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Effect of Some Growing Media on Fresh and Dry Matter Accumulation of Cashew (*Anacardium occidentale.* L) Seedlings Raised in the Nursery

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Abstract
The nursery experiment was carried out to evaluate the effects of growing media on fresh and dry matter accumulation of cashew seedlings. The experiment consisted of two cashew nut types and five growing media, laid out in a Completely Randomized Design (CRD). The ten treatments replicated three times were: (Ts/J)= Topsoil and jumbo nut as control; (Sd/J)= Sawdust and jumbo nut; (Sd3:Ts1/J)= 3 sawdust:1 topsoil and jumbo nut; (Sd1:Ts1/J)= 1 sawdust:1 topsoil and jumbo nut; (Sd1:Ts3/J)= 1 sawdust:3 topsoil and jumbo nut; (Ts/M) = Topsoil and medium nut as control; (Sd/M)= Sawdust and medium nut; (Sd3:Ts1/M) = 3 sawdust:1 topsoil and medium nut; (Sd1:Ts1/M) = 1 sawdust:1 topsoil and medium nut; (Sd1:Ts3/M) = 1 sawdust:3 topsoil and medium nut. At three months after sowing, the treatments were subjected to destructive sampling, weighed to obtain fresh weight, then oven-dried between 65-80°C for 48 hours, and weighed with a sensitive scale to obtain total, shoot, and root dry weight. Data collected were analyzed using Analysis of Variance (ANOVA) and means separated using Least Significant Difference (LSD) at a 0.05% probability level. The result showed that control treatments Ts/J and Ts/M had the least total fresh seedling weight of 26.10g and 39.0g and total dry seedling weight of 6.90g and 9.60g, respectively when compared with other treatments. Sawdust sole or as mix with topsoil as a growing media can give an improved result of both fresh and dry matter accumulation for both jumbo and medium cashew seedlings than topsoil only.

Keywords: Cashew, Seedling, Growing Media, Top Soil, Sawdust, and Nursery

Introduction

Cashew (*Anacardium occidentale* L.) is a major source of income for many smallholder farmers in the growing parts of Nigeria (Adeigbe *et al*., 2015), and is believed to be next to cocoa as a major export crop in West Africa (Nitidae, 2019). Cashew is a fast-growing, hardy, and drought-resistant multipurpose tree species cultivated in many tropical countries (Malik and Bhadauria, 2020). It is one of the most well-known species grown for its nuts and pseudo apple from which products such as cashew juice, wine vinegar, jams chocolate, cashew nut shell liquid (CNSL), and cooking oil are made (Dendena and Corsi, 2014), although all parts of the tree are useful. It is adapted to a wide range of agroecologies (Olubode *et al*., 2018) but it is cultivated economically in the savannah and rainforest agroecologies of Nigeria. Aliyu *et al*., (2014) highlighted some areas of the savannah such as Kwara State, and North Central Nigeria such as Kogi State where cashew is being commercially produced. Falade (1978) reported that its cultivation has spread to other agroecological zones of Nigeria as well as Oyo, Enugu, Abia, Anambra, Ekiti, and Imo. The producing states are grouped into minor and major cashew states based on the current production level. The minor producers are concentrated in the southwest, south-south, and northern states while central and southeastern states dominate the major producing class. The minor producing states combine cashew with other major commodity crops like cocoa, oil palm, rubber, and kola in the south and cereals and pulses in the north. The field establishment of most tree crops starts from the nursery (Powell, 2018) with cashew inclusive. Good performance of cashew seedlings in the nursery translates into a good and encouraging field establishment of crops (Brown, 1984). In the nursery, the use of appropriate growing media is critical for the development of high-quality seedlings because it has a direct impact on the growth, development, and maintenance of a healthy root system.

Topsoil is a typical growing media used in nurseries to raise seedlings (Marjenah, *et al*., 2016). However, there is a need to eliminate or lessen the dependence on topsoil in raising seedlings in the nursery due to the degradation of land caused by the collection of topsoil and the ever-increasing demand to enlarge agricultural areas.

Therefore, it is important to investigate and select the best-growing media that can replace or lessen the reliance on topsoil without a negative impact on the shoot and root development of seedlings. Some common example of nursery growing media includes sawdust, sand, soil, manure, and a combination of these in various mixes. Dry matter accumulation is directly related to the nutrient uptake of plants as these nutrients serve as building blocks for growth and physiological processes (Gaspar et al. 2018; Seleiman and Abdelaal 2018). In evaluating the performance of cashew, morphological parameters such as plant height, number of leaves, and stem diameter have always been considered over time with less importance attached to the fresh and dry matter contents of the plant.

