUCTION

Cashew (*Anacardium occidentale* L.) is a hardy, drought-resistant, and fast-growing tree species, which is widely cultivated in tropical countries due to its versatility. (Malik and Bhadauria, 2020). This species is renowned for its nuts and pseudo apple, producing products like cashew juice, wine vinegar, jams, chocolate, cashew nut shell liquid (CNSL), and cooking oil (Adeigbe et al., 2016; Dendena and Corsi, 2014). Although, all parts of the tree are useful. It is adapted to a wide range of agro-ecologies, but it is cultivated economically in the savannah and rainforest agro-ecologies of Nigeria (Olubode et al., 2018). 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, some researcher suggested that in-situ sowing of cashew seeds is also highly recommended when special management practices are implemented (Adeyemi and Nduka, 2019). In the nursery, topsoil is a traditional growth medium for seedling production as the growth and development of seedlings or crops are determined by soil characteristics and innate nutrition (Marjenah, et al., 2016; Chintala et al., 2012).

Chemical fertilizers have revolutionized crop production by providing a ready source of plant nutrients. Previously, organic wastes were used for nutrient sources, but rapid urbanization and mechanization have led to a shift toward chemical fertilizers. However, their use faces challenges like poor plant quality, disease susceptibility, and environmental pollution (Adeoluwa and Adeogun 2010). This diverted the attention of agronomists towards making use of organic nutrients from organic manures or organic wastes to improve soil fertility and increase crop production (Somani and Totawat, 1996). Integrated approaches that sustain both agriculture and the environment are needed to maintain the long-term ecological balance of the soil ecosystem and also to reduce the high cost of production and environmental pollution (Zahir et al., 2007).

The addition of organic fertilizer to the soil does influence many physicochemical and biological properties of the soil such as increased infiltration rate, reduced bulk density, aggregate stability, cation exchange capacity (CEC) and biological activities. Organic fertilizers serve as a slow-release reservoir for plant macronutrients and also aid in increasing plant micronutrients and facilitate water and air infiltration. Organic-based fertilizers are obtained from plant and animal residues. Studies carried out on these fertilizers have shown their potential in crop growth as well as in the sound management of tropical soils (Olowoake, 2014). Olowoake and Adeoye have observed that several types of organic materials and residues in Nigeria can be processed, packaged and made available as organic-based fertilizers at a relatively cheaper rate compared to synthetic fertilizers for sustainable crop production (Olowoake and Adeoye, 2010). Among several organic-based fertilizers made from food market waste in Nigeria available in the market are the Aleshinloye Grade A and B fertilizers. From the recommendation of who suggested the use of organic fertilizers in raising cashew seedlings as against inorganic fertilizers, it is therefore important to evaluate and observe some rates and application methods of Aleshinloye Grade B organic fertilizer (AOF) on cashew seedling growth in the nursery (Aremu-Dele et al., 2024). Therefore, the objective of this study is to:

Quick Response Code	Access this article online	
	Website: www.jwbm.com.my	**DOI:** 10.26480/jwbm.02.2024.84.87

Cite the Article: Uthman Oyewole Oyediran, Umar Salisu, Olufemi Aremu-Dele Aduragbemi Oladayo Agboluaje, Taye Shuaib (2024). Effect Of Organic Fertilizer Derived from Food Market Waste on Cashew Seedlings Growth in The Nursery. *Journal of Wastes and Biomass Management, 6(2): 84-87.*

- Observe the effect of two rates and two application methods of AOF on cashew seedling growth parameters and plant biomass at 3 months after sowing (MAS).
- Observe the most appropriate rate and fertilizer application method with the best cashew seedling growth.

2. Materials and Method

2.1 Experimental Location, Design, Factors and Treatments.

The 3-month nursery trial was established at the Cocoa Research Institute of Nigeria's nursery section located in Ibadan, Oyo State Nigeria. The organic fertilizer used in this study is the Aleshinloye Grade B Organic Fertilizer (AOF) which is made by the processing of plant source wastes from the market. The experiment is a 2-factorial experiment with fertilizer rate (200t/ha and 100t/ha) and application method (Top dressing and Soil mixed) being the factors considered. The treatments are: Top dressed AOF at 200t/ha (T1TD), Soil mixed AOF at 200t/ha (T1M), Top dressed AOF at 100t/ha (T2TD), Soil mixed AOF 100t/ha (T2M) and the control treatment of which no fertilizer was applied (NF). The treatments were laid in a Complete Randomized Design (CRD). The large cashew nut biotype was used in this experiment which was sown in 650g topsoil capacity perforated nursery polythene bags at the rate of one nut per bag. The quantity of topsoil used per polythene bag was 554g excluding the weight of the fertilizer. For the soil mixed treatments, this was done by mixing the topsoil and the fertilizer in a bowl before bagging while the top-dressed treatments were done by applying the fertilizer on the soil surface after sowing in the nursery polythene bags. 8 cashew seedling stands were used per treatment making 40 stands per replication. The experiment was replicated 3 times making a total of 120 cashew seedling stands. Watering of the seedlings was done every 48 hours.

