

Evaluating the Growth of Compost-Modified Moringa

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Abstract

The experiment was conducted to evaluate the growth of compost-modified moringa, it has shown that the addition of compost from different animal manures can increase the development of leaves and stems of plants depending on the amount of compost applied. Various amounts of compost were added to 800 grams of soil. A total of 168 experimental units were provided using a random complete block design (RCBD) with 14 treatments. The results showed that cow dung compost (100 g, 200 g and 300 g) significantly increased the stem diameter of moringa, which was 33.09%, 33.09% and 29.93, respectively, compared with the control after 55 days in the greenhouse. Compared to the control group, it was observed after 40 days that the number of leaves increased by 48.54% due to the application of 100 g of cow manure compost. In general, organic improvers, especially cow manure compost, may be the best fertilizer to improve the growth of potted moringa.

Keywords

Moringa oleifera; Animal composts; Randomized complete block design.

Introduction

Moringa oleifera Lam is a shrub native from India, Pakistan, Bangladesh and Afghanistan that has being populated everywhere. This plant is cultivated in plantation and around habitations in tropical area of Africa. It's used in food, medicine and water treatment. Cited as one of the world's most useful plants, that moringa leaves are edible and are of high nutritive value. Studies have shown that different parts of this plant

consider as a source of protein, vitamin and carotene, all essentials amino acids and phenolic components. Some of the plant parts could also be dried, turned into powder and used for several food diets. According to Azeez et al. (2013), moringa has more vitamin A than carrots, more vitamin C than oranges, more calcium than milk and more iron than spinach and therefore, is a complete food in itself. Moringa tree contains also antioxidants, anti-inflammatory, phytochemical elements, lipids such as omega-3 and omega-6. It was reported that it has

ability to reduce children nutritional deficiency in India, or use to feeding people having HIV. It has taken high socio-economic interest in the tropic. It's important to valorize its production in this area where hunger is occurring constantly (Abidin et al., 2017; El Rabey et al., 2017).

Organic manure is becoming an important component of environmentally sound sustainable agriculture. Residual nature of organic sources makes them more value based for the whole system compared to individual crops. Recently, the use of organic materials as fertilizers for crop production has received attention for sustainable crop productivity. This shrub does not need enough fertilizers but an average amount could improve its growth, particularly organic fertilizers for long term basis fertilization (Ebrahimi et al., 2017). It has been proven that addition of organic matter improved soil properties such as aggregation, water-holding capacity, hydraulic conductivity, bulk density, the degree of compaction, fertility and resistance to water and wind erosion.

Generally, fertile soils have a relatively high structure stability index and percentage. Improvement in soil aggregation by organic matter may positively affect seed germination, roots, shoots plant growth and development. The effect of long-term organic and inorganic fertilizer on soil physical properties such as aggregation, porosity and water-holding capacity has been reported (Lopez-Teros et al., 2017; Rahma et al., 2017).

Organic sources like farm yard manure, poultry manure, green manure and compost do not only supply the organic matters. but also increase the fertility status of soil. They provide organic acids that help dissolve soil nutrients and make them available to the plants. Recently, attention has been directed towards organic manure because of the rising cost of inorganic fertilizers coupled with their inability to give the soil the desired sound health. In a related literature, effects of compost applied on growth parameters were studied, but the application of different amounts has not yet been investigated. The use of organic manure to fertilize moringa in the field is increasing, but very few studies have been carried out to evaluate the effect of this fertilizer in the nursery. This inadequacy makes it difficult to make any recommendation to farmers on the

quantity and type of organic manure to apply.

The main objective of this experiment was to test the efficiency of various amounts of composts on growth of moringa under controlled conditions in the greenhouse. The responses to plant growth parameters are discussed.

Materials and Methods

Study Area

The study was carried out in greenhouse at the International Institute of Tropical Agriculture (IITA) station at Nkolbisson-Yaounde in Cameroon. This greenhouse is transparent with average intensity of solar light, air and without insects or pests. Trials were conducted for 55 days.

Biological Materials

Seeds for this experiment were collected from local variety of moringa, while soil and animals' wastes were collected in southern region of Chad (10°16'50.002"N 15°22'19.999"E). Compost was obtained after decomposition of domestic animals wastes using pile composting method from the manures of goat, cow, poultry and the mixture of wastes. Mineral fertilizer (NPK: 20:10:10) was obtained from IITA Cameroon. Pots (130 mm) were used to contain the applied treatments (Figure 1).



Figure 1: Partial view of the experiment showing treatments.