The weight that is recorded instantly after a plant or any of its components, such as its fruits, leaves, roots, or shoots is harvested is referred to as "fresh weight" which includes water content in the plant or any of its components at the harvest time. However, the weight of plant material after the moisture within the plant material has been drained is referred to as the dry matter content (Bonham, 1989) which is embedded with nutrients contained in the plant. In addition to genotype, cultivation techniques and growing conditions such as on the field or at the nursery affect how much dry matter plants gather (Kinhal, 2019). It has also been observed that different growing media could affect both the fresh and dry matter content of plants due to the difference in nutrient composition of the media. The objective of this study is to study the effect of selected growing media on the fresh and dry matter content of the shoot, root, and total seedling weight of jumbo and medium cashew seedlings.

Materials and Methods

The experiment was carried out in the nursery of the Cocoa Research Institute of Nigeria (CRIN), Ibadan Nigeria from March 2021 to June 2021. The duration for nursing the cashew seedlings was three months which is a recommended period for raising cashew seedlings before transplanting them to the field. The experimental design was a Completely Randomized Design (CRD). The two factors considered are cashew biotypes (Jumbo and Medium) and growing media which consists of topsoil only, sawdust only, 3 topsoil:1 sawdust, 1 topsoil:1 sawdust, and 1 topsoil:3 Sawdust). The ten treatments replicated three times include:

- (Ts/J) = Topsoil only with jumbo nut (Control treatment)
- (Sd/J) = Sawdust only with jumbo nut
- (Sd3:Ts1/J) = (3 sawdust:1 topsoil) with jumbo nut
- (Sd1:Ts1/J) = (1 sawdust:1 topsoil) with jumbo nut
- (Sd1:Ts3/J) = (1 sawdust:3 topsoil) with Jumbo nut
- (Ts/M) = Topsoil only with medium nut (Control treatment)
- (Sd/M) = Sawdust only with medium nut
- (Sd3:Ts1/M) = (3 sawdust:1 topsoil) with medium nut
- (Sd1:Ts1/M) = (1 sawdust:1 topsoil) with medium nut
- (Sd1:Ts3/M) = (1 sawdust:3 topsoil) with medium nut

Each treatment was replicated three times, giving a total of 40 seedlings per replication and 120 seedlings across the three replications. Topsoil was sourced from within the nursery field, and the sawdust was sourced from a nearby sawmill. Samples of the topsoil and sawdust were taken for analysis to determine the physicochemical properties of the topsoil and the chemical properties of the sawdust. Both topsoil and sawdust were mixed according to the treatments and were then filled into perforated 30cm by 15cm black polythene nursery bags. The cashew nuts used for the experiment were sourced within the institute and were from the latest season. One seed per nursery bag was sown at 4 cm depth and watering was done twice a week. The treatments were subjected to destructive sampling after three months, and data on fresh shoot weight, fresh root weight, and total fresh seedling weight were taken. The fresh samples were oven dried between 65-80°C for 48 hours. Data on dry shoot weight, dry root weight, and total dry seedling weight were also taken. The sample's weight was taken using a sensitive scale. Data collected were analyzed using Analysis of Variance (ANOVA) with GenStat statistical software (Edition 4) and means were separated using Least Significant Difference (LSD) at 0.05% probability level.

Results and Discussion

The analysis of the topsoil and sawdust used in this experiment is shown in Table 1. From the Table, it could be observed that the sawdust used contains some essential elements needed to support plant growth. According to the rating of Hazelton and Murphy (2007), the total nitrogen level of the topsoil (0.21%) is at a moderate level while that of sawdust (0.35%) is high. According to the scale set by Food and Agriculture Organization (FAO, 1980), the organic carbon content of the topsoil (11.91%) is high while the sawdust has a Loss on Ignition (L.O.I) of 55.53%. Following the phosphorous range set by Hazelton and Murphy, (2007), the topsoil with 19.34 mg/kg P has high available phosphorous while sawdust with 400.00mg/kg has very high total phosphorous.

