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EFFECTS OF ORGANIC AMENDMENTS AND SHADING ON THE EARLY GROWTH OF *Moringa oleifera* (Lam.) SEEDLINGS IN YOLA, ADAMAWA STATE, NIGERIA

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ABSTRACT

Effect of organic amendments (Bagasse, Rice hull, Sawdust and Control) and shade was investigated on the early growth of *Moringa oleifera* (Lam). The experiment was 3 x 4 factorial experiment laid out in a Randomized Complete Block Design, (RCBD). The organic amendments were mixed with top soil and river sand, and filled into polythene pots and arranged under varying light regimes, with each replicated five times. Data on early growth variables (seedling height, stem girth and number of leaves) were collected for six weeks after germination and were analysed, using two-way analysis of variance. The result on seedlings heights shows that the soil treated with sugarcane bagasse under partial shade had the highest mean of 31.4 cm, while the ANOVA revealed a significant effect ($P< 0.05$) on both the light regime and the amendments on the seedlings height. For the seedling girth, rice hull under the shade has the highest mean of 1.17mm, while, the ANOVA conducted shows significant difference ($P< 0.05$). Also, the soil treated with bagasse under partial shade the highest mean number of leaves (7), while the result on ANOVA shows a significant effect ($P< 0.05$) on the early growth of the seedlings. The finding shows that *Moringa oleifera* at its early stage requires partial shade and soil amendments as a supplement for water percolation and nutrient uptake for growth.

Keywords: Soil amendment; Growth variable; Light regimes; Supplement

INTRODUCTION

Moringa oleifera is a plant popular for its numerous uses in the tropics. It has been recently introduced to other parts of Nigeria, even though, it has been around in the Northern part of the country, where, it is cultivated and serves as part of the delicacy (Radovich, 2009). *M. oleifera* is a tree crop and like most tree crops, benefits from initial cultivation in a Nursery. Its rate and quality of growth at the nursery will go a long way to determine how well it is established and develops when transferred to the field. More often, all tree crops are established with seedlings grown in the nursery allowing for economy of planting materials and permitting intensive management with the result that infestation of pathogen and attacks of insect pests on seedlings is reduced (Essien *et al*., 2010; Essien *et al*., 2014). However, the quality of seedlings grown is considerably subjective to growth

medium because, plant roots are restricted by the size and content (moisture, nutrient and air) of the nursery container.

Moringa is one of the important traditional multipurpose food plants that is produced and used in many African countries (Amaglo, 2007). It has a great potential to become one of the most economically important crops for the tropics and subtropics considering its use in many fields as a medicine, food and fodder plant (Peixoto *et. al*., 2011; Pontual *et al*., 2012).The leaves also provide excellent materials for the production of biogas (Kivevele *et.al*., 2011).The fried seeds are eaten in Nigeria and are said to taste like groundnuts. The seeds are added locally to sauces for their bitter taste. The seed oil known as 'Ben oil' or 'Behen oil' can be used for cooking, in hair dressing, as a lubricant and in the perfume industry as a base for fragrant volatile compounds in perfumes (Grubben and Grubben, 2015). Almost all parts have traditional medicinal applications. The bark exudes a white to reddish gum ('Ben gum' or '*Moringa* gum') with the properties of tragacanth (*Astragalus*) oil, which is used for tanning, in calico printing and sometimes added for thickening. Apart from this, *M. oleifera* is said to be used for living fences, in alley cropping and as a source of nectar for bees. The leaves are eaten by livestock, especially goats, camels and donkeys. The seed cake is considered unsuitable as animal feed because of the high content of alkaloids and saponins and is mainly used as fertilizer. The soft wood burns smoke-free and yields a blue dye. In India its pulp has been used to make paper.

Moringa seedlings are influenced by some environmental factors, for proper growth. According to Jahn *et al*., 1986 and GFU, 2008) light is an important environmental factor that influences germination. As with germination, growth of the seedlings is said to be much affected by light conditions, particularly during the hot periods of the year. Early removal of tender seedlings to full light, combined with irregular watering, can have disastrous consequences. Apart from this, good cultural practices in the nursery also improve seedling growth and development. Most of the plants require specialized nursery techniques that ensure the production of quality seedlings that can be transplanted at the proper time, which may ensure high percentage survival in the field. The nursery media must be considered, if good quality and profitable seedlings are to be produced as to fully and effectively obtain the potentialities of *Moringa oleifera* (Essien *et al.*, 2014). Soil amendments are often used in nurseries to improve rate of growth of nursery stock and possibly give an indication of effects/implications that could arise from using them (the soil amendments) on the field.