Experimental Design and Treatment

The experiment was carried in a randomized complete block design (RCRD) with 14 treatments, each of which was replicated 12 times, giving a total of 168 experimental units (Figure. 1). On each of the 25, 40 and

55 days after sowing, 4 plants were randomly chosen and destroyed per treatments to measure development. Table 1 describes details on treatments combinations, whereas Table 2 illustrates the chemical content of different organic manures.

Treatments and Sowing

For this experiment, 168 pots were used. Each pot has a fixed amount of soil (800 g) and compost varying from 100 g, 200 g, to 300 g according to a given treatment.

Each pot was placed into a bowl to avoid water loss. The bowl-pot complex was then placed on a shelf in a greenhouse. Seeds were soaked for 24 h in tap water before sowing. Two seeds were sowed at 2 cm maximum depth, and germination occurred between 7 and 10 days after sowing. After germination, one vigorous plant was allowed to grow in each pot. Plants were watered at the rate of 250 mL/pot after every 3 days.

Table 1: Description of treatments

Types of composts			Treatments	Soil quantity (g)	Compost quantity (g)	Mineral fertilizer NPK (g)
Poultry manure compost (PMC)			PMC100	800	100	00
			PMC200	800	200	00
			PMC300	800	300	00
Goat waste compost (GWC)			GWC100	800	100	00
			GWC200	800	200	00
			GWC300	800	300	00
Cow manure compost (CMC)			CMC100	800	100	00
			CMC200	800	200	00
			CMC300	800	300	00
Mixture of fertilizers (MF)			MF100	800	32gPMC+32gGWC+32gCMC	03
			MF200	800	65gPMC+65gGWC+65gCMC	05
			MF300	800	97gPMC+97gGWC+97gCMC	09
Mineral fertilizer (NPK)			NPK10	800	00	10
Control (ctrl)			C800	800	00	00

Table 2: Physical and chemical properties of different levels of soil mixtures and compost before and after experiment

Treatments	pH water	Ca	Mg	K	Na	CEC	O.C.	N	C/N	Bray P	Moisture content
		cmol(+)/kg or meq/100 g					%	%	%	µg/g	%
PMC100	6.79	3.76	1.84	1.76	0.47	3.59	1.35	0.102	13.15	266.23	2.51
PMC200	6.76	5.13	3.33	3.11	0.74	5.5	1.74	0.132	13.15	408.62	4.59
PMC300	6.77	5.7	4.05	3.82	0.9	6.56	2.18	0.208	10.45	401.35	13.1
GWC100	7.52	5.25	1.79	2.86	0.4	4.23	1.43	0.095	15.09	116.66	3.34
GWC200	8.04	7.41	2.76	5.05	0.52	5.86	2.14	0.175	12.21	146.85	5.87
GWC300	8.21	8.67	2.97	5.73	0.57	6.31	2.5	0.206	12.16	170.56	8.65
CMC100	6.66	3.08	1.42	1.15	0.25	3.66	1.36	0.083	16.36	51.08	2.35
CMC200	6.54	4.68	2.49	2.18	0.35	6.01	2.17	0.149	14.56	61.29	5.09
CMC300	6.71	6.62	3.95	3.44	0.46	8.59	3.46	0.217	15.95	88.2	9.5
MF100	7.28	5.59	3.09	3.63	0.59	5.9	2.73	0.209	13.09	259.17	17.29
MF200	7.3	11.29	6.06	8.73	1.18	11.63	4.84	0.424	11.41	366.02	16.67
MF300	7.35	10.12	6.2	9.11	1.2	12.11	5.26	0.481	10.93	375.41	16.14
C800	6.34	1.71	0.59	0.35	0.07	1.88	0.75	0.042	17.73	20.65	0.86

Data Collection

At each of 15 days from germination up to 40 days after planting, the following parameters were evaluated: plant growth was measured from the base of stem to the last leaf using a graduated ruler; stem diameter was measured at the soil level using a slide calliper; leave number was determined by counting the leaves on plant; leave length was estimated on the basal leave at 15 days after germination and on leave located in the middle of plant (as from 30 days after germination).

Data Analysis

All data collected were analyzed using the R 3.3.1. The Analysis of Variance (ANOVA) was used to compare different treatments and Turkey test for multiple comparison range of means.

