*Journal of Agriculture and Ecology Research International*
*3(2): 81-88, 2015; Article no.JAERI.2015.035*

**SCIENCEDOMAIN** *international*
*www.sciencedomain.org*

# Effect of Cow Dung and Urea Fertilization on Soil Properties, Growth, and Yield of Cucumber (*Cucumis sativus* L)

**I. A. Nweke[1*] and L. N. Nsoanya[1]**

*[1]Department of Soil Science, Anambra State, University Igbariam Campus, Anambra State, Nigeria.*

***Authors' contributions***

*This work was carried out in collaboration between both authors. Author IAN designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author LNN managed the literature searches, analyses of the study performed the structural equation modeling and discuss the conclusion. Both authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/JAERI/2015/14084
*Editor(s):*
(1) Edward Wilczewski, University of Technology and Life Sciences in Bydgoszcz, Poland.
*Reviewers:*
(1) Tunira Bhadauria, Department of Zoology, Feroz Gandhi College, Kanpur University, India.
(2) Anonymous, Nigeria.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=922&id=37&aid=8200

***Original Research Article***

***Received 18th September 2014***
***Accepted 23rd December 2014***
***Published 20th February 2015***

## ABSTRACT

In this work, effect of cow dung and urea fertilization on soil properties, growth and yield of cucumber was evaluated. Four different rates of treatments [12 kgplot$^{-1}$ cow dung (CW), 391 g ureaplot$^{-1}$ equivalent to 150 kgha$^{-1}$, 6 kg cow dung + 196 g urea equivalent to 75 kgha$^{-1}$ thoroughly mixed (CWU) and CO kgplot$^{-1}$ (control that received no treatment application)] were used. The treatments were applied following a randomized complete block design (RCBD). Results obtained showed significant differences between the treatments in the soil and in agronomic parameters assessed. The CWU treated plots recorded the highest value in all growth parameters measured. The values of the fruit yield vary from 3.21 kgha$^{-1}$ – 8.29 kgha$^{-1}$ with the highest value 8.29kgha$^{-1}$ recorded in CWU treated plots. The CWU had the highest values in bulk density (1.41 gcm$^{-3}$), moisture content (28.38%) and aggregate stability (32.05%) but showed non-significant values in hydraulic conductivity (2.45 cmhr$^{-1}$) and least value in mean weight diameter (0.85). The results revealed that the combination of cow dung manure and urea fertilizer could enhance cucumber growth, yield quality and soil fertility in the studied area.

**Corresponding author: Email: nwekson@hotmail.com;*

Keywords: Cow dung; growth; soil; urea; fertilization.

## 1. INTRODUCTION

Crop productions in most part of Nigeria are mainly done by the poor resource farmers. They over the years practiced slash and burn cultivation to sustain the soil fertility and yield even though at a low level. However increase in population and urbanization has led to intensive cultivation without adequately replenishing soil nutrients. The end result was depletion in soil nutrients and decline in yield. The soils when exposed to harsh environmental conditions or intensive cultivation, become fragile, lose nutrients and organic matter. The decline in soil fertility has been recognized by Mokwunye et al. [1] as one of the major biophysical constraints for agriculture, particularly nitrogen (N) and phosphorous (P) deficiencies. Bush fallowing has been an efficient balanced and sustainable agricultural system for soil productivity and fertility restoration in the tropics [2], but as a result of increase in population, the fallowing periods have drastically reduced to the extent that some farmers do not fallow their land any more. This has had an adverse effect on the fertility restoration leading to poor yields of crops. Therefore, the use of external inputs in the form of organic manure or fertilizer had become imperative as the use of organic manure and/or chemical fertilizer increased soil nutrients and microbial biomass.

Organic manure can sustain crop production through better nutrient recycling and improvement of soil physical attributes, environmental conditions and public health [3,4,5], while the use of inorganic fertilizer has not been helpful under intensive agriculture because of its high cost and unavailability. It is often associated with reduced crop yields, soil degradation, nutrient imbalance and acidity [6,4]. This calls for the complementary or integrated use of organic manure and chemical fertilizers. The complementary use of organic and inorganic fertilizers sustains long term cropping in the tropics and increased nutrient use efficiency [7,8].

