Effects Of Nutrient Sources And Variety On The Growth And Yield Of Three Cultivars Of Pepper (*Capsicum Annum* L.) In Southwestern Nigeria

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Abstract: The effect of nutrient sources and variety on the growth and yield of three cultivars of pepper was investigated in a field experiment carried out at the Teaching and Research Farms of Federal University of Technology, Akure. Treatments were 3 x 3 factorial combinations of three cultivars of pepper (Bell pepper, Sweet pepper and Cayenne pepper) and three types of fertilizer (5t ha^{-1} poultry manure, 5t ha^{-1} organominerals and 2lts ha^{-1} liquid NPK 15:15:15 fertilizer). There was a control treatment with no fertilizer application. The treatments were replicated three times. The results showed that varietal effects were significant on some plant characters such as plant height, number of lateral branches, root length, number of days to 50% flowering, number of fruits and weight of fruits per plant. Nutrient sources significantly influenced growth parameters and yield attributes evaluated per plant compared to the unmanured plants. The applied nutrient sources brought about improvement in soil chemical properties; soil pH, total N, available P, organic matter and exchangeable cations were improved. It is evident from the study that pepper variety responded independently to nutrient source. Findings revealed that organominerals could be used for soil management as they improve soil nutrient status and could be used for sustainable pepper production in the study area. Application of organomineral gave the best performances on bell pepper.

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Introduction

Inherently poor soil fertility, depletion of soil nutrients as a result of continuous cropping and crop removal have been reported to reduce soil fertility which limit its yield and productivity. Most of the soils in Nigeria are strongly weathered and dominated by low-activity clay minerals with low nutrient status. Thus, they are adversely affected by sub-optimal soil fertility even as erosion causes deterioration of nutrient status and changes in soil organism's population (Omotayo and Chukwuka, 2009; E. C. A. 2014).

Nigeria soil has a high potential for crop production but yield levels obtained under farmer's conditions are usually low due to poor soil management and conservation method. This type of problem is solved through the use of either organic or inorganic fertilizer. Generally, excessive amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield (Stewart *et al.,* 2005) and maximum value of growth (Dauda *et al*., 2008). However, the use of inorganic fertilizers alone may cause problems for human health and the environment (Arisha *et al* 2003). The use of inorganic fertilizer by resource-poor farmers is limited by its scarcity and cost (Akanbi *et al*., 2001) and untimely availability (Adedoyin, 1995). Also, cultivation with persistent application of inorganic fertilizers increases soil acidity and soil physical degradation which may reduce crop yield (Ojeniyi *et al*., 2007).

Organic manure can serve as alternative practice to inorganic fertilizers (Naeem *et al*., 2006) for improving soil structure (Dauda *et al*., 2008) and microbial biomass (Suresh *et al*., 2004). Organic manure serves as a store house for plant nutrient acting as a major contributor to cation exchange capacity and as a buffering agent against undesirable pH fluctuation (Ngeze, 1998). Sole application of organic nutrient sources may not be able to maintain and synchronize the required supply of nutrients to the growing plants for optimum crop production, because of relatively less quantity of plant-available nutrients and more time needed for mineralization to release nutrients for effective plant uptake (Malhi *et al* 2013).

Nigeria is the largest producer of pepper (*Capsicum* spp) in Africa, accounting for about 50% of African production (Adamu, *et al* 1994) and Nigeria produced 695,000 metric tons from total area of 77,000ha (FAO, 2008). Although pepper is largely grown in many parts of Nigeria, but the bulk of its production is found in the drier Savanna zone and derived Savanna areas of the Northern Nigeria (Erinle, 1989).

Pepper is the world second most important vegetable- crop after tomato (AVRD, 1989). Consumption of pepper accounts for about 20% of the average vegetable consumption per person per day in Nigeria (Alegbejo 2002), making it an indispensable part of the daily diet of millions of Nigerians owing to its increase in popularity and demand (Adesina *et al* 2014). It is used extensively in food flavouring in the daily diet of over 1.2 million Nigerian irrespective of their socio-economic status. It is used as spice in the preparation of soup and stew (Benson *et al* 2014), used as a condiment and extensively in flavouring of processed meat, colouring certain food preparation (Alabi, 2006). It was also discovered to be a good source of medicinal preparation for black vomit, tome for gout and paralysis (Knott and Deanon, 1967).

Pepper being a heavy feeder of NPK and the need to increase production as indicated by the ever increasing demand for pepper throughout the year, which has been hampered as result of inherent low soil fertility due to continuous cropping and demand for land use, the study therefore is to evaluate the growth and yield of pepper and soil chemical properties as influenced by nutrient sources and pepper varieties.

Materials and methods

Experimental site and soil analysis

A field experiment was conducted at the Teaching and Research Farms, Federal University of Technology, Akure, Ondo State, Nigeria located at geographical coordinates of 5° 15' N and 5° 12' E. Optimum rainfall ranged from 1100mm – 1300m per annum, temperature 22°C - 30°C and relative humidity is 80% which are considered adequate for pepper production. The site was under fallow for 18 months after cassava had been harvested, the site was covered with *Eurphobia* spp. and *Aspillia* spp.

