AFRICAN JOURNAL
OF ORGANIC AGRICULTURE
AND ECOLOGY

NOARA Network of Organic Agriculture Researchers in Africa
RÉSEAU DES CHERCHEURS EN AGRICULTURE BIOLOGIQUE EN AFRIQUE
شبكة الباحثين في الزراعة العضوية بإفريقيا

www.noara.bio

Efficacy of Foliar Application Rates of Liquid Poultry Manure Fertilizer on Tomato Performance and Soil Fertility Improvement in Southern Guinea Savanna

Abdulmaliq, S.Y.,[1] Salahudeen, A.,[1] Kumar, N.,[1] Abubakar, A.,[2] Omolaran, B.[3] and Kareem, I.[4]
[1]Department of Crop Production, Faculty of Agriculture, Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria
[2]Department of Biological Sciences, Federal University of Technology, Minna, Nigeria
[3]Department of Agronomy, Federal University Gashua, Yobe State, Nigeria
[4]Department of Agronomy, University of Ilorin, Nigeria.
Corresponding Author E-mail: drsmaliq@gmail.com

Abstract
Nutrition is an essential need of all plants. It is a common belief that if nutrient is in a liquid form it will be easily absorbed by plants. Therefore, field experiment was carried out at the Teaching and Research Farm of Ibrahim Badamasi Babangida University, Lapai (Latitude 09° 02" N and 06° 34" E), Niger State, Nigeria during 2017 and 2018 raining seasons (May to November) to examine the effects of different foliar application rates of liquid poultry manure fertilizer on growth and yield of two tomato varieties. The experiment was a 5 × 2 factorial arrangement in a Randomized Complete Block Design (RCBD) and replicated three times. The two factors were five application rates; 10000, 20000, 30000, 40000 l/ ha, and control (0.00 litre/ ha) and two varieties of tomato (Roma VF and UC82B). Data were collected on growth (plant height, number of leaves per plant, leaf area) and yield (days to first flowering, days to 50% flowering, number of fruits per plant, fruit length (cm), fruit circumference (cm),fresh weight of fruits per plant (kg) and cumulative fruit weight/ha) parameters. All data collected were subjected to Analysis of Variance (ANOVA). Means of significant treatments were separated using the least significant method. The results revealed that application of liquid poultry manure fertilizer had significant ($P<0.05$) effects on vegetative growth and yield performance of tomato varieties in the two cropping seasons. The application of 20,000 l /ha significantly produced highest tomato plant growth (vine length/plant, number of leaves/plant and number of branches/plant)and yield number of fruit/plant, fruit diameter/plant, fruit weight/plant, fruit weight/plot and cumulative yield/ha (tonnes). Also, UC82B variety of tomato significantly supported better growth and yield when compared with Roma VF variety.

Keywords: Liquid poultry manure, growth, yield, tomato varieties, Nigeria.

Efficacité des taux d'application foliaire d'engrais liquide pour fumier de volaille sur la performance des tomates et l'amélioration de la fertilité des sols dans le sud de la savane guinéenne

Abstrait
La nutrition est un besoin essentiel de toutes les plantes. Il est communément admis que si le nutriment est sous forme liquide, il sera facilement absorbé par les plantes. Par conséquent, une

ISSN: 2734-2913
Volume 2, 2019, pp 55-65
Date Published: December 16, 2019

expérience sur le terrain a été réalisée à la Ferme d'enseignement et de recherche de l'Université Ibrahim Badamasi Babangida, Lapai (Latitude 09o 02 "N et 06o 34" E), Etat du Niger, Nigéria pendant les saisons de pluie 2017 et 2018 (mai à novembre) pour évaluer les effets de différentes doses d'application foliaire d'engrais liquide pour fumier de volaille sur la croissance et le rendement de deux variétés de tomates. L'expérience était un arrangement factoriel 5 × 2 dans une disposition de bloc complet aléatoire (RCBD) et répliquée trois fois. Les deux facteurs étaient cinq taux d'application; 10000, 20000, 30000, 40000 l /ha, et le témoin (0,00 litre / ha) et deux variétés de tomates (Roma VF et UC82B). Des données ont été recueillies sur la croissance (hauteur de la plante, nombre de feuilles par plante, surface foliaire) et le rendement (date d'apparition de la première fleur, nombre de jours à 50% de floraison, nombre de fruits par plante, longueur des fruits (cm), circonférence des fruits (cm), poids frais de fruits par plante (kg) et poids cumulé des fruits / ha). Toutes les données recueillies ont été soumises à une analyse de variance (ANOVA). Les moyennes des traitements significatifs ont été discriminées en utilisant la méthode la moins significative. Les résultats ont révélé que l'application d'engrais liquide de fumier de volaille a eu des effets significatifs (P <0,05) sur la croissance végétative et le rendement des variétés de tomates au cours des deux saisons de culture. L'application de 20000 l/ha a produit de manière significative la plus forte croissance des plants de tomates (longueur de la vigne / plante, nombre de feuilles / plante et nombre de branches / plante) et rendement nombre de fruits / plante, diamètre du fruit / plante, poids du fruit / plante, fruit poids / parcelle et rendement cumulé / ha (tonnes). En outre, la variété de tomate UC82B a présenté de meilleures performances en croissance et en rendement comparativement à la variété Roma VF.

