Comparative effects of Varying Rates of Moringa Leaf, Poultry Manure and NPK Fertilizer on the Growth, Yield and Quality of Okra (Abelmoschusesculentus L. Moench)

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Abstract— The fertilizer management practices have not ensure the desired improvement in yield for okra (Abelmoschusesculentus L. Moench) due to differences in fertilizer types. The search continues for nutrient sources that would provide adequate nutrition for the crop on the season. A pot experiment was carried out at the Teaching and Research Farm, Ekiti State University, Ado Ekiti, Nigeria to evaluate the growth and fruit yield responses of okra (Abelmoschusesculentus L. Moench) to the application of air-dried milled moringa leaf (MML), poultry manure (PM) and NPK fertilizer. The MML was applied at 400, 800, and 1200 kg/ha; NPK 15-15-15 at 250 kg/ha and PM at 10 t/ha separately and in all possible combinations in completely randomized design in three replicates. The parameters measured were plant height, stem girth, number of leaves, leaf area, number of fruits and fruit weight. The single treatments differed significantly (P = 0.05) with the combinations of the treatments giving better performance. The 800 kg/ha MML + PM treatment gave the tallest plants (103.33 cm) and followed by single application of PM (102.33 cm). The application of 400 kg/ha MML + PM + NPK produced the highest number of fruits but 800 kg/ha MML + PM + NPK gave the highest fresh fruit (42.70 g) and dry fruit (20.50 g) weight. 800 kg/ha gave best growth performance among MML but 1200 kg/ha gave best yield. This suggests that MML can be used as source of nutrients to grow okra.

Keywords— npk, milled moringa leaf, okra (Abelmoschusesculentus), poultry manure.

1. INTRODUCTION

Okra (Abelmoschusesculentus L., Moench) is grown for fresh fruits in the tropical and subtropical regions and ranks first in terms of calorie for human consumption (Babatunde, 2007). The output of okra constituted about 4.6 percent of the total staple food production in Nigeria between 1970 and 2003 (CBN, 2004). Inadequate weed management, infertile soils, cultivation of low-yielding varieties and sub-optimal planting densities are some of the major constraints to high okra yield and production in Nigeria (Iyagba, et al., 2013) which necessitated the development of various agronomic practices the farmers can adopt to improve okra growth and fresh pod yield. The soil in Nigeria are inherently poor in fertility on account of low available nutrients and organic matter contents such that the application of organic and inorganic fertilizers would be the rule for high crop production. Inorganic fertilizers have been promoted as the panacea to this low fertility and nutrient losses, more so as the added fertilizer nutrients become immediately available in the soils for uptake by crops. The fresh fruit yields of okra increased with NPK fertilizer application and the recommended optimum rates had differed among the varieties (Babatola, 2006). However, the long term dependence on high rates of inorganic fertilizer has demerits: soil acidification, nutrient imbalance and trace element deficiencies especially of manganese (Mn) and zinc (Zn) (Asadu et al., 2004). These have catalyzed the identification and use of organic materials as alternative nutrient sources. Besides, the scarcity of fertilizers and resultant high prices which are beyond the reach of resource-poor farmers mean that the recommended fertilizer rates are hardly met if any at all (Rahman,
Organic manures are relatively resistant to microbial degradation but are essential for enhancing soil nutrient availability and maintaining optimum soil physical conditions.

