International Journal of Plant & Soil Science

18(4): 1-7, 2017; Article no.IJPSS.34553
ISSN: 2320-7035

Studies on Effects of Rates of Poultry Droppings on Growth and Yield of Cucumber (*Cucumis sativus*) in Niger Delta Region of Nigeria

A. G. Iyagba[1*] and C. B. Isirima[2]

[1]Department of Agricultural Science, Ignatius Ajuru University of Education, Port – Harcourt, Rivers State, Nigeria.
[2]School of Secondary Education (Vocational), Federal College of Education (Technical) Omoku, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Authors AGI and CBI designed the study. Author CBI carried out the field work, wrote the protocol and the first draft of the manuscript. Author AGI performed the statistical analysis, managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2017/34553
Editor(s):
(1) Scd Victoria Anatolyivna Tsygankova, Department for Chemistry of Bioactive Nitrogen-Containing Heterocyclic Compounds, Institute of Bio-organic Chemistry and Petrochemistry, Plant Physiology, NAS, Ukraine.
(2) Francisco Cruz-Sosa, Biotechnology Department, Metropolitan Autonomous University Iztapalapa Campus Av. San Rafael Atlixco 186 México City 09340 México.
Reviewers:
(1) Adjolohoun Sébastien, University of Abomey-Calavi, Benin.
(2) Md. Ashraful Islam, Bangladesh Agricultural University, Bangladesh.
(3) Lucas Ricardo Petigrosso, Universidad Nacional de Mar del Plata, Argentina.
Complete Peer review History: http://www.sciencedomain.org/review-history/20822

Original Research Article

Received 31st May 2017
Accepted 31st August 2017
Published 5th September 2017

ABSTRACT

The study on the effect of rates of poultry dropping on the growth and yield of Cucumber (*Cucumis sativus* L.) was conducted at the Teaching and Research Farm of the Federal College of Education (Technical) Omoku, Rivers State, Nigeria. The school is located at latitude 5°2'N and longitude 6°40'E with elevation of 200 m above sea level. The area is characterized with rainfall range of 2000 m to 3500 m with high relative humidity and maximum annual temperature varying between 27.3°c and 35°c. Experimental design used in this study is the Randomized Complete Block Design (RCBD). The treatment, Poultry dropping was applied at the rates of 0t, 5t, 10t, and 15t per hectare and replicated three (3) times. Analysis of variance (ANOVA) was used to determine degree of

**Corresponding author: E-mail: apegragba@yahoo.com;*

variability at 5% probability level. Result obtained from data analysis shows that Cucumber growth, yields and yield components were enhanced with the incorporation of Poultry droppings across various treatment rates. This is evident in the significant difference in germination %, growth and yield and yield components recorded during the assessment period at 5% level of probability (P≤0.05). Further work is necessary to determine the optimum level of applying the manure for cucumber production.

Keywords: Cucumber; poultry manure; yield; growth; inorganic fertilizer; Omoku; Niger Delta.

1. INTRODUCTION

Cucumber (*Cucumis sativus* L.) is an important vegetable crop, one of the most popular members of the cucurbitaceae family and the oldest vegetables cultivated by prehistoric man. It is believed to have originated from tropical Asia and Africa [1]. Though it is cultivated in commercial quantity in Northern Nigeria, it is largely consumed in various parts of the country and relished across various ethnic groups. Cucumber is a herbaceous plant used for various culinary purposes and plays vital role in maintaining good health owing to the presence of mineral elements and vitamins [2]. The minerals and vitamins contained in cucumber helps in building up our bone, teeth, protects the human body and helps to promote vital metabolic processes in the body and is known to enhance vitality and good health. Aside these, the crop has a weed suppressing ability especially in *Panicum millaceum* and *Brasica hirta* by allelopathic means through its possession of benzoic and cinnamic acids [3,4]. Its huge biomass helps in increasing the organic matter status of the soil.