Mots clés: Fumier liquide de volaille, croissance, rendement, variétés de tomates, Nigéria.

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crops grown in Nigeria. It is the world's largest vegetable crop after potato and sweet potato but it tops the list of canned vegetables. In Nigeria, tomato is regarded as the most important vegetable after onions and pepper (Olaniyi *et al*., 2010). It is widely grown both in most home gardens and commercially because of its importance and values (Adepoju, 2014). It is an important condiment in most diets and a very cheap source of vitamins. It contains a large quantity of water, calcium and niacin all of which are of great importance in the metabolic activities of man. Tomato juice is an excellent source of vitamins, minerals, and antioxidants which helps in the control of cancer as well as improves the general health of man (Ogundare *et al*., 2015).In spite of the importance of the crop in Nigeria, its yield across the country is low and not encouraging.

The tomato yield in Nigeria was reported as (7.0t/ha) compared with average yields recorded in other countries which, are about 9.9 t ha-1 in Thailand, 8.8 t ha-1 in Philippines, 15.6 t ha-1 in India, 25.3 t ha-1 in China, 52.8 t ha-1 in Japan, and 63.6 t ha-1 in USA. In Africa, highest yield was obtained in South Africa (76.25 t ha-1) and the least was from Angola (3.7 t ha-1) (Mohammed and Sighn, 2007).

The use of organic fertilizers is a sustainable way of improving crop productivity because of its ability to support the production of soil without jeopardizing the future productivity of the soil (Abdulmaliq *et al.,* 2016). Organic fertilizer improves the physical and chemical conditions of soil such as anion and cation exchange capacity, organic matter and carbon contents of soil, as well as its biological activities thereby increasing the yield and quality (Nithiya*et al*., 2015). Effective application of organic manure and maximum crop growth and yield depend on its mode of application and concentrations(Amanullah *et al.,* 2010).

Liquid fertilizer is one of the alternative methods of poultry manure application with the aim of improving crop growth and yield. Liquid poultry manure fertilizer is a liquid extract of compost consisting of essential plant nutrients and beneficial microorganisms, and referred to as compost tea (Ingham, 2005 and Arowosegbe, 2010). It boosts the plant and soil life; and has been used as a fertilizer, pesticide and fungicide. Liquid organic fertilizers (poultry manure tea) have been found to contain nitrogen mainly in inorganic form like ammonia (Gross *et al.,* 2007) and can provide nutrients instantly to the plants like the chemical fertilizers. However, there were insufficient information on fertigation of crops by manure teas. Thus, study examined the effects of different foliar application rate of liquid poultry manure fertilizer on growth and yield of tomato varieties.

Materials and Methods

Experimental Site

Field experiment was carried out between May 2017and November 2018 cropping seasons at the Crop Production Department Research Farm of Ibrahim Badamasi Babangida University (IBBUL), Lapai on latitude 09° 02"N and 06° 34"E at an elevation of 162m, with a land mass of 3,051km^2.

Experimental Materials

The organic fertilizer (poultry manure) that was used for the study was collected from the Animal Research Farm of the University (IBBUL) in the two cropping seasons, while the tomato varieties were purchased from an Agro-allied Store in Minna, Niger State, Nigeria. The two tomato varieties were selected based on their growth and yield potentials. The seeds of the tomatoes were raised in the nursery for 28 days before transplanting to the field in June 2017 and 2018 cropping seasons.

Preparation of Poultry Manure Liquid Fertilizer

The liquid poultry manure was prepared using modified method of Peiris and Weerakkody (2015) a week before application using 1:3 ratio of poultry manure to water, gram/ litre (weight/ volume). A total of 20g partly dried poultry manure was weighed and packed in a permeable sack. The tea-bag (the sac) was securely tightened and immersed in a 60 litres of water. The bucket was covered with the lid to discourage flies and other unwanted contaminations. The liquid was manual agitated twice a day to ensure proper mixture and filtration.

Treatments and Experimental Design and Crop Establishment

The experiment was a 5 x 2factorial arrangement in a Randomized Complete Block Design (RCBD) and replicated three times. The two factors were five application rates of liquid poultry manure; 0 l/ha (Control), 10,000 l/ha, 20,000 l/ha, 30,000 l/ha and 40,000 l/haand two varieties of tomato (Roma VF and UC 82B).Each block comprised of 10 plots, each plot was 2 m x 3 m, separated with 1 m and 0.5 m alley ways between blocks and plots respectively. The plot comprised of three rows, with a total of four stands per row, intra and inter spaced by 50 cm x 50 cm given a total of 12 stands per plot.