Poultry manure has been reported to influence positively the growth and fruit yield of okra (Ashraf et al., 2016; All et al., 2013; Tiamiyuet al., 2012) which had led to the increase in the its use as nutrients sources by farmers. Poultry manure is a very cheap and effective source of nutrients, especially nitrogen (N) but ready availability remains an important issue since large amounts must be applied to give optimum yield. Also, plant residues: banana peels (Jonathan et al., 2012), Senna siamea, Leucaena leucocephala and Gliricidia sepium (Akande et al 2010; Olujobi and Ayodele, 2013), sea weeds (Khan et al., 2009), Moringaoleifera (Fahey, 2005) are sources of nutrients needed to improve crop production. Moringaoleifera is a good sources of green manure as it compared very well with other green manure crops such as lablab beans (Fuglie, 2008). Fuglie (2008) reported the use of moringa seedlings as green manure for crop production. Moringaoleifera was one of the green manure used by Makinde et al. (2016) in the production of fluted pumpkin who concluded that plant materials can be used as an alternative to synthetic fertilizers. Moringa leaves are rich in zeatin, a naturally-occurring cytokinin and other compounds such as ascorbates, vitamin E, and phenolics which confer on the leaf extract the status of a natural plant growth enhancer (Nagar et al., 2006). Harlinnet et al. (2004) advocated for the integrated use of organic manure and inorganic fertilizers to supply the nutrients required to sustain maximum crop productivity and profitability while minimizing the negative environmental impacts from nutrient use. Therefore, this study was carried out to evaluate the comparative effects of moringa leaf, poultry manure and NPK fertilizer singly and in combination on the growth and yield of okra (Abelmoschusesculentus) in Ado – Ekiti, Southwestern Nigeria.

II. MATERIALS AND METHOD

Experimental Site

The experiment was conducted at the Teaching and Research Farm, Ekiti State University, Ado-Ekiti, during the 2015 cropping season. The study site lies on latitude 5°45’ N and longitude 8°15’ E and experiences tropical climate characterized by a wet and dry seasons. The long wet season is from late March to November and divided into early and late seasons by little dry season in July to August.

Collection and analysis of soil, moringa and poultry manure samples

Top soil (0-15 cm) samples were randomly collected from cultivated farm, bulked to form a composite sample, air-dried and sieved using a 2mm mesh size. The routine analyses as described in Udo et al. (2009) for physical and chemical properties were carried out on the soil sample. 10 kg of the soil sample were measured into 10l plastic containers that were perforated at the base. Fresh Moringaoleifera leaves were air-dried and milled. Poultry manure was also obtained from the dump site of the Poultry House on the Farm, air-dried and finely crushed.

Experimental design

The treatments consisted of milled moringa leaf (MML) at 400, 800 and 1200 kg/ha, 10 t/ha poultry manure (PM) and 250 kg/ha NPK 15-15-15 fertilizer singly and in all possible combinations and control. The MML and PM were applied 2 weeks before planting while the NPK fertilizer was applied 2 weeks after planting (WAP). Two seeds of okra (NHAe 47-4 variety) were sowed to each pot and thinned to one seedling after emergence at 2 WAP. The experiment was laid out in a Completely Randomized Design (CRD) with three replicates. Adequate watering, weeding and pest control were carried out as required.

Data collection and statistical analysis

Data were collected on plant height, number of leaves and leaf area at intervals of two (2) weeks from 2 WAP. The leaf area was calculated as the product of leaf length and leaf breadth and coefficient factor obtained with the graphical method (Pandey and Singh, 2011). Harvesting of fresh fruits begins at 9 WAP which was done in 4 days interval. The number of fruits per plant was counted while the fruit weight per plant (fresh and dry) were recorded. All data collected were subjected to analysis of variance (ANOVA) and the treatment means were separated by Fisher’s Least Significant Difference (LSD) at 5% probability.

III. RESULTS

Moringa, poultry manure and soil samples

Table 1 shows the pre-cropping soil properties and some chemical properties of the PM and MML. The soil was a slightly acidic (pH=6.24) loamy sand, containing 0.09% N, 1.48% organic matter and 16.59 mg kg⁻¹ available P while exchangeable K, Na, Ca, and Mg were 0.25, 0.03, 2.38, and 1.12 cmol kg⁻¹ respectively. The MML was slightly acidic (pH=6.37) while PM was slightly alkaline (pH=8.25). MML was higher in exchangeable K (10.40 cmol kg⁻¹), total N (4.51 %) and available P (7.16 mg kg⁻¹) than PM with 0.09 cmol kg⁻¹ exchangeable K, 3.76% total N and 3.00 mg kg⁻¹ available P.