Table 2 shows the result of the effect of the growing media on cashew seedling fresh root. The control treatments of both the jumbo (Ts/J) and medium (Ts/M) cashew seedlings weighed the least when compared with treatments within their biotypes with a weight value of 7.30g and 9.00g respectively. This could occur as a result of the other growing media when used encouraged improved root growth and development than sole topsoil alone. This result correlates with Kaur (2017) in his work on mango that favourable medium

promoted the growth of seedlings and much more importantly root development. Among the jumbo treatments, a slight significant difference in the root fresh weight was only observed between Topsoil only (Ts/J) and Sawdust only (Sd/J) as the latter had a superior weight value of 12.70g as against the former with a weight value of 7.30g. Sd3:Ts1/J (11.20g), Sd1:Ts1/J (11.80g), and Sd1:Ts3/J (10.50g) all had higher fresh root weight but were not significantly different from the control (7.30g). For the medium treatments, Sd1:Ts3/M (12.80g) and Sd/M (12.70g) both had a significantly superior fresh root weight than the control treatment (9.00g). However, despite a higher fresh root weight recorded in Sd1:Ts1/M (11.50g) and Sd3:Ts1/M (10.50g), they are not notably different from the control (9.00g). Unagwu *et al*., (2023) observed that the introduction of sawdust in topsoil and other growing media can improve the growth and development of cashew seedling's fresh roots.

The fresh shoot weight of the jumbo control treatment (Ts/J) has the least weight value of 18.80g when compared with other treatments among the same biotype (Table 2). However, Ts/J is not significantly different from Sd1:Ts3/J (37.30g), Sd/J (36.50g), and Sd3:Ts1/J (34.50g) even though they had superior fresh shoot weight. Sd1:Ts1/J (41.30g) proved to be significantly different from the control Ts/J (18.80g) and it was also observed to have the highest weight value. A contrasting trend of the result was observed in the fresh shoot weight of the medium cashew seedlings as one of the growing mix Sd3:Ts1/M had the least fresh shoot weight value of 28.50g as against the previously observed trend of Topsoil only being the least (Table 2). Sd1:Ts1/M (47.00g), Sd1:Ts3/M (45.50g), and Sd/M were significantly superior to Sd3:Ts1/M (28.50g). Furthermore, the control Ts/M didn't give a notable difference when compared with Sd/M (44.30g), Sd1:Ts3/M (45.50g), and Sd3:Ts1/M (28.50g). From this result, it can be said that sawdust as sole or a mix with other growing media has the potential to improve the fresh shoot development of cashew seedlings. A similar result was also obtained by Akanbi *et al*. (2019); Unagwu *et al*. (2023) in their work on moringa and tomato seedlings respectively.

The total fresh seedling weight of the jumbo seedlings (Table 2) shows that the control treatment Ts/J had the least weight of 26.10g among the jumbo treatments but was not significantly different from Sd3:Ts1/J (45.70g). However, Sd1:Ts1/J (53.10g), Sd/J (49.20g), and Sd1:Ts3/J (47.80g) were all significantly superior to the control Ts/J (26.10g). The highest total fresh seedling weight was recorded in Sd1:Ts1/J > Sd/J > Sd1:Ts3/J > Sd3:Ts1/J > Ts/J among the jumbo treatments. The total fresh seedling weight of the medium seedlings (Table 2) shows that both the control treatment Ts/M and Sd3:Ts1/M had the same and also the least weight value of 39.00g. In addition, they are both significant from Sd1:Ts1/M (58.50g), Sd1:Ts3/M (58.30g), and Sd/M (57.00g). The highest total fresh seedling weight was recorded in Sd1:Ts1/M > Sd1:Ts3/M > Sd/M > (Ts/M and Sd3:Ts1/M). This indicates that all the treatments including sawdust for both jumbo and medium cashew seedlings all had higher total fresh seedling weight than when topsoil only was used as a growing media in raising cashew seedlings. Various researchers have observed that sawdust can improve the total fresh seedling weight of cucumber (Sawan and Eissa, 1995), while Akpalu *et al*. (2021) have observed that growing media such as sawdust have the potential to improve general growth such as cocoa.