Prior to planting and at crop maturity, six core samples were collected at 15-cm depth of the soil to have a composite sample that was mixed, air–dried and crushed to pass through a 2-mm sieve and analyzed for its texture and chemical properties. Soil pH in water was determined in a 1:2.5 (w/v) soil:water suspension (Ibitoye, 2006). Organic C was determined by chromic acid digestion and spectrophotometric analysis (Heanes, 1984). Total N was determined from a wet acid digest (Buondonno *et al* 1995) and analyzed by colorimetric analysis (Anderson and Ingram, 1993). Exchangeable Ca, Mg, K and Na were extracted using the Mehlich procedure and determined by atomic absorption spectrophotometry. Available P was extracted by the Bray-1 procedure and analyzed using the molybdate blue procedure described by Murphy and Riley (1962). Soil particle analysis was determined by Bouyoucos hydrometer method using Sodium hexametaphosphate as the dispersing agent (Gee and Bauder, 1986).

The result of the analysis is presented in Table 1. The soil used for the experiment was slightly acidic at pH 5.50. The organic matter content of the soil was low at 1.53g/kg. The total N content and the available P and the exchangeable K contents were also low. It had 0.62% N; 3.85mg/kg P and 0.36 cmol/kg K. The soil texture was sandy loam which inferred that the experimental soil was of good drainage and aid good plant root penetration (Eleduma and Sanni, 2015). The sandy loam texture of the soil would also encourage rapid leaching of cations into the subsoil from the surface soil (Amhakhian et al 2010). The fertility status of the soil revealed low major nutrient elements below critical level required for sustainable crop production. This implies that cropping the soil without fertilizer use will not be economical.

Land preparation, Crop Management and fertilizer application

The experimental site was ploughed, harrowed and prepared into slightly raised seedbeds of 3 x 2m dimension separated by 1m discard, preparatory to transplanting of the pepper seedlings. The seedbeds were fortified by high ridges to keep applied nutrients from being washed into other plots. The total area used was 481m^2.

Seeds of pepper were sourced from Ondo State Agricultural Development Project, Akure and were raised in nursery, for six weeks before being transplanted onto experimental plots. In the nursery, the seedlings were shaded against direct impact of solar radiation. The nursery were kept weed free and watered every other day. Prior to seedling transplant into the field, the soil was heavily watered to enhance easy seedling removal. Vigorous seedlings were then transplanted onto the experimental plot at 6 weeks old and spaced 50 cm x 70 cm.

2lts ha^{-1} NPK 15:15:15 liquid fertilizer, 5t ha^{-1} organomineral and 5t ha^{-1} poultry manure were the nutrient sources applied as the treatment. For plots that were to receive poultry manure (PM), the nutrient sources were incorporated a week to seedling transplant, while for those plots to be amended with organomineral and NPK 15:15:15 liquid fertilizer, were applied 2 weeks after seedling transplant using ring method and foliar application method respectively.

Weed control was done manually at 3, 6 and 9 weeks after transplanting to avoid competition with the pepper seedlings. Dithane M45 at 10g/5lts and Lamdacyahalothrin at 50ml/15lts were applied at vegetative stage to control fungal infection and insect pest infestation (IAR&T, 2000).

Experimental design, Data collection and Statistical Analysis

The design of the experiment was 3 × 3 factorial arrangement fitted into randomized complete block design with three replications. Treatments were combination of 3 cultivars of pepper (Bell pepper, Sweet pepper and Cayenne pepper) and 3 types of nutrient sources (5t ha^{-1} Poultry manure (PM), 5t ha^{-1} organomineral and 2lts ha^{-1} NPK 15:15:15 liquid fertilizer). There was also control in which no fertilizer or manure was applied.

Data on plant height, root length, number of branches and number of leaves were determined per plot as means of five randomly sampled plants within the middle row. Other parameters taken include number of days to 50% flowering, biomass, number of fruits and fruit weight. The growth and yield parameters collected were subjected to analysis of variance (ANOVA) using GLM procedure in SAS (2004). Treatment means found to be significantly different from each other, were separated by Duncan Multiple Range Test (DMRT) at $p < 0.05$ (Gomez and Gomez 1984).

Results and discussion

Table 1: Experimental site properties before planting

Properties	value	Rate
pH (H_2O)	5.50	Strongly acidic
Organic carbon (g/kg^{-1})	1.53	Very low
Organic matter (g/kg^{-1})	2.64	Low
Total N(g/kg^{-1})	0.62	Low
Available P (mg/kg^{-1})	3.85	Low
Exchangeable bases		
Na^{2+} ($cmol/kg^{-1}$)	0.38	Very low
K^{+} ($cmol/kg^{-1}$)	0.36	Moderate
Ca^{2+} ($cmol/kg^{-1}$)	4.3	Low
Mg^{2+} ($cmol/kg^{-1}$)	1.7	
Particle size		
Sand (%)	76.40	
Clay (%)	16.50	
Silt (%)	6.10	
Textural classification	sandy loam	

Experimental soil analysis

Pre-cropping soil properties are shown in Table 1. Analysis of the texture and chemical properties of the soil showed that the soil was strongly acidic, sand loamy in texture and seemingly low in fertility based on the rating of FMANR, (1996) as reflected by low organic carbon, organic matter, total N, available P and exchangeable bases. Consequently, optimum crop growth and yield cannot be achieved without supplementary nutrients through soil amendment in form of organic manures and/or inorganic fertilizer (Sanni, 2014).