Plant height

Table 2 shows that okra plant height increased with the MML levels and the application of NPK 15-15-15 and
PM. Among the single application treatments, M₂ and M₃ gave the highest values which did not differ significantly at 2 WAP. NPK gave the highest value at 4 WAP which did not differ from M₁ at 4 WAP. M₂ gave the highest value at 6 WAP while PM gave the highest followed by M₂ which was similar to NPK fertilizer application at 8 WAP. Okra treated with M₂ gave the tallest plant (71.33 cm) among the MML rates which was significantly different from M₁ and M₃. M₃ + NPK produced the tallest plants at 2, 4 and 6 WAP and did not differ from M₂ + PM at 2 and 4 WAP which gave the best value at 8 WAP. M₂ + PM + NPK produced the tallest plants throughout the sampling period.

Table 1: Chemical and physical properties of soil, poultry manure and dried milled moringa leaf samples

| Parameter                        | Soil  | Poultry manure | Dried milled moringa leaf |
|----------------------------------|-------|----------------|---------------------------|
| pH                               | 6.24  | 8.25           | 6.37                      |
| Organic C (%)                    | 0.86  | 21.35          | 51.87                     |
| Organic matter (%)               | 1.48  | 36.80          | 89.40                     |
| N(%)                             | 0.09  | 3.76           | 4.51                      |
| C:N ratio                        | 9.56  | 5.68           | 11.5                      |
| Available. P (mgkg⁻¹)            | 16.59 | 3.00           | 7.16                      |
| Exchangeable K (cmolkg⁻¹)        | 0.25  | 0.09           | 10.40                     |
| Exchangeable Na (cmolkg⁻¹)       | 0.03  | -              | -                         |
| Exchangeable Ca (cmolkg⁻¹)       | 2.38  | 0.13           | 2.11                      |
| Exchangeable Mg (cmolkg⁻¹)       | 1.12  | 1.57           | 2.20                      |
| ECEC (cmolkg⁻¹)                  | 4.19  | -              | -                         |
| Physical Characteristics         |       |                |                           |
| Sand (gkg⁻¹)                     | 840   | -              | -                         |
| Silt (gkg⁻¹)                     | 98    | -              | -                         |
| Clay (gkg⁻¹)                     | 62    | -              | -                         |
| Textural Class                   | Loamy Sand |              |                           |

Table 2: The Comparative effects of Moringa Leaf, Poultry manure and NPK Fertilizer on the Plant Height (cm) of Okra (Abelmoschusesculentus)

| Treatments       | 2   | 4   | 6   | 8   |
|------------------|-----|-----|-----|-----|
| Control          | 8.50c| 21.33f| 38.17f| 54.57e|
| M₁               | 9.23c| 22.50f| 38.67f| 59.70e|
| M₂               | 21.50ab| 36.00d| 55.67d| 71.33cd|
| M₃               | 20.13b| 34.33de| 47.00e| 66.00de|
| NPK              | 15.13bc| 38.00cd| 51.67de| 70.40d|
| PM               | 13.67c| 28.33e| 50.00de| 76.67cd|
| M₁+NPK           | 21.50ab| 36.50d| 57.00d| 78.60c|
| M₂+NPK           | 18.00bc| 31.25e| 50.00de| 70.50d|
| M₃+NPK           | 25.83a| 60.17a| 85.67a| 102.33a|
| M₁+PM            | 13.33c| 41.83c| 65.00c| 83.00c|
| M₂+PM            | 19.27b| 52.17b| 81.67ab| 103.33a|
| M₃+PM            | 16.10bc| 47.67b| 73.00b| 94.33b|
| M₁+PM+NPK        | 17.00bc| 42.33c| 70.33bc| 94.67b|
| M₂+PM+NPK        | 25.83a| 60.33a| 80.00ab| 98.33a|
| M₃+PM+NPK        | 17.50bc| 48.67b| 75.07b| 94.00b|
| LSD (5%)         | 5.26 | 4.62 | 7.91 | 7.69 |