Cucumber grows best under conditions of high temperature, with an optimum temperature of between 20 to 25°c, low humidity, moderate light intensity, good soil structure with an uninterrupted supply of water and nutrients [5]. Fertile soils are used for the production of cucumber as infertile soils result in lower quality of fruits which are not often accepted by consumers [6]. Today such fertile soils are hard to come by in most parts of the Niger Delta Zone of Nigeria and this is due mainly to decline in adoption of sustainable farming system practices that hitherto ensured maintenance of soil fertility in the area. Shifting cultivation, bush fallow and reuse of crop residues which was one of the most efficient methods practiced by small holder farmers in maintaining soil productivity and restoration in various parts of the region have been abandoned [6]. This is not just only because of increase in human population leading to pressure on available land and oil exploration/exploitation activities, but also due to scarcity and high cost of farm labour arising from economic recession. The effect of this is loss in soil fertility status and poor crop yield [7].Though inorganic fertilizers have much higher nutrient concentration and is an important source of nitrogen, the greatest criticism against its use in crop production is that it could also lead to heavy vegetative growth especially when wrongly applied and that it lacks soil binding and soil improving ability or potentials [8]. Extensive use of inorganic fertilizers has depressing effects on yield of cucurbits as it causes reduction in number of fruits, delay and reduced fruit setting and delay in fruit ripening [9]. In view of the forgoing criticisms therefore, the use of farm inputs in the form of organic manures in the production of cucurbits becomes the best alternative strategy.

The use of organic manures has been recommended for long term cropping in the tropics as slow mineralization of these manures is known to promote crop yield for a long period of time. Though organic manures are usually very bulky and the costs of transportation from one location to another very high, they are not only safer sources of plant nutrients but are also environmentally friendly [6,8]. They release their nutrients in a slow and steady manner to crops in the field thereby activating soil microbial activities [6]. Again, they sustain cropping systems through better nutrient recycling and improvement in soil physical, chemical and biological properties [10,11].

Poultry manure have long been used by ancient farmers as a source of nutrition and its benefits have been fully realized because it is cheap and readily available [12]. With increase in poultry production annually, there is a large quantity of poultry refuse which can be an alternative to chemical fertilizer. Poultry manure supplies macronutrients (N, P, K, and micronutrients). The

nutrients included in poultry manure can support crop production and enhance the physical and chemical properties of the soil organic matter, improve the moisture holding capacity of the soil and promote lateral water movement thereby supporting the irrigation, efficiency and reducing the general droughtiness of sandy soils [13,14,15]. It also helps to improve soil retention and uptake of plant nutrients, raises the varieties of soil microorganisms especially in sandy soils. This outcome improves crop health by increasing the water and nutrient availability, as well as suppressing harmful levels of plant parasitic nematodes, fungi and bacteria. Despite all these, there are challenges of its use such as storage, emission of ammonia, water pollution, flies, manure gases, etc [14]. Scientists in Zaria, Nigeria revealed that poultry manure has the following soil characteristics: pH (in H_2O) = 4.70, organic materials (g kg^{-1}) = 15, organic carbon (g kg^{-1}) = 11.14, N (g kg^{-1}) = 4.11, Ca (g kg^{-1}) = 40.24, Mg (g kg^{-1}) = 3.21, Available P (cmol Kg^{-1}) = 48.42 and ECEC (cmol kg^{-1}) = 1.90 [16].

However, the chemical composition of poultry manure is a function of several factors such as source of manure, feed of the animal, storage and managing of manure and litter, age and condition of animal, etc [17]. Improvement in environmental conditions with respect to public health has been observed as some of the major reasons for the need to adopt organic farming by farmers in the world [6].

Some authors have advocated on the combination of farmyard manure and inorganic fertilizers for vegetable production. The work in Nigeria showed that application of 10 t ha^{-1} of farmyard manure and 400 kg ha^{-1} of inorganic fertilizer produced the highest weight of cucumber per plant and yield per hectare. In a similar vein [18,19] suggested that combining organic and inorganic fertilizers increased the yield performance of cabbage and tomato in Bangladesh.

Though the usefulness of poultry dropping and other animal manure does not just end with the benefits stated above for optimum plant growth, it's use in vegetable crop production in various parts of the Niger Delta of Nigeria is very minimal, resulting in low output amidst steady rise in consumption rate. The aim of this study therefore is to determine the extent to which application of rates of poultry dropping can enhance cucumber growth and yield in Niger Delta Region of Nigeria.

2. MATERIALS AND METHODS

2.1 Location of the Experiment

The field experiment was conducted at the Teaching and Research Farm of the Federal College of Education (Technical), Omoku, which lies on latitude 5°21'N and longitude 6°40'E with elevation of 200 m above sea level. The climate is of the humid tropical ecological zone of Nigeria with an average rainfall range of 2000 mm to 3500 mm with high relative humidity. Annual maximum temperatures vary between 27.3°C and 35°C. The vegetation is mostly secondary forest.

