



AGRONOMIC RESPONSE OF WATERMELON (*Citrulus lunatus* (Thumb) Matsum and Nakai) TO PLANT POPULATION AND FERTILIZER TYPES IN LOW FERTILE SOIL ENVIRONMENT

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ABSTRACT: The productivity of watermelon in Nigeria is low owing to low fertility status of the soil and inappropriate planting population among other factors. Field experiment was conducted in the 2016 and 2017 at the experimental farm of the faculty of Agriculture, University of Benin, Benin City to evaluate the effect of plant population and fertilizer types on the growth and yield of watermelon (*Citrulus lunatus* (Thumb) Matsum and Nakai). The study was laid in a 3 x 4 factorial arrangement involving three plant population (5,000, 6,666, and 10,000) and four fertilizer types (control, cattle manure, poultry manure and NPK) fitted into a randomized complete block design with three replications. Data were collected on vine length (cm), vine girth (cm), number of leaves and leaf area index (LAI) at 2, 4, 6 and 8 weeks after sowing (WAS). At harvest, fruit girth (cm), fruit size (g), fruit weight (g) and fruit yield (t ha⁻¹) were collected at harvest. Mean values for vine length, vine girth, number of leaves and LAI were significantly higher in plots with higher plant population and fertilizer application. However, fruit weight per plant was significantly depressed at higher plant population. At a plant population of 10,000 plants ha⁻¹, the fruit yield of 8.26 t ha⁻¹ was highest. All fertilizer types significantly enhanced fruit yield components. Plants treated with cattle manure, poultry manure and NPK had similar fruit yield with 6.77, 6.75 and 7.83 t ha⁻¹, respectively. There was no significant interaction between plant population and fertilizer types for all parameters measured.

Keywords: Fertilizer types, fruit yield, growth, plant population.

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1. INTRODUCTION

Watermelon (*Citrulus lanatusis*) is an annual, trailing or climbing vine and a flowering plant belonging to the plant family *Curcubitaceae*. It is believed to have originated from the Middle-East with a long history of cultivation in Egypt (Maynard and Maynard, 2012). Cultivation is mostly done in tropical and subtropical areas of the world for its vegetable and large edible fruit parts (Schippers, 2000) which are used in preparation of juice and salads. The fruits are excellent sources of nutrients, anti-oxidants, vitamin-C, flavonoids carotenoids including lycopene (Perkins-Veazie *et al.*, 2006; Fassa, 2010) which are essential for optimum

health in humans. In the Triennium 2011-13, global production of the crop is estimated at 106, 384 million tons cultivated on 3.475 million hectares (yield of 30.6 t ha⁻¹) (Wikipedia, 2013). China topped the list of highest producers, producing about 68% of global watermelon production for that year (Wikipedia, 2013).

Due to the ever-growing need for watermelon in Nigeria (Akintoye, *et al.*, 2009), there is need to delineate optimal spacing requirement for the crop and overcome the critical yield limiting factors of low soil fertility status (Kolodziej, 2006; Demmler, 1998). Crop yield improvement is usually attained through better cultural techniques such as planting density, fertilizer application

and the use of improved varieties (Law-Ogbomo and Egharevba, 2008). Low soil nutrient status and the pressure for more yield has resulted to augmenting soil with different (organic and chemical) fertilizer types as these are known to improve the quantity of soil mineral nutrients and soil organic matter available for plant uptake (Bijlsma and Lambers, 2000; Loginow, *et al.*, 1991).

Some studies carried out in many parts of Nigeria have confirmed organic fertilizers as effective nutrient sources for increasing yield and nutrient status of crops such as maize, amaranth, sorghum and pepper (Adeniyi and Ojeniyi, 2005). Adejoro *et al.*, (2011) reported that organic matter and soil nutrients increased with application rate of organic fertilizer, affirming the presence of organic matter, N, P, K, Ca and Mg which are released into the soil upon decomposition. Hence, this study was conducted to evaluate the influence of plant population and fertilizer types on growth and yield of watermelon in low fertile soil environment.

2. MATERIALS AND METHODS

The field trial was conducted in 2016 and 2017 at the experimental farm of the Faculty of Agriculture, University of Benin, Benin City (Latitude 6° 19' N and Longitude 5° 39' E) with an altitude of 162 m asl which is in the rain forest ecological zone of Nigeria and the soils classified as an Ultisols (Umwani *et al.*, 2014). Weather conditions in Benin City is characterized by a bimodal rainfall pattern with mean annual of over 2000mm and daily temperature of 26.5°C (Climate-Data, 2017).