Physicochemical Analysis of Soil and Poultry Manure Liquid Fertilizer Samples

Prior to commencement of the experiment, top soil samples at the depth of 0 – 30 cm was collected randomly from the field using a core sampler to assess the soil physico-chemical properties with standard laboratory procedure described by Msibi *et al*., (2014). Particle-size analysis was done using Bouyoucous hydrometer method (Gee and Or, 2002). The organic matter was determined by the procedure of Walkley Black using the dichromate wet oxidation method (Nelson and Sommers, 1996). Total N was determined by micro-Kjeldahl digestion method (Bremner, 1996), and available P was determined by Bray-P1 extraction followed by molybdenum blue colorimetry (Frank *et al.,* 1998). Exchangeable K, Ca and Mg were extracted using ammonium acetate, Thereafter, K level was analysed with a flame photometer,Ca and Mg were determined with an atomic absorption spectrophotometer (Okalebo *et al.,* 2002). Poultry manure used for the liquid fertilizer composition was analysed for some pretreatment nutrient contents before application. All analyses were conducted at the National Cereal Research Institute (NCRI) Badeggi, Bida, Niger State, Nigeria.

Nursery Operations and Planting

A nursery (2 × 3 m) was used to raise each variety. A total of 150 g seeds were sown on a flat nursery bed, covered with fine sand and mulched. The beds were watered twice a day to ensure sufficient absorption for proper seed germination. The seedlings were properly taken care of for 28 days in the nursery before transplanting to the permanent field plots. However, the experimental field was cleared and stumped, then ploughed, harrowed and ridged. At the onset of the raining season, healthy grown seedlings were randomly selected from the nursery for transplanting in a well-prepared seed beds. The seedlings were transplanted at the rate of one plant per-hole at a spacing of 50 cm by 50 cm, totalling 12 stands per plot and 36 plants per treatment combination. Thereafter, the seedlings were mulched to preserve soil moisture.

Crop Husbandry

The seedbeds were regularly watered once a day in the absence of rainfall to keep the soil moist. Weeds were manually removed using hand hoe at two weeks interval and the plant stands were staked. Insects and diseases control were done using water and oil extracts of neem (*Azadiracter indica* L.) seeds. Application of the formulated liquid poultry manure (manure tea) was done every two weeks using foliar application method. The foliar application of liquid poultry manure commenced a week after transplanting and thereafter applied biweekly. The application rates were as specified in the experimental design (control, 10000 l/ha, 20,000 l/ha, 30,000 l/ha and 40,000 l/ha). Weeds were controlled by hoe weeding at 4 and 6 weeks after transplanting. Pests and diseases were also controlled using neem seed oil extract. The oil was prepared in emolsifyable concentrations using detergent. Tomato harvesting started at eight weeks after transplanting and continued for about two months.

Growth Development and Yield Parameters

Growth parameters such as plant height, number of leaves per plant, leaf area were taken from three randomly selected tagged plants from each plot two weeks after transplanting (WAT) following the method of Ogundare*et al.*,(2015).

Development and yield parameters such as days to first flowering, days to 50% flowering, number of fruits per plant, fruit length (cm), fruit circumference (cm) and fresh weight of fruits per plant (kg) were also taken from selected tagged plants.

Statistical Analysis

The Proc Mixed procedure in SAS (SAS version 9.1.3, SAS Institute, 2012) was used to to test for significant differences among the treatments mean. Significant means were separated using Least Significant Differences (LSD) at 5% probability level.

Results

Physico-chemical Properties of the Soil

The physico-chemical properties of the soil from the experimental sites and liquid poultry manure in the 2017 and 2018 cropping seasons are presented in Table 1. The soil was sandy loamy and slightly acidic. It also contained low organic carbon, total nitrogen and exchangeable Mg as compared to liquid poultry manure. With the exception of exchangeable K of the soil sample, the exchangeable Ca, Mg and P of the two samples were adequate.

Effect of liquid poultry manure application rates on the growth of two tomato varieties

Table 2 showed the vine length (cm) of tomato varieties as affected by the application of liquid poultry manure. In both years, there were significant ($P< 0.05$) differences in the vine length of tomato as a result of application of different rates of liquid poultry manure at 3, 6, 9, and 12 WAT. The application of 20,000 l/ha liquid poultry manure consistently and significantly ($P<0.05$) produced longer vine at 3, 6 and 9 WAT. The least vine length was recorded from the application of 40,000 l/ ha. However, at 12 WAT, there was no significant difference in the vine length for all the treatments. The two tomato varieties were significantly different in their vine length at 3 and 6 WAT, with UC82B recording significantly ($P<0.05$) longer vine than Roma VF.