Results

Effect of Treatments on Plant Size

The influence of the treatments on moringa size is illustrated in Figure 2. It shows that there was a significant difference between the treatments ($p < .01$). At 25 DAS, treatments 100 g MF, 200 g CMC and the mixture of fertilizers (MF100), 200 g cow manure compost (CMC 200), 100 g poultry manure compost (PMC 100) recorded heights of respectively 20.73 ± 0.66 , 19.27 ± 2.15 , 18.75 ± 1.49 cm that were significantly greater than 11.0 ± 0.94 , 12.8 ± 1.86 for 300 g MF and 100 g GMC. At 40 DAS, it was instead treatments 100 CMC, 300 CMC, 100 GMC and 100 MF that contributed to an improvement of the plant height. The lowest plant size was observed in MF treatment. At 55 DAS the plant size was improved by 29.33% when treatment 300 CMC was applied, as compared to that of the control. Throughout the experiment, some treatments such as GWC and chemical fertilizer caused plant death.

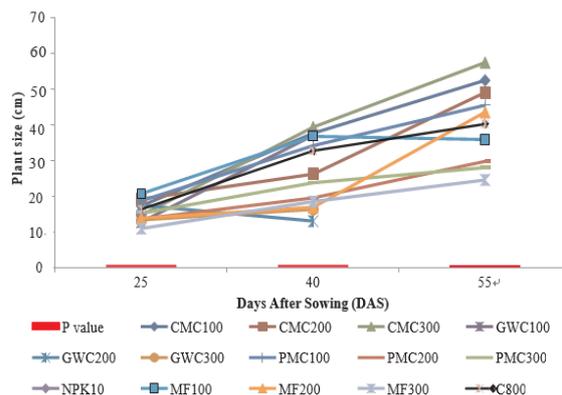


Figure 2: Variation of moringa size (cm) between treatments. C800=Control (800 g of soil); PMC=Poultry Manure Compost, GWC=Goat Manure Compost, CMC=Cow Manure Compost (100=100 g, 200=200 g; 300=300 g); MF=Mixture of Fertilizers (100=32 g PMC+32 g GWC+32 g CMC+3 g NPK; 200=65 g PMC+65 g GWC+65 g CMC+5 g NPK; 300=97 g PMC+97 g GWC+97 g CMC+9 g NPK); NPK=Mineral Fertilizer (10 g).

Effect of Treatments on Plant Diameter (mm)

Data recorded in Figure 3 indicate that the diameter of plants varied from one treatment to another ($p < .05$). At 25 days after sowing (DAS), the highest diameters were obtained from plants treated with 100 and 200 CMC, 100 and 200 MF, as well as with 100 and 300 PMC. The highest diameter was recorded in treatment 100 and 200 g CMC, with 38.9% as compared to the control (800 g soil), and 38.07% compared to the chemical fertilizer. The effects of CMC (100, 200 and 300 g), PMC (100, 200 and 300 g) and GMC (100 g) were more pronounced at 55 DAS. Similarly, mixture manure compost (MF) stimulated highest growth of plantlets from 2.24 ± 0.74 mm at 40 DAS to 5.05 ± 1.20 mm at 55 DAS for 100 MF, and from 2.21 ± 0.52 mm at 40 DAS to 4.04 ± 0.00 mm at 55 DAS for 200 MF.

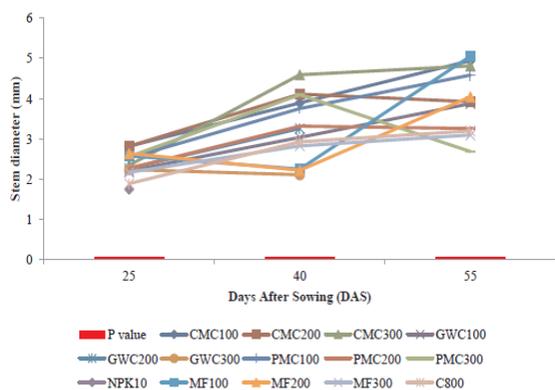


Figure 3: Stem diameter of moringa as affected by treatments (mm). C800=Control (800 g of soil); PMC=Poultry Manure Compost, GWC=Goat Manure Compost, CMC=Cow Manure Compost (100=100 g, 200=200 g; 300=300 g); MF=Mixture of Fertilizers (100=32 g PMC+32 g GWC+32 g CMC+3 g NPK; 200=65 g PMC+65 g GWC+65 g CMC+5 g NPK; 300=97 g PMC+97 g GWC+97 g CMC+9 g NPK); NPK=Mineral Fertilizer (10 g).

