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Performance of Cucumber (*Cucumis sativus* L.) on Ferruginous Soil Amended with Poultry Manure and NPK 15:15:15 Fertilizer

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Abstract
Low fruit quality and yield in cucumber is linked directly to continuous cropping under poor soil fertility management practices in Nigeria. In 2014 and 2015 planting seasons, field trials were conducted at the National Horticultural Research Institute (NIHORT), Ibadan to determine effects of poultry manure and NPK 15:15:15 fertilizer on growth, nutrient uptake and yield of cucumber on Ferruginous soil. Ten treatment combinations comprising two cucumber varieties and five levels of soil amendments were laid out in randomized complete block design with three replicates. The field was re-established for residual trial. Vegetative parameters were higher in Marketer but not significantly different from Poinsett in plots supplied 5 t/ha poultry manure + 60 kg/ha NPK 15:15:15 . Poinsett produced higher fruit yield (163.60 g/plant) and dry matter (71.90 g/plant) than Maketer. Nutrient uptake was highest in Marketer plots that received 5 t/ha poultry manure + 60 kg/ha NPK. Residual study showed that the two cucumber varieties performed better in plots previously supplied 10 t/ha poultry manure or combinations of NPK + poultry manure than NPK fertilized or control (unfertilized) plots. Application of poultry manure in combination with mineral fertilizer enhanced soil nutrient status of Ferruginous soil both in short and long term.
Keywords: Cucumber yield, Poultry manure and NPK fertilizers, Nutrient uptake, Residual effects.

Introduction

Cucumber (*Cucumis sativus* L.) is a monoecious annual crop belonging to family Cucurbitaceae and its cultivation dated back to over 3,000 years (Adetula and Denton, 2003; Okonmah, 2011). Cucumber is a soft and succulent fruit vegetable crop cherished and eaten in salads or sliced into stew. It is a crop of high economic importance which ranks fourth after tomatoes, cabbage and onion in Asia (Eifediyi and Remison, 2010), and second after tomato in Western Europe. This crop has not been ranked in tropical Africa owing to its minimal utilization (Phu, 1997) however; its cultivation is becoming more popular among vegetable growers in Nigeria owing to its economic and nutritional importance.

In spite of the increasing relevance of cucumber among vegetable farmers in Nigeria, low fruit quality and yields are often recorded. This has been linked directly to continuous cropping and disregard for effective soil fertility management practices leading to diminishing soil fertility. It is noteworthy that crops in different seasons or environments respond differently to a range of climatic conditions, soil characteristics and cultural practices (Makinde and Bello, 2009; Singh and Ram, 2012). Belay *et al*. (2000) reported that cucumber rarely grows luxuriantly on marginal

soils hence, its performance on soil low in nutrient results in low fruit yield and malformed fruits that have little marketable value.

Although, report of Eifediyi and Remison (2010) showed that combined rates of farmyard manure at 10 t/ha with 400 kg/ha inorganic fertilizer increased growth characters such as the vine length and the number of leaves as well as fruit yield of cucumber. However, plant nutrient requirements by crops vary depending on soil type, native fertility, previous cropping, cultural practices and varietal differences. Besides, adoption of utilzation of organic fertilizer for improving yield quality and soil fertility depends on quality and ease of release of the available plant nutrients in an amendment. To this end, precise, well timed, and necessary information on soil properties, plant nutrient uptake and residual nutrients are essential to making soil fertility management decisions that will ensure high yields, improve crop quality and safe environment.
Information on the optimum nutrients needed for maximising growth, yield and quality of cucumber on Ferruginous soils in southwestern Nigeria is scanty. Therefore, effects of poultry manure and NPK fertilizer applied singly or in combination on growth, fruit yield and nutrient uptake of cucumber in Ibadan, southwestern Nigeria was investigated.

Materials and Methods

Experimental site

The experiment was carried out at the botanical garden of National Horticultural Research Institute (NIHORT) Idishin, Ibadan, Nigeria. Poultry droppings was collected from the heap of droppings at a layer chicken poultry farm in Idi-Ishin, Ibadan. The sample was cured by separating non-degradable materials such as nylon, stone, iron materials etc. after which the manure was air-dried. The cured manure was ground to pass through a 0.5 mm sieve to determine the pH as well as N, P, K, Ca, Mg, and organic matter concentrations. Soil sample (0 – 15 cm depth) was collected from the field before the main cropping. After the residual planting, samples were collected from each of the treated plot for determination of chemical properties of the soil in the study site using standard procedures.

Experimental design, treatments and field layout

There were ten treatment combinations laid out in randomized complete block design. The treatments comprised of two varieties of cucumber commonly grown in Nigeria (Poinsett and Marketer) and five levels of soil amendments: 0 (Control), 120 kg NPK 15:15:15/ha, 10 t/ha poultry manure, 90 kg NPK 15:15:15 + 2.5 t/ha poultry manure and 60 kg NPK 15:15:15 + 5 t/ha poultry manure. Each plot measured 2 m x 3 m with 1 m walkway between each plot and replicated three times. The total land area was 29 m × 11 m. Well cured poultry manure was applied two weeks before sowing by incorporating it into the soil through light hoeing while the inorganic fertilizer (NPK 15:15:15) was split applied in equal proportion at 2, 4 and 6 weeks after sowing.