The low fertility status of the soil is a true reflection of most ultisols of humid environment that are strongly weathered of low activity clay mineralogy and high acidity due to intense precipitation with its associated erosion and leaching in the environment (Enujeke, 2013). The slightly acidic nature of the soil could be adduced to the coarse nature of the soil which should have enhanced leaching of exchangeable bases and to the continuous cropping history of the site (Ayeni and Adetunji, 2010).

Effects of nutrient sources and varietal on the growth parameters

Number of leaves

The response of number of leaves/plant of pepper to nutrient sources and variety is shown in Tables 3 and 4. Nutrient sources significantly ($P<0.05$) influenced number of leaves compared to control plot. Plants that received 5 t ha^{-1} of organomineral and NPK liquid fertilizer were outstanding in number of leaves/plant with mean value of 249.11 and 249.78 respectively, while plants grown without fertilization had the lowest number of leaves/plant with mean value of 112.98 (Table 4). Pepper varieties do not significantly ($P>0.05$) affect the number of leaves produced by the plant (Table 3). Law-Ogbomo and Remison (2008) reported that uptakes and utilization of applied fertilizers significantly enhanced number of plant leaves. The enhancement in the number of leaves by fertilizer application was a precursor to greater amount of assimilate and thus allowing more translocation to the berry. Changes in number of leaves are bound to affect the overall performance of the plant as the leaves serves as the photosynthetic organ of the plant. Increase in number of leaves leads to better utilization of solar radiation (Law-Ogbomo and Remison, 2008).

Plant height

Plants' heights as influenced by nutrient sources and pepper variety are presented in Tables 3 and 4. Pepper grown without manure or fertilizer application had the shortest height with mean value of 35.0cm. Application of 5 t ha^{-1} organomineral resulted in substantial increase in plant height (55.44cm) giving the tallest plant, followed by PM (51.56cm). The superiority in plant height of pepper based on nutrient sources was organomneral>NPK>poultry manure>control (Table 4). Statistically, there exists significant difference ($P<0.05$) between pepper grown with fertilizer compared to control. This might be due to the availability of N required for plant growth and development. Pepper variety significantly ($P<0.05$) influenced plant height; with Bell pepper being the tallest (51.40cm), followed by Cayenne pepper (46.80cm) and Sweet pepper being the shortest with the mean value of 42.20cm (Table 3). Increase in plant height with fertilizer application treatment resulted in retention of appreciable amount of assimilates in the stem for node and leaf production. The height of plant is an important growth character directly linked with the productive potential of the plant. Saeed *et al* (2001) opined that plant height is positively connected with productivity of plant such as increased number of branches. This accounted for higher number of leaves in the treated plants. More plant height due to better usage of sunlight in competing with weeds have positive effect on fruit yield and total dry matter (Duman, 2006).

Number of branches

Results obtained from the study showed that Cayanne pepper recorded the highest number of branches (22.90) and was significantly different from all other varieties (Table 3). Nutrient sources had similar value of branches while organomineral, NPK and poultry manure were statistically the same and different from pepper that do not received fertilizer application (Table 4). Number of branches of pepper is significantly affected by manuring. Pepper growing on amended soil performed better than the plant on the control plots. This shows that fertilizers applied to the soil were readily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant. This support the findings of Law-Ogbomo and Egharevba, (2010) who reported that number of branches associated with various soil amendments were at par and significantly different from control.

Root length

Root length development was not significantly ($P<0.05$) influenced by pepper variety, while nutrient sources significantly affect root length development (Table 3). Result presented in Table 4 showed that, pepper that received 5 t ha^{-1} organomineral recorded the longest root (32.22cm) followed by NPK liquid fertilizer (30.89cm) and pepper with no fertilizer recorded the shortest root length (16.89cm). The Nitrogen and Phosphorus fortification due to nutrient sources may have resulted in a corresponding greater Nitrogen and phosphorus release for probable plant uptake through enhanced microbial mineralization of organic nutrients and consequently more massive rooting. Organomineral and poultry manure can increase soil porosity which led to lower soil bulk density that permits better root growth. Good root system enhances above ground growth and development that finally causes higher yield production and higher dry weight (Salehabadi *et al*., 2014).