Effects of Treatments on Improvement of Leaves Length

Leave length of plants was significantly influenced by treatments ($p < .05$). The average of leaf length varied from 3.26 cm (300 MF) to 7.73 cm (200 CMC) at 25 DAS, from 1.70 cm (300 GWC) to 13.60 cm (200 CMC) at 40 DAS, and from 17.63 cm (100 MF) to 7.8 cm (300 MF) at 55 DAS (Figure 4).

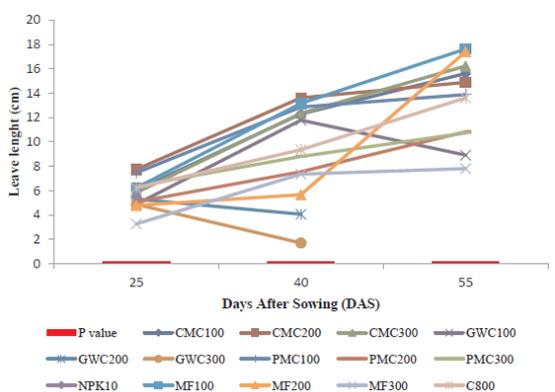


Figure 4: Effect of treatments on leaf length (cm) of moringa. C800=Control (800 g of soil); PMC=Poultry Manure Compost, GWC=Goat Manure Compost, CMC=Cow Manure Compost (100=100 g, 200=200 g;

300=300 g); MF=Mixture of Fertilizers (100=32 g PMC+32 g GWC+32 g CMC+3 g NPK; 200=65 g PMC+65 g GWC+65 g CMC+5 g NPK; 300=97 g PMC+97 g GWC+97 g CMC+9 g NPK); NPK=Mineral Fertilizer (10 g).

Discussion

Infertility in tropical soils is the main cause of declines agricultural productivity. Organic amendments contributed to important growth and yield of moringa in the greenhouse, indicating the effectiveness of animal composts in this study. Its application on maize, and beans was reported to considerably increased yield of these two plants. The objective was to evaluate the influence of composts of animal manure on the production in potted moringa plants at the greenhouse. The results of the vegetative parameters obtained were influenced by various treatments. The application of poultry manure, cow, goat’s compost and their mixtures significantly improved the size of plant, number and the length of leaves compared to chemical fertilizer NPK and the negative control (800 g soil).

At the beginning of the experiment, all plants treated with organic manure did not show a significant variation compared to untreated plants. This was explained by the time required by soil micro-organisms to begin their activity, to mineralize an efficient amount of organic matter and to allow a high absorption and accumulation of dry matter by plants. It is only after 55 days that 300 CMC amended plants showed improved plant growth rate of 29.93% compared to the control. The composition of organic manure was reported to enrich the soil with humus, consisting mainly of cellulose, hemi-celluloses and lignin which are a real source of energy for soil microorganisms. These results are agreement to those obtained by Dania et al. (2014), who pointed out that the poultry waste compost was better than the chemical fertilizer NPK (20:10:10) on the vegetative development of moringa, the composition of mineral elements such as nitrogen favoring the development of upper parts of plants. The above results are in agreement with those obtained by Adebayo et al. (2011).

In a research by Adebayo et al. (2011), compost

and other organic manures were sources of soil amendments that improved soil nutrient status. Compost has the ability to provide a continuous supply of nutrients for plant growth and increased the soil's ability to retain essential minerals. Compared with raw organic wastes, mature compost provides a stabilized form of organic matter and has the potential to enhance nutrient release in the soil. In most of the result obtained, the cow manure compost and poultry manure compost were the best of all the others. This efficacy comes from its physical and chemical composition. We found out that a sandy soil added to small amount of compost (100 g) improves the growth parameters. Recent researches have suggested that the addition of compost in sandy soils can facilitate moisture dispersion by allowing water to move more readily laterally from its point of application. However, a high application of compost may exhibit toxicity due to iron and manganese and this can justify the low plant growth from treatments with significant amount of compost, such as mineral fertilizer and 300 g compost, which recorded plants death, less leave number, small height, small size of leave and stem diameter.

Conclusion

The experiment carried out to evaluate the growth of compost amended moringa proved that addition of compost from different animal manures increased leave and stem development of plants depending on compost application rate. Treatments CMC significantly increase up to 29.93% (CMC 300), 33.09% (CMC 100 and CMC 200) the stem diameter of moringa compared to the control 55 DAS under greenhouse conditions. An increase in the number of leaves by 48.54% following application of 100 g cow manure compost was observed after 40 DAS compared to the control C800. It's a desirable privilege of growing moringa in pot or any other suitable container, preferably with a mixture of soil and cow manure composts.

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