RESPONSE OF THREE VARIETIES OF TOMATOES (LYCOPERSICON ESCULENTUM) TO LIQUID ORGANIC FERTILIZER (ALFA LIFE) AND INORGANIC FERTILIZER (NPK 20:10:10) AND FOR SOIL IMPROVEMENTS

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ABSTRACT

The response of three varieties of tomatoes to liquid organic fertilizer (Alfa Life) and inorganic fertilizer (NPK 20:10:10) and for soil improvements was studied in the Teaching and Research Farm of the Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu Univerrsity, Igbariam Campus. The treatments comprised 1.4ml Alfa life (organic fertilizer) mixed with 81ml of water, 180gNPK 20:10:10 (mineral fertilizer) and control where no treatment was applied. These were laid out in Randomized Complete Block Design (RCBD) with 9 replications, while treatment means were separated using least significant difference (LSD 0.05). The results of the study indicated non-significant differences among the tomato varieties and rates of treatment applied in most of the parameters assessed. Higher fruit yield was recorded in local variety and NPK Fertilizer with value of 96.0gplant^{-1} and 57.20gplant^{-1} respectively. The interaction between fertilizers and tomato varieties significantly affected the plant height relative to other growth parameters and was effective as week after planting increased. The soil chemical parameters (pH, P, OC, OM, N, K) assessed were enhanced but not significantly different except for N. From the findings of the study local variety and NPK 20:10:10 performed competitively better than the other two tomato varieties and Alfa life respectively. Therefore, Alfa life though organic fertilizer cannot be used for effective tomato production and soil management in the studied area.

Keywords: Alfa Life, NPK (20:10:10), Tomatoes, Soil.

INTRODUCTION

Tomato plant is one of the most important vegetable crops grown in Nigeria both in commercial quantity and in subsistent form. Even some local industries engage in commercial production of the crop to ensure immediate supply of their raw material. One good aspect of the crop is that it can be grown in large quantity in any part of Nigeria. The only limitation in the south is high intensity of rainfall usually observed in the area, and this will be detrimental to tomato production, as most of the diseases that attack the crop require damp situation or condition, though dry season farming with irrigation have been an alternative in the South. Apart from this, tomato is an ideal crop as it has been found to grow in wide soil and environmental variations.

Uguru (1996) observed that the crop grows well in many types of soil ranging from sandy to the heavy clayey soils. While Villa real, (1980) found out that the tomato plant thrive well under a wide range of environmental conditions, the crop requires warm days, well drained soil. moderately cool night temperature and sufficient sunshine for optimum production. Tomato is grown for its edible fruits of which when cooked or processed can be used for any

of these products:- soup, stew, ketchup, powdered or juice in canning industries (Akanbi et al., 2005). The crop has become widely distributed in Nigeria and indeed all over the tropics and the whole world as an integrated part of human diet commonly consumed in both fresh and raw such as salad making and juice. Tomato production in Nigeria can amount to over 7,000,000 tons per year. The FAO (2008) recorded tomato production in Nigeria to vary between 88900 and 89800 tons from year 2004 and 2007. While FAO (1993) record, put the average tomato production in Nigeria to be 10tha.

However, one of the major draw backs of tomato production in Nigeria is the inherent low soil fertility and according to Adekiya and Ojeniyi (2002) unfavourable soil physical properties such as bulk density. Tomato plant requires nutrient such as N,P,K, Mg, Ca, Na for good production, these nutrients are specific in function and must be supplied to the plant at the right time and in the right quantity (Shuka and Naik, 1993). For example, adequate supply of nitrogen will increase the photosynthetic activities and vigorous vegetative growth of the crop as well as dark green colour of the leaves (John et al., 2004). While Uzo (1971) emphasized on the importance of not only of the adequate amount of N, P and K for optimum yields but also of a satisfactory balance amongst the amounts of the three fertilizer elements. Tomato production can be increased if there is proper fertilizer and manure application.