Cucumber production requires fertile soil of moderate to high nutrient levels so as to achieve high yields. The use of infertile soils results in bitter and misshaped fruits which are often rejected by consumers and thereby reducing farmers' income and increased financial burden. Cucumber, in addition to its palatability and fairly good caloric value, is very important to humans for its medicinal value. It is very useful as natural diuretic and therefore, can be used as active drug for secreting and promoting the flow of urine. To sustain these attributes require an increase in production of cucumber which is largely in the hands of peasant farmers who lack information on some important cultural practices such as manure utilization. Thus the essence of the present study is to evaluate the effect of cow dung and urea fertilization on soil properties, growth and yield of cucumber.

## 2. MATERIALS AND METHODS

### 2.1 Site Location

The field experiment was conducted at the experimental farm of the Department of Crop Science and Horticulture, Faculty of Agriculture, Anambra State University, Igbariam Campus. The experimental site lies on latitude 06º 14'N and longitude 06º 45'E. The soil of the study area is of the sandy clay loam textural class, hydromorphic and poorly drained. The detailed meteorological record within the period under study is presented in Table 1.

#### 2.1.1 Land preparations, experimental design and treatment applications

The study area was manually cleared of the natural vegetation, debris removed and cultivated using hoe. The experiment was then laid out in a randomized complete block design (RCBD), with four replicates to give 16 plots, each measuring 3 m x 4 m. Plots were separated from each by 0.5 m path and each block was separated by 1m alley. The treatments consisted rates of cow dung and urea fertilizer, as follows;

- CO = O kg per plot (control that received no treatment application).
- CW = 12 kg cow dung per plot.
- U = 391 g urea per plot equivalent to 150 $kgNha^{-1}$
- CWU = 6 kg cow dung + 196 g urea equivalent to 75 $kgNha^{-1}$.

**Table 1. Meteorological parameters recorded during the period of the trial**

| Parameters | Month | | | |
|---|---|---|---|---|
| | June | July | August | September |
| Rain fall (mm) | 17.2 | 21.1 | 18.3 | 21.4 |
| Rain days (day) | 11 | 16 | 15 | 16 |
| Mean Minimum monthly temperature (0C) | 17.9 | 16.4 | 23.4 | 22.6 |
| Mean Maximum monthly temperature (0C) | 23.9 | 21.8 | 29.7 | 29.4 |
| Relative humidity (%) at 6.00hours | 54 | 50 | 74 | 73 |
| Relative humidity (%) at 18.00hours | 65 | 62 | 94 | 84 |

*Source: Meteorological unit, Faculty of Agriculture, Anambra State University, Igbariam Campus, 2013.*

The 12 kg cow dung (CW) was applied evenly on the respective plots and incorporated into the soil one week before planting to allow for proper decomposition and mineralization of nutrients in the fertilizer. The urea fertilizer was applied two weeks after planting using ring method while the integrated one that is 6 kg cow dung + 196 g urea was mixed thoroughly and applied using ring method at two weeks after planting. Two seeds of cucumber were planted per hole at a spacing of 50 cm between rows and 40 cm within rows. This was later thinned down to one plant per hole two weeks after germination. Empty stands were supplied. Weeding was done manually with hoe at 3 weeks interval till harvest.

Composite soil samples collected from 0 – 20 cm in the study area before application of treatments were air dried and analyzed for their nutrient contents (Table 2). Eight cucumber plants per plot were randomly selected and tagged. These were used to measure weight of fruits, number of fruits, leaf area, number of branches and number of leaves per plant. At the end of the study soil samples were collected from respective plots and used for the determination of the physical properties of the soil. Particle size distribution of the soil was determined using Bouyoucous hydrometer method as described by Gee and Bauder, [9] and the textural class of the soil was determined using textural triangle. The method of Middleton [10] was used for determination of dispersion ratio and the method of Black [11] for gravimetric moisture content. Hydraulic conductivity was determined by the method of Landon [12]. Available phosphorous was determined by the method of Bray and Kurtz [13], Soil pH was measured with a pH glass electrode measured in extract of soil solution (1:2.5) in water. Organic carbon was analyzed by the method of Nelson and Sommers [14] and the value of organic matter was obtained by multiplying the carbon value with the conventional van Bemmelar factor of 1.724.