The effect of the growing media on jumbo and medium cashew seedling's root dry weight is shown in Table 3. The results reveal that jumbo cashew seedlings raised on topsoil only (Ts/J) which is the control treatment had the least root dry weight of 1.70g and was significantly ($p<0.05$) lower than the 3.40g recorded by dry weight of sawdust only (Sd/J), the highest among the sawdust treatments. The same trend was observed among the treatments for medium cashew seedlings (Table 3). Medium cashew nut seedlings raised on topsoil only (Ts/M) with 2.10g dry weight also had the least dry root weight among the growing media treatments. Treatments Sd1:Ts3/M (3.80g), Sd/M (3.50g), and Sd1:Ts1/M (3.00g) had significantly higher dry root weights than the control Ts/M (2.10g). From this result, it could be deduced that the sole sawdust and mix of both sawdust and topsoil encouraged the accumulation of more root dry matter of both jumbo and medium cashew seedlings. This outcome could be related to improved aeration and water drainage of sawdust due to enhanced overall porosity, which has been shown to encourage root development (Olubunde and Fawusi, 2003). In addition, sawdust performed well compared to the conventional use of topsoil in cashew seedling root dry matter accumulation from this experiment in both jumbo and medium nut sizes for unknown reasons, but it may be that young cashew seedlings probably do not need the resistance that even loam-sandy soil offers the fragile feeble feeder and anchor roots.

The results of the dry shoot weight of the jumbo and medium cashew seedlings as influenced by the growing media are shown in Table 3. For the jumbo seedlings, the 5.20g shoot dry weight of the topsoil control treatment Ts/J was the least dry shoot weight recorded, though not significantly different ($p>0.05$) from the 9.80g of sawdust only (Sd/J), the 9.40g of sawdust 3:1 Topsoil (Sd3:Ts1/J) and the 9.70g of sawdust 1:3 Topsoil (Sd1:Ts3/J). However, the 10.60g mean shoot dry weight recorded by sawdust 1:1 topsoil (Sd1:Ts1/J) was significantly higher than the control for the jumbo nuts. For seedlings from the medium cashew nuts, the topsoil control treatment (Ts/M) had the least dry shoot weight of 7.50g which was significantly lower than the shoot dry weights of treatments Sd1:Ts3/M (12.70g) and Sd1:Ts1/M (12.10g). Badar *et al*. (2015) observed in their work that both composted and un-composted sawdust improved chickpea plants' fresh and dry weight of both shoot and root systems. This is similar to the result observed earlier as sawdust sole as a growing media and its mixture with topsoil also improved both

the dry shoot and root weight of jumbo and medium cashew seedlings in this experiment. Rafique *et al*. (2020) also observed that sawdust is rich in plant nutrients required by plants which can be responsible for the improvement in cashew seedling dry shoot weight as against the lower values recorded for seedlings raised using topsoil. Though the topsoil also contained rich soil nutrients,

Furthermore, in Table 3, the jumbo seedling's total dry weight raised on the 5 growing media used in this experiment ranged between 6.90 and 13.6g. As observed previously, Topsoil only (Ts/J) least supported total cashew seedling growth with a total dry seedling weight of 6.90g. All the various sawdust treatments had higher dry seedling weight (range = 12.40 – 13.60g) compared to Topsoil only (control), though the differences were not significant ($p>0.05$). For the medium cashew nuts seedlings (Table 3), the control treatment Ts/M had the least total seedling dry weight of 9.6g. All the sawdust treatments (Sd1:Ts3/M - 16.5g; Sd1:Ts1/M - 15.1g; and Sd/M - 14.5g) had significantly higher dry seedling weight compared to Topsoil (control) treatment except Sd3:Ts1/M (10.6g) that had no significant differential. The introduction of sawdust as sole or as a mix enhanced cashew seedling's total dry weight. Badar *et al*. (2015) and Vano *et al*. (2011) have all observed sawdust to improve dry matter accumulation in plants. Akpalu *et al*., (2021); Ugese (2010); Baiyeri and Mbah, (2006) have all observed soilless media such as sole sawdust to improve seedling growth and development of cocoa (*Theobroma cacao* L.), tamarind (*Tamarindus indica* L.) and African breadfruit (*Treculia africana Decne*) than topsoil respectively.

Conclusion

The use of sawdust as a sole growing media can be used in raising cashew seedlings with improved fresh and dry matter accumulation as against the use of topsoil only. However, the mixture of sawdust and topsoil as a growing media in the ratios 1:3, 1:1, and 3:1 can also be used to give an improved result of both fresh and dry matter accumulation of both jumbo and medium cashew seedlings than topsoil only depending on the sufficiency of sawdust around the nursery area.