2.1 Materials

Organic fertilizers used in the study were cattle and poultry manures were obtained from the University of Benin Farm Project. Seeds of watermelon variety (Super Marketer) were obtained from Eddy Bagger Agricultural Shop, Sakponba Road, Benin City, Edo State.

2.2 Laboratory Analysis

Prior to sowing, soil samples were randomly collected from experimental site at a depth of 0–15 cm using auger and bulked together to form a composite sample and analyzed using standard laboratory procedures to assess the physical and chemical properties of the soil (particle sizes (5%) pH, organic carbon (g kg⁻¹), total nitrogen (g kg⁻¹), available P (mg kg⁻¹), exchangeable cations (cmol kg⁻¹) and exchangeable acidity (cmol kg⁻¹)). Cattle and

poultry manures were also analyzed for their chemical composition.

2.3 Experimental Design

The experiment was laid out in a 3 x 4 factorial arrangement fitted into randomized complete block design with three replications. The two factors were three plant population (5,000 plants ha⁻¹ (1 x 2 m), 6,666 plants ha⁻¹ (1 x 1.5 m) and 10,000 plants ha⁻¹ (1 x 1m)) and four fertilizer types (control, cattle manure, poultry manure and NPK). The area of the experimental site measured 18.5 x 22 m divided three replicates and 12 plots per block (totaling 36 plots). Each plot had a dimension of 4 x 6 m and 0.5 m apart and 1.0 m between blocks. After bed construction, cured cattle and poultry manures were incorporated into the designated beds at the rate of 15 t ha⁻¹ and left for four weeks to equilibrate with the soil. Seeds were sowed at the rate of 3 seeds per hole and spacing of 2 x 1 m (5,000 plants ha⁻¹), 1 x 1.5 m (6,666 plants ha⁻¹) and 1 x 1 m (10,000 plants ha⁻¹) as per treatment. Seedlings were later thinned to one per stand at two weeks after sowing (WAS). Watering was done when no rain for two days by supplying 250 ml per plant with watering can.

NPK was applied to the designated plots at the rate 400 kg ha⁻¹ at 2 WAS and 5 cm away from the root region of the plants. The plots were weeded first at two weeks after sowing and subsequently as at when due. Fruits were harvested from the plants at physiological maturity at 90 days after sowing.

2.4 Data Collection

Data were collected for both growth and yield variables from three randomly selected plants from the inner rows of each plot. Vine length was measured with a flexible tape rule from the ground level to the tip of the three randomly selected plants and the mean computed, vine girth was taken 5 cm above ground level on each of the randomly selected plants by the use of vernier caliper and average computed, number of leaves and branches were assessed by visual count of fully expanded green leaves, and developed branches of the three randomly selected plants and the mean computed, leaf area and leaf area index were measured. The leaf area (cm) was measured by taking the length and width of three randomly selected leaves out of three selected plants. The mean values were obtained and used to estimate the leaf area using the formula.

$$LA = 0.859 (LW) \times 2.7 \times \text{number of leaves}$$

(Flavio and Marcos, 2003)

Where LA = Leaf area

L=Length,

W = width

Data collected on yield parameters were fruit Length (cm) measured with a flexible tape rule, number of fruits that were counted during harvesting, fruit girth (cm) measured using a flexible tape and fruit weighed using a digital weighing balance. Fruit yield was expressed as t ha⁻¹ using the formula:

$$\text{Yield (t ha}^{-1}\text{)} = \frac{\text{Yield (kg plot}^{-1}\text{)} \times 10,000}{\text{plot area} \times 1,000}$$

2.5 Data Analysis

Data collected was subjected to analysis of variance (ANOVA) after computing means of the two cropping seasons with GENSTAT statistical package. Differences among treatment means were separated using the least significant difference (LSD) test at 0.05 level of probability.

3. RESULTS

3.1 Chemical composition soil and of organic fertilizers

The physical and chemical properties of the soil of the experimental site prior cropping with watermelon and chemical composition of organic fertilizers (cattle and poultry manures) are presented in Tables 1. The soil was sandy loam texturally with strongly acidic reaction. The soil had low organic carbon, total nitrogen, available phosphorus, exchangeable bases (except sodium and potassium) and effective cation exchange capacity.