**Table2. Physical and chemical characteristics of the soil prior to the experiment**

| | |
|---|---|
| Clay% | 22 |
| Silt% | 22 |
| Fine sand% | 42.2 |
| Coarse sand% | 14 |
| Bulk density | 1.10 $gcm^{-3}$ |
| Moisture content | 20.77% |
| Aggregate | 18.83% |
| Total porosity | 50.70% |
| Dispersion ratio | 0.77% |
| pH $H_2O$ | 4.9 |
| Organic carbon | 0.94% |
| Organic matter | 1.62% |
| Available phosphorus | 2.80 mg $kg^{-1}$ |
| Saturated hydraulic conductivity | 4.49 $cmhr^{-1}$ |

The principle described by Blake and Hartage [15] was used in Bulk density determination and total porosity calculated from bulk density. Aggregate stability was determined using the wet sieving method described by Kamper and Rosenau [16].

Data generated from the experiment were subjected to analysis of variance (ANOVA) according to Steel and Torrie [17] and significantly different treatment means were separated using the least significant difference (LSD) at 5% alpha level.

## 3. RESULTS

### 3.1 Effect of Cow Dung and Urea on the Growth Parameters and Yield of Cucumber

The result of leaf area index measured at 35 Days after planting (DAP) and number of branches showed no significant effect (Table 3), though the treated plots recorded higher values than the control, with highest value of 52.63

obtained from Urea for 35 DAP and 5.6 obtained from CWU for number of branches. The order of increase relative to control for 35 DAP were U>CWU>CW>CO for leave area index and CWU>U>CW>CO for number of branches. At 65DAP the values obtained for leaf area index showed significant (P=0.05) difference among the treatments. The application of CWU gave the highest leaf area index value of 73.36 relative to other treatments. The values ranged from 25.61 – 73.36.

The result of the number of leaves per plant presented in Table 3 showed significant (p = 0.05) difference among the treatments and the order of increase was CWU >U>CW>CO. The percentage increase relative to control was 71.87% for CWU, 60.42% for U and 51.08% for CW.

The number of fruit obtained from the plots varies from 3.83 – 7.01. The plots treated with CWU (cow dung + Urea) gave the highest number of fruits 7.01 per plant. This was significantly (P = 0.05) different when compared to the control and cow dung (CW), while the number of fruits result obtain in CWU and U, CW and CO, CW and U were statistically equal (that is not significantly different from each other).

The weight of fruits showed significant differences among the treatments except for CW and CO which was statistically similar. The cucumber yield varied between 3.21 – 8.29 kgplot$^{-1}$. The highest cucumber yield was obtained in plots treated with cow dung + urea (CWU) with a value of 8.29 kgplot$^{-1}$. The value (8.29 kgplot$^{-1}$) was 27.14% higher than the cucumber yield obtained in U plots, 48.25% higher than the fruit yield obtained in CW plots and 61.28% greater than the fruit yield obtained in the control.

### 3.2 Effect of Cow Dung and Urea on the Soil Physical Properties

The result of bulk density and mean weight diameter of the experimented soil presented in Table 4 indicated that there were no significant (P = 0.05) differences among the treatment means. The least value of the bulk density of 1.26 gcm$^{-3}$ was recorded in the control plots, while the highest value of 1.41 gcm$^{-3}$ was recorded in cow dung + urea (CWU). The bulk density ranged from 1.26 gcm$^{-3}$ – 1.41 gcm$^{-3}$ and the order of increase relative to control was CWU>U>CW>CO. The mean weight diameter (MWD) varies from 0.85 – 1.39, the cow dung (CW) treated plots recorded the highest value of MWD among the treatments and the order of decrease relative to the CW was CWU<CO<U<CW. The total porosity (TP) data (Table 4) showed significant (P = 0.05) differences among the treatments, although the effect of CW and U were statistically equal. The TP value range was between 46.79% - 52.42% and the order of decrease relative to the control plots was CWU<U<CW<CO. Data on moisture content indicated that there is significant (P = 0.05) difference among the treatments. The plots treated with CWU gave the highest moisture content with a value of 28.38% and the least value of 24.22% was obtained in U treated plots. The moisture content values obtained in CO and CW as well as CW and CWU were statistically equal. Soil saturated hydraulic conductivity values vary from 2.35 cmhr$^{-1}$ – 7.05 cmhr$^{-1}$, these values were statistically significant ($P \le 0.05$) the order of increase were CW>CO>CWU>U.