M: Moringa, (M₁=400kg/ha, M₂=800kg/ha, M₃=1200kg/ha); NPK 15:15:15 Fertilizer, PM: Poultry manure. Mean with different letter in the same column are significantly different at 5% probability.
Number of leaves
Single and combined application of MML, PM and NPK 15-15-15 did not significantly affect the number of leaves in okra (Table 3). At 2 WAP, the single application of NPK and M₂ gave the highest number of leaves while PM produced most leaves at 4-8 WAP followed by M₁, M₂ and NPK at 4 and 6 WAP and M₁ at 8 WAP. M₂ + PM gave the highest number of leaves over the 2-8 WAP while M₂ + PM + NPK and M₁ + PM + NPK produced the highest number of leaves at 2-4 and 6-8 WAP respectively.

Leaf area
Sole application of M₂ gave the largest leaf area 2-4 WAP while the largest area was with PM at 6-8 WAP. M₃ + NPK gave largest leaf area at 2 WAP, M₂ + PM produced largest leaf area at 4 WAP while M₃ + NPK, M₁ + PM, M₂ + PM and M₁ + PM gave highest values which were not significantly different at 6 WAP. M₂ + PM + NPK gave the highest value at 2-8 WAP.

Fruit yield
Table 5 shows that PM and NPK produced the same average number of fruit per plant (4) followed by M₃ (3). NPK has the highest average fresh and dry fruit weights of 37 and 17.10 g respectively which were different significantly from PM with 22.80 and 10.20 g. M₃ gave the best performance in okra yield compared to M₁ and M₂. M₃ + NPK and M₂ + PM did not differ in their average number of fruit per plant but M₃ + NPK gave higher values of average fresh fruit weight that is significantly different to M₂ + PM. The treatment combination M₁+PM+NPK produced the highest average number of fruits per plant (5) while M₂+PM+NPK had the highest average fresh fruit weight (42.72g) and dry fruit weight (20.50 g). The fresh and dry fruit weight yields recorded from the combination of MML, PM and NPK were significantly higher than other combinations.

### Table 3: The comparative effects of milled moringaleaf, poultry manure and NPK fertilizer on the number of leaves of okra

| Treatments* | Week after planting |
|-------------|---------------------|
|             | 2  | 4  | 6  | 8  |
| Control     | 3.33 | 4.67 | 5.00 | 5.00 |
| M₁          | 3.00 | 5.00 | 5.00 | 6.00 |
| M₂          | 5.00 | 5.00 | 5.00 | 6.00 |
| NPK         | 3.00 | 4.33 | 5.00 | 6.33 |
| PM          | 5.00 | 5.00 | 5.00 | 6.00 |
| M₁+NPK      | 4.67 | 5.67 | 6.00 | 6.67 |
| M₂+NPK      | 3.67 | 4.33 | 5.00 | 5.67 |
| M₃+NPK      | 4.00 | 4.50 | 5.50 | 6.00 |
| M₁+PM       | 3.50 | 4.50 | 5.00 | 6.00 |
| M₂+PM       | 3.33 | 5.00 | 5.67 | 6.00 |
| M₁+PM+NPK   | 5.00 | 5.33 | 6.00 | 6.33 |
| M₂+PM+NPK   | 3.67 | 5.33 | 5.67 | 6.33 |
| M₃+PM+NPK   | 3.33 | 5.00 | 6.00 | 6.67 |
| M₂+PM+NPK   | 5.33 | 6.33 | 5.67 | 6.33 |
| M₃+PM+NPK   | 4.00 | 5.00 | 5.67 | 6.67 |
| LSD (5%)    | 1.64 | 1.60 | 1.00 | 1.00 |

M: Moringa, (M₁=400kg/ha, M₂=800kg/ha, M₃=1200kg/ha); NPK 15:15:15 Fertilizer, PM: Poultry manure, NS: Not significant.