Significant and consistent highest number of leaves per plant was obtained from the application of 20,000 l /ha treated tomato plants

Table 1: Physicochemical Properties of Experimental Soil, Poultry Manure and Liquid Poultry Manure

Sample Description	2017 Soil	2018 Soil	2017 Poultry Manure	2018 Poultry Manure	2017 Liquid Poultry manure (Manure Tea)	2018 Liquid Poultry manure (Manure Tea)
pH (H_2O)	6.80	6.58	5.86	5.89	6.02	6.05
Organic Carbon (%)	0.77	0.77	1.32	1.45		
Organic Matter (%)	1.33	1.28	1.42	1.55		
Total N (%)	0.16	0.15	3.14	3.15	2.84	2.95
Available P (ppm)	25.98	20.95	16.54	17.55	23.23	24.85
Na ($cmolKg^{-1}$)	0.15	0.8	0.36	0.45	0.21	0.25
Potassium ($cmolKg^{-1}$)	0.05	0.08	1.36	1.52	0.33	0.35
Calcium ($cmolKg^{-1}$)	2.80	2.75	2.32	2.85	3.28	3.45
Magnesium ($cmolKg^{-1}$)	3.28	3.45	7.02	6.95	6.77	6.55
Exchangeable Acid ($CmolKg^{-1}$)	0.44	0.43	0.53	0.58		
CEC ($CmolKg^{-1}$)	6.72	6.50	6.25	7.15		
Sulphur (ppm)+					0.066	0.064
Zinc (ppm)			0.373	0.385		
Sand (%)	84.4	83.5				
Silt (%)	6.36	6.30				
Clay (%)	9.24	9.20				
Texture	Loamy Sandy	Loamy Sandy				

Table 2: Effects of Liquid Poultry Manure rates and Varieties on the Vine Length (cm) of Tomato

Treatment	Tomato Vine Length (cm) 3 WAT 2017	3 WAT 2018	6 WAT 2017	6 WAT 2018	9 WAT 2017	9 WAT 2018	12 WAT 2017	12 WAT 2018
Application Rates								
Control	15. 40	16.50	26.70	30.25	52.20	54.50	60.55	65.30
10,000 l/ha	19.77	20.42	34.83	40.80	58.10	58.25	65.80	64.40
20,000 l/ha	21.47	20.65	38.14	41.50	62.70	65.20	80.65	82.20
30,000 l/ha	14.79	13.80	23.52	30.75	49.10	50.60	67.10	68.50
40,000 l/ha	11.67	12.70	20.28	28.20	42.66	43.20	53.00	55.20
$LSD_{(0.05)}$	3.438	3.522	6.174	6.255	7.104	7.322	9.400	9.625
Varieties								
Roma VF	14.76	15.52	26.14	27.30	50.47	54.30	69.95	69.80
UC82B	18.48	20.85	30.45	31.50	58.45	72.80	76.54	77.30
$LSD_{(0.05)}$	2.175	2.245	3.902	3.925	5.758	5.955	6.016	6,255
PM xV	ns	ns	ns	ns	ns	ns	ns	ns

Means followed with same letter(s) along each column are not significantly different at 5% probability level

throughout the experimental period in the two cropping seasons (Table 3). Least number of leaves/plant was obtained from the application of 40,000 l/ha during experimental study periods. However, there were no significant differences between the application of 40,000L/ha and 30,000 l/ha in the number of leaves/plant. UC82B variety produced higher number of leaves per plant, although, there were no significant differences among the two varieties in the two cropping seasons.

Table 3: Effects of Liquid Poultry Manure and Varieties on Tomato Number of Leaves/Plant

Location/year Treatment	Tomato Number of Leaves/Plant							
	2017	2018	2017	2018	2017	2018	2017	2018
	3 WAT		6 WAT		9 WAT		12 WAT	
Application Rate								
Control	11.45	11.10	17.50	17.20	46.20	46.20	66.80	67.10
10,000 l/ha	12.10	11.45	27.10	27.60	49.30	49.60	79.30	79.80
20,000 l/ha	14.20	14.45	32.50	32.80	61.20	62.10	104.60	106.40
30,000 l/ha	8.60	9.00	13.70	13.20	32.50	33.80	59.20	59.30
40,000 l/ha	6.60	6.70	10.45	11.40	21.20	22.10	60.30	60.20
$LSD_{(0.05)}$	2.008	2.025	6.790	7.042	13.212	13.642	20.400	21.050
Varieties								
Roma VF	10.30	10.80	18.60	19.80	41.40	41.80	65.70	65.10
UC82B	10.90	11.10	21.90	22.50	42.60	44.20	82.30	84.80
$LSD_{(0.05)}$	NS	1.274	4.294	4.500	8.358	8.536	12.912	13.062

Means followed with same letter(s) along each column are not significantly different at 5% probability level

Table 4: Effects of Liquid Poultry Manure and Varieties on Tomato Number of Branches

Treatments/Year	Number of Branches/Plant							
	2017	2018	2017	2018	2017	2018	2017	2018
	3 WAT		6 WAT		9WAT		12WAT	
Rates								
Control	8.67	8.90	17.67	18.20	25.17	26.30	39.33	38.40
10,000 l/ha	10.17	10.35	21.17	22.10	25.50	26.40	42.50	43.80
20,000 l/ha	12.33	12.40	24.83	25.50	32.17	33.50	63.50	63.20
30,000 l/ha	8.33	8.35	14.50	15.30	25.00	26.40	40.50	40.80
40,000 l/ha	6.17	6.20	12.17	13.10	19.17	20.60	36.33	77.20
$LSD_{(0.05)}$	2.274	2.282	5.435	5.845	6.212	6.314	9.256	9.825
Varieties								
Roma VF	9.13a	9.80	15.27	15.50	21.40	22.10	39.87	38.60
UC82B	9.13a	10.20	19.67	20.30	27.20	27.50	49.00	49.60
$LSD_{(0.05)}$	NS	1.555	4.437	4.255	5.664	5.825	8.386	8.555