2.2 Data Collection and Method of Analysis

Morphological data collection such as plant height (cm), number of leaves, stem girth (mm), leaf area (cm^2) and number of branches commenced at 4 WAS which were collected fortnightly till 12 WAS. At 12 WAS, destructive sampling was carried out on the seedlings and data such as fresh shoot weight (g), fresh root weight (g) and tap root length (cm) were recorded. Additionally, the fresh samples were oven-dried at 60°C for 48 hours to observe the dry shoot weight (g) and dry root weight (g) of the samples. The macronutrient analysis of the fertilizer such as nitrogen, phosphorous and potassium was obtained from the fertilizer label. Data collected were subjected to SAS (2010) statistical software for analysis using Analysis of Variance (ANOVA). Treatment mean separation was done using Least Significant Difference (LSD) at a 0.05% probability level.

3. Result and Discussion

3.1 Macronutrient Composition of Aleshinloye Grade B Fertilizer.

The macronutrient analysis of Aleshinloye Grade B fertilizer used in this experiment is shown in Table 1. The fertilizer consists of 1.2% N, 0.8% P and 2.9% K.

Table 1: Macronutrient composition of Aleshinloye Grade B fertilizer.

Nutrient Element	Nutrient %
Nitrogen (N)	1.2
Phosphorous (P)	0.8
Potassium (K)	2.9

3.2 Cashew Seedling Morphological Growth Analysis

Plant height is a plant growth variable that is easily observed as a parameter to determine the effect of the environment or treatments on plants. The result from Table 2 shows statistical variation among the treatment at 1 month after sowing (MAS) as NF (17.87cm) was significantly taller than T2M (14.20cm), T1M (14.65cm) and T1T (12.67cm). NF has the highest plant height (17.87cm) followed by T2T (16.30cm) but no statistical variation was observed between the two treatments (14.20cm). However, there was no significant difference in plant height among the treatments at 2 MAS and 3 MAS. At 3 MAS, T1M (22.47cm) recorded the highest plant height followed by NF (21.13cm), T2T (20.45cm), T2M (20.03cm) and T1T (19.22cm. The inability of the fertilizer treatments to improve cashew seedling height could be a result of the slow nutrient release capacity of most organic fertilizers (Shaikh and Patil, 2013). However, its presence improves immediate soil characteristics and nutrients which are progressively released into the soil (Shaikh and Patil, 2013).

Table 2: Cashew seedlings height as influenced by the fertilizer treatments.

	PLANT HEIGHT (cm)		
Treat	**1 MAS**	**2 MAS**	**3 MAS**
NF	17.87^{a}	20.68^{a}	21.13^{a}
T1T	12.67^{c}	17.37^{a}	19.22^{a}
T1M	14.65^{bc}	20.42^{a}	22.47^{a}
T2T	16.30^{ab}	19.30^{a}	20.45^{a}
T2M	14.20^{bc}	19.00^{a}	20.03^{a}
S.Er±	0.97	1.57	1.86
LSD @ 0.05%	***3.149***	***5.127***	***6.057***

Note: MAS= Months after sowing; T1TD= Top-dressed AOF at 200t/ha; T1M= Soil-mixed AOF at 200t/ha; T2TD= Top-dressed AOF at 100t/ha; T2M= Soil-mixed AOF 100t/ha; NF= No fertilizer. Treatment means with the same letter(s) are not significantly different from each other.

Table 3 shows no significant difference in the number of leaves produced across the treatment at 1 MAS with cashew seedlings with no fertilizer treatment NF and T2T having the highest number of leaves (7.5). However, at 2 MAS, a comparable difference in number of leaves produced among the treatments was observed.