**Table 3. Effect of cow dung and urea on the growth parameters and yield of cucumber**

| Treatment | Leaf area Index at 35 DAP | Leaf area index at65 DAP | Number of branches/plant | Number of leaves/ plant | Number of fruits/plant | Weight of fruits kgplot$^{-1}$ |
|---|---|---|---|---|---|---|
| CO | 11.56 | 25.61 | 2.45 | 6.59 | 3.83 | 3.21 |
| CW | 20.89 | 42.38 | 4.19 | 13.47 | 4.64 | 4.29 |
| U | 52.63 | 65.56 | 4.43 | 16.65 | 5.70 | 6.04 |
| CWU | 45.25 | 73.36 | 5.6 | 23.43 | 7.01 | 8.29 |
| LSD | NS | 1.79 | NS | 2.01 | 1.90 | 1.23 |

*CO = Control, CW = Cow dung, U = Urea, CWU = Cow dung/Urea.DAP = Days after planting, NS = Non Significant, LSD = Least Significant difference.*

**Table 4. Effect of cow dung and urea on the physical properties of soil**

| Treatment | Bulk density $gcm^{-3}$ | Total porosity (%) | Moisture content (%) | Hydraulic conductivity $cmhr^{-1}$ | MWD (%) | Aggregate stability (%) |
|---|---|---|---|---|---|---|
| CO | 1.26 | 52.42 | 26.77 | 2.94 | 0.98 | 19.94 |
| CW | 1.35 | 49.06 | 27.55 | 7.05 | 1.39 | 30.67 |
| U | 1.37 | 48.30 | 24.22 | 2.35 | 1.05 | 24.38 |
| CWU | 1.41 | 46.79 | 28.38 | 2.45 | 0.85 | 32.05 |
| LSD | NS | 0.96 | 1.20 | 0.06 | NS | 2.17 |

*CO = Control (no treatment applied), CW = Cow dung, U = Urea, Fertilizer, CWU = Cow dung + Urea fertilizer, LSD = Least significant difference, NS = Not significant*

The aggregate stability values showed significant (P = 0.05) difference among the treatments, although aggregate stability values obtained in CW and CWU were statistically equal, but better than the control. The highest value of 32.05% and least value of 19.94% were obtained in CWU and CO treated plots respectively. The observed aggregate stability values in the study increase in the order CWU>CW>U>CO.

## 4. DISCUSSION

The non-significant result observed in leaf area index at 35 DAP and in number of branches could be attributed to the fact that organic fertilizer needed some period of decomposition in order to release nutrients into soil solution for plant uptake. Nweke et al. [18] made similar report in their work on the effect of organo-mineral fertilizer on the growth and yield of maize. Organic manure when applied will be mineralized gradually or converted into inorganic forms over time before their nutrients can be made available or used by the plant. However, the nutrient content in organic manure varies due to the type of diet fed to the animal, amount and type of bedding, method and period of storage, the method and rate of application in the field. These variations affect the rate of growth and yield in crop production and nutrient content of the soil. The result of leave area index obtained in urea (U) treated plots at 35 DAP compared to other treatments indicated an increase in value, showing that urea fertilizer has effect on the leaf area of cucumber at 35 DAP. The availability of sufficient growth nutrients from inorganic fertilizer lead to improved cell activities enhanced cell multiplication and enlargement and luxuriant growth [19].