Stefano et al., (2004) observed that inorganic fertilizer exerts strong influence on plant growth development and yield, while the availability of sufficient plant nutrients from inorganic fertilizers lead to improved soil activities enhanced cell multiplication and enlargement and luxuriant growth (Fashina et al., 2002). Luxuriant growth resulting from fertilizer application leads to larger dry matter production (Obi et al., 2005) owing to better utilization of solar radiation and more nutrients (Saeed et al., 2001). The use of inorganic fertilizers on crop production increased yield as Adediran and Banjoko (2003), Nweke and Nsoanya (2013a) and Uyovbisere et al., (2007), reported decrease in crop yield where no NPK fertilizer was applied. Uyovbisere and his companion further observed that nitrates and available phosphorus were substantially reduced with cropping in humid zone of southwestern, Nigeria. However, the use of inorganic fertilizer has been observed not to with stand intensive crop production as it is associated with depressing effect on yield. Aliyu et al., (1992) and John et al., (2004) observed that it causes reduction in number of fruits, delays fruits setting which subsequently delays ripening and leads to heavy vegetative growth. It also causes soil acidity and nutrient imbalance (Ojeniyi, 2000, Ano and Agwu 2005, Ayoola and Adeniyan, 2006, Agbede et al., 2008), leaching and pollution of ground water (Sridhar and Adeoye, 2003). On the other hand, organic fertilizers take the place of inorganic fertilizers in sustainable agriculture as they do not have chemicals with strong side effects; they improve crop yield and in some cases prevent diseases and pest from affecting the plants. In addition, they increase the activities of soil organisms that will release phytohormones that stimulate nutrient absorption and plant growth, anion and cation exchange capacity, organic matter and carbon content of soil. These potentialities of organic fertilizers ensure increase in crop yield and quality of agricultural crops as was reported in the works of Hoitink and Boehn; (1999). Bulluck and Ristaino (2002), Bulluck et al., (2002). Arancon et al., (2004); Heeb et al., (2005ab); (2006); Liu et al., (2007), Nweke and Nsoanya (2013b), Nweke et al., (2013) and Nweke et al., (2014).

Alfa life is an excellent liquid organic fertilizer as it contains macro and micro nutrients in available forms during mineralization, a high quality foliar fertilizer which is 100% organic and environmentally friendly and 100% chemical free and has capacity to improve soil quality and fertility. Thus the essence of this study was to evaluate the response of three

different varieties of tomatoes to liquid organic fertilizer (Alfa Life) and inorganic fertilizer (NPK 20: 10:10) and for soil improvements.

Materials and Methods

The field experiment was conducted at the Faculty of Agriculture Teaching and Research Farm, Chukwuemeka Odumegwu Ojukwu University (formerly Anambra State University), Igbariam Campus, Anambra State. The experimental site is geographically located within latitude $6^{o}14^{1}$N and Longitude 6^{o} 45^{1}E. The total mean annual rainfall ranges between 1800mm – 2000mm. The temperature is between 21^{o}C – 24^{o}C. The relative humidity (RH) of the study area is moderately high all the year round with the highest RH of 85% during the wet season and the lowest 64% during the dry season.

Land preparation, experimental design and treatment allocation

The experimental site measuring 12m x 22m was manually cleared and debris removed. The area was demarcated into three blocks each measuring 12m x 3m. Each block was further divided into 9 plots with each rectangular plot measuring 2m x 3m ($6m^2$) with 0.5m pathway between plots and 1m space between blocks, making a total 27 experimental plots in 3 experimental blocks. The experiment was then laid in a randomized complete block design (RCBD) with 9 replicates and three treatments. The tomato varieties, Roma Vf, Tima and local variety (Igala) used for the experiment was sourced from the Agricultural Development Programme (ADP) of the Ministry of Agriculture, Awka, Anambra State. The treatment levels applied to their respective plots were no treatment or control (CO), 180g NPK 20:10:10 (mineral fertilizer) applied two weeks after planting by ring method and 1.4ml Alfa life (organic fertilizer) mixed with 81ml of water and then spray on the plants, this was repeated for every week till 8weeks maturity.