T2M had the highest number of leaves which is significantly different from NF (9.0) and T2T (9.2) at 2 MAS. At 3 MAS, T1M (14.7) had the highest number of leaves which was not statistically different from T2M (13.7), T1T (13.0) and T2T (11.2). NF (9.8) had the least number of leaves among the treatments and was only comparable with T1M (14.7). This result implies that T1M only improved the cashew seedling number of leaves when compared with the control treatment NF. However, other fertilizer treatments still had a higher number of leaves than NF though not comparable. It has been observed by that plants of the same species with more leaves enhance plant growth due to an increase in photosynthate production (Zhang et al., 2012). According to a study, the number of leaves is a major determinant of plant growth rate (Leghari et al., 2016).

Table 3: Cashew seedlings numbers of leaves as influenced by the fertilizer treatments.

	NUMBER OF LEAVES		
Treat	**1 MAS**	**2 MAS**	**3 MAS**
NF	7.5^{a}	9.0^{b}	9.8^{b}
T1T	6.8^{a}	10.0^{ab}	13.0^{ab}
T1M	6.7^{a}	9.5^{ab}	14.7^{a}
T2T	7.5^{a}	9.2^{b}	11.2^{ab}
T2M	7.0^{a}	11.3^{a}	13.7^{ab}
S.Er±	0.6	0.6	1.4
LSD @ 0.05%	***1.96***	***1.97***	***4.67***

Note: MAS= Months after sowing; T1TD= Top-dressed AOF at 200t/ha; T1M= Soil-mixed AOF at 200t/ha; T2TD= Top-dressed AOF at 100t/ha; T2M= Soil-mixed AOF 100t/ha; NF= No fertilizer. Treatment means with the same letter(s) are not significantly different from each other.

Table 4 shows the effect of the fertilizer rates and application methods on cashew seedling stem girth. T2M (4.18mm) produced the thickest cashew seedlings of all the treatments and was comparable with T1M and T2M which both had the same stem girth of 3.75mm. However, at 2 MAS and 3 MAS, no statistically different result in stem girth was observed among the treatments. T2M maintained a thicker stem girth all through the trial than NF though both treatments were not comparable. This result implies that no distinct improvement in cashew seedling stem girth was observed at the end of the trial. However, T2M had a prospective result.

The plant growth rate is influenced by the net assimilation rate and leaf area. A high net assimilation rate and optimum leaf area have been observed to be crucial and can also improve plant growth (Leghari et al., 2016). The photosynthetic growth rate of plants is majorly influenced by leaf area. A significant difference in leaf area was observed at 1 MAS (Table`5) with NF having the largest leaf area. However, no significant difference in leave area was observed when comparing NF (46.43cm^2) with other treatments except T1M (33.92cm^2). As further shown in Table 5, cashew seedlings leaf area were not influenced at 2 MAS and 3 MAS. However, NF had the largest leaf area all through the trial period. This result implies that no notable improvement in cashew seedlings leaf area was observed as a result of the fertilizers and method used in application.

Table 4: Cashew seedlings stem girth as influenced by the fertilizer treatments.

STEM GIRTH (mm)			
Treat	**1 MAS**	**2 MAS**	**3 MAS**
NF	3.83^{ab}	4.37^{a}	4.68^{a}
T1T	3.80^{ab}	4.47^{a}	4.67^{a}
T1M	3.73^{b}	4.07^{a}	4.55^{a}
T2T	3.75^{b}	4.17^{a}	4.30^{a}
T2M	4.18^{a}	4.53^{a}	4.70^{a}
S.Er±	0.12	0.16	0.20
LSD @ 0.05%	***0.398***	***0.51***	***0.642***

Note: MAS= Months after sowing; T1TD= Top-dressed AOF at 200t/ha; T1M= Soil-mixed AOF at 200t/ha; T2TD= Top-dressed AOF at 100t/ha; T2M= Soil-mixed AOF 100t/ha; NF= No fertilizer. Treatment means with the same letter(s) are not significantly different from each other.

Table 5: Cashew seedlings leaf area as influenced by the fertilizer treatments.

LEAF AREA (cm^2)			
Treat	**1 MAS**	**2 MAS**	**3 MAS**
NF	46.43^{a}	49.20^{a}	54.73^{a}
T1T	40.75^{ab}	43.66^{a}	53.12^{a}
T1M	33.92^{b}	39.37^{a}	54.64^{a}
T2T	43.88^{ab}	47.02^{a}	53.58^{a}
T2M	39.78^{ab}	47.21^{a}	53.41^{a}
S.Er±	3.40	3.36	5.40
LSD @ 0.05%	11.096	10.963	17.600

Note: MAS= Months after sowing; T1TD= Top-dressed AOF at 200t/ha; T1M= Soil-mixed AOF at 200t/ha; T2TD= Top-dressed AOF at 100t/ha; T2M= Soil-mixed AOF 100t/ha; NF= No fertilizer. Treatment means with the same letter(s) are not significantly different from each other.