### Table 4: The Comparative effects of Moringa Leaf, Poultry manure and NPK Fertilizer on the Leaf Area (cm²) of Okra (Abelmoschusesculentus)

| Treatments | Week after planting |
|------------|---------------------|
|            | 2  | 4  | 6  | 8  |
| Control    | 11.43g | 32.89i | 63.83g | 95.67i |
| M₁         | 11.85g | 35.86h | 83.57f | 127.11h |
| M₂         | 51.87c | 84.13e | 131.74de | 167.32g |
| M₃         | 29.18e | 64.49f | 94.56f | 156.09g |
| NPK        | 27.87e | 62.66fg | 103.37e | 190.07f |
PM 19.72f 47.87g 164.43cd 285.92e
M1+NPK 33.95d 72.17f 180.54c 274.15e
M2+NPK 21.21f 53.24h 61.04 136.17
M3+NPK 83.42a 177.96c 227.93b 341.43bc
M1+PM 28.33e 156.33d 224.98b 338.22c
M2+PM 35.46d 202.49b 217.35b 333.67cd
M3+PM 33.50d 185.73c 232.21b 334.75c
M1+PM+NPK 33.53d 92.00f 210.00b 322.19d
M2+PM+NPK 64.95b 292.89a 328.68a 418.59a
M3+PM+NPK 33.11d 152.19e 236.53b 350.55b
LSD (5%) 3.79 10.29 36.48 12.10

M: Moringa, (M1=400kg/ha, M2=800kg/ha, M3=1200kg/ha); NPK 15:15:15 Fertilizer, PM: Poultry manure. Mean with different letter in the same column are significantly different at 5% probability.

**Table 5:** The comparative effects of milled moringa leaf, poultry manure and NPK fertilizer on the number of fruit, fresh and dry fruit weight of okra.

| Treatments     | Number of Fruit | Weight of Fruit (g) |
|----------------|-----------------|---------------------|
|                | Fresh           | Dry                 |
| Control        | 1.10e           | 2.10i               | 1.30i               |
| M1             | 2.20d           | 5.50h               | 3.40h               |
| M2             | 2.67c           | 10.50g              | 5.10g               |
| M3             | 3.00c           | 16.70f              | 6.80f               |
| NPK            | 4.00b           | 37.80b              | 17.10b              |
| PM             | 4.00b           | 22.80de             | 10.20e              |
| M1+NPK         | 3.00c           | 19.40e              | 7.50f               |
| M2+NPK         | 3.00c           | 7.90gb              | 3.00h               |
| M3+NPK         | 4.00b           | 38.90b              | 16.30bc             |
| M1+PM          | 3.00c           | 20.60e              | 9.60d               |
| M2+PM          | 4.00b           | 34.50c              | 17.30b              |
| M3+PM          | 3.00c           | 23.70d              | 15.30c              |
| M1+PM+NPK      | 5.00a           | 23.40d              | 12.00d              |
| M2+PM+NPK      | 3.00b           | 42.70a              | 20.50a              |
| M3+PM+NPK      | 4.00b           | 38.50b              | 19.60a              |
| LSD (5%)       | 0.47            | 2.27                | 1.08                |

M: Moringa, (M1=400kg/ha, M2=800kg/ha, M3=1200kg/ha); NPK 15:15:15 Fertilizer, PM: Poultry manure. Mean with different letter in the same column are significantly different at 5% probability.

**IV. DISCUSSION**

The pH value of the soil (pH=6.24) was within the pH range of 6 – 7 considered as suitable for optimum performance of vegetables (Purselglove 1992). The total N was very low compared to the critical level of 0.1% for N in the soils of Nigeria (FMANR, 1990) suggesting the need for its increased supply in the soil to improve the growth and yield of okra. This expectation was met with the application of NPK, PM and MML singly and in all combinations which increased the selected growth parameters at all sampling occasions.