The plot of land used for this experimentation was earlier cropped with cassava and maize with alternating short fallow period. Dominant herbs and shrubs found before clearing the land were *Panicum maximum*, *Chromolaena odorata*, *Emelia* species, *Boerhivia diffusa*, *Alchornia cordifolia, Anthonata macrophylla,* etc. The overriding soil in Omoku is classified as Typic Kandiudult derived from the Alluvial Plain of the Upper Delta (Sombrieiro-Warri). The top soil texture of the experimental site is sandy loam.

2.2 Land Preparation

The site where this trial was carried out was first ploughed with a tractor, mapped out and thereafter pulverized with a hand hoe and seedbeds were constructed and smoothened to produce suitable seedbed for easy germination and establishment of the crop. Soil samples were randomly collected from the field at a soil depth of 0-15 cm for physico-chemical analysis.

2.3 Experimental Design/Treatment

The experiment was laid out in a Randomised Complete Block Design (RCBD) covering an area of 96 m^2. Treatment given was poultry dropping (PD) at the rates of 0, 5, 10 and 15 tons per hectare, replicated three times to give a total of twelve treatment units. The poultry droppings were applied to the soil two weeks before planting in order to enable proper decomposition and release of nutrients that would serve as starter dose for the crop. Each seed bed (plot) size was 3.75 m x 3.75 m with a 1.5 m pathway.

2.4 Cultural Details

The planting material (Cucumber seeds) used for this study was obtained from a fruit market in

Omoku in the Niger Delta Region of Nigeria. Seeds were planted on the 9th of October 2014. Planting was done by dibbling four seeds per hole at a spacing of 75 cm x 75 cm each way which were later thinned to two seeds per stand two weeks after planting.

2.5 Measurement

Growth parameters determined were germination percentage, vine length per plant while yield and yield components such as number of fruits per plant, fruit length (cm), fruit girth (cm) and fruit yield (k gha^{-1}) were equally determined at harvest. Emergence rate was determined by counting number of emerged seedlings against number of sown seeds per treatment unit while length and girth of fruits were determined with the use of Veneer calliper across harvested fruits. Fruit yield was determined with the use of weighing balance and results obtained were recorded. Data collected were subjected to statistical analysis of variance and response trends are presented in line graphs [20].

Table 1. Physio-chemical characteristics of the soil before planting and chemical composition of poultry manure

Parameters	Soil sample	Poultry manure
Particle size distribution		
Sand (%)	83.0	
Clay (%)	5.0	
Silt (%)	12.0	
Textural class	**Sandy loam**	
pH (in H_2O)	5.2	6.40
Organic carbon (%)	0.68	10.98 (g Kg^{-1})
Organic matter (%)	1.36	14.85 (g Kg^{-1})
Total N(%)	0.08	4.03 (g Kg^{-1})
Available P ($cmolKg^{-1}$)	8.9	48.34 (g Kg^{-1})
Exchangeable bases		
Ca ($cmolKg^{-1}$)	2.32	39.23 (g Kg^{-1})
Mg ($cmolKg^{-1}$)	1.30	3.40 (g Kg^{-1})
K ($cmolKg^{-1}$)	0.19	2.86 (g Kg^{-1})
Na ($cmolKg^{-1}$)	0.98	3.10 (g Kg^{-1})
CEC ($cmolKg^{-1}$)	9.6	

2.6 Soil Analysis

Samples of top soil at a depth of 0 to 15 cm from the experimental site prior to planting were collected for analysis. Particle size distribution was carried out using the hydrometer method [21]. Soil pH was determined with a pH meter using 1:2.5 soil to water ratio according to [22], organic carbon using the Walkey and Black digestion method [23] while soil organic matter content was obtained by multiplying the value of organic carbon by 1.724. Total Nitrogen determination was by the Micro-Kjeldahl procedure, [24] available P as determined by [25] and exchangeable Potassium as described by [26]. Calcium and Magnesium were measured as outlined by [27]. Cation exchange capacity was determined by the method of [28]. Chemical composition of the poultry manure applied was also determined. The results presented in Table 1.

3. RESULTS PRESENTATION

The result of PD on germination percentage (emergence), yield and yield components of cucumber is as shown in the graphs presented herein. Lowest and highest mean seed germination (shoot emergence) of 53.3% and 90.0% were obtained across control treatments at lowest and highest PD application rates of 0t ha^{-1} and 15t ha^{-1} respectively. The observed linear increase was significant at $P< 0.05$ (Fig. 1).