Organic amendments usually are derived from plants or plant *products* that occur naturally (peat moss from peat bogs), or are the by-*products* of processing plants or mills (sawdust, cedar chips, bark, bagasse, rice hulls). They loosen the soil and create large pores to increase aeration, drainage, usable water holding capacity and nutrient holding capacity (Reed, 2007). The primary role of soil amendments is to provide nutrients for crop growth or to provide materials for soil improvement. Misuse of soil amendments can result not only in damage to crops but can also cause negative impacts on the receiving soil, water, air or habitat environment. The particle size of materials used as soil amendments affects the efficiency of their utilization in soil and their impact on the environment. Fine particle sized materials such as sawdust can easily be incorporated into the soil and decompose rapidly in comparison to coarser materials such as woodchips. The more rapidly an amendment decomposes the sooner nutrients from that material are made available for plant uptake (BC, 2016).

One of the factors required for optimum yield of crops is adequate nutrient in the soil and its proper management. Organic amendments are sustainable relatively cheap materials of plant and animal origin that are incorporated into the soil before seeding to increase its productivity and crop yield (Adebayo *et al.*, 2011). The main purpose of using organic amendments is to loosen the soil and create large pores to increase (Reed, 2007).

MATERIAL AND METHODS

Study Area

The study was conducted at the nursery of the Department of Forestry and Wildlife, Modibbo Adama University of Technology, Yola, Adamawa State. It is located on Latitude 9°14'N and Longitude 12°28'E, at an altitude of 185.5m above sea level (Adebayo and Tukur, 1999).Annual rainfall ranges from 700-1000mm, starting from late April and terminating in late October and reaching its peak during August-September. Average minimum temperature is 15.2°C and the maximum is 39.7°C (FUTY, 2004). The soil in the study area is sandy loam, classified as Typic Haplustalf (Musa, 2005).The major vegetation zones in the state are the southern Guinea savannah, Northern Guinea Savannah, and the Sudan Savanna (Adebayo, 2010).

Experimental Layout and Procedure

Seeds of *Moringa oleifera* were procured from Jimeta market in Yola, Adamawa State. The seeds were soaked in water overnight before planting in order to overcome the dormancy. The treated seeds were then planted into polythene pot already filled with organic amendments mixtures (Bagasse, Rice hull, Sawdust and Control). All the three organic amendments were grinded into particles and thoroughly mixed with planting component before filling into the polythene pot. The potted mixtures were watered a few days before planting was done to allow the decomposition of organic materials. Three seeds were sown per polythene pot and later thinned to one at the emergence of two leaves. The germinating seedlings, already treated with four different treatments were arranged in a layout and placed under three different light regimes viz: shade, partial shade and light, which were replicated five times.

Data Collection

The first Germination occurred five days after planting and a week later, the following basic growth variables were assessed and recorded on the early germination of *Moringa oleifera* seedlings.

i. Seedling Height: This was measured by placing ruler at the bottom (soil brim) of the seedling up to the apex
ii. Number of Leaves: this was done by counting the number of germinated leaves
iii. Stem girth: this was done using micrometer screw gauge, by placing the screw gauge anvil face and the spindle face at the seedling girth and took the reading on the calibrated side.

Data Analysis

Data collected on growth variables were subjected to a two-way Analysis of Variance, Significantly different treatments means were separated using Fisher's Least Significant Difference (LSD) test at 0.05 probability level (Rangaswamy, 2010).

RESULTS AND DISCUSSION

Seedling Height

Table 1 shows the growth performance of the seedlings of *Moringa oleifera*. The result (Figure 1.) on seedlings height shows that the soil treated with Bagasse, under partial shade has the highest mean height (31.4 cm), while, the least mean height was 26.3cm and obtained under the soil amended with rice hull under light. The analysis of variance conducted revealed a significant difference ($P < 0.05$), among the four treatments, while, the interaction of both the soil amendments and light regime shows, no significant difference ($P > 0.05$). The mean values of the treatments were separated, using the LSD (Table 1) and the error bar (Fig. 2) depict significant difference among the treatments under three light regimes examined. This implies that *M. oleifera* seedlings require shading at the early stage of its life for good performance. The increase in height also supports the claim that Shoot biomass accumulation is less inhibited than root biomass accumulation by light competition, when compared with full illumination (Hébert *et al.*, 2001). This indicates that there is a significant difference resulting from use of sugarcane bagasse as amendment.