3.3 Destructive Samples Parameter Analysis

Table 6 shows the effect of the treatments applied on plant biomass parameters. Cashew seedlings fresh shoot weight (FSW) was not influenced as a result of the treatments applied as all treatments were statistically the same. T2M (13.43g) and T1T (10.48g) had the highest and least FSW respectively. However, significant differences in DSW were observed as T2M had significantly higher DSW than T2T (3.14g), T1T (2.30g) and T1M (2.14g). T2M had the highest DSW. The DSW result implies that T2M accumulated the highest shoot dry matter followed by NF, T2T, T1T and T1M.

As shown in Table 6, a significant difference in FRW was observed as T2T (5.43g) had a significantly higher FRW than T2M (3.31g). NF was not significantly different from all other treatments. T2T (5.43g) had the highest FSW followed by T1M (4.58g) and NF (4.53g). After drying the roots, no comparable difference in DRW was observed among the treatments. However, T2T (1.22g) had the highest DRW, followed by NF (1.17g) and T1M (0.85g).

Furthermore, in Table 6, though no comparable difference was observed, T2T (20.7cm) established the longest TRL of all the treatments followed by NF (17.5cm) and T1T (14.6cm). A comparable difference in TRL was only observed in T2T (20.7cm) when compared with either T1M (11.2cm) or T2M (13.2cm)

From this result, T2T showed the potential to improve cashew seedling root system while T2M in the long run can improve cashew seedling shoot. From previous research, it has been observed that organic manure has the potential to enhance crop growth performance and considerably increase dry matter accumulation as also observed in this study (Moyin-Jesu, 2007; Ipimoroti and Akanbi, 2012).

Table 6: Cashew seedlings destructive analysis as influenced by the fertilizer treatments.

Treat	**FSW**	**DSW**	**FRW**	**DRW**	**TRL**
NF	11.12^{a}	3.28^{ab}	4.53^{ab}	1.17^{a}	17.5^{ab}
T1T	10.48^{a}	2.30^{b}	4.33^{ab}	0.84^{a}	14.6^{ab}
T1M	10.54^{a}	2.14^{b}	4.58^{ab}	0.85^{a}	11.2^{c}
T2T	11.42^{a}	3.14^{b}	5.43^{a}	1.22^{a}	20.7^{a}
T2M	13.43^{a}	4.09^{a}	3.31^{b}	0.82^{a}	13.2^{bc}
S.Er±	1.31	0.40	0.60	0.14	1.92
LSD @ 0.05%	***4.257***	***1.291***	***1.966***	***0.448***	***6.270***

Note: FSW= Fresh shoot weight; DSW= Dry shoot weight; FRW= Fresh root weight; DRW= Dry root weight; TRL= Tap root length; T1TD= Top-dressed AOF at 200t/ha; T1M= Soil-mixed AOF at 200t/ha; T2TD= Top-dressed AOF at 100t/ha; T2M= Soil-mixed AOF 100t/ha; NF= No fertilizer. Treatment means with the same letter(s) are not significantly different from each other.

4. Conclusion

This study emphasizes the potential of Aleshinloye Grade B Organic Fertilizer (AOF) in enhancing cashew seedling growth and also determines the rate and method of application that can promote seedling improvement in the nursery. Morphologically, no notable improvement in cashew seedling height, stem diameter and leaf area was observed at the 3 MAS while 200t/ha of AOF when mixed with topsoil only improved cashew seeding number of leaves. Furthermore, there was no improvement in cashew seedling Fresh Shoot Weight, Dry Shoot Weight,

Fresh Root Weight, Dry Shoot Weight and Tap Root Length as a result of the fertilizer treatments.

Either of the two application rates and methods of application did not improve cashew seedling growth and development in the nursery. However, notable improvement was only observed in the number of leaves when 200t/ha of AOF was applied as a mix with topsoil. For subsequent trials and to guarantee notable improvement in cashew seedlings raised in the nursery, it is therefore recommended that the period of observation be extended as organic fertilizers don't mineralize quickly in soil and secondly, higher AOF rates than the ones used in this study should be used.

ACKNOWLEDGEMENTS

I want to appreciate Mr. Peter, an Agricultural Superintendent at Cocoa Research Institute of Nigeria for his contribution towards the establishment of this experiment.

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