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Table 1: Physicochemical properties of the topsoil and chemical properties of the sawdust used as growing media for the experiment

Media	Parameters	Value
TOPSOIL	p.H	6.6
	Soil Texture	Loamy Sand
	Organic carbon (%)	11.91
	Available Phosphorous (mg/kg)	19.34
	Total Nitrogen (%)	0.21
	Exchangeable Acidity (cmol/kg)	0.24
	Ca (cmol/kg)	2.55
	Mg (cmol/kg)	1.87
	K (cmol/kg)	2.05
	Na (cmol/kg)	0.61
	Mn (mg/kg)	112.10
	Fe (mg/kg)	31.40
	Cu (mg/kg)	2.10
	Zn (mg/kg)	13.80
SAWDUST	Ca (cmol/kg)	5.50
	Mg (cmol/kg)	5.80
	K (cmol/kg)	12.20
	Na (cmol/kg)	1.30
	Mn (mg/kg)	182.5
	Fe (mg/kg)	150.10
	Cu (mg/kg)	31.50
	Zn (mg/kg)	110.60
	Total Phosphorous (mg/kg)	400.00
	Total Nitrogen (%)	0.35
	Loss on Ignition. LOI (%)	55.53

Table 2: Effect of the experimental growing media on cashew seedling fresh root, shoot, and total seedling weight

Treatments	Root Fresh Weight (g)	Shoot Fresh Weight (g)	Total Fresh Seedling Weight (g)
Jumbo			
(Ts/J) Control	7.30	18.80	26.10
(Sd/J)	12.70	36.50	49.20
(Sd3:Ts1/J)	11.20	34.50	45.70
(Sd1:Ts1/J)	11.80	41.30	53.10
(Sd1:Ts3/J)	10.50	37.30	47.80
LSD (P≤0.05)	**5.37**	**18.96**	**23.73**
Medium			
(Ts/M) Control	9.00	30.00	39.00
(Sd/M)	12.70	44.30	57.00
(Sd3:Ts1/M)	10.50	28.50	39.00
(Sd1:Ts1/M)	11.50	47.00	58.50
(Sd1:Ts3/M)	12.80	45.50	58.30
LSD (P≤0.05)	**2.72**	**15.58**	**15.82**

Key: (Ts/J)= Topsoil only with jumbo nut (Control treatment); (Sd/J)= Sawdust only with jumbo nut; (Sd3:Ts1/J)= (3 sawdust:1 topsoil) with jumbo nut; (Sd1:Ts1/J)= (1 sawdust:1 topsoil) with jumbo nut; (Sd1:Ts3/J)= (1 sawdust:3 topsoil) with Jumbo nut; (Ts/M)= Topsoil only with medium nut (Control treatment); (Sd/M)= Sawdust only with medium nut; (Sd3:Ts1/M)= (3 sawdust:1 topsoil) with medium nut; (Sd1:Ts1/M)= (1 sawdust:1 topsoil) with medium nut; (Sd1:Ts3/M)= (1 sawdust:3 topsoil) with medium nut

Table 3: Effect of the experimental growing media on cashew seedling dry root, shoot and total seedling weight

Treatments	Root Dry Weight (g)	Shoot Dry Weight (g)	Total Dry Seedling Weight (g)
Jumbo			
(Ts/J) Control	1.70	5.20	6.90
(Sd/J)	3.40	9.80	13.10
(Sd3:Ts1/J)	3.0	9.40	12.40
(Sd1:Ts1/J)	3.0	10.60	13.60
(Sd1:Ts3/J)	2.80	9.70	12.50
LSD (P≤0.05)	**1.69**	**5.19**	**6.80**
Medium			
(Ts/M) Control	2.10	7.50	9.60
(Sd/M)	3.50	11.0	14.50
(Sd3:Ts1/M)	2.80	7.90	10.60
(Sd1:Ts1/M)	3.0	12.10	15.10
(Sd1:Ts3/M)	3.80	12.70	16.50
LSD (P≤0.05)	**0.77**	**3.51**	**3.72**

Key: (Ts/J)= Topsoil only with jumbo nut (Control treatment); (Sd/J)= Sawdust only with jumbo nut; (Sd3:Ts1/J)= (3 sawdust:1 topsoil) with jumbo nut; (Sd1:Ts1/J)= (1 sawdust:1 topsoil) with jumbo nut; (Sd1:Ts3/J)= (1 sawdust:3 topsoil) with Jumbo nut; (Ts/M)= Topsoil only with medium nut (Control treatment); (Sd/M)= Sawdust only with medium nut; (Sd3:Ts1/M)= (3 sawdust:1 topsoil) with medium nut; (Sd1:Ts1/M)= (1 sawdust:1 topsoil) with medium nut; (Sd1:Ts3/M)= (1 sawdust:3 topsoil) with medium nut.