Ground nursery was used to raise the seedlings used for the study. Seeds of the tomato varieties were sown using broadcasting method in the nursery and then covered lightly with sand for easy emergency. The ground nursery was shaded to reduce the direct impact of rainfall and sunlight. Routine nursery practices of weeding and shading were maintained. The shading was removed and other hardening process of the seedlings done to acclimatize the seedlings to field condition. On the eve of the transplanting day, the seedlings were watered to field capacity so that the seedlings would be transplanted with ball of the earth the following day at the rate of one plant per stand using a planting distance of 60cm x 45cm at seedling leaf stage of 5 – 8 leaves. Gapping up (replacement of dead seedlings) was done from one week of transplanting of the seedlings. Weeding was carried out manually by hand and hoe at two weeks interval till maturity and harvest.

Composite soil samples collected from top 0-15cm in the study site before application of treatments were air dried and analyzed for their nutrients contents. At the end of the study, Soil samples were collected from respective plots and used for the determination of the chemical properties of the soil. The soil chemical parameters determined were soil pH using glass electrode pH meter, organic matter and carbon was determined by Walkley and Black (1934) wet oxidation method. The kjeldahl digestion method of Black et al., (1965) was used for total nitrogen determination. Available phosphorus was determined using the method of Bray and Kurtz (1945). While exchangeable potassium was determined by Flame photometer.

Three plants were selected randomly from each plot and were tagged for data collection on growth and yield components. Data were collected for the following parameters, plant height measured at 4, 6 and 8 weeks after planting, number of leaves recorded at 4, 6, 8 weeks after planting. Number of fruits and weight of fruits at maturity, Data collected from the study were subjected to analysis of variance test based on RCBD using GENSTAT software package. Treatment means were separated with least significant difference (LSD) at 5% level of significance.

RESULTS

The result of the study presented on Table 1 indicated that, there was no significant difference among the varieties used in respect to the growth parameters; plant height, number of leaves at 4, 6 and 8 weeks after planting (WAP). However, the value recorded for each of the varieties increased as the week after planting (WAP) increased. The local variety showed the highest performance with regard to these growth parameters at 4, 6 and 8 WAP and least performance was observed in Tima variety. There was also significant (P = 0.05) difference between the local variety and the Tima in number of leaves at 4WAP. The effect of NPK 20:10:10 and Alfa life organic fertilizer on tomato varieties on Table 2 showed that, the NPK fertilizer produced the highest number of leaves at 4, 6 and 8 WAP, the least values were observed in the control plots. The result obtained from Alfa life organic fertilizer showed that the treatment stimulated the growth of the tomato plants at 4 and 6 WAP but not efficient at 8WAP with regard to the plant height and the value 16.1cm at 4WAP was significantly difference from the other values. The order of decrease in plant height at 8WAP was Alfa life < CO <NPK and the order of increase in the number of leaves at 4, 6 and 8 WAP were NPK > Alfa life >CO. However, there was no significant difference among the treatments.

Table 1: Effects of Tomato varieties on plant height and number of leaves at 4, 6 and 8 WAP

Tomato Varieties	4 WAP		6 WAP		8 WAP	
	Plant Height (cm)	Number of Leaves	Plant Height (cm)	Number of Leaves	Plant Height (cm)	Number of Leaves
Local	10.69	10.81	16.77	27.2	26.49	27.2
Roma vf	10.22	8.67	16.01	24.6	23.65	24.6
Tima	9.24	8.11	16.77	23.6	24.62	23.6
LSD 0.05	NS	2.59	NS	NS	NS	NS

WAP = Weeks after planting, LSD = Least significant difference, NS = Non significant

Table 2: Effect of NPK 20:10:10 and Alfa life organic fertilizer on Tomato Varieties at 4, 6 and 8 WAP.