Effects of nutrient sources and varietal on pepper yield attributes

Days to Flowering

There was significant difference ($p<0.05$) between the varieties and nutrient sources with respect to the number of days to flowering (Tables 3 and 4). Table 3 showed that Bell pepper and Cayenne pepper were the earliest to flower (74.4 and 74.5 DAT) with sweet pepper flowering last (85 DAT). On the other hand, data presented in Table 4 showed that pepper with no fertilizer application flower late (81.33 DAT), while Pepper planted on Organomineral fertilized plot flowered early at 73.33 DAT closely followed by pepper planted on plot amended with NPK (78.33 DAT) and poultry manure (78.89 DAT). This implies that fertilizer application provide added advantage with respect to days to flowering. The early flowering of pepper to different sources of nutrient might be due to acceleration of the vegetative phase through the simulative effect of the absorbed nutrients on photosynthesis process which certainly reflected positively on both vegetative and flowering initiation (Kawthar *et al* 2010). The longest day to flowering in the control is as a result of insufficient P and K. Jilani *et al*., (2009) reported that a deficiency of major nutrients results in longer days to flowering. Ehaliotis *et al* (2005) had reported that Fe, Zn and Mn encourages vegetative growth, total chlorophyll and the photosynthetic rate of plants which enhance flowering and fruiting thus leading to an increase early fruit maturity.

Number of fruits and fruits weight

Pepper varieties responded positively to nutrient sources for number of harvested fruits and weight of fruits (Table 3). Bell pepper produced 51.80 fruits being the highest, followed by Sweet pepper which recorded 38.30 and Cayenne pepper produced the lowest number of fruits (22.50). Similar trend was observed with the fruit weight where Bell pepper recorded the maximum weight (479.70g) and pepper fruits produced by Sweet pepper had the lowest weight (213.10g). There was no significant difference in weight of fruits harvested from Cayenne pepper and Sweet pepper, but there existed significant difference when compared with fruit weight obtained from Bell pepper (Table 3). Number of fruits produced from pepper grown with manure/fertilizer in order of superiority was 5 t h^{a-1} organomineral > 5 t h^{a-1} poultry manure > NPK > control. Pepper that received 5 t h^{a-1} organomineral recorded the heaviest fruit weight (438.89g), NPK (357.56g), 5 t h^{a-1} poultry manure (306.11g) and pepper grown on plots that did not receive fertilizer application had the lowest pepper fruits weight (137.33g). Statistically, pepper that received fertilizer application recorded significantly different fruit weight compared to those that did not receive fertilizer application (Table 4). The influence of nutrient sources on pepper fruit weight might be due to the effect of N in increasing water content of vegetables. The increase in number of fruits and average weight could be attributed to the ability of nutrient sources to promote vigorous growth, increase meristematic and physiological activities in the plants due to supply of plant nutrients and improvement in the soil properties, thereby, resulting in the synthesis of more photo-assimilates, which is used in producing fruits. (Dauda *et al* 2008).

The results obtained from the study revealed that number of fruits per pepper variety was not significantly affected by the nutrient sources. This may be attributed to the reason that fruit bearing potential of a variety is controlled by its genetic makeup rather than the agronomic practices. Akinfosoye *et al.* (1997) reported that differential in yields of crops could be attributed to the choice of cultivar grown and its specific genetic make-up. Similarly, Adetiloye and Salau (2002) who worked on Soybean found that variation among Soybean varieties is due to differences in their genetic make-up. The non-significant effects of nutrient sources on number of fruits per plant recorded in this study confirmed the findings of Maqsood *et al.,* (2001).

Increased plant yield as observed with nutrient sources compared to pepper that did not receive fertilizer may also be due to increased soil aggregate stability which might have favored the beneficial microbes which in turn could have contributed to improve biomass production (Basso and Ritchie, 2005; Bwenya and Terokun, 2001). The significant effect due to organomineral application could be attributed to easy dissolution effect of released plant nutrient leading to improved nutrient status of the soil for crop uptake.

Effect of Nutrient sources on post cropping soil chemical properties

The initial pH of the experimental plot which was sandy loam was strongly acidic (5.50), low in organic carbon, available phosphorus, total nitrogen and exchangeable cations below critical level (Table 1). Under such conditions, the availability of the base forming cations is limited since the soil solution is mostly occupied by aluminium and hydrogen ions. It should therefore be expected that the fertility status of the soil would benefit from fertilizer application since manure is known to improve soil organic matter, as well as macro and micro-nutrient status of the soil (Adeniyan and Ojeniyi, 2003).

Table 2 shows the soil chemical properties at crop maturity after fertilization. The soil pH increased ranging from moderately acidic to slightly alkaline (5.67 – 8.11). The increment of soil pH with additions of nutrient sources could be attributed to the reduction of exchangeable aluminium in the acidic soils. This reduction is considered to occur through aluminium precipitation or chelation of organic colloids (Hue, 1992). Increased pH with organomineral and poultry manure additions could also be attributed to increased levels of exchangeable bases (K, Mg and Ca). Increasing the pH of acidic soils improves plant-availability of macro- nutrients while reducing the solubility of elements such as Al and Mn (Mucheru et al 2007; O'Hallorans et al 1997). The magnitude of the rise in soil pH varies depending on the type of manure, its rate of application and the buffering capacity of the soil (Haynes and Mokolobate 2001). However, pepper is tolerant to slightly acidic condition but a pH of 5.5-6.8 is preferable (Wang et al 2005). The application of organic and inorganic fertilisers marginally increased the organic carbon, total N and available P values. The increments were not significantly enough to improve the rating from low to moderate or medium nutrient status. The low values of total N and P could be as a result of crop uptake, immobilisation by microorganisms and nitrogen loss through volatilisation (Defoer *et al,* 2000). In spite of soil amendment, potassium level at crop maturity ranges from 0.32 – 1.76 cmol/kg and still remains at moderate level. Sodium level in the soil due to fertilizer application increased from 0.38 cmol/kg recorded at the commencement of the experiment to 0.40 -1.46 cmol/kg. Pepper variety affect the values of calcium and magnesium present in the soil. Sweet and Cayenne pepper varieties that received organomineral resulted in the decline of calcium and magnesium levels, while pepper varieties that received poultry manure and NPK improve the calcium and magnesium contents of the soil. The positive improvement of the experimental soil chemical properties is due to the fact that poultry manure and organomineral acted as a store houses for plant nutrients; also as major contributors to cation exchange capacity and as buffering agents against undesirable pH fluctuation (Ngeze, 1998).