Studies have shown that MML and PM are rich in nutrients (Patterson et. al., 1998; Fahey, 2005; Mark, 2010; Annette, 2012) and can thereby be used as soil amendments. Treatments with PM significantly influenced the height of okra plants. Moringa has been used as a growth enhancer (Fahey, 2005, Aluko, 2016) through foliar spray of the leaf extract but not as soil amendment. The response of okra to soil-applied MML was reflected in the growth parameters and fruit yield. Fuglie (2008) and Mvumiet et al. (2012 and 2013) had reported increased in the yields of crops with the application of moringa leaf extract. The increase in MML rates resulted in higher fruit yield which is similar to the observation of Aluko (2016) that the increase in concentration of moringa leaf extract as foliar spray improved pepper fruit yield. The significant increase in the growth parameters confirms the ability of plant residues to compete favorably with the inorganic fertilizers as sources of nutrients (Olujobi and Ayodele,
V. CONCLUSION

The results showed that the application of NPK 15-15-15, poultry manure and milled moringa leaf had significant effect on the performance of okra. The combination of NPK 15-15-15, poultry manure and milled moringa leaf gave better performance. Application of MML at different rates gave significant effect in growth characters except in number of leaves. Thus, milled moringa leaf can serve as source of nutrients for the production of okra.

REFERENCES

[1] Akanbi, W. B. (2010). Growth, Dry Matter and Fruit Yield Components of Okra under Organic and Inorganic Sources of Nutrients. American – Eurasian Journal of Sustainable Agriculture, 4(1): 1-13.

[2] Akande M. O., Oluwaterinbo F. I., Makinde, E. A., Adepoju A. S. and Adepoju I. S. (2010). Response of Okra to organic and inorganic fertilization. Nature and Science. 8 (11): 261-266.

[3] Akinlele, B. O. and Osekita, O. S. (2006). Correlation and path coefficient analyses of seed yield attributes in okra (Abelmoschusesculentus(L.) Moench). Afri. J. Biotechnol., 5(14): 1330-1336.

[4] Ali, M. B., Lakun, H. I., Sani, S. M., and Adamu, H. M. (2014). Effect of organic manure and sowing date on the growth and yield of okra (AbelmoschusesculentusMoench) in Samaru Zaria, Nigeria. International Journal of Agronomy and Agricultural Research (IJJAAR), 5(5), 111-117.

[5] Aluko, M. (2016). Moringa leaf extract on the growth and yield of pepper (Capsicum annuum). APRN Journal of Agricultural and Biological Science, 11 (3): 106-109.

[6] Annette F. (2012). Moringa: Tree helps in Niger’s food crisis. Australia: The World Today/ABC News. Retrieved 13 August 2013.

[7] Asadu, C. L. A., Ezeaku, P. I., and Nnaji, G. U. (2004). The soils of Sub-Saharan Africa and management needs for sustainable farming. Strategies and Indices of Sustainable Agriculture in the Tropics, 2: 1-27.

[8] Ashraf, I., Ahmad, I., Nafees, M., Yousaf, M. M., and Ahmad, B. (2016). A review on organic farming for sustainable agricultural production. Pure and Applied Biology. 277-286

[9] Babalola, L. A. (2006). Effect of NPK 15:15:15 on the performance and storage life of okra (Abelmoschusesculentus). Proceedings of the Horticultural Society of Nigeria Conference. 125-128

[10] Babatunde, R.O., Omotesho, O.A and Sholotan, O.S. (2007). Socio-economic characteristics and food security status of farming household in Kwara State, North – Central Nigeria. Pakistan Journal of Nutrition. 6 (1): 49-58.

[11] Central Bank of Nigeria (CBN) (2004). Annual Report and Statistical Bulletin. 6 (12) December 2004.

[12] FMANR, (1990). Literature Review on Soil Fertility Investigation in Nigeria (in Five Volumes). Federal Ministry of Agriculture and Natural Resources, Lagos. 32-45

[13] Fahey, J. W. (2005). Moringaoleifera: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties. Part 1. Trees for life Journal, 1(5).

[14] Fuglie, L. J.(2008). New Uses of Moringa Studied in Nicaragua: ECHO’s Technical Network Site-networkingglobal hunger solutions. ECHO, Nicaragua: 1-7.

