



EFFECT OF SOILLESS AND SOIL MEDIA ON GROWTH AND DEVELOPMENT OF MORINGA (*Moringa oleifera* Lam)

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Abstract: To find out how growing media influence the growth and development of Moringa (*Moringa oleifera* Lam.), an experiment was carried out at the University Orchard screen house at Bayero University in Kano. Both soil (river sand) and soilless (sawdust) growing media were used in the experiment. Four treatment levels of organic manure—T0 (0 kg), T2 (2 kg), T4 (4 kg), and T6 (6 kg) were applied to each experimental medium. Each treatment level was replicated four times. For approximately eight weeks, data were collected every two weeks on growth metrics such as plant height, number of leaves, and number of branches. Stem diameter, number of roots, root length, fresh weight, and dry weight were taken once in the tenth week of the experiment. The data collected was subjected to analysis of variance (ANOVA) using GenStat (15th edition). Significant treatment means were compared using Tukey HSD at a 5% probability level. Significant differences were recorded under the same growth parameters, as were the non-significant differences existing between and within the soil media and soilless media. The overall result shows how the growth media influenced plant growth, as the soilless media (sawdust) favors early germination and seedling emergence, whereas the soil media (river sand) favors a steady increase in plant height, number of leaves, number of branches, stem diameter, number of roots, root length, fresh weight, and dry weight. It is recommended that soilless media (sawdust) is best for nursery preparation, while soil media (river sand) is good for plants' growth after emergence. Therefore, sawdust might be suggested as a substrate for rapid germination of moringa seedlings; however, river sand should be substituted for sawdust in order to promote effective growth and the generation of dry matter.

Keywords: Dry matter, moringa, growth media, soil, soil less.

INTRODUCTION

Alternative fuel sources must be explored in this period of diminishing oil reserves and skyrocketing oil costs. Biodiesel is one such alternate fuel source. While many oil-producing crops are already grown all over the world to produce biodiesel, finding a crop that can withstand the harsh climate is a difficulty for African nations. (Atabani *et al.*, 2012; Chozhavendhan *et al.*, 2020). *Moringa oleifera* Lam. is a tree with a lot of promise in this regard. (Azad *et al.*, 2015; Takase *et al.*, 2022). Due to their chemical inertness, inorganic substrates like pumice, sand, vermiculite, and perlite allow for the controlled delivery of nutrients (Bar-Tal *et al.*, 2019). Other typical procedures in greenhouse production include fertilizer addition, composting, aging, washing locally accessible materials, and combining inorganic and organic materials (Igbal *et al.*, 2019). According to Adeli *et al.* (2019) and Paradelo *et al.* (2024), these techniques overcome the limitations of individual materials and increase substrate porosity and water holding capacity. They also lessen or eliminate toxicity issues related to organic or inorganic substrates and inappropriate carbon (C): nitrogen (N) ratios. In some places of the world where it has not been widely used, soilless culture in greenhouse environments has gained more attention. The prevalence of soil-limited elements,

such as high soil salt levels in natural soils, poor yields and potential plant residues, costly chemical soil disinfection procedures, and water scarcity (Marinou *et al.*, 2013).

Because moringa oleifera is very easy to cultivate, few scientific trials have been carried out to further understanding and enhance farming methods. Therefore, the purpose of this study was to determine how likely it was that *M. oleifera* would grow in various soil types. The creation of commercial moringa plantations in tropical climes will greatly improve the production potential of this biofuel crop, as Nigeria has limited production areas both internationally and in Africa.

MATERIALS AND METHODS

Experimental site

The Experiment was conducted at the screen house of the University Orchard, Department of Agronomy, Faculty of Agriculture, Bayero University, Kano (Latitude 11° 58' N and Longitude 8° 26' E, alt. 458 m, asl) located in the Sudan savanna agro ecology of Nigeria.

Experimental Materials and Design

Using a variety of *Moringa oleifera* that was purchased from Technisem Seeds Company in Kano, the experiment was set up in a completely randomized design (CRD) with two different growth media types—which functioned as experimental factors- and four different levels of organic manure treatment in both the soil and soilless media. This resulted in eight treatments total, each of which was replicated four times. A watering can, camera, masking tape, ruler, Vanier calliper, and permanent marker pen are additional tools used.