Interaction effect of nutrient sources and variety on the growth and yield of pepper

The interaction effect of pepper varieties and nutrient sources on all the parameters accessed was significant except for pepper that did not receive fertilizer application (Table 5). The poor performances recorded from plants that did not received fertilizer application is due to the low nutrient status of the experimental site; the plants had to rely solely on the inherent soil nutrients which is low due to continuous farming on the land hence its nutrients might have been depleted. The poor result obtained from the control was an indication that no significant production could be made without fertilizer application. The positive influence of nutrient sources on the growth of the crop might be due to the release of the balanced nutrient contained in the materials. The improved growth parameters due to nutrient sources could be related to the release of mineral elements such as N, P, K and exchangeable cations (Ca, Mg and Na) to the soil by the different fertilizers used which established and maintained optimum soil physical condition for plant growth. The variation in growth parameters due to nutrient sources was considered to be due to variation in the availability of major nutrients (Sanni *et al* 2015).

The best growth and yield performances were observed from pepper that received organomineral compared to NPK and poultry manure. This may be attributed to increased and timely released and availability of nutrient elements. With the results from the study we opined that emphasis should be placed on the use of organomineral as plant nutrient sources for sustainable pepper cultivation and agent of soil management to improve soil nutrient status in the study area, as this will bridge the gap between non-availability and high cost of inorganic fertilizers and the problems associated with the use of organic manure.

Table 2: Soil chemical properties at crop maturity

Treatments	pH (H_2O)	OC (g/kg)	OM (g/kg)	N (g/kg)	P (mg/kg)	Na (cmol/kg)	K (cmol/kg)	Ca (cmol/kg)	Mg (cmol/kg)
OM/Sweet Pepper	5.99	1.49	2.58	0.72	5.07	0.42	0.50	3.90	1.60
OM/Cayenne pepper	5.77	1.40	2.41	0.70	5.28	0.40	0.33	3.20	1.10
OM/Bell pepper	6.18	1.30	2.64	0.66	5.54	0.40	0.35	4.60	1.90
PM/Sweet Pepper	5.37	0.79	1.35	0.69	2.67	0.47	0.42	5.10	2.30
PM/Cayenne pepper	5.54	1.40	2.41	0.72	3.15	0.49	0.44	3.80	1.70
PM/Bell pepper	6.15	1.72	2.97	0.76	6.19	0.43	0.43	4.60	1.60
NPK/Sweet Pepper	8.11	2.28	3.98	1.10	9.20	1.36	1.50	6.90	2.4
NPK/Cayenne pepper	5.67	2.24	3.86	0.80	2.23	0.45	0.48	4.20	2.0
NPKl/Bell pepper	6.13	1.72	2.97	0.78	3.15	0.48	0.44	5.10	2.2
Control/Sweet Pepper	7.58	2.20	3.96	1.28	16.12	1.46	1.76	7.8	3.0
Control/C. pepper	6.57	1.60	2.74	0.70	8.62	0.41	0.41	4.60	1.80
Control/Bell pepper	6.41	1.26	2.18	0.68	3.82	0.41	0.32	4.60	2.0

Table 3: effects of variety on the growth and yield of pepper

flowering Varieties	Plant height (cm)	Root length (cm)	No of lateral branches	No of leaves (g)	a	Biomass 50%	Days to fruits	no of fruits (g)	weight of
Bell pepper	51.4a	27.7a	14.0b	193.7a	10.7a	74.4b	51.8a	479.7a	
Cayenne pepper	46.8ab	27.7a	22.9a	204.1a	10.6a	74.5b	22.5c	237.2b	
Sweet pepper	42.2b	27.6a	18.6ab	189.5a	11.2a	85.0a	38.3b	213.1b	

Mean followed by the same letter in each column for each parameter are not significantly different from each other by Duncan's Multiple Range Test (DMRT) at 5% level of probability.