Sowing and field management

Two seeds per hole was sown at 50 cm × 50 cm spacing and later thinned to one plant per hole a week after sowing to give plant population of 58,333.33 plants/ ha. Weeding was manually done when necessary. The field was prepared for residual trial three months after the first planting. The experimental design, layout and data collection for residual trial were the same with the main planting.

Data collection, Plant and Data Analysis

Five plants were tagged from the inner rows of each plot for growth parameters, which included number of leaves, leaf area, length and diameter of vine. Yield and yield components such as number of flowers, length and girth of fruit, number of fruits as well as weight of fresh fruits were also taken at appropriate periods.

At final harvest, tagged plants were uprooted and partitioned into shoot and root, oven dried at 70 ^{0}C until a constant weight was attained. The oven dried samples were milled and passed through 20 mm sieve and ashed in a Muffle furnace at 600 ^{0}C for three hours. The ashed samples were digested in conc. H_2SO_4 for nutrient analysis following standard procedures described by AOAC (2002). Nutrient accumulated in plant was evaluated using the procedures described by Ombod (1994) and used by Akanbi and Togun (2002). Data were analysed using analysis of variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT) at $P \leq 0.05$.

Results

Chemical properties of soil and poultry manure used for the trial are shown in Table 1. The soil and poultry droppings were acidic however, poultry droppings were more acidic (5.98) than the soil. The N content of poultry droppings was 2.5 g/kg, Ca, (42.8 mg/kg) available P, (70.0 cmol/kg), K (3.2 mg/kg) and organic carbon (36.5 g/kg). All these nutrients values were higher than that obtained in the soil of experimental site.

Influence of organic and inorganic fertilizers on number of leaves produced by the two varieties of cucumber is presented in Table 2. Marketer variety produced highest number of leaves (41.3) in plots fertilized with 60 kg/ha NPK + 5 t/ha poultry manure but not significantly different from Poinsett (39.3 or 38.2) in plots fertilized with either 60 kg/ha NPK + 5 t/ha poultry manure or 90 kg/ha NPK + 2.5 t/ha poultry manure. The residual effect of the previously applied fertilizers showed that Poinsett produced highest number of leaves (54.0) though not significantly different from the number of leaves produced by Marketer in plots fertilized with 60 kg/haNPK + 5t/ha poultry manure.

Marketer variety had highest leaf area (326.9 cm^2) in plots fertilized with 60 kg/ha NPK + 5 t/ha poultry manure but was not significantly different from Poinsett variety (324.5 cm^2) grown in plots with the same fertilizer treatments at 8 weeks after sowing. Leaf area of both cucumber varieties was least in control plots. Poinsett had the highest leaf area (346.7 cm^2) during the residual trial in plots supplied with 60 kg/ha NPK + 5 t/ha poultry manure treatment but not significantly different from the results obtained from other plots (Table 3).

Also, Marketer variety had highest vine diameter (0.82 cm) in plots fertilized with 60 kg NPK + 5 t/ha poultry manure but was not significantly different from Poinsett variety (0.81 cm) or Marketer (0.79 cm) in plots fertilized with 120 kg/ha NPK. Vine diameter of both cucumber varieties was least in the control plots (Table 4). In the residual trial, Poinsett had the highest vine diameter (0.87cm) in cucumber field previously fertilized with 90 kg/ha NPK + 5 t/ha poultry manure this was not significantly different from values obtained in all the previously amended plots. However, least vine diameter was observed in the control plots.

Table 1: Chemical properties of soil and poultry manure

Parameters	Soil Sample	Poultry Manure
pH	6.0	5.9
Organic carbon (g/kg)	15.2	36.5
Soil organic matter (g/kg)	23.6	56.5
Nitrogen (g/kg)	1.4	2.5
Calcium (mg/kg)	10.2	42.8
Magnesium (mg/kg)	1.2	8.5
Available P (cmol/kg)	11.3	70.
Exchangeable K (mg/kg)	0.4	3.2

Table 2: Effects of organic and inorganic fertilizers on number of leaves of cucumber grown on Ferruginous soil

		Main		Residual	
		Weeks after sowing			
Varieties	Fertilizers	4	8	4	8
Poinsett	Control (No amendment)	8.07±0.41ab	23.47±2.58a	11.89±0.38a	39.11±4.33a
	120kg/haNPK	8.93±0.81abc	33.80±3.42b	15.00±2.67ab	45.11±9.94ab
	10t/ha PM	9.20±0.35abc	34.70±3.03b	15.11±3.83ab	50.57±13.28b
	90kg/ha NPK +2.5t/ha PM	9.67±1.62bc	38.15±4.22c	13.78±3.56ab	47.33±10.36ab
	60 kg/haNPK + 5t/ha PM	12.0±1.92d	39.33±2.10c	15.55±3.97ab	54.00±13.60b
Marketer	Control (No amendment)	7.53±0.12a	21.76±0.76a	12.22±0.84ab	39.00±4.73a
	120kg/haNPK	9.22±0.72abc	34.23±3.06b	12.78±3.34ab	37.677.22a
	10t/ha PM	9.33±1.01abc	34.27±1.30b	15.89±2.27b	51.45±2.91b
	90kg/ha NPK +2.5t/ha PM	10.27±0.70c	34.4±3.41b	14.89±1.02ab	45.11±5.62ab
	60kg/ha NPK + 5t/ha PM	12.80±1.42d	41.27±6.57c	14.22±3.72ab	52.66±11.99b

Means ± standard deviation with the same letter on the same column are not significantly different at P > 0.05 using DMRT; PM – Poultry Manure.