Pot Preparation

After identifying the textural class of one of the media (river sand) in the soil science lab, two different kinds of growth substrates (media) were used. Various components of the medium were used for the preparation. Thirty-two plastic buckets in all were utilized; sixteen of them were filled with river sand (10 kg each), and the other sixteen were filled with sawdust (5 kg each). There were four different amounts of organic manure applied to these two distinct media (0, 2, 4, and 6 kg). Whereas the soilless material (sawdust) was acquired from the carpenters near the school, the soil (river sand) was taken from the Watari River. In order to promote pore opening, aeration, and appropriate water infiltration, the pots were irrigated shortly after they were placed, and they were then allowed to drain for two days to prevent a situation like to a flood.

Cultural practices

The seeds were first soaked in water, in order to break their dormancy for about two hours, before being manually sown inside the 32 buckets, based on the results of randomization on July 17,

2018. The seeds were sown at a depth of 2 cm at the rate of 2 seeds per hole. The buckets were irrigated at three-day intervals using small plastic containers, so as not to disturb the soil structure (as would happen if larger pores in the watering can were used). Frequent weeding was carried out by hand pulling to check for weed manifestation in the pots and the surrounding environment, to avoid creating the natural environment for most agricultural pests.

Data related to the growth and development of the *Moringa* were collected and recorded continuously at intervals of two weeks, among which include plant height, number of leaves, and number of branches. At harvest, data such as the number of roots, root length, stem diameter, fresh weight, and dry weight were collected using standard agronomic procedures. So, also, data on days to germination among the two growth substrates was recorded and reported. The data collected was subjected to analysis of variance (ANOVA) using GenStat (15th edition). Significant treatment means were compared using Tukey HSD at a 5% probability level.

RESULTS AND DISCUSSION

While the soilless (sawdust) medium had a higher germination percentage (87.5%) than the river sand (18.75%), other factors and growth did not follow the same pattern. The study's findings showed that growth media had a major impact on *Moringa* plants' heights at 2, 4, 6, and 8 WAS. The results show that plants grown using river sand significantly produce taller plants than plants grown in sawdust media (Table 1).

TABLE 1: Influence of growth media on Plant height of *Moringa* at 2, 4, 6 and 8 WAS at screen house of BUK during 2018 wet season

Treatment	2	4	6	8	2	4	6	8
	<u>River sand (Kg)</u>				<u>Saw dust (Kg)</u>			
0	13.30 ^a	22.8 ^b	31.1 ^c	33.8 ^c	14.43 ^b	19.38 ^b	17.1 ^b	3.5 ^b
2	9.93 ^b	26.5 ^a	46.8 ^b	60.5 ^b	15.45 ^b	21.88 ^a	24.1 ^a	4.9 ^b
4	8.68 ^b	19.6 ^c	36.0 ^c	66.6 ^b	16.80 ^a	21.57 ^a	25.1 ^a	16.5 ^a
6	8.75 ^b	25.1 ^a	51.2 ^a	96.2 ^a	13.62 ^c	17.38 ^c	14.2 ^c	5.2 ^b
SED	2.034	4.86	9.03	20.34	1.151	1.719	5.60	7.02

Means followed by the same alphabet are not significantly different according to Tukey HSD AT 5%

The application of 6 kg of organic manure in river sand significantly ($p < 0.05$) produced the tallest plant at 4–8 WAS compared to what is obtainable from the sawdust media. A similar pattern was equally observed in terms of the number of leaves per plant and the number of branches per plant (Tables 2 and 3). In contrast to *moringa* plants cultivated in sawdust media, which experience a decline in leaf count after reaching a substantial number, plants grown in river sand media exhibit a significant increase in leaves per plant during sampling periods (Table 2). The results additionally demonstrated that *moringa* plants grown in sawdust media showed a steady increment in the number of branches per plant from 2-4 WAS, which was followed by a rapid decline, whereas *moringa* plants grown in river sand media showed a steady increase in the number of branches at 4-6 WAS, followed by a steady decline (Table 3). *Moringa* on sawdust media exhibits a greater germination rate and early seedling emergence, this suggests that it can be a good medium for a variety of horticultural crops to germinate. This result was consistent with the findings of Ayoola et al. (2013). Sawdust, however, is susceptible to slow decomposition during the course of the growing season, resulting in unfavorable physical properties of the substrate. This causes the substrate to change from dry to wet, with a greater volume of retained water and a lower availability of oxygen, which in turn causes crop growth parameters to decline. After the organic manure breaks down, it can also act as a breeding ground for disease-causing organisms and insect pests, as noted by Köninger et al. (2021).