Means followed with same letter(s) along each column are not significantly different at 5% probability level using LSD

The number of branches/plant was significantly affected by liquid poultry manure rates throughout the evaluation period in both cropping seasons (Table 4). The application of 20,000 l/ha significantly supported highest number of branches/plant when compared with other poultry liquid poultry manure application rates at 3, 6, 9 and 12 WAT. The least number of branches was produced from the application of 40,000 l/ha with no significant difference among the two varieties. However, the UC8 2 B variety consistently supported higher number of branches/plant when compared with Roma VF.

Effect of Liquid Poultry Manure Rates and Varieties on Days to Flowering and Fruiting of tomato

Table 5 shows that there were significant differences ($p < 0.05$) in days to 50% flowering. On average 50% of plants treated with 20,000 l/ha liquid poultry manure attained 50% flowering earlier than all other treatments and the least was the control treatment which attained 50% flowering at latter days. First days to fruiting, were not significantly different ($p > 0.05$) among all the treatments plants. Plants treated with 10,000 l/ha liquid poultry manure commenced its fruiting earlier when compared with other poultry manure treatments. The varieties of the tomato examined differed significantly in the number of days to first and 50% flowering ($p < 0.05$). The UC82B variety commenced its first flowering, 50% flowering and first fruiting earlier than Roma VF variety.

Effect of Liquid Poultry Manure Rates and Varieties on Yield Parameters of Tomato

Table 6 shows significant variations ($p < 0.05$) in yield parameters of tomato varieties among all the treatments of liquid poultry manure for all the yield parameters evaluated. Plants treated with 20,000 l/ha liquid poultry manure significantly produced highest number of fruit/plant, widest fruit diameter/plant, heavier fruit weight/plant and fruit weight/plot in the two cropping seasons. The least number of fruit/plant and fruit weight /plant were recorded in control plants while the least fruit diameter/plant and fruit weight/plot were obtained from 40,000 l/ha treatments. The result also revealed that there were significant differences between the two varieties yield parameters evaluated. UC 82 B supported highest number of fruit/plant, widest fruit diameter/plant, fruit weight/plant and fruit weight/ plot respectively than Roma VF for all the yield parameters in the two cropping seasons.

Across the cropping seasons, cumulative yield/ha (tonnes) showed that there were significant differences among the application rate of liquid poultry manure. Significantly higher cumulative yield was obtained from 20,000 l/ha followed by both 10,000 and 30,000 l/ha and the least was obtained from 40,000 l/ha in the two cropping seasons. However, there were no significant differences among the cumulative yield of the control, 10,000 and 30,000 l/ha. The UC 82 B was significantly superior in cumulative yield ha^{-1} when compared with Roma VF.

Table 5: Effects of Liquid Poultry Manure and Varieties on Days to First and 50% Flowering and First Fruiting of Tomato

Treatment Application rates	Days to First Flowering		Days to 50% Flowering		Days to First Fruiting	
	2017	2018	2017	2018	2017	2018
Control	60	60	70	71	70	70
10,000 l/ha	57	56	64	63	67	68
20,000 l/ha	49	50	62	62	68a	68
30,000 l/ha	50	50	66	64	71	71
40,000 l/ha	54	52	67	65	74	75
$LSD_{(0.05)}$	NS	NS	5.908	5.805	7.286	7.955
Varieties						
Roma VF	59	60	69	70	71	71
UC82B	49	51	62	64	69	68
$LSD_{(0.05)}$	6.404	6.454	4.737	4.386	NS	NS

Means followed with same letter(s) along each column are not significantly different at 5% probability level using LSD

Table 6: Effects of Liquid Poultry Manure and Varieties on Yield Parameters of Tomato

Treatment	Number of Fruits per plant		Fruit Diameter per plant (cm)		Fruit Weight per plant(g)		Fruit Weight Per plot (kg)		Cumulative Yield/Ha (tonnes)	
Application Rate	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Control	23.20	25.30	6.62	6.65	207.40	210.50	21.28	20.82	0.22	0.35
10,000 l/ha	40.80	39.80	10.25	11.80	269.73	250.20	24.14	24.19	2.24	2.40
20,000 l/ha	47.30	47.50	14.40	15.20	359.31	358.60	29.94	30.50	3.30	2.95
30,000 l /ha	34.40	35.50	10.97	10.65	271.86	280.50	24.32	24.52	2.24	2.45
40,000 l/ha	30.80	30.20	10.10	10.20	257.94	245.60	21.50	21.90	1.21	1.40
$LSD_{(0.05)}$	2.198	2.164	3.158	3.254	32.166	32.326	2.685	2.755	0.270	0.355
Varieties										
Roma VF	30.80	32.89	12.35	12.40	274.28	268.30	22.86	25.48	1.23	1.25
UC82B	39.76	40.20	13.86	14.50	312.22	315.25	26.02	28.32	3.26	3.42
$LSD_{(0.05)}$	1.3862	1.565	0.735	0.785	20.346	20.426	1.695	1.785	1.170	1.235