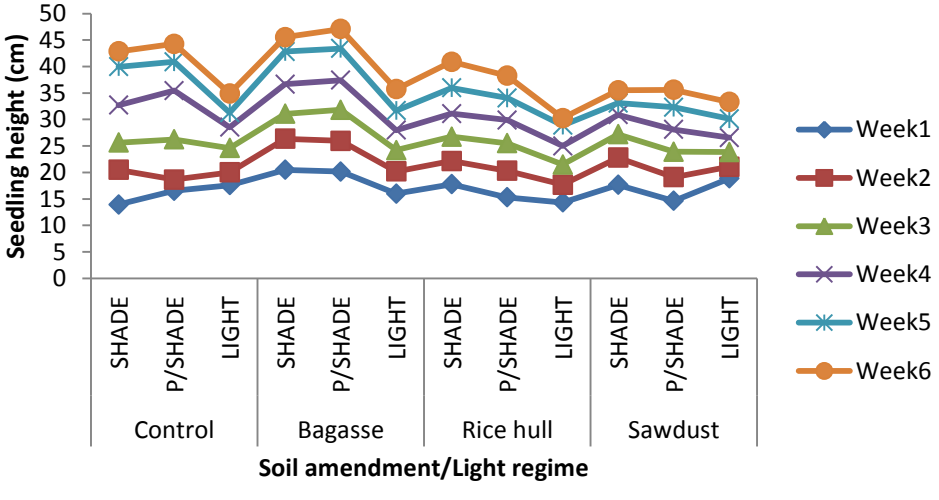

Figure 1: Weekly height growth of *Moringa oleifera* seedling by treatments

Table 1: Growth performance of *M. oleifera* seedlings

Treatment	Mean Height (cm)	Mean Girth (mm)	Mean Number of Leaves
Bagasse	31.4[a]	1.15[ab]	6.6[a]
Control	27.7[ab]	1.16[a]	6.2[a]
Rice hull	26.4[b]	1.17[a]	5.7[a]
Sawdust	26.3[b]	1.04[b]	5.2[b]
LSD Value	3.96	0.11	1.35

Means followed by the same alphabet are not significantly different (p > 0.05)

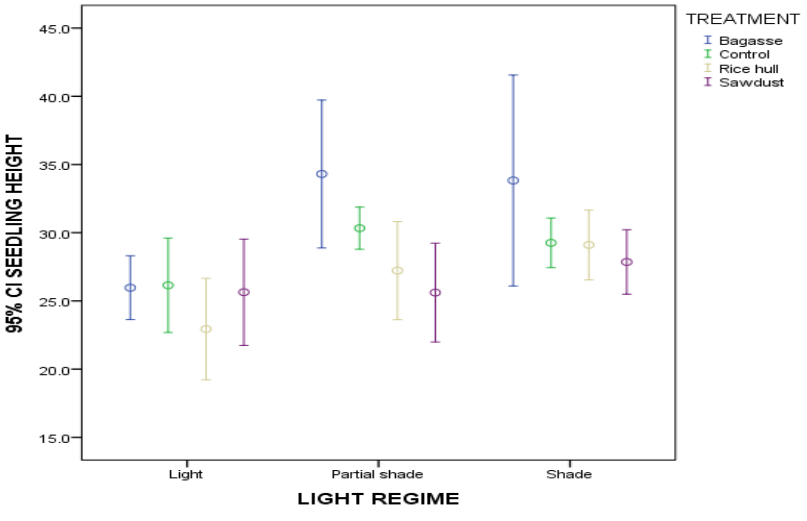

Figure 2: Error bar showing the mean difference in height of *Moringa oleifera* seedling

Seedling Girth

The result on the seedling girth (Figure 3) revealed that *Moringa oleifera* sown in media treated with rice hull, under the light has the highest mean girth (1.17), while, the least mean girth of 1.04mm was observed on the soil treated with sawdust under shade. The analysis of variance revealed a significant difference among the treatment (P < 0.05), while, light regime, and interaction between light regime and the treatment showed no significant difference (P > 0.05).The means treatments (Table 1.) were separated using, LSD, and the results indicate a significant difference between saw dust and the other treatments (Control, Bagasse and Rice hull) The error bar (Figure 4.) depict significance different among the treatments under different light regime. This result is in accordance with that of Adebayo, *et al.*, 2011, which reported that organic amendments and light are sustainable relatively cheap materials of plant and animal origin that are incorporated into the soil before seeding to increase its productivity and crop yield.