Similarly mean shoot length differed significantly at $P< 0.05$ with lowest and highest mean shoot length of 9.6 and 87.5 cm across the control experiment (0t ha^{-1}) and highest PD (15t ha^{-1}) application rates (Fig. 2). Mean number of 1000 fruits were obtained at the control experiment whereas a mean number of 3000 was obtained at the highest PD treatment level (Fig. 3). The observed difference in mean number of fruits was significant at $P< 0.05$.

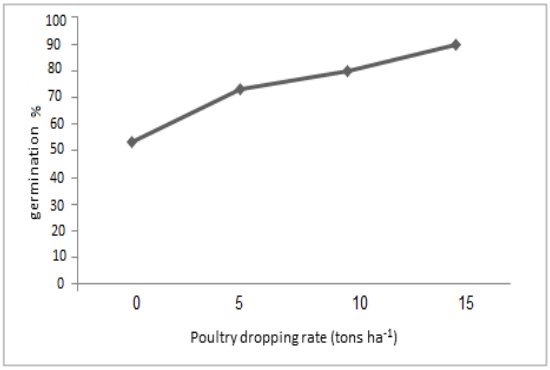

Fig. 1. Effect of poultry dropping on germination of cucumber

Again, a linear increase was observed in fruit weight with application of increasing rate of poultry droppings as shown in Fig. 4. A mean fruit weight of 433.3 g per plant was observed at

the control treatment whereas 15 t ha^{-1} PD treatment level recorded a mean fruit weight of 2.27 kg per plant. There was a significant increase of mean fruit weight across the treatment levels at P< 0.05 (Fig. 4).