Both cattle and poultry manures were slightly acidic (6.60 and 6.80) with high amount of organic carbon (28.60 and 32.40, respectively). The organic fertilizers also contained total nitrogen, available phosphorus and exchangeable bases in adequate amount for the plant uptake.

3.2 Growth of watermelon

The vine length of watermelon as influenced by plant population and fertilizer types is presented in Table 3. Plant population had no significant ($P > 0.05$) effect on vine length at 2 and 4 weeks after sowing (WAS). At 6 WAS, the longer vines were observed on 6,666 (67.80 cm) and 10,000 (73.10 cm) plants ha⁻¹ than on 5000 plants ha⁻¹. At 8 WAS, 10,000 plants ha⁻¹ had the longest vines while the shortest vines were observed on 5,000 and 6,666 plants ha⁻¹.

Table 1: Physical and-chemical properties of the soils of the experimental site prior to cropping with watermelon and chemical composition of organic Fertilizers

Parameter	Soil	Organic manure	
		Cattle	Poultry
Sand (%)	89.30	NA	NA
Silk (%)	5.00	NA	NA
Clay (%)	5.70	NA	NA
pH (H ₂ O)	5.00	6.60	6.80
Total Nitrogen (g/kg)	0.84	10.30	11.20
Organic Carbon (g/kg)	12.00	28.60	32.40
Available Phosphorus (mg/kg)	4.24	14.40	15.80
Exchangeable cations (cmol kg ⁻¹)			
Potassium	0.18	0.20	0.22
Calcium	0.67	2.81	2.72
Magnesium	0.30	0.43	0.56
Sodium	0.14	NA	NA
Exchangeable Acidity (H ⁺ + Al ³⁺)	1.11	0.08	0.05
Effective Cation Exchange Capacity	2.40	NA	NA

NA-Not applicable

Table 2: Effect of plant population and fertilizer type on the vine length (cm) of watermelon

Treatment	Week after planting			
	2	4	6	8
Plant population (plant/ha)				
5000	25.10	33.90	55.20	63.20
6666	26.00	40.80	67.80	65.20
10000	22.20	51.50	73.10	83.80
LSD (0.05)	ns	9.28	15.06	10.37
Fertilizer Type				
Control	19.60	32.50	49.60	55.50
Cattle Manure	25.10	48.30	69.60	82.70
Poultry Manure	26.20	45.10	69.10	72.60
NPK	26.90	42.30	73.10	72.00
LSD (0.05)	ns	10.72	17.39	11.97
Interaction	ns	ns	ns	ns

ns – Not significant at 0.05 level of probability.

Fertilizer types had significant ($P < 0.05$) effect on vine length at 4, 6 and 8 WAS. The shortest vines were observed on unfertilized plots at 4, 6 and 8 WAS. At 4 WAS, only plants treated with cattle (48.10 cm) and poultry (45.10 cm) manures were significantly ($P < 0.05$) longer than unfertilized plants. At 6 and 8 WAS, all fertilized plants statistically had the same vine length but significantly ($P < 0.05$) longer than untreated plants.

The result of vine girth of watermelon as influenced by plant population and fertilizer types is presented in Table 3. The values of vine girth among plant populations were similar at 2 and 4 WAS. But the 10,000 plants ha⁻¹ had the thickest vines at 6 and 8 WAS. The vine girth observed on fertilizer types including control at 2 and 4 WAS were similar. At 6 and 8 WAS, all fertilized plants had statistically the same vine girth but significantly (P<0.05) thicker than vines of unfertilized plants. The number of leaves as influenced by plant population and fertilizer types is presented in Table 4. At 2 and 8 WAS, number of leaves were not significantly (P>0.05) difference among plant populations. At 4 and 6 WAS, 6,666 and 10,000 plants ha⁻¹ had similar number of leaves but significantly (P<0.05) more foliate than the 5,000 plants ha⁻¹.