Treatment	4 WAP		6 WAP		8 WAP	
	Plant Height (cm)	Number of Leaves	Plant Height (cm)	Number of Leaves	Plant Height (cm)	Number of Leaves
Control	9.19	8.89	16.45	22.30	25.00	22.3
NPK 20:10:10	10.35	9.63	15.31	27.00	25.39	27.0

Alfa Life	16.1	9.07	16.79	26.10	24.38	26.1
LSD 0.05	3.16	NS	NS	NS	NS	NS

WAP = Weeks after planting, LSD = Least significant difference, NS = Non significant

The result presented on Table 3 showed that the interaction between fertilizer and varieties significantly (P = 0. 05) effected the plant height at 6 weeks after planting and number of leaves at 4WAP. Though the significant effect was not effective, the local variety and Tima variety produced the least plant height at 6 WAP while Roma variety produced highest plant height with organic manure at 6 WAP. The data recorded also showed that the interaction between fertilizers and varieties were effective as the WAP increased.

Table 4 shows the result of interaction effects of tomato variety and fertilizer type on number of fruits and weight of fruits which indicated no significant difference on yield parameters. Local variety however, produced the highest number of fruits and highest fruit weight and lowest values were obtained from Tima variety where no fertilizer was applied.

Table 3 Interaction effects of tomato variety and fertilizer type on plant height and number of leaves at 4, 6 and 8 WAP.

		4 WAP		6 WAP		8 WAP	
Tomato Variety	Fertilizer	Plant Height (cm)	Number of Leaves	Plant Height (cm)	Number of Leaves	Plant Height (cm)	Number of Leaves
Local	Control	8.39	10.89	18.43	24.7	26.82	24.80
	NPK	13.60	12.22	16.56	30.4	28.32	30.40
	Alfa life	10.09	9.33	15.32	26.6	24.98	26.60
Roma vf	Control	8.84	7.56	13.88	20.3	22.54	20.30
	NPK	9.27	8.00	14.22	29.6	23.43	29.60
	Alfa life	12.54	10.44	19.92	23.8	24.98	23.80
Tima	Control	10.33	8.33	17.54	21.9	25.62	21.9
	NPK	8.18	8.67	15.17	21.0	24.40	21.10
	Alfa life	9.21	7.44	15.11	27.9	23.83	27.9
LSD 0.05		NS	4.49	4.54	NS	NS	NS

WAP = Weeks after planting, LSD = Least significant difference, NS = Non significant

Table 4 Interaction effects of tomato variety and fertilizer type on number of tomato fruits and weight of fruits

Tomato Variety	Fertilizer Type	Number of Fruits	Weight of fruits ($gplant^{-1}$)
Local	Control	11.00	11.35
	NPK	5.67	100.3
	Alfa life	4.57	74.3
Roma vf	Control	1.67	29.7
	NPK	1.33	24.7

	Alfa life	3.00	47.4
Tima	Control	1.33	23.3
	NPK	2.33	46.6
	Alfa life	1.89	24.8
LSD O.05		NS	NS

LSD = Least significant difference, NS = Non significant

The effect of variety on number of fruits and weight of fruits were presented on Table 5. There was significant difference (P = 0.05) among varieties used in weight of fruits. The local variety produced the highest number of fruits and weight of fruits. The least value was obtained from Tima variety. The values obtained from Roma vf and Tima were statistically similar. In the result presented on Table 6, the effect of NPK and Alfa life fertilizers were not effective on number of fruits and weight of fruits as the result showed no significant difference among the treatments. However, the highest weight of fruits was obtained from NPK treated plots with a value of 57.20gplant^{-1} and the least value was obtained from Alfa life.