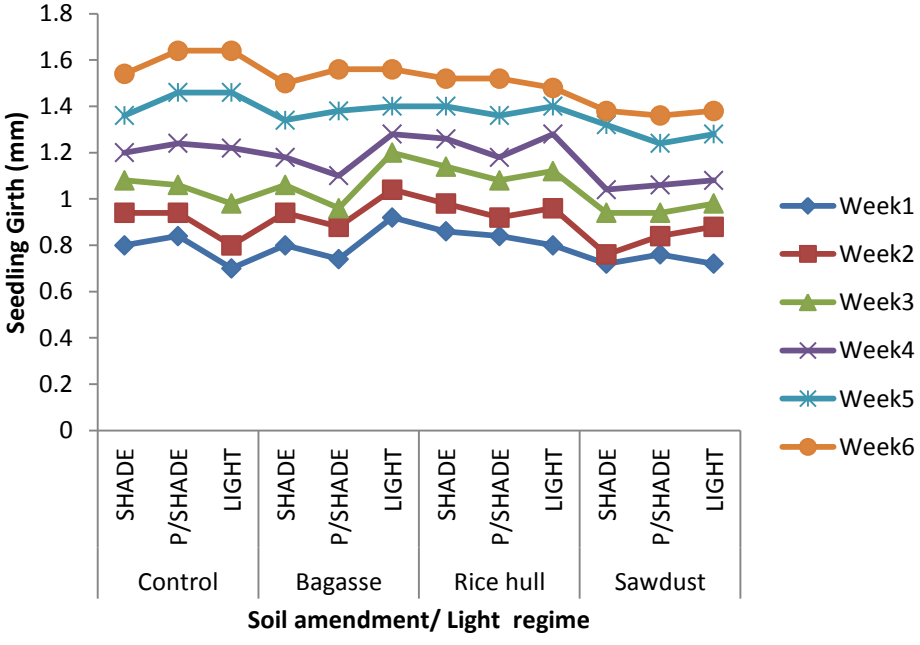

Figure 3: Weekly girth growth of *Moringa oleifera* seedlings

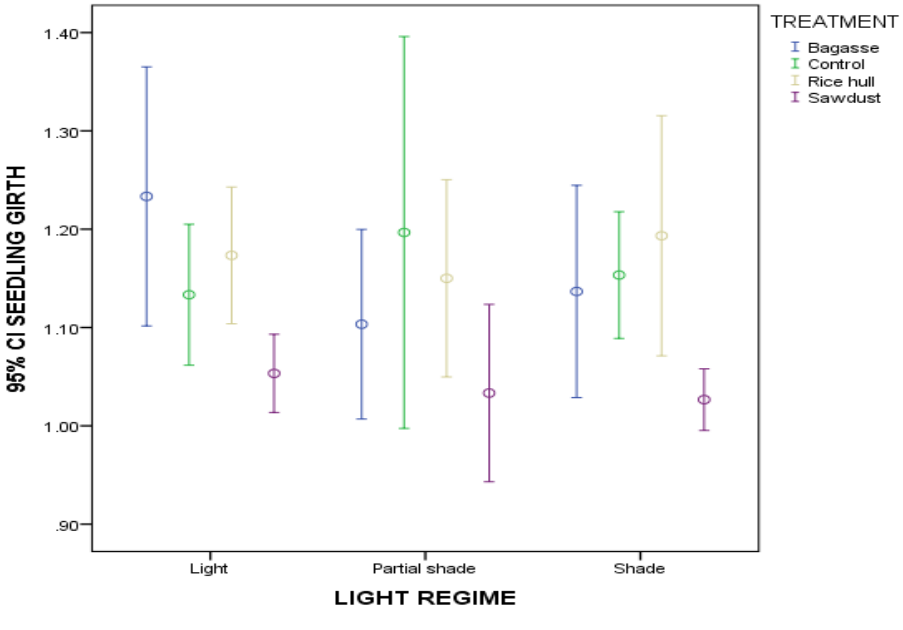

Figure 4: Error bar showing the mean difference in Girth of *Moringaoleifera* seedling