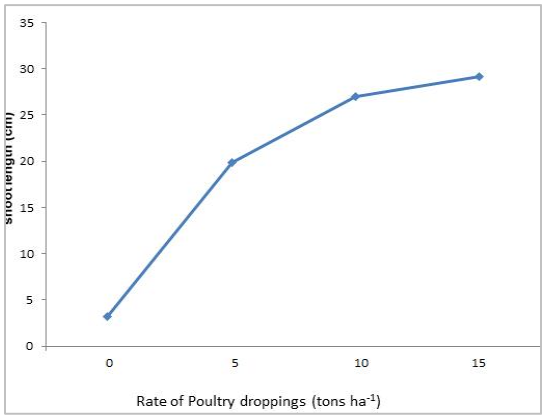

Fig. 2. Effects of poultry droppings on shoot length

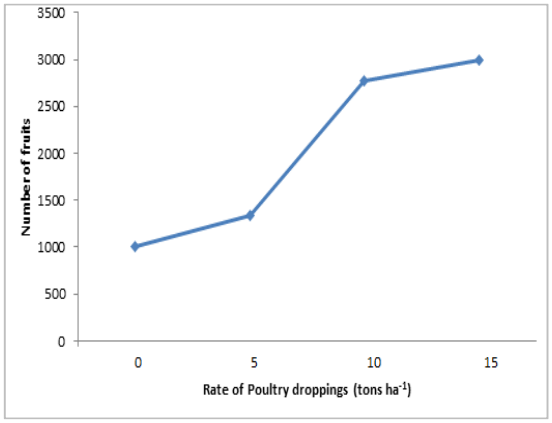

Fig. 3. Effect of PD on number of fruits

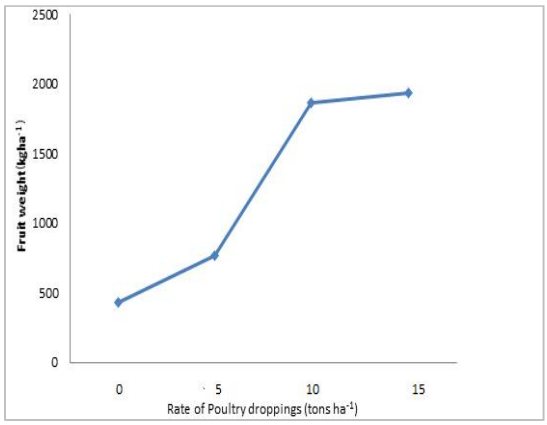

Fig. 4. Effect of poultry dropping on fruit weight

4. DISCUSSION

The greatest criticism against the use of organic manure in the production of vegetables is that it is bulky and costly to transport from location of production to places of utilization. However, studies have shown that irrespective of the criticisms, organic manures are safer sources of plant nutrients since they are environmentally friendly and are known to enhance the growth and yield of most vegetable crops [8,12]. The observed linear increase in seed germination/emergence is due to an increase in soil temperature which is a favourable environmental condition for seed germination. The subsequent significance increase in shoot length, fruit number and fruit weight with application of increasing level of poultry dropping is a proof of the potency of the organic manure to release minerals that are capable of enhancing growth and yield of cucumber. Earlier other workers have recommended the use of organic manure for long term cropping since according to them, slow mineralization of the manures promote crop yield for a longer period of time [29]. In a separate study, it had been noted that application of 0 t ha^{-1} poultry dropping significantly produced lower values for all growth and yield parameters determined during the period of their study while applying 12 t ha^{-1} of pig manure produced a significantly higher vine length of 28.33 cm compared to the application of 9 t ha^{-1} that produced 25.68 cm [16]. Their work also showed that the trend was similar in the other growth and yield parameters determined in cucumber. Their report is in accordance with the findings of the present study. The observed lower rate in vine length and shoot length at 0 t ha^{-1}PD treatment could be attributed to low nutrient content of the soil at the control experiment. The observed increase in shoot length at the highest PD treatment level suggest that the slow mineralization of the organic manure enhanced the release of nutrients needed by the plant for growth and yield.

The increase in vine length with application of higher levels of the organic manure also translated to increased number of fruits resulting from increase in degree of photosynthesis which culminated to higher fruit yield and fruit weight. It was also earlier observed that organic manure treatment have the capacity to sustain cropping system through better nutrient recycling which ultimately will lead to rise or improvement in both growth and development as well as number of

leaves and fruit yield per plant [6,30]. The observed increase in fruit yield in the study collaborates the findings of other researchers who reported that nutrients from mineralization of organic manure promoted growth in cucumber [31,32].

Earlier study had reported significant increase in fruit length and fruit girth following application of poultry dropping and this is associated with the increase in fruit weight observed in this study following increasing application of poultry dropping. Fruit girth and fruit length sum up to what is herein recorded as fruit weight [7]. Whatever that supports increase in fruit length and girth will eventually support total fruit weight. In similar studies, elsewhere it had been observed that increasing application of PD increased cucumber yield, a report that is in agreement with the finding of this research study [16,33].

5. CONCLUSION

The results obtained from this study have shown that substantial increase in fruit yield, growth and growth components of Cucumber can be achieved with soil incorporation of poultry droppings. Further studies therefore are required to determine the optimum level after which further addition of PD will be uneconomical and less rewarding.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Yagodin BA. Manure in Agricultural Chemistry 2, Mir Publication, Moscow. 2005;132-144.
2. Yamaguchi M. Cucurbits in world vegetable: Principles, production and nutritive values. AVI Publishing Company Inc. West Port, Connecticut. 2000;317-322.
3. Putman AR, Duke WB. Biological suppression of weeds evidence for allelopathy in accessions of cucumber. Sci. 1974;85:370-371.
4. Bhadoria PBS. Allelopathy: A natural way towards weed management. American Journal of Experimental Agriculture. 2011;1(1):7-20.
5. Papadopoulos AP. Growing greenhouse cucumber in soil and soiless media. Documentary from Agriculture and Agri-Food Ottawa: Canada. 1994;5-126.
6. Eifediyi EK, Remison SU. Growth and yield of cucumber (*Cucumis sativum* L) as influenced by farm yard manure and inorganic fertilizer. Journal of Plant Breeding and Crop Science. 2010;2(7): 216-220.
7. Ayoola OT, Adediran 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.
8. Matthew IP, Karikari SK. Horticulture: Principles and practices. Published by Macmillan Education Limited, London. 1995;7,63-67.
9. John P, Russell D, Andrew B. From farmer field schools to community IPM. FAO Community IPM Programme in Asia. Bangkok, Thailand. 2004;6.
10. Ojeniyi SO. Effect of goat manure on soil nutrients and Okra yield in a rain forest area of Nigeria. Applied Tropical Agric. 2000;5:20-23.
11. Ojeniyi SO, Awodun MA, Odedina SA. Effect of animal manure ammended spent grain and cocoa husk on nutrient status, growth and yield of tomato. International Journal of Agricultural Research. 2000;2(4):406-410.
12. Makinde EA, Ayoola OT, Akande MO. Effects of organo-mineral application on the growth and yield of egusi melon. Australian J. Basic Appl. Sci. 2007;1:15-19.
13. Gilley JE, Risse LM. Runoff and soil loss as affected by the application of manure. Transactions of the American Society of Agricultural Engineers. 2000;43(6):1583-1588.
14. Risse LM, Cabrera ML, Franzluebbers AJ, Gaskin JW, Gilley JE, Kilborn R, Radcliffe DE, Tullner WE, Zhang H. Land application of manure for beneficial reuse. In: Rice JM, Codwell DF, Humenik FJ, (eds). Animal Agriculture and the Environment. ASABE Pub. Humber 913C0306. St. Joseph, Michigan, USA. 2006;283-316.
15. Amanullah MM, Sekar P, Muthukrishnam P. Prospects and potentials of poultry manure. Asian Journal of Plant Sciences. 2010;9(4):172-182.
16. Hamma IL, Ibrahim U, Haruna M. Effect of poultry manure on the growth and yield of cucumber (*Cucumis sativum*, L.) in