Table 5 Effects of Variety on Number of Fruits and Weight

Tomato Variety	Number of Fruits	Weight of Fruits (gplant^{-1})
Local	7.11	96.0
Roma vf	2.00	33.9
Tima	1.85	31.6
LSD 0.05	NS	48.51

LSD = Least significant difference, NS = Non significant

Table 6 Effects of NPK 20:10:10 and Alfa life organic fertilizer on number of fruits and weight of fruits

Fertilizer Type	Number of Fruits	Weight of Fruits (gplant^{-1})
Control	4.60	55.50
NPK 20:10:10	3.11	57.20
Alfa Life	3.19	48.80
LSD 0.05	NS	NS

LSD = Least significant difference, NS = Non significant

The result of soil chemical properties presented on Table 7 showed that, the amendments enhanced the chemical properties of the studied soil. The total N result indicated significant (P = 0.05) difference among the treatments. The result of P, K, OC, and OM were statistically similar but better than the control. The pH of the soil was enhanced, highest value was obtained from the control plot and the least was obtained from the NPK fertilizer treated plots indicating the possibility of the soil becoming acidic in continuous use of NPK fertilizer.

Table 7 Effects of Soil Amendments on Soil Chemical Properties

Treatment	N %	P $mgkg^{-1}$	K $Cmolkg^{-1}$	pH_{H2O}	Organic Carbon %	Organic Matter %
Control	0.20	43.60	0.14	5.33	2.35	4.05
NPK 20:10:10	0.18	49.00	0.16	5.00	2.45	4.23
Alfa Life	0.02	43.70	0.15	5.03	2.71	4.67
LSD 0.05	0.08	NS	NS	NS	NS	NS

LSD = Least significant difference, NS = Non significant

DISCUSSION

The result of the study showed that the growth and yield parameters of the treated tomato varieties were enhanced following the application of Alfa Life and NPK fertilizers, though significant differences were not recorded in most of the treatments assessed in this trial. All the growth and yield parameters were found to be increased as the week after planting increased. The differences in growth and yield parameters may have resulted probably as a result of differences in plant nutrients in the rates of the treatments applied. The statistically similar values obtained in virtually all the parameters assessed could be attributable to the insufficient quantity of plant nutrients to stimulate the plant growth and yield; as a number of elements must be present in the soil for good crop production and nutrients naturally found in soil are very essential for the growth and yield of the plants.

From the values recorded, it was also observed that the local variety performed competitively better and responded better to the treatments applied more than the Roma vf and Tima varieties in most of the parameters measured in this study. The differences observed among the varieties could be attributable to the genetic makeup of the individual variety and adaptability to the soil under study as well as the soil nutrient content, type and nature of the microorganisms, present in the soil. For instance, the local variety has being in use by the farmers in the study area and therefore, has been accustomed to the soil ecology of the study area. Also the findings of Shuka and Naik (1993) showed that tomatoes require nutrient such as N, P, K, Mg, Ca and Na for good production, these nutrients are specific in function and must be supplied to the plant at the right time and in the right quantity. Uzo (1971) also emphasized on the satisfactory balance of N, P, and K nutrient elements for good production of tomato. Probably also, soil micro organism may not have actually been stimulated to release phytohormones that will stimulate nutrient absorption and plant growth in tomato plant as a result of short duration and rate of amendments applied. The higher weight of fruits observed in NPK 20:10:10 treated plots, compared to the other treatments is an indication that inorganic fertilizer exerts strong influence on plant growth, development and yield (Stefano et al., 2004) and the works of Adediran and Banjoko, (2003), Uyovbisere et al., (2001), Nweke and Nsoanya (2013a) and Nweke and Nsoanya (2013b) showed that, the use of NPK fertilizer in crop production increased yield.

The result of the soil chemical parameters indicated that the treatments applied had effect on the chemical parameters of the soil, although with the exception of total nitrogen, all the parameters measured were non-significant at P = 0.05. Higher levels of chemical nutrients were more observed in NPK treated plots compared to the other treatments. The level of

values obtained from Alfa life liquid organic fertilizer showed that the treatment is not effective for soil nutrient management system.

CONCLUSION

The result of the present study showed that the application of NPK 20:10:10 improved the growth and yield of tomato varieties and enhanced the soil chemical parameters better than the Alfa life liquid organic fertilizer. The interaction between fertilizers and tomato varieties significantly affected the plant height but other growth parameters and yield were not significantly affected. The result obtained from Alfa life liquid organic fertilizer showed that, the fertilizer was not effective for soil nutrient management system in the studied area.