Number of Leaves

The results(Figure 5.) on weekly growth of*Moringa oleifera* seedlings, revealed that, the soil media amended with Bagasse, rice hull and control under shade has the highest mean number of leaves of 7 each, while the soil treated with saw dust have mean the least mean number of leave (5). Also, the analysis of variance revealed a significant difference on both treatment and light regime ($P < 0.05$), while, the interaction between light and treatment shows no significant difference ($P > 0.05$) across the treatments. The means of the treatments were separated, using LSD (Table 1.) the error bar (Figure 6.) depict the differences among the treatment means. The significant effect of shade on shoot biomass as reported by Hebert *et al.*(2001) and Lamia *et al.*(2016) in their work is also in agreement with this finding. This indicated that shade significantly affects the early growth of seedling stems which is corroborated by this study.

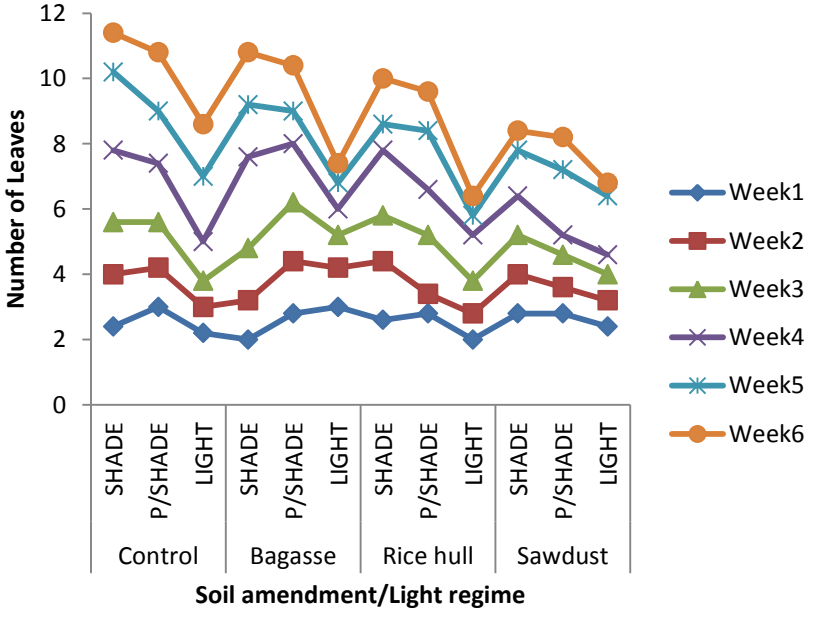

Figure 5: Weekly distribution of number of seedling leaves for *Moringa oleifera*

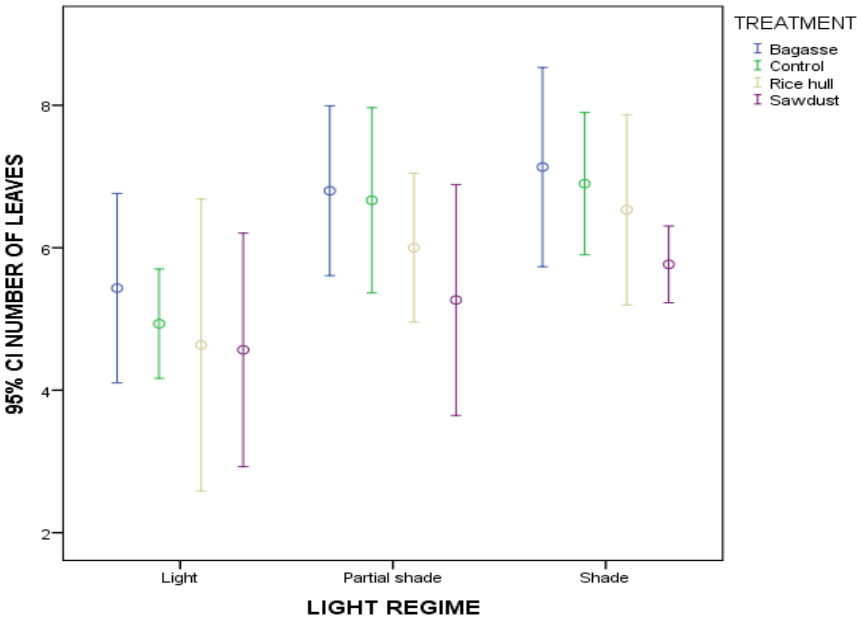

Figure 6: Error bar showing mean difference on number of Leaves of *M. oleifera* Seedling

CONCLUSION

The finding had proved that there was significant difference only, in seedling height and number of leaves of *Moringa oleifera* under the three light regimes examined, while, the soil amendments showed significant different in all the three growth variables measured.