Table 4: Effects of different nutrient sources on the growth and yield of varieties of pepper

flowering Treatments	Plant height (cm)	Root length (cm)	No of lateral branches	No of leaves (g)	Biomass 50%	Days to fruits	no of fruits (g)	weight of
Organo Minerals 5t ha^{-1}	55.44a	32.22a	21.56a	249.11a	13.85a	81.33c	47.00a	438.89a
NPK 15:15:15 2 lts ha^{-1}	51.56ab	30.89b	24.67a	249.78a	11.84ab	78.33a	37.33a	357.56ab
Poultry manure 5t ha^{-1}	45.11b	27.22c	18.33a	171.22b	10.70b	78.89b	45.22a	306.11b
Control (No fertilizer)	35.00c	16.89d	9.44b	112.89c	6.91c	73.33d	20.67b	137.33c

Mean followed by the same letter in each column for each parameter are not significantly different from each other by Duncan's Multiple Range Test (DMRT) at 5% level of probability.

Table 5: Interaction effects of different nutrient sources and variety on the growth and yield of varieties of pepper

flowering Treatments	Plant height (cm)	Root length (cm)	No of lateral branches	No of leaves (g)	Biomass 50%	Days to fruits	no of fruits (g)	weight of
Bell pepper/OM	60.3a	35.0a	18.0bcd	228.0a	13.7ab	75.0f	67.3a	720.a
Bell pepper/NPK	57.3ab	30.7bcd	17.3bcd	228.78a	10.8abcd	78.0e	46.3bc	512.0b
Bell pepper/PM	47.3abc	27.0de	12.0bcd	197.7ab	12.5abc	74.7f	67.3a	500.0b
Bell pepper/Control	40.7cde	18.0f	8.7d	120.3bc	5.7e	70.0g	26.3de	186.7cd
Cayenne pepper/OM	54,0abc	36.0a	23.3b	266.0a	13.3ab	75.0f	21.0e	296.7cd
Cayenne pepper/NPK	52.7abc	33.0abc	35.0a	263.67a	12.46abc	78.0e	23.3de	333.3c
Cayenne pepper/PM	44.7bcd	25.0e	23.7b	180.0abc	9.5bcde	75.0f	28.0cde	205.0cd
Cayenne pepper/control	35.7de	15.7f	9.7d	106.7c	7.3de	70.0g	17.7e	113.7d
Sweet pepper/OM	52.0abc	34.7ab	23.3b	253.3a	14.7a	85.0c	52.7ab	300.0cd
Sweet pepper/NPK	44.7bcd	29.0cde	21.7bc	257.0a	12.3abc	8.0a	42.3bcd	227.3cd
Sweet pepper/PM	43.3cd	29.7	19.3bcd	136.0bc	10.1bcde	87.0b	40.3bcd	213.3cd
Sweet pepper/control	28.7e	17.0f	10.0d	111.7c	8.0cde	80.0d	18.0e	111.7d

Mean followed by the same letter in each column for each parameter are not significantly different from each other by Duncan's Multiple Range Test (DMRT) at 5% level of probability.

References

1. Adamu SU, Ado SG, Eruofor PG, Olarenwaju JD. Variations in the fruit of pepper. Nigerian Journal of Horticultural Science 1994; 2:10-14.
2. Adedoyin SF. An assessment of the linkage in the delivery of technologies on rehabilitation and management of soil: A paper presented at 3rd All African Soil Science Conference, University of Ibadan 1995; 19-26.
3. Adeniyan ON, Ojeniyi SO. Comparative effectiveness of different levels of poultry manure with NPK fertilizer on residual soil fertility, nutrient uptake and yield of maize. Moor Journal of Agricultural Research, 2003; 191-197.
4. Adesina JM, Sanni KO, Afolabi LA Eleduma AF. Effect of Variable Rate of Poultry Manure on the Growth and Yield of Pepper (*Capsicum annum*) in South Western Nigeria. Academic Arena 2014; 6 (1):9-13.
5. Adetoliye PO, Salau AW. Response of Soya bean cultivars to inoculation with Rhizobium in South-Western Nigeria. Tropical Oil Seed Journal 2002; 7: 1-10.
6. Akanbi NB, Adediran JA, Togun AO, Sobulo RA. Effect of organic based fertilizer on the growth, yield and storage of tomato. Bioscience. Resource Communication 2001; 20(5):10-16.
7. Akinfosoye JA, Olufolaji AO Tairu FM, Adewoola RA. Effect of different phosphorus levels on the yield of four cultivars of rain fed tomato (*Lycoperiscon esculentum* Mill.) Proceedings of the 15th Annual Conference of Horticultural Society of Nigeria, 1997; pp 65-66.
8. Alabi DA. Effects of fertilizer phosphorus and poultry droppings treatments on growth and nutrient components of pepper (*Capsicum annuum* L). African Journal of Biotechnology 2006; 5(8): 671-677.
9. Alabi DA. Effects of fertilizer phosphorus and poultry droppings treatments on growth and nutrient components of pepper (*Capsicum annuum* L). African Journal of Biotechnology 2006; 5 (8): 671-677.
10. Alegbejo MD. Evaluation of pepper cultivars for resistance to pepper veinal mottle poly-virus in northern Nigeria. Journal of Arid Agriculture 2002; 12:93–103.
11. Amhakhian SO, Oyewole CI Isitekhale HH. Effects of different levels of Phosphorus on the growth and yield of maize *(Zea mays L.*) in Ofere (Basement complex) soils Kogi State, North Central ecological zone, Nigeria. Continental Journal of Agricultural Science 2010; 4:20-28.
12. Anderson JM, Ingram JSI. Tropical soil biology and fertility: A handbook of methods, Second ed., CAB Int., Wallingford, Oxfordshire, UK, 1993: 221 p.
13. Arisha HME, Gad AA, Younes SE. Response of some pepper cultivars to organic and mineral nitrogen fertilizer under sandy soil conditions. Zagazig Journal Agricultural Research 2003; 30 1875–99.
14. AVRDC. Tomato and Pepper production in the tropics. Asian Vegetable Research Development Council, Taiwan 1989; P. 585.
15. Ayeni LS, Adetunji MT. Integrated Application of Poultry Manure and Mineral Fertilizer on Soil Chemical Properties, Nutrient Uptake, Yield and growth components of maize. Nature and Science 2010; 8(1):60-67.