The broad leaves and number observed in CWU plots for 65DAP compared to other treatments was a good indication of combined effect of cow dung and urea fertilizer. Leaves are the main organ of photosynthesis, any reduction in leaf number results to lower yields. Nweke and Nsonanya, [20] made similar report on maize when they reported highest leave area index on the combined rate of poultry manure and NPK (20-20-20] fertilizer. Also the growth parameters of cucumber assessed in this study revealed the essence of addition of mineral fertilizer at the same time with organic manure to supply the nutrients that the plant requires in the early stages of development. Since the use of organic manure alone, had the problem of not being able to release plant nutrients for plant up take especially at the period of growth, there is the need for organic fertilizers to be fortified to improve their nutrient release efficiency and plant uptake through integration with chemical fertilizer to diminish the leaching losses of running and still waters [21,18].

The fruit yield result indicated significant differences among the treatments applied. This could be attributed to the differences in the nutrient content in the treatments applied. The yield result observed in the cow dung treated plots compared to the control plots may be due to that organic fertilizers ‘feed’ plants while adding organic matter to the soil. It makes the soil loose, airy and holds greater organisms and provides a healthier plant root system. They activate the activities of bacteria, fungi which enhance decomposition and release of and organic matter into the soil in the forms that plants can use to improve on their yield [22,23] while on the other hand the CW yield result when compared to Urea and CWU treatments could be attributed to the fact that organic fertilizers must be mineralized or converted into organic forms over time before the nutrients in them can be assessed and utilized by the plants. The yield result recorded in the urea fertilizer treated plots perhaps indicated that among the environmental factors that interact with a crop in the field, N is perhaps the most important of the nutrients because of its biological roles and because it is required in large quantities by the plants [24].

All crops show some response to Nitrogen fertilizers particularly in the early stage of development. It is a vital plant nutrient and a major yield determining factor required in vegetable production like cucumber. Adediran and Banjoko, [25], found N a major yield determining factor in maize production. The result obtained therefore suggests that the cucumber plant required sufficient amount of N at the onset of growth and throughout the fruiting period of development. However, the positive interaction effect observed in the yield result of CWU treated plots in Table 3 proves that the combination of the two manure sources could enhance the yield of the cucumber crop. Makinde et al. [26]; Nweke and Nsoanya [20] made similar observation when they found out that crop yield can be obtained and sustained with judicious and balance NPK fertilizer combined with organic amendments. Naturally, the application of organic manure and the inorganic or chemical fertilizer separately causes several problems among which is their bulky, transportation and high cost of application, nutrient imbalance and leaching, but the combination of both will address the problem and allow the combined supply of plant nutrients and organic matter. This made Ipimoroti el al. [7] to submit that for sustenance of long term cropping in the tropics, there is need for complementary use of organic and inorganic fertilizers.

The bulk density of a soil is the mass of dry soil per its unit volume while porosity is the fraction of soil that is occupied by the pores. Thus, the higher bulk density obtained from the treatment plots relative to the control could be attributable to the breakdown of manure application forming the component of the soil. However, the result obtained generally reveal that the soil bulk density is less than 1.56 $gcm^{-3}$ which indicates that the soil have no problem with root penetration as soil bulk density facilitates root growth and penetration [27]. Evanylo and Mc Guinn [28] suggested that soil bulk density of 1.40 $Mgm^{-3}$ can be ideal for optimum root growth, while density values from 1.55 $Mgm^{-3}$ - 1.65 $Mgm^{-3}$ will adversely affect or restrict root growth and development in silt loams. The non-significant effect of cow dung and urea fertilizer (CWU) on soil bulk density could be due to short term farming period of the study. Nweke and Nsoanya [20] made a similar observation when they found out that the application of poultry manure and NPK fertilizer does not significantly increase the bulk density.

Total porosity depends on the structure of the soil and its texture [29]. The lower total porosity relative to control plots indicates that the treated plots may be better aerated than the untreated plots. Also, the nature and type of manure applied or short term farming period might have influenced the nature of the result obtained in the soil bulk density and total porosity as Rasol et al. [30] observed that long term application of farm yard manure significantly increased soil total porosity compared with chemical fertilizer.