Table 7: Physical and Chemical Properties of Experimental Plot Soil after Harvest in 2017 and 2018

Soil Property	Control (l/ha)		10,000 (l/ha)		20,000 (l/ha)		30,000 (l/ha)		40,000 (l/ha)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
pH (H_2O) 1:1	6.40	6.45	6.80	6.82	5.90	5.95	6.60	6.70	6.40	6.50
Organic Carbon (%)	0.92	0.96	1.82	1.79	3.55	3.54	1.99	1.95	3.51	3.50
Organic Matter (%)	1.60	1.59	3.14	3.18	6.12	6.09	6.06	6.00	6.09	6.10
Total Nitrogen (%)	0.07	0.09	1.05	1.09	0.53	0.55	1.97	2.00	0.43	0.45
Available Phosphorus (ppm)	22.36	22.30	21.16	20.80	22.20	22.80	21.05	21.00	20.22	20.25
Sodium ($cmolKg^{-1}$)	0.17	0.19	0.12	0.10	0.08	0.07	0.13	0.15	0.11	0.10
Potassium ($cmolKg^{-1}$)	0.13	0.12	0.28	0.30	0.23	0.25	0.10	0.10	0.26	0.30
Calcium ($cmolKg^{-1}$)	3.92	3.90	4.48	4.50	2.24	2.26	3.60	3.55	2.92	2.95
Magnesium ($cmolKg^{-1}$)	5.65	5.55	5.99	6.01	4.60	5.00	5.08	5.05	4.84	4.90
Exchangeable Acid ($cmolKg^{-1}$)	0.23	0.25	0.20	0.20	0.18	0.20	0.06	0.10	0.39	0.40
CEC ($CmolKg^{-1}$)	10.1	9.8	11.07	11.05	7.33	8.20	8.97	8.80	8.52	8.55
Sand (%)	85.52	85.50	74.24	74.20	78.24	77.80	78.24	78.00	76.24	76.20
Silt (%)	5.20	5.18	3.48	3.40	7.48	7.68	8.48	8.75	6.48	6.35
Clay (%)	9.28	9.32	22.28	22.40	14.28	15.52	13.28	13.25	17.28	17.45

L/ha = Litre per Hectare

Physicochemical Properties of Experimental Plot Soil after Harvest

The results of physical and chemical characteristic of each experimental plot soil after harvest in 2017 and 2018 cropping seasons showed that the pH of all the liquid poultry manure treated soils and the control (Non-manure) samples were slightly acidic even at the end of each of the years (Table 7). The liquid poultry manure treated plots contained higher organic carbon, organic matter and total Nitrogen than the control soil. Among the manure tea treated plant soils, the highest organic carbon and organic matter were obtained from the plots applied with 20,000 l/ha and the lowest was 10,000 l/ha. The exchangeable acid was observed in all the treated plant soil to be lower than the value of control.

Discussions

The consistent highest vine length/plant, number of leaves/plant and number of branches/plant recorded following the application of 20,000 l/ha of liquid poultry manure application rates in 2017 and 2018 cropping seasons could be attributed to the availability of appropriate quantity of nutrients in the liquid poultry manure supplied in required form for rapid uptake by the plants. This result is in line with Toluwase *et al*., (2014) who reported that processing of organic manure (materials) into liquid form eases the decomposition processes and enhances the release of nutrient for plant use.

The effectiveness of liquid poultry manure on plant growth is attributed to the presence of essential nutrients such as nitrogen, phosphorus and potassium and their vital role in physiological processes in the plants such as photosynthesis, carbohydrate transport, protein formation, control of ionic balance, regulation of stomata size and activation of plant enzymes (El-Dissoky, 2008). Also, the result obtained could be due to high phosphorus content of the sample which is an important constituent in nucleic acid and coenzyme for cell division. This result is in line with earlier report that organic manure increased soil nitrogen and phosphorus which play significant role in promotion of plants vegetative growth through their ability to enhance cell division and elongation (Qamar-uz-Zaman *et al*., 2011).The result is also in agreement with Fayed (2010), who found that the compost manure tea significantly increased the vegetative parameters of the Roghini olive trees. El-Tantawy (2009) also reported that farmyard compost tea increased the height and leaf area of potato plant.

The non-significant effects of application rates of liquid poultry manure on the days to first flowering and first fruiting indicated that these traits are not influenced by quantity of the liquid poultry manure in this study. This can be attributed to the response of some plants basically to photoperiodic phenomenon. This result is in agreement with the work of Abdulmaliq *et al.,* (2016) who also reported that soil amendment had no significant effect on days to first flowering and other flowering and fruiting characteristics of okra plant.