16. Basso B, Ritchie JT. Impact of compost manure and inorganic fertilizer on nitrate leaching and yield for a 6 year maize alfalfa rotation in Michigan, Agriculture, Ecosystems and Environment 2005; 108: 309-341.
17. Benson GAS, Obadofin AA, Adesina JM. Evaluation of plant extracts for controlling insect pests of pepper (*caspicum* spp.) in Nigeria humid rainforest. New York Science Journal 2014; 7(1):39-43.
18. Bouyocus CJ. Hydrometer method improved for making particles size analysis of Soil Science Society Proceedings 1981; 26: 446-465.
19. Buondonno A, Rashad AA, Coppola E. Comparing tests for soil fertility. II. The hydrogen peroxide/sulfuric acid treatment as an alternative to the copper/selenium catalyzed digestion process for routine determination of soil nitrogen-Kjeldahl, Communication of Soil Science and Plant Analysis 1995; 26: 1607–1619.
20. Bwenya S Terokun OA. Effect of *Cassia spectabilis*, cow dung and their combination on growth and grain yield of maize, Seventh Eastern and Southern Africa Regional Maize Conference, Nairobi, Kenya 2001; 361-406.
21. Dauda SN, Ajayi FA Ndor E. 2008. Growth and yield of water melon (*Citrullus lanatus*) as affected by poultry manure application. Journal of Agriculture and Social Science 2008 4: 121–124.
22. Defoer T, Budelman A, Toulimin C, Carter SE. Managing soil fertility in the tropics. FAO and Kit press, Amsterdam 2000; 47– 63.
23. Duman I. Effects of seed priming with PEG and K3Po4 on germination and seedling growth in Lettuce. Pakistan Journal of Biological Science 2006; 9:923-928.
24. Economic Commission of Africa (E. C. A.). State of the Environment in Africa. Economic Commission of Africa, P.O.Box 3001, Addis Ababa, Ethiopia, ECA/FSSDD/01/06, 2001. http://www.uneca.org/water/State_Environ_Afri.pdf Date assessed 20th September, 2014.
25. Ehaliotis C, Zervakia GI, Karavitis P. Residues and by-products of Olive oil mills for root-zone heating and plant nutrition in organic vegetable production. Science Horticulture 2005; 106:293-308.
26. Eleduma AF, Sanni KO. Effects of Different Rates of Pig Manure on The Growth and Yield of Cucumber (*Cucumis sativus* L.) In South Western Nigeria. Academic Arena 2015; 7(3):9-13.
27. Enujeke EC. Growth and yield responses of cucumber to five different rates of poultry manure in Asaba area of Delta state, Nigeria. International Research Journal of Agricultural Science and Soil Science, 2013; 3(11): 369-375.
28. Erinle JO, Present status and prospects for increased production of tomato and pepper in Northern Nigeria. In: Tomato and pepper in the tropics AVRDC Shauhua Taiwan, 1989: 545.
29. FAO 2008. Food and Agriculture Organization of the United Nations. Tomato Production statistic 2008 www.faostat.fao.org. Accessed on 21/09/2015.
30. FMANR Federal Ministry of Agricultural and Natural Resources, Soil fertility investigation (In 5 volumes); Fertility ratings. Produced by the Federal Ministryof Agriculture, Lagos, Nigeria 1996.
31. Gee GW, Bauder JW. Particle size analysis p. 404-407. In A Klute (ed) Methods of soil analysis. Part 1 (2nd ed.) Agronomy Monograph 9. ASA and SSSA. Madison W.I. USA 1986.
32. Gomez AK, Gomez AA. Statistical Procedures for Agricultural Research 2nd ed. John Willy and Sons 1984.
33. Haynes RJ, Mokolobate Ms. Amelioration of aluminum toxicity and P deficiency in acid soils by addition of organic residue. A critical review of the phenomenon and the mechanism involved. Nutrient Cycling in Agroecosystems 2001; 59: 47-63.
34. Heanes DL. Determination of organic C in soils by an improved chromic acid digestion and spectrophotometric procedure, Communication in Soil Science and Plant Analysis 1984; 15:1191–1213.
35. Hue NV. Correcting soil acidity of a highly weathered ultisol with chicken manure and sewage sludge. Communications in Soil Science and Plant Analysis 1992; 23:241-264.
36. IAR&T Institute of Agricultural Research and Training package Recommendation for food crops production in south western Nigeria 2000: 58pp.
37. Ibitoye AA. Laboratory Manual on Basic Soil Analysis. 2nd ed. 82 pp. Foladave Publishing Company, Akure, Ondo State, Nigeria 2006.
38. Jilani MS, Bakar A, Waseem K. Kiram, M. Effect of different levels of NPK on the growth and yield of cucumber (*Cucumis sativus*) under the plastic tunnel. Journal of Agriculture and Social Science 2009; 5: 99-101.
39. Knott JE, Deanon JR. Eggplant, Tomato and Pepper. Vegetable production in Southeast Asia, Laguna, Philippines. Univ. of Philip. Press. 1967; 99-109.
40. Kwathar AE, Rabie HH, Manaf H, Hasnaa AH, Gouda I Shahat IM. Influence of Compost and