Soil moisture content or retention is the amount of water in the soil which can be expressed either on volume or mass basis and is more influenced by the texture and less by the structure and composition of soil materials. Thus, the significant effect of the moisture content could be due to absorption rather than capillary action and changes in the specific surface area of the soil material as a result of integrating cow dung and urea fertilizer. Nweke and Nsoanya [20] observed high gravimetric moisture content in plots amended with combined poultry manure and NPK fertilizer. This shows that among all the treatments that CWU have more effect on the ability of the soil to supply nutrients to plant and the amount of water available to the plant.

Hydraulic conductivity of the soil is the measure of the ability of soil to transmit water. Generally, the results showed lower values in hydraulic conductivity which does not indicate a good water transmission and reduction in water logging. The result probably could be associated with soils of the study area as it is prone to water logging and reduced drainage. Lower conductivity means reduction in physiologic activities which translates to lower values observed in growth parameters and fruit yield. The influence of cow dung and urea mixture on the mean weight diameter (MWD) was insignificant and generally, lower values were observed. The result indicates less influence of organic matter which might be dependent on the rate and type of manure applied and the duration of the cropping season.

The cementing effect of the organic matter in soil particles was observed in increased aggregate stability values recorded among the treatments. Aggregate stability describes the cohesiveness of soil aggregates. The amended plots increased percentage aggregate stability relative to control plots. Perfect et al. [31] observed that structural stability of a soil has an impact on a wide range of processes that influence crop growth, erosion and runoff.

## 5. CONCLUSION

This study has shown that, the effect of combination of cow dung and urea fertilizer on the soil properties, growth and yield of cucumber was significant. Therefore in sustainable low input agriculture systems like in the study area where nutrient depletion is a serious constraint to crop production and despite cultivation preferences by farmers, the alternative organic manure may not meet up plant nutrient demand due to low nutrient composition and release efficiency and limited availability. Thus, integrating organic manure with chemical fertilizer is ideal in achieving increased crop yield.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Mokwunye AU, De Yager A, Smaling EMA. Restoring and maintaining the productivity of West African soils; Key to sustainable development. International fertilizer development center (IFDC). Muscle shoals, Alabama. 1996;94.
2. Ayoola OT, Adeniran ON. Influence of poultry manure and NPK fertilizer on yield components of crops under different cropping systems in South West Nigeria. African Journal of Biotechnology. 2006;5:1336-1392.
3. El-Shakweer MHA, EL-Sayad EA, Ewees MSA. Soil plant analysis as a guide for interpretation of the improvement efficiency of organic conditions add to different solid in Egypt. Communications in Soil Science and Plant Analysis. 1998;29:2067-2088.
4. Ojeniyi SO. Effects of goat manure on the soil physical properties and okra yield in a rainforest area of Nigeria. Applied Tropical Agriculture. 2000;5:20-23.
5. Maritus CHT, Vleic PLG. The management of organic matter in tropical soils. What are the priorities? Nutrient Cycling in Agro Ecosystem. 2001;61:1-6.
6. Obi ME, Ebo PO. The effect of different management practice on the soil nutrients and Okra yield in a rainforest area of Nigeria. Biological Resources Technology. 1995;51:117-123.
7. Ipimoroti RR, Daniel MA, Obatolu CR. Effect of organic mineral fertilizer on tea growth of Kusuku mambilla plateau Nigeria. Moor Journal of Agriculture Resource. 2002;3:180-183.
8. Muwira HK, Kirchman AK. Carbon and nitrogen mineralization of cattle manure subjected to different treatment in Zimbabwean and Swedish soil. In Mulungoy and Mercker (Eds) soil organic matter dynamics and sustainability of tropical agriculture. 1993;189-198.
9. Gee GW, Bauder JW. Particle size analysis by hydrometer method, a simplified method for routine textural analysis and sensitivity test of mineral parameters. Soil Science Society of American Journal. 1986;43:1004-1007.
10. Middleton HE. Properties of soils which influences soil erosion USDA Technical Bulletin. 1930;178.
11. Black CA. Methods of soil analysis part 1, physical and mineralogical properties. American Society of Agronomy, Madison, Wisconsin USA; 1965.
12. Landon JR. Book on tropical soil survey and agricultural land and graduation in the tropical and sub-tropics book Tate, New York. 1991;480.
13. Bray RH, Kurtz LT. Determination of total ogarnic and available forms of phosphorous in soils. Soil Sci. 1945;58:39-45.
14. Nelson DW, Sommers LE. Total carbon, organic carbon and organic matter In Page, A. L. (ed) Method of soil analysis part 2 chemical and microbiological properties 2$^{nd}$ edition, agronomy series No. 9 ASA, SSSA Madison WI USA; 1982.
15. Blake GR, Hartage KH. Bulk density in Klute A (Ed). Method of soil analysis part 1, American society of Agronomy no. 9 Madison, Wisconsin. 1986;365-375.
16. Kamper WD, Rosenau RC. Aggregate and size distribution, in: Klute A (Ed). Methods of soil analysis, Part1 physical and mineralogical methods 2$^{nd}$ edn, American society of Agronomy. Soil Science society of America, Madison, I. USA. 1986;442.
17. Steel RGD, Torrie YH. Principle and procedures of statistics a biometrical approach 2$^{nd}$ edn. McGraw Hill Book