At 2 and 6 WAS, all fertilized plants had statistically the same number of leaves but significantly (P<0.05) higher than unfertilized plants. At 4 WAS, the most foliated plants (14.29) were observed from cattle manure treated plants which was not significantly (P>0.05) higher than NPK treated plants (12.86). The least foliated plants were observed on unfertilized plants. All plant populations had similar LAI at 4 and 8 WAS (Table 5). At 4 and 8 WAS, 6,666 and 10,000 plants ha⁻¹ has similar LAI but significantly lower (P<0.05) than 5,000 plants ha⁻¹ (Table 5). There was no significant difference recorded in LAI responses among fertilizer types except at 8 WAS. At 8 WAS, LAI values were similar among cattle manure, poultry manure and NPK treated plants but significantly (P<0.05) higher than unfertilized plots (Table 5).

Table 3: Vine girth (cm) of watermelon as influenced by plant population and fertilizer types

Treatment	Weeks After Sowing			
	2	4	6	8
Plant population (plant ha ⁻¹)				
5,000	0.40	0.51	0.66	0.84
6,666	0.50	0.52	0.84	0.87
10,000	0.50	0.68	1.17	1.17
LSD (0.05)	ns	ns	0.157	0.231
Fertilizer types				
Control	0.30	0.42	0.70	0.70
Cattle manure	0.50	0.57	1.04	0.99
Poultry manure	0.72	0.68	0.93	1.09
NPK	0.50	0.59	0.89	1.06
LSD (0.05)	ns	ns	0.181	0.260
LSD (0.05)	ns	ns	ns	ns

ns - not significant at 0.05 level of probability

Table 4: Number of leaves of watermelon as influenced by plant population and fertilizer types

Treatment	Weeks After Sowing			
	2	4	6	8
Plant population (plant ha ⁻¹)				
5,000	9.02	8.45	12.63	19.30
6,666	12.21	14.29	18.63	20.20
10,000	10.09	12.86	19.28	19.30
LSD (0.05)	ns	1.741	3.405	ns
Fertilizer types				
Control	7.36	8.01	12.19	13.10
Cattle manure	10.96	14.68	17.09	19.30
Poultry manure	11.72	11.91	18.09	26.20
NPK	11.72	12.86	20.02	19.80
LSD (0.05)	2.203	2.011	3.932	6.560
LSD (0.05)	ns	ns	ns	ns

ns - not significant at 0.05 level of probability

Table 5: Leaf area index of watermelon as influenced by plant population and fertilizer types

Treatment	Weeks After Sowing			
	2	4	6	8
Plant population (plant ha ⁻¹)				
5,000	0.10	0.36	0.38	0.20
6,666	0.22	0.63	1.04	0.26
10,000	0.21	0.63	1.12	0.33
LSD (0.05)	0.083	ns	0.358	ns
Fertilizer types				
Control	0.12	0.26	0.64	0.13
Cattle manure	0.16	0.69	0.83	0.29
Poultry manure	0.22	0.63	1.01	0.37
NPK	0.21	0.58	0.92	0.26
LSD (0.05)	ns	ns	ns	0.136
LSD (0.05)	ns	ns	ns	ns

ns - not significant at 0.05 level of probability

3.3 Fruit yield and yield component of watermelon

The fruit yield and yield components of watermelon as influenced by population and fertilizer types are presented in Table 6. There was no significant (P>0.05) differences observed in the fruit girth (cm) and fruit size (g) responses among plant populations. Fruits were heaviest (1.18 kg) on 5,000 plants ha⁻¹ which was significantly (P>0.05) different from other plant populations. The highest fruit yield (8.26 t ha⁻¹) of watermelon was observed on 10,000 plants ha⁻¹ plots. Fertilizer types had significant effect on fruit girth, size, weight and yield. All fertilized plants had similar fruit girth, size, weight and yield but significantly (P<0.05) higher than control plants.

Table 6: Fruit yield and its components of watermelon as influenced by plant population and fertilizer types

Treatment	Fruit girth (cm)	Fruit size (kg)	Fruit weight (kg)	Fruit yield (t ha ⁻¹)
Plant population (plant ha ⁻¹)				
5,000	27.38	0.39	1.18	5.92
6,666	26.01	0.33	0.68	4.57
10,000	26.67	0.37	0.83	8.26
LSD (0.05)	ns	ns	0.308	2.232
Fertilizer types				
Control	22.44	0.26	0.51	3.65
Cattle manure	29.75	0.40	1.01	6.77
Poultry manure	26.65	0.37	0.92	6.75
NPK	27.91	0.43	1.16	7.83
LSD (0.05)	3.446	0.081	0.355	2.578
LSD (0.05)	ns	ns	ns	ns

ns - not significant at 0.05 level of probability

4. DISCUSSION

The soil was a typical Ultisols, being strongly acidic and with very high proportion of sand. The content of organic carbon, total nitrogen, available phosphorus, and exchangeable cations were below the critical levels of the nutrients in the soil (Enwezor *et al.*, 1989). This could probably be as a result of continuous cultivation could have been responsible for low organic carbon, total nitrogen, available phosphorus and exchangeable calcium and magnesium.