REFERENCE

Adediran, J. A. and Banjoko V. A. (2003). Comparative effectiveness of some compost fertilizer formulations for maize in Nigeria, Nig. J. Soil Sci; 13: 42 – 48.

Adekiya, A. O. and Ojeniyi, S. O. (2002). Evaluation of tomato growth and soil properties under method of seedling bed preparation in an Alfisol in the rainforest zone of Southwest Nigeria. Soil Tillage Research, 64:275 – 279.

Agbede, T. M. Ojeniyi, S. O. and Adeyeyemo, A. J. (2008). Effect of poultry manure on soil Physical and chemical properties growth and grain yield of sorghum in Southwest Nigeria. Am. Eur J. Sust. Agric 2(1): 72 – 77.

Akanbi, W. B., Akande, M. O. and Adediran J. A. (2005). Suitability of composted maize straw and mineral N fertilizer for tomato production Journal of Vegetable Science 11(1): 57 – 65.

Aliyu, L., Karikari, S. K. and Ahmed, M. K. (1992) Yield and yield components of egg plant (Solanum gilo L.) as affected by date of transplanting, intra-row spacing and nitrogen Fertilization. Journal of Agricultural Science and Technology, 2 (1): 7 – 12.

Ano, A. O. and Agwu, J.A. (2005). Effect of animal manures on selected soil chemical properties (1) Niger. J. Soil Sci. 15: 14 – 15.

Arancon, N. Q., E Edwards, C. A., Bierman, P. Metzge, J. D., Lee, S. and Welch, C. (2004). Effect of vermicomposts on growth and marketable fruits of field grown tomatoes, peppers and strawberries, Pedobiologia, 47 (56): 731 – 735.

Ayoola, O. T. and Adeniyan, O. N. (2006). Influence of poultry on yield and yield components of crops under different cropping systems in Southwest, Nigeria. African J. Biotechnology, 5: 1386 – 1392.

Black, C. A. Evans, D. D., White, J. L., Ensmingen, L. E. and Clark, F. E. (eds) (1965). Methods of soil analysis. Part 2 Agronomy, Madison: Soil Science of America.

Bray, R. H. and Kurtz, L. T. (1945). Determination of total organic and available forms of Phosphorous in soils. Soils Science 59:39 – 48.

Bulluck, L. R. , Brosius, M., Evanylo, G. K. and Ristaino, J. B. (2002. Effects of synthetic and organic fertility amendments on southern blight, soil microbial communities and yield of processing tomatoes. Phytopathology, 92: 181 – 189.

Bulluck, L. R., Brosius, M., Evanylo, G. K. and Ristaino, J. B. (2002). Organic and Synthetic Fertility amendments influence soil microbial physical and chemical properties on organic and conventional forms. App. Soil Ecol; 19 (2): 147 – 160.

Food and Agricultural Organization (1993). Year book of production; Food and Agricultural Organization of the United Nations, Rome P 524.

Food and Agricultural Organization (2008). Food and Agricultural Organization of the United Nations, Food Security Statistics. Faost. FAO, Org.

Fashina, A. S., Olatunji, K. A. and Alasiri, K. O. (2002). Effects of different plant Population and poultry manure on yield of Ugu (Telfaria accidentails) in Lagos State, Nigeria in Proceedings of the annual Conference of Horticultural Society of Nigeria (HORSTON), Pp. 123 – 127.

Heeb, A., Lundegardh, B., Ericsson, T., Savage, G. P (2005a). Effects of nitrate-ammonium and Organic-nitrogen-based fertilizers on growth and yield of tomatoes, J. Plant Nut. Soil; 168(1): 123 – 129.

Heeb, A., Lundegardh, B., Ericsson, T., Savage G. P. (2005b). Nitrogen form affects yield And taste of tomatoes. J. Sci. Food Agric; 85; 1405 – 1414.

Heeb, A., Lundegardh, B., Ericsson, T. Savage , G.P. (2006). Impact of Organic and Inorganic Fertilizer on yield, taste and nutritional quality of tomatoes. J. plant Nut. Soil Sci.169: 535 – 544.