company incorporated New York. 1980;633.

18. Nweke IA, Nsoanya LN, Okolie EC. Effect of organo - mineral fertilizer on growth and yield of maize (*Zea mays*.L.) at Igbariam southeastern, Nigeria. International Journal of Agriculture and Rural Development. 2013;16(1);1404 -1408.
19. Fashina ASK, Olatunji A, Alasiri KO. Effects of different plant population and poultry manure on yield of Ugu (*Telfaina occidentalis*) in Lagos State, Nigeria in proceedings of annual conference of horticultural society of Nigeria. (HORTSON). 2002;123-127.
20. Nweke IA, Nsoanya LN. Effect of poultry manure and inorganic fertilizer on the performance of maize (*Zea mays* .L.) and selected physical properties of soils of Igbariam Southeastern, Nigeria. International Journal of Agriculture and Rural Development. 2013;16(1):1348-1353.
21. Hansen B. Nitrogen leaching from conventional versus organic farming system - a system modeling approach. Australia Journal of Agronomy. 2000;13:63-82.
22. Schomberg HH, Steiner JL, Under PHD. Decomposition and nitrogen dynamics of crop residues. Residues quality and water effects. Soil Science Society of American Journal. 1994;58:372-381.
23. Liu CS, Liv XK, Gao Z. Effect of combined application of organic manure and inorganic fertilizer on crop yield and soil fertility in a located experiment ACTA Pedagogical Sinica. 1996;33:138-147.
24. Akintoye HA, Adeyemi AO, Adedipe AR. Fruit yield and yield components of cucumber growth at four N levels in South Western Nigeria, in proceedings of annual conference of Horticultural society of Nigeria (HORTSON). 2001;94-97.
25. Adediran JA, Banjoko VA. Comparative effectiveness of some compost fertilizer formulation for maize in Nigeria. Nigeria Journal of Soil Science. 2003;13:42-48
26. Makinde EA, Akande MO, Agboolu AA. Effects of fertilizers type on performance of melon in a maize-melon Inter-crop. Asset Series A. 2001;(2):151-158.
27. Ikpe FN, Powel JW. Nutrient cycling practice and changes in soil properties in the coop-livestock farming systems of western Nigeria. Republic of west Africa-Nutrient cycling. Agro Ecosystem. 2002;62:37-45.
28. Evanylo G, McGuinn R. Agriculture management practices and soil quality; measuring, assessing and comparing laboratory and yield test kit indicators of soil quality attribute. Virginia Polytechnic Institute and State University. 2000;8.
29. Baver LD. Physical properties of soil in some of the humid tropics. National Academy of Science, Washington D.C; 1972.
30. Rasol R, Kukal SS, Hira GS. Soil organic carbon and physical properties as affected by long term application of FM and inorganic fertilizer in maize-wheat system. Soil and Tillage Research. 2008;101:31-36.
31. Perfect E, Kay BD, Valoon WP, Sheard RW, Pojasok T. Rates of changes in soil structural stability under forages and corn. Soil Science Society of American Journal. 1990;54:179-186.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://www.sciencedomain.org/review-history.php?iid=922&id=37&aid=8200*