Samaru, Zaria. Nigerian Journal of Agriculture, Food and Environment. 2012;8(1):94-98.
17. Mariakulandai A, Manickan TS. Chemistry of fertilizers and manures. Asia Publication House, NY, USA. 1975;224-230.
18. Islam MA, Islam S, Akter A, Rahman MH, Nandwani D. Effect of organic and inorganic fertilizers on soil properties and the growth, yield and quality of tomato in Mymensingh, Bangladesh. Agriculture. 2017;7(3):18.
19. Islam MA, Ferdous G, Akter A, Hussain MM, Nandwani D. Effect of organic, inorganic fertilizers and plant spacing on the growth and yield of cabbage. Agriculture. 2017;7(4):31.
20. Duncan DB. Multiple range and F test. Biometric. 1995;1-42.
21. Gee GW, Bauder D. Particle size analysis. In: Dane JH, Jopp GC. (Eds). Methods of soil analysis. Part 4, Physical Methods. Soil Sci. Soc. Am. 2002;5:225-229.
22. Page JR, Miller RH, Keeney DR, Baker DE, Roscoe Ellis JR, Rhoades JD. Method of soil analysis 2. Chemical and Microbiology Properties (2nd Edn) Madison, Wisconsin, USA. 1982;1159.
23. Bremner JM, Mulvaaney CS. Total nitrogen. In: Page AL, (Eds). Methods of soil analysis. Part 2. Chemical and Microbial Properties, Second Edition Agronomy Series No. 9 Madison, WI, USA, ASA, SSSA; 1982.
24. Murphy J, Riley JP. A modified single solution method for determination of phosphate in natural water. Anal Chem. Acta. 1962;27:31-36.
25. Anderson JM, Ingram JSI, (Eds). Tropical soil biology and fertility: A handbook of methods (2nd edition). CAB International. 1993;221.
26. McLean EO. Soil pH and lime requirements. In: Page AL, (Eds). Methods of soil analysis, part 2. Chemical and Microbial Properties, Second Edition Agronomy Series No. 9 Madison WI, USA, ASA, SSSA; 1982.
27. Chapman HD. Total exchangeable bases. In: C. A. Black (Ed), methods of soil analysis, part 2. ASA, Madison, USA. 1982;9:902-904.
28. Rhoades JD. Cation exchangeable capacity. In: Page, AL, Miller RH, Kenney DR, (eds.). Methods of soil analysis, Part 2: Chemical methods. Agronomy Monograph No. 9, American Society of Agronomy Madison, Wisconson, USA; 1982.
29. Gambo BA, Magaji MD, Yakubu AL, Dikko AU. Effect of farm yard manure and weed interference on the growth and yield of onion (*Allium cepa* L). Journal of Sustainable Agriculture and Environment. 2008;3(2):87-92.
30. Ayuso MA, Pascal JA, Garcia, Hernandez I. Evaluation of urban wastes for agricultural use. Soil Science Plant Nutrition. 1996;42:105-111.
31. Aduloju MO, Fawole OB, Abubakar AJ, Olaniyan JO. Effect of sawmill wastes, animal manure and NPK fertilizer on the performance of okra (*Abelmoschus esculentus* L. Moench) on an alfisol. Department of Agronomy, University of Ilorin-Nigeria; 2010.
32. Dada OA, Fayinminnu OO. Influence of cattle dung and weeding regimes on period of weed control in okra. Not. Bot. Hort. Agrobot. Cluj. 2010;38(1):149-154.
33. El-Shakweer MA, El-Sayad EA, Ewees MS. Soil and plant analysis as a guide for interpretation of improvement in efficiency of organic conditioners added to different soils in Egypt. Communication and Soil Science and Plant Analysis. 1998;29:2067-2088.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/20822