Hoitink, H. A. J. and Boehn, M. J. (1999). Biocontrol within the context of soil Microbial communities: A substrate dependent phenomenon, Ann. Rev. phytopath; 37 : 427 – 446.

John, L. W., Jamer, D. B., Samuel, L. T and Warner, L. W. (2004). Soil fertility and Fertilizers. An introduction to Nutrient Management. Pearson Education, Indian Pp. 106 – 153.

Liu. B., Gumpertz, M. L., US H, Ristarino J. B. (2007). Long-term effect of organic and Synthetic soil fertility amendments on soil microbial communities and the Development of southern blight. Soil, Biochem; 39: 2302 – 2316.

Nweke, I. A., Nsoanya, L. N. and Okolie, E. C. (2013). Effect of organio- mineral fertilizer on growth and yield of maize (Zea mays L.) at Igbariam, southeastern, Nigeria. INT'l. J. Agric Rural Dev. 16 (1): 1404 – 1408.

Nweke, I. A., Okoli, P. S. O. and Enyioko, C. O. (2014). Effect of different rates of Poultry droppings and plant spacing on soil chemical properties and yield of Cucumber. Elixir Agriculture. 70 (2014): 23934 – 23940..

Nweke, I. A., and Nsoanya, L. N. (2013a). Evaluation of different NPK (15:15:15) Fertilizer levels on an improved maize variety in proceedings of the 47th Annual Conference of the Agricultural Society of Nigeria, Ibadan 2013. P 19 – 22.

Nweke, I. A., and Nsoanya, L. N. (2013b). Effect of different rates of rice mill waste on soil chemical properties and grain yield of maize (Zea mays L.). INT'L J. Agric. Rur. Dev. 16 (1): 1431 – 1436

Obi, C. U., Nnabude, P. C. and Onucha, E. (2005). Effects of Kitchen Waste Compost and Tillage on Soil Chemical Properties and yield of okra (Abelmuschus esculentus), Soil Sci./ 15: 69 – 76.

Ojeniyi, S. O. (2000). Effects of goat manure on soil nutrients and Okra yield in rainforest area of Nigeria. Applied Tropical Agriculture 5: 20 – 23.

Saeed, I. M., Abbasi, R. and Kazim, M. (20001). Response of maize (Zea mays) to nitrogen And phosphorous fertilization under agro- climate condition of Rawalokol, Azad Jammu and Kaslim and Kashmir, Pak. J. Biological Sci., 4: 949 – 952.

Shuka, V. and Naik, L. B. (1993). Agro-technique for Solanaceous Vegetables, In: Advance in horticulture, Vol. 5. Malhotra publishing house, New Delhi, India, Pp. 364 – 399.

Sridhar, M.K.C and Adeoye, G. O. (2003). Organo – mineral Fertilizer from urban wastes The Field, 68: 91 – 111.

Stefano, P. Dris, R. and Rapparini, F. (2004). Influence of growing conditions and yield on quality of cherry. 11. Fruit J. Agric, and Env. 2: 307 – 309.

Uguru, M. I. (1996). Crop Production techniques. Fulladan Publication Company, Nsukka, Nigeria.

Uyovbisere, E. O., Chude, V. O. and Batiano, A. (2001). Promising nutrient ratios In the fertilizer formulations for optimal performance of maize in Nigeria Savanna. The need for a review of current recommendations. Nig. Soil Res. 1: 29 – 37.

Uzo, J. O. (1971). Effect of nitrogen, phosphorous and Potassium on yield of tomato (Lycopesicon esculentum mill) in the tropic: Hort. Res. 11: 65 – 75.

Villa real, R. L. (1980). Tomatoes in the tropical. West View Press, Inc. Boulder Colorado, 174 Pp.

Walkley, A. and Black, I. A. (1934). An examination of the Degtjareff method for determining soil organic matter and the proposed modification of the chronic acid titration method. Soil Science 37: 29 – 38.