The low fertility status of the soils is a true reflection of most humid ultisols as the strongly weathered of low activity clay mineralogy and high acidity due to intense precipitation with its associated erosion and leaching. These relatively low levels of major nutrients signify the need for their augmentation to enhance the optimal performance of *C. lanatus*. Consequently, optimum crop growth and yields cannot be achieved without supplementary nutrients through soil amendment in form of organic fertilizer and/or inorganic fertilizer (Sanni *et al.*, 2015).

Cattle and poultry manures contained high amount of organic carbon and plant nutrients in adequate amount that can be utilized by plants for optimal productivity. This observation was in agreement with Adenawoda and Adejoro (2005) who reported that poultry manure contained organic carbon, nitrogen, potassium, phosphorus, calcium and magnesium which is released into the soil upon decomposition and mineralization of the manure, and that depletion of soil organic matter

under intensive cropping can be amended by proper addition of poultry manure into the soil.

The enhancement of growth and yield of watermelon may be attributed to increase in vegetative growth as effected by fertilizer. This agreed with the report of Messiaen (1992) that watermelon responds well to fertilizer application due to the soil enrichment with plant nutrients from the applied fertilizer. This nutrient availability is precursor to the promotion of root and vegetative growth (John *et al.*, 2014). Increase in fruit girth, size, weight and yield can be attributed to the ability of fertilizer sources to promote vigorous growth resulting in increased meristematic and physiological activities. The increase in meristematic and physiological activities in plant due to abundant supply of plant nutrients led to the synthesis of more assimilates, which is used in producing fruits.

The significant effect of plant population on vine length, vine girth, number of leaves and leaf area index is an indication that vegetative growth and yield components are under the influence of plant population. Higher vine length, vine girth, number of leaves and leaf area index associated with higher population was due to better light interception and proper utilization of growth resources (physical space, light, nutrient and moisture). The lower fruit yield for lowest plant population (5,000 plants ha⁻¹) was probably due to insufficient plant population leading to lower utilization of growth resources and light interception. The plot occupied by 5,000 plants ha⁻¹ was sub-optimal due to inadequate coverage of the available space and thus, encouraging soil temperature fluctuation and increased evapotranspiration. The lower fruit weight per plant for 6,666 and 10,000 plants ha⁻¹ could be as a result of increased competition for growth resources. This was in agreement with Knavel (1991) who reported that higher plant population reduced total fruit weight and count per plant under some conditions for watermelon and other vegetable crops.

5. CONCLUSION AND RECOMMENDATION

1. A population of 5,000 plant ha⁻¹ had the lowest growth and yield parameters; however, it maintained highest fruit weight. A population of 10,000 plant ha⁻¹ had the highest growth and yield parameters except fruit weight per plant which was low.
2. All fertilizer types enhanced growth and yield parameters of watermelon. Hence cattle and poultry manures (organic fertilizer) are viable alternative to NPK (inorganic fertilizer).
3. Plant populations higher than 10,000 plants ha⁻¹ should be evaluated to ascertain the level of plants at

which productivity maximized and adopted by watermelon farmers.