[15] Havlin, J. L., Beaton, J. D., Tisdale, S. L. and Nelson, W. L. (2004). Soil fertility and fertilizer: an introduction to nutrient management. Pearson Education. India, 2004: 106-153.

[16] Iyagba, A. G., Onuegbu, B. A. and Ibe, A. E. (2013). Growth and yield response of okra (Abelmoschusesculentus(L.) Moench) to NPK fertilizer rates and weed interference in South-
[17] Jonathan, W. C., Wong, D. J., Lee and Jaya Nair. (2012). An evaluation of aerobic and anaerobic composting of banana peels treated with different inoculums for soil nutrient replenishment. In Advances in Biological Waste Treatment and Bioconversion Technologies. Eds: Jonathan, W. C., Wong, D. J., Lee and Jaya Nair. Bioresource Technology. 126: 375-382.

[18] Khan, W., Rayirath, U. P., Subramanian, S. et al. (2009). Seaweed extracts as biostimulants of plant growth and development. Journal of Plant Growth Regulation. 28 (4): 386-399.

[19] Makinde, A. I., Are, K. S., Oluwafemi, M. O., Ayanfeoluwa, O. E. and Jokanola, O. O. (2016). Green Manure Source Affects Growth and Vegetative Yield of Fluted Pumpkin. American Journal of Experimental Agriculture 12 (4): 1-6.

[20] Mark, O. (2010). Moringaceae Martinov. Drumstick Tree Family. Flora of North America, 1993. Flora of North America North of Mexico 7: 167 – 169.

[21] Mvumi, C., Tagwira, F. and Chiteka, A. Z. (2012). Effect of moringa extract on growth and yield of tomato. Greener Journal of Agricultural Sciences. 2 (5): 207-211.

[22] Mvumi, C., Tagwira, F. and Chiteka, A. Z. (2013). Effect of moringa extract on growth and yield of maize and commonbeans. Greener Journal of Agricultural Sciences. 3 (1): 055-062.

[23] Nagar, P. K., Iyer, R. I. and Sircar, P. K. (2006). Cytokinins in developing fruits of Moringapterigosperma Gaertn. Physiol Plant. 55: 45-50.

[24] Olaniyi, J. O. (2006). Influence of nitrogen and phosphorus fertilizers on seed yield and equality of egusi melon (Citrulluslanatus (Thunb) Mansf) in Ogbomoso, South – Western Nigeria. Ph.D Thesis, University of Ibadan, Ibadan. 57 – 155.

[25] Olujobi, O. J. and Ayodele, O. J. (2013). Growth and yield of okra (Abelmoschusesculentus L.) in response to tree lrgume manure and urea fertilizer. IJAFS 4(12): 502-509

[26] Pandey, S. K and Singh, H. (2011). A simple, cost-effective method for leaf area estimation. Journal of Botany. 2011: 1-6.

[27] Patterson, P. H., Lorenz, E. S. and Weaver, Jr. W. D. (1998). Litter production and nutrients from commercial broiler chickens. Journal of applied Poultry Research, 7: 247-252.

[28] Purseglove, J. W. (1992). Tropical crops. Dicotyledon. Longman. 1:1-719.

[29] Rahman, S. A. (2004). The place of organic manure in sustaining agricultural development in Nigeria. Paper presented at Science Technology and Society National Workshop in Lafia, Nasarawa State, 11th July, 2004.

[30] Tiamiyu, R. A., Ahmed, H. G., & Muhammad, A. S. (2012). Effect of sources of organic manure on growth and yields of okra (Abelmoschusesculentus L.) in Sokoto, Nigeria. Nigerian Journal of Basic and Applied Sciences, 20(3), 213-216.

[31] Udo, E.J., Ibia, T. O., Ogunwale, J. A., Ano, A. O. and Esu, I. E. (2009). Manual of Soil, Plant and Water Analyses. Sibon Books Limited, Lagos, Nigeria, Pages: 183.