In conclusion, the study shows that, *Moringa oleifera* grows well under shade at its early stage and the use of soil amendments on potting mixtures for its growth makes a significant difference for the low nutrient content observed in soils. *M. oleifera* should therefore be cultivated under shade or partial shade and the use of sugarcane bagasse should be considered in amending the soil for proper aeration and nutrient uptake.

REFERENCES

Adebayo, A.A. and Tukur, A. L. (1999) Adamawa State in Maps, Paraclete Publishers and Department of Geography, Federal University of Technology, Yola, 112p..

Adebayo, A.A. (2010) Climate: Resources and Resistance to Agriculture. Eighth Inaugural Lecture, Federal University of Technology, Yola. 19th May, 2010. 43p

Adebayo, A.G.Akintoye, H.A.Olufolaji, A.O.Aina, O.O. Olatunji, M.T. and Shokalu, A.O. (2011). Assessment of organic amendments on vegetative development and nutrient uptake of *Moringa oleifera* Lam in the nursery. *Asian J. Plant Sci*., 10: 74-79.

Amaglo, N.K. (2007).Effects of Spacing and Harvest Frequency on the Growth and Leave Yield of Moriga (*Moringa oleifera* Lam), a Leafy Vegetable Crop.MSc.Thesis. KNUST, Ghana.

British Columbia (2016). Environmental Farm Plan: Reference Guide Chapter 6. P2. Accessed 18thMay, 2016.

Essien, B. A., Essien, J. B., Ogbu, J. U., Nwite, J. C., Anaele, U. M. and Keke, C. I. (2010). Study on nursery media for germination and early seedling growth of (*Dennettia tripetala*). *Nigerian Journal of Horticultural Science*, 15: 9-13.

Essien, B. A., Essien, J. B.Nwite, J. C. and Agunnanah, M. U. (2014).Effect of different nursery media on the sprouting and growth performance of *Moringa oleifera* cuttings. *Proceedings of the 48th Annual Conference of the Agricultural Society of Nigeria*, 588-591.

Federal University of Technology, Yola. (2004). Weather Station Report Department of Geography

GFU (2008) Global Facilitation Unit for Underutilized Species, Via dei Tre Denari, 472/a00057 Maccarese, Rome, Italy.

Grubben, G. and Grubben, G. J.H. (2015). *Plant resources of tropical Africa.Ed. Vegetables 2.)p. 394. Retrieved 2015-02-02.*

Hébert, Y.,Guingo, E. and Loudet, O. (2001).The response of root/shoot partitioning and root morphology to light reduction in Maize Genotypes. Crop Physiology and Metabolism.*Crop Science*,41:363-371.

Jahn, S. A. Musnad, H. A. and Burgstaller, H. (1986). The tree that purifies water: Cultivating multipurpose Moringaceae in the Sudan. *Unasylva*, 38, pp 23-28.

Kivevele T. T, Mbarawa MM, Bereczky A, Zöldy M (2011). Evaluation of the oxidation stability of biodiesel produced from *Moringa oleifer*a oil. *Energy Fuels*, 25(11):5416-5421

Musa, H. (2005)"Characterization and Evaluation of Soil of School of Agriculture and Agricultural Farm. Unpublished M. Tech. Thesis.Department of Soil Science, Federal University of Technology Yola, Nigeria.

Peixoto ROJ, Silva GC, Costa RA, Joseí res Lira de Sousa Fontenelle, Vieira GHF, Filho A. A.F, Vieira HSFR (2011). In vitro antibacterial effect of aqueous and ethanolic *Moringa* leaf extracts. Asian Pacific J. Trop. Med. 4(3):201-204.

Radovich,T., (2009). Farm and Forestry Production and Marketing Profile for *Moringa* o*leifera*. In: Specialty Crops for Pacific Island Agroforestry, Elevitch, C.R. S (Ed.). Permanent Agriculture Resources (PAR), Holualoa, Hawai'I.

Rangaswamy, R. (2010). A Text Book of Agricultural Statistics, Second Edition and New age International Publishers, New-Delhi, India, P458.

Reed, D. (2007): Horticulture Workshops: Plant Propagation, Soil and Soilless Growing Media, Simple Soil and Water Testing. Texas University