The superiority of UC 82 B over the Roma VF in terms of vine length, number of leaves, number of branches as well as earliness to flowering and fruiting could be attributed to variation in the genetic make-up of the two varieties. The findings of this study is also similar to that of Enujeke and Emuh (2015) who reported higher growth rate of UC 82 B variety over other varieties examined and attributed the differences in plant height and other growth parameters to genetic composition and suitability of the variety to the agro-ecological conditions of the environment.

Also, it has been reported that genetic constitution of crop varieties influences the growth expressed by the plant (Sajjan *et al.,* 2002). The mean days to 50% flowering of 62.67 and 69.20 obtained in this study falls within the earlier range of 50-72 days reported by Ullah *et al*., (2015), who worked on some genotypes of tomato and attributed their variability in growth and development to their genotypic variations.

The significant variation in the number of fruit and fruit parameters obtained in this study is an indication that the application rate of the liquid poultry manure had effect on the production rate of the crop. The significant yield of the liquid poultry manure treated with 20,000 l/ha plants could be due to the consistent release of nutrients in an appropriate quantity to the soil. These are made available for use by the plants, in addition to several interrelated positive influence of foliar application of liquid poultry manure tea which leads to availability of nutrients in a soluble form, beneficial microorganisms and microbial metabolites in the manure that plays a vital role in increased plant growth and yield. This finding is in agreement with Jigme *et al*., (2015) that liquid organic fertilizers contain nitrogen mainly in inorganic form like ammonia, which are instantly available in nutrients form for plants uptake during growth periods leading to better growth and higher yield.

The differences in the number of fruits and fruit yield parameters observed from the two varieties in this study could be attributed to the difference in their genetic make-up. Similar affirmation had been made by earlier authors, Ibrahim *et al*. (2000) and Abdulmaliq *et al*. (2016). They affirmed that the disparity in growth of crops under similar environmental conditions can be due to their genetic make-up differences. Similarly, the higher fruit weight per plant and per plot obtained in this study was in conformity with the result of Enujeke and Emuh (2015), who obtained higher fresh fruit weight from UC82B over Roma VF and other varieties.

Conclusion and Recommendation

The results from this study showed that the liquid poultry manure had significant effect on the growth, development and yield of tomato varieties in the Southern Guinea Savanna Ecology of Nigeria. The 20,000 litres/ ha of liquid poultry manure supported significantly better growth and yield of tomato when compared with other treatments. Also, the local variety UC82B significantly produced better growth and yield. From the results of this study, it is recommended that the farmers should be encouraged to be using liquid manure for the fertilization of tomato at 20,000 litre/ha since it resulted in better growth and higher yield of tomato.

References

Abdulmaliq, S. Y., Abayomi, Y. A., Aduloju, M. O. and Olugbemi, O. (2016). Effects of curing period of livestock droppings on the growth and yield of okra (*Abelmoschusesculentus* L.) Varieties. *International Journal of Agronomy*, volume, pp.1-7.

Amanullah, M. M., Sekar, S. and Muthukrishnan, P. (2010). Prospects and potential of poultrymanure. *Asian Journal of Plant Sciences,* 9: 172-182.

Adepoju, A. O. (2014). Post-harvest losses and welfare of tomato farmers in Ogbomosho, Osun State, Nigeria. *Journal of Stored Products and Postharvest Research*, 5(2), 8-13.

Arowosegbe, S. (2010). Impact of organic and folia fertilizer application on the growth, yield and medicinal potential of *Hybiscussabdariffa* L. *Global Journal of Agricultural Research*, 4(2), 7-17.

Bremner, J. M., (1996). Nitrogen-total. In: Sparks, D.L. (Ed.), *Methods of Soil Analysis*. Part 3. Chemical Methods, second ed., SSSA Book Series No. 5 ASA and SSSA, Madison, WI, USA, pp. 1085–1121.

El-Dissoky, R. A. (2008). Studies on the use efficiency of potassium and organic fertilizers on potatoes and its role in improving soil properties. PhD Thesis. Faculty of Agriculture, Mansoura, University, Egypt.

El-Tantawy, I. M., El-Ghamry, A. M. and Habib, A. H. (2009). Impact of farmyard manure and manure compost tea on potato yield and soil fertility. *Journal of Agriculture Science*, 34(1): 669 – 678.

Enujeke, E.C. and Emuh, F.N. (2015). Evaluation of some growth and yield indices of five varieties of tomato (*Solanum lycopersicum* L) in Asaba Area of Delta State, Nigeria. *Global Journal of Bio-Science and Biotechnology*, Vol.4 (1): 21-26.

Frank, K., Beegle, D. and Denning, J., (1998). *Phosphorus*. In: Brown, J.R. (Ed.), *Recommended Chemical Soil Test Procedures for the North.*

Fayed, T. A. (2010). Optimizing yield, fruit quality and nutrient status of Roghiani olive grown in Libya using some organic extracts. *Journal of Horticulture Science and Ornamental Plants*, 2(2): 63-78.

Gee, G.W. and Or, D., (2002). *Particle-size analysis*. In: Dane, J.H., Topp, G.C. (Eds.). Methods of Soil Analysis. Part 4. Physical Methods. Soil Science Society of America, Madison, Wisconsin, USA, 5, 255–293.