4. Either of Cattle manure or poultry manure can be used to supplement NPK, since they are cheaper and easily available.

REFERENCES

- Adejoro, S. A., Okunlola, A. I and Fakanlu, C. (2011). Evaluation of some manure types for the growth and yield of watermelon in southwestern Nigeria. *Researcher*, 3:393-395
- Adeniyani, O.N. and Ojeniyi, S.O. (2005). Effect of poultry manure, N.P.K 15:15:15 and combination of the reduced levels on maize growth and soil chemical properties. *Nigerian Journal of Soil Science*, 15, 34-41.
- Adenawoola, A. R. and Adejoro S. A. (2005). Residual effects of poultry manure and NPK Fertilizer residues on soil nutrient and performance of Jute (*Corchorus olitorius* L.). *Nigerian Journal of Soil Science*, 15: 133-135
- Akintoye, H. A. Kintomo, A. A. and Adekunle, A. A. (2009). Yield and fruit quality of watermelon in response to plant population, *International Journal of Vegetable Science*, 15 (4), 369-380.
- Bijlsma, R. J. and Lambers, H. (2000). A dynamic whole-plant model of integrated metabolism of nitrogen and carbon. *Plant and Soil*. 220: 71-87.
- Climate-Data.org (2017). Climate: Benin City. Available at <http://en.climate-data.org/location/764230/>. Accessed 18 Nov. 2017.
- Demmler, D. (1998). Grundungung zur Stabilisierung der Bodenfruchtbarkeit bzw. Zur Verringerung von N-Verlusten. *Kartoffelbau*. 1998; 49 (6), 232-235.
- Enwenzor, W.O., E.J. Udo, N.J. Usoroh, K.A. Ayotade, J.A. Adepetu, V.A. Chude and C.I. Udegbe, (1989). *Fertilizer Use and Management of Crops in Nigeria*. FDDD, Federal Ministry of Agriculture, Water Resources and Rural Development, Lagos, Nigeria, pp: 163.
- Fassa, P. (2010). Find out why watermelon is a nutritional powerhouse. Tags: watermelon, nutrition, health news. Retrieved from http://www.naturalnews.com/029157_watermelon_nutrition.html#ixzz4U7tF4Iq7.
- Flavio, F. B and Marcos, B. F. (2003). A 'new method for estimating the leaf area index of cucumber, watermelon and tomato plants'. *Horticultura Brasileira*, 21:4.
- John, L. W., Jamer, D. B., Samuel, L. T. and Warmer, L. W. (2014). *Soil fertility and fertilizer: An introduction to nutrient management*. Pearson Education, India, pp 106 – 153.
- Knavel, D. E. (1991). Productivity and growth of short-internode muskmelon plants at various spacing of densities. *Journal of American Social and Horticultural Science*, 116:926-929
- Kolodziej, B. (2006). Effect of mineral fertilization on ribwort plantain (*Plantago lanceolata* L.) yielding (in Polish). *Acta Agrophysica*. 2006; 141: 637-647.
- Law-Ogbomo, K. E. and Egharevba, R. K. A. (2008). Effect of planting density and NPK fertilizer on growth and fruit yield of tomato (*Lycopersicon esculentus* Mill). *Research Journal of Agricultural and Biological Sciences*, 4(3):265-27
- Loginow, W., Andrzejewski, J. and Janowiak, J. (1991). Role of organic fertilization in maintenance of stock of organic stuff in soil (in Polish). *Roczn.Glebozn*, 42 (3/4), 19-25.
- Maynard, D. and Maynard, D. N. (2012). *Cucumbers, melons and watermelons*. In Kiple, Kenneth F.: *Ornelas, Kriemhild Coneè. The Cambridge World History of Food, Part 2*. Cambridge University Press.
- Messiaen, C. M. (1992). *The tropical vegetable garden*. Macmillan Press Limited, London and Basingstoke in cooperation with CTA, The Netherland, 514 pp.
- Perkins-Veazie, P., Collins, J. K., Davis, A. R., and Robert, W. (2006). Carotenoid content of 50 watermelon cultivars. *Journal of Agriculture, Food Chemistry*, 54(7):2593-7.
- Sanni, K. O., Ewulo, B. S., Godonu, K. G. Animashaun, M. O. (2015). Effects of Nutrient Sources on the Growth and Yield of Cucumber (*Cucumis Sativus*) and on Soil Properties in Ikorodu Agro-Ecological Zone. *Report and Opinion*, 7 (4), 24-32.
- Schippers, R.R. (2000). *African Indigenous Vegetables. An overview of the species*. Chatthan, UK., N.R/ACO. EU, 56-60.
- Umweni, A.S., Uwadiae, I. and Okunsebor, F.E. (2014). Evaluating the distribution of some selected heavy metals in the soils of a university community farm land in Mid-Western Nigeria. *Journal Research of Environmental and Earth Science*, 1(3): 1-16
- Wikipedia (2013). Free encyclopedia. <http://en.wikipedia.org/w/index>