TABLE 2: Influence of growth media on Number of leaves per plant of Moringa at 2, 4, 6 and 8 WAS at screen house of BUK during 2018 wet season

Treatment	2	4	6	8	2	4	6	8
	River sand (Kg)				Saw dust (Kg)			
0	19.8 ^a	65.2 ^a	81.0 ^b	96.0 ^d	22.2 ^b	41.2 ^b	33.2 ^b	11.5 ^b
2	17.2 ^b	76.5 ^a	154.0 ^a	183.0 ^c	23.8 ^b	43.2 ^b	60.5 ^a	16.0 ^a
4	13.5 ^c	40.0 ^b	121.0 ^b	309.0 ^b	28.0 ^a	62.8 ^a	79.8 ^a	33.5 ^a
6	14.5 ^c	81.2 ^a	132.0 ^a	364.0 ^a	19.5 ^c	43.2 ^b	42.2 ^b	12.0 ^b
SED	5.15	21.32	49.00	52.50	3.18	12.45	23.32	18.27

Means followed by the same alphabet are not significantly different according to Tukey HSD AT 5%.

The moringa's fresh weight, dried weight, root length, and stem diameter were all noticeably higher in river sand media compared with soilless media (Table 4). This shows the efficacy of organic manure in ameliorating the augmenting the nutrient status of river sand compared to the saw dust. The results of Mujiyo et al. (2022), Bilong et al. (2014) and Biratu et al. (2019), who noted that organic manure might improve the sandy clay textural class marginal soils for crop development, are also supported by this. Because of this, the media can serve as effective topsoil substitutes when establishing crops with short nursery lifetimes. Similar to other plants, moringa can be cultivated in river sand media and used as food, medicine, or biofuel because of its increased dry matter accumulation.

CONCLUSION

The study's conclusions showed that while growing moringa in river sand media promotes larger plant height, more leaves, more branches, stem diameter, longer roots, dry weight, more roots, and fresh weight, growing moringa in sawdust medium supports earlier seedling emergence. Therefore, sawdust might be suggested as a substrate for rapid germination of moringa seedlings; however, river sand should be substituted for sawdust in order to promote effective growth and the generation of dry matter.

TABLE 3: Influence of growth media on Number of branches of Moringa at 2, 4, 6 and 8 WAS at screen house of BUK during 2018 wet season

Treatment	2	4	6	8	2	4	6	8
	River sand (Kg)				Saw dust (Kg)			
0	4.50 ^a	7.00 ^a	6.8 ^c	4.25 ^b	4.50 ^a	6.00 ^a	3.75 ^b	1.00 ^a
2	3.50 ^a	6.00 ^{ab}	10.2 ^b	4.50 ^b	4.50 ^a	6.50 ^a	6.75 ^a	1.50 ^a
4	2.25 ^b	5.25 ^b	10.0 ^b	6.25 ^a	4.50 ^a	6.75 ^a	6.25 ^a	2.50 ^a
6	2.00 ^b	6.50 ^a	12.8 ^a	6.75 ^a	4.00 ^a	4.50 ^b	4.75 ^b	1.00 ^a
SED	0.835	1.440	2.921	1.649	0.456	1.094	1.926	1.581

Means followed by the same alphabet are not significantly different according to Tukey HSD AT 5%

TABLE 4: Influence of growth media on Stem diameter, number of roots, root length, fresh weigh, dry weight of Moringa at 2, 4, 6 and 8 WAS at screen house of BUK during 2018 wet season

Treatment	Stem diameter		Number of roots		Root length (cm)		Fresh weight (g)		Dry weight (g)	
	River sand	Saw dust	River sand	Saw dust	River sand	Saw dust	River sand	Saw dust	River sand	Saw dust
0	20.1 ^d	12.53 ^a	16.8 ^b	5.50 ^b	14.5 ^a	11.4 ^a	20.1 ^b	10.6 ^a	5.9 ^b	4.80 ^a
2	41.3 ^c	13.11 ^b	28.2 ^a	5.00 ^b	21.6 ^a	13.6 ^a	44.5 ^b	11.3 ^a	9.7 ^b	4.03 ^a
4	49.0 ^b	7.35 ^c	26.8 ^a	6.50 ^a	17.8 ^a	13.6 ^a	35.2 ^b	9.6 ^a	9.1 ^b	4.67 ^a
6	68.2 ^a	3.30 ^d	28.8 ^a	4.25 ^b	21.2 ^a	6.5 ^b	64.0 ^a	7.8 ^b	23.3 ^a	1.93 ^b
SED	4.72	1.171	13.66	2.089	6.14	3.05	15.75	3.21	4.53	1.790

Means followed by the same alphabet are not significantly different according to Tukey HSD AT 5%

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