Gross, A., Arusi, R. and Nejidat, A. (2007). Assessment of extraction methods with fowl manure for the production of liquid organic fertilizers. *Bioresource Technology*, 99: 327–334.

Ibrahim, M.H., Jaafar, H.Z.E., Karimi, E. and Gbasemzadeh, A. (2000). Impact of organic and inorganic fertilizers application on the phytochemical and antioxidant activity of Kacip Fatimah (*Labisia pumila* Benth). *Molecules,* 18, 10973-10988.

Ingham, E. R. (2005). The Compost Tea Brewing Manual (5th). Soil Food International Inc. In: Kim, J.M., Chang, K. S., Yong, K. K., Sung, J. H., Jong, H.P., Eun, J. H., Jin, H. K. and Suk, C.K. (2015). Effect of Aerated Compost Tea on the Growth Promotion of Lettuce, Soybean, and Sweet Corn in Organic Cultivation. *The Plant Pathology Journal,* 31(3), 259-268.:

Jigme, Jayamangkala, N., Sutigoolabud, P., Inthasan, J. and Sakhonwasee, S. (2015). The effect of organic fertilizers on growth and yield of broccoli (*Brassica oleracea*L. var. *italic* Plenck cv. Top Green). *Journal of Organic Systems*, 10(1), 9 -14.

Msibi, B.M., Mukabwe, W.O., Manyatsi, A.M. Mhazo, N. and Masarirambi, M.T. (2014). Effects of liquid manure on growth and yield of spinach (Beta vulgaris VarCicla) in a Sub-tropical Environment in Swaziland. *Asian Journal of Agricultural Sciences,* 6(2): 40-47.

Muhammad, A. and Singh, A. (2007). Intra-row spacing and pruning effects on fresh tomato yield in Sudan Savanna of Nigeria. *Journal of Plant Sciences,* 2,153-161.DOI: 10.3923/jps. 2007. 153.161 URL: https://scialert.net/abstract/?doi=jps.2007.153.161.

Nelson, D.W., and Sommers, L.E.(1996). T*otal carbon, organic carbon and organic matter*. In: Sparks, D.L. (Ed.), Methods of Soil Analysis, Part 3, 2nd Edn., SSSA Book Series No. 5 ASA and SSSA, Madison WI, USA, pp. 961–1010.

Nithiya, T., Alphonse, J. and Ligoriya, M. (2015). Effect of organic and inorganic fertilizer on growth, phenolic compounds and antioxidant activity of *Solanumnigrum*. L. *World Journal of Pharmacy and Pharmaceutical Sciences*, 4(5), 808 - 822.

Ogundare, S.K, Babalola, T.S, Hinmikaiye, A. S. and Oloniruha, J.A. (2015). Growth and fruit yield of tomato as influenced by combined use of organic and inorganic fertilizer in Kabba, Nigeria. *European Journal of Agriculture and Forestry Research*, 3(3), 48-56.

Okalebo, J. R., Gathua, K. W., Woomer, P. L., (2002). *Laboratory Methods of Soil and Plant Analysis. A Working Manual*. 2nd Edn. TSBF-CIAT, SACRED Africa, KARI, Soil Science Society of East Africa, Nairobi, Kenya, p. 128.

Olaniyi, J. O., Akanbi, W. B., Adejumo, T. A. and Akande, O. G. (2010). Growth, fruit yield and nutritional quality of tomato varieties. *African Journal of Food Science*, 4(6), 398 – 402.

Peiris, P. U. S. and Weerakkody, W.A.P. (2015). Effect of organic based liquid fertilizers on growth performance of leaf lettuce (*Lactuca Sativa* L.). International Conference on Agricultural, Ecological and Medical Sciences. Phuket (Thailand) (AEMS-2015) April 7-8.

Qamar-uz-Zaman, S. S., Ahmad, F. and Hamid, F. S. (2011). Effect of nitrogenous fertilizer on growth and yield of tea (*Camellia sinensis L*)pruned in curved vs. flat shape*. Journal of Agricultural Research.* 49:477-482.

SAS (2012). The Statistical Application Software (SAS) Statistics System for Windows Release Version 9.2. SAS Institute, Inc. Cary, NC, USA.

Sajjan, A.S., Shekhargouda, M. and Badanur, V.P. (2002). Influence of date of sowing, spacing and levels of nitrogen on yield attributes and seed yield in okra. *Karnataka Indian J. Agril. Sci*., 15(2):267-274.

Toluwase, O., Jamiu, I., Azeez, O., Adetunji, M. T. and Oyekanmi, A. A. (2014). Effect of the sequential application of liquid organic manure and phosphorus on maize agronomic traits and P uptake in some tropical soils. *Journal of Plant Nutrition*, 37, 1040–1055.

Ullah, M. Z., Hassan, L., Shahid, S. B. and Patwary, A. K (2015). Variability and inter relationship studies in tomato (*Solanumly copersicum* L.). *Journal of the Bangladesh Agricultural University* 13(1):65-69.

ISSN: 2734-2913
Volume 2, 2019
pp 55-65