Rock Amendments on Growth and Active Ingredients of Safflower (*Carthamus tinctorius* L.). Australian Journal of Basic and Applied Science 2010; 4(7): 1626-1631.
41. Law-Ogbomo KE, Remison SU. Growth and yield of white guinea yam (*Dioscorea rotundata* Poir.) influenced by NPK fertilization on a forest site in Nigeria Journal of Tropical Agriculture 2008; 46(1-2): 9-12.
42. Law-Ogbomo KE, and Egharevba RKA. Nutrient uptake and productivity of sweet pepper (*Capsicum annum*) as influenced by soil amendments on an ultisol environment. Proceedings for the 28th Annual conference of Horticultural Society of Nigeria 2010:17-22.
43. Malhi SS, Vera CL, Brandt SA. Relative effectiveness of organic and inorganic nutrient sources in improving yield, seed quality and nutrient uptake of canola. Agricultural Sciences 2013; 4 (12): 1-18.
44. Maqsood M Abid AM, Iqbal A and Hussain MI. Effect of variable rate of nitrogen and phosphorus on growth and yield of maize (golden). Online Journal of Biological Science 2001; 1: 19-20.
45. Mucheru M, Mugendi DN, Kung'u JB, Mugwe J Bationo A. Effects of organic and mineral fertilizer inputs on maize yield and soil chemical proper-ties in a maize cropping system in Meru South District, Kenya. Agroforestry Systems 2007; 69: 189-197. doi:10.1007/s10457-006-9027-4.
46. Murphy J Riley JP. A modified single solution method for determination of phosphate in natural waters, Analytical Chemistry Acta 1962; 27: 31–36.
47. Naeem M Iqbal J, Bakhsh, MAA. Comparative Study of Inorganic Fertilizers and Organic Manures on Yield and Yield Components of Mungbean (*Vigna radiat* L.). Journal of Agriculture and Social Science 2006; 2: 227–9.
48. Ngeze PB, Artificial fertilizers and how to use them. Stantex publishers, Nairobi, Kenya 1998; 55.
49. O'Hallorans J, Muñoz MA, and Marquez PE. Chicken manure as an amendment to correct soil acidity and fertility. Journal of Agriculture of the University of Puerto Rico 1997; 81:1-8.
50. Ojeniyi SO, Awodun MA Odedina SA. Effect of Animal Manure Amended Spent Grain and Cocoa Husk on Nutrient Status, Growth and Yield of Tomato. Middle-East Journal of Scientific Research, 2007; 2 (1): 33-36.
51. Omotayo OE, Chukwuka KS, Soil fertility restoration techniques in sub-Saharan Africa using organic resources. African Journal of Agricultural Research 2009; 4 (3): 144-150.
52. Saeed IN, Abbasi K and Kazim M. response of maize (*Zea mays* L.) to nitrogen and phosphorus fertilization under agro-climatic condition of Rawalokot Azad Jammu and Kashmir. Pakistan Journal of Biological Sciences 2001; 4: 53-55.
53. Salehabadi G, Azimzadeh SM Tatary M. Effect of organic fertilizers on cucumber (*Cucumis sativus*) yield. International Journal of Agriculture and Crop Sciences 2014; 7 (11): 808-814.
54. Sanni KO, Ewulo BS, Godonu KG Animashaun MO. Effects of Nutrient Sources on the Growth and Yield of Cucumber (*Cucumis Sativus*) and on Soil Properties in Ikorodu Agro-Ecological Zone. Report and Opinion 2015; 7(4):24-32.
55. Stewart MW, Dibb WD, Johnston EA and Smyth JT. The Contribution of Commercial Fertilizer Nutrients to Food Production. Agronomy Journal 2005; 97: 1–6.
56. Suresh KD, Sneh G, Krishn KK, and Mool CM. Microbial biomass carbon and microbial activities of soils receiving chemical fertilizers and organic amendments. Archives Agronomy Soil Science 2004; 0: 641–7.
57. Wang JF, Green SK Moris R. International cooperator guide. Asian Vegetable Research and Developmennt Centre. AVRD publication 05 620 2005.

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