Table 3: Effects of organic and inorganic fertilizers on leaf area (cm^2) of cucumber grown on Ferruginous soil

		Main		Residual	
		Weeks after sowing			
Varieties	**Fertilizers**	**4**	**8**	**4**	**8**
Poinsett	Control (No amendment)	70.00±2.03ab	189.10±18.24a	180.40±20.06a	300.90±26.65a
	120kg/haNPK	152.80±13.28abc	231.80±24.07abc	225.40±3.32a	343.40±11.36a
	10t/ha PM	162.80±53.34cd	257.40±65.65bc	204.20±85.88a	326.70±72.29a
	90kg/ha NPK +2.5t/ha PM	142.50±16.10bc	277.40±28.10d	226.20±27.44a	333.10±32.75a
	60kg/ha NPK + 5t/ha PM	208.80±38.86d	324.50±28.10d	243.20±95.54a	346.70±104.85a
Marketer	Control (No amendment)	68.80±3.63a	200.00±34.28ab	201.60±34.36a	284.60±53.20a
	120kg/haNPK	160.50±14.34ab	239.40±13.60abc	194.90±42.10a	284.90±50.06a
	10t/ha PM	175.80±51.56cd	275.60±26.79cd	218.00±52.31a	300.90±45.56a
	90kg/ha NPK +2.5t/ha PM	146.50±16.10bc	289.50±12.72bcd	211.50±25.57a	322.90±76.80a
	60kg/ha NPK + 5t/ha PM	196.30±27.62cd	326.90±12.72d	220.80±35.65a	334.80±51.81a

Means ± standard deviation with the same letter on the same column are not significantly different at P > 0.05 using DMRT; PM – Poultry Manure

Table 4: Effects of organic and inorganic fertilizers on vine diameter (cm) of cucumber grown on Ferruginous soil

		Main		Residual	
		Weeks after sowing			
Varieties	**Fertilizers**	**4**	**8**	**4**	**8**
Poinsett	Control (No amendment)	0.27±0.03a	0.60±0.06a	0.43±0.00a	0.72±0.04a
	120 kg/haNPK	0.41±0.03bc	0.81±0.03d	0.58±0.06b	0.82±0.05ab
	10 t/ha PM	0.39±0.04bc	0.64±0.02abc	0.57±0.14b	0.82±0.16ab
	90 kg/ha NPK +2.5 t/ha PM	0.42±0.08bc	0.70±0.07bcd	0.59±0.10b	0.87±0.14b
	60 kg/ha NPK + 5 t/ha PM	0.47±0.03c	0.78±0.05cd	0.62±0.08b	0.87±0.06b
Marketer	Control (No amendment)	0.28±0.02a	0.60±0.02a	0.52±0.08ab	0.73±0.09a
	120 kg/haNPK	0.38±0.10bc	0.79±0.07d	0.54±0.03ab	0.83±0.02ab
	10 t/ha PM	0.32±0.07ab	0.66±0.05ab	0.54±0.04ab	0.80±0.04ab
	90kg/ha NPK +2.5 t/ha PM	0.39±0.04bc	0.75±0.06bcd	0.57±0.06b	0.82±0.07ab
	6 0kg/ha NPK + 5 t/ha PM	0.44±0.03c	0.82±0.08d	0.53±0.04ab	0.83±0.04ab

Means± standard deviation with the same letter on the same column are not significantly different at P > 0.05 using DMRT; PM – Poultry Manure

The effects of organic and inorganic fertilizers on the vine length of two cucumber varieties showed that vine length of the two cucumber varieties were significantly affected by application of both fertilizers (Table 5). Marketer variety had significantly highest vine length (155.2 cm) at 8 weeks after sowing, but was not significantly different from Poinsett variety (152.3cm) in plots fertilized with 60 kgNPK + 5 t/ha poultry manure. Vine diameter of both cucumber varieties was least in control plots. Poinsett had the longest vine (163.2 cm)/plant in field previously supplied with 90 kg/ha NPK + 5 t/ha poultry manure and the least (133.0 cm) observed in the control plots.

Table 5: Effects of organic and inorganic fertilizers on vine length (cm) of cucumber grown on Ferruginous soil

		Main		Residual	
		Weeks after sowing			
Varieties	**Fertilizers**	**4**	**8**	**4**	**8**
	Control (No amendment)	20.50±0.85a	64.10±10.78a	47.65±2.80a	137.50±13.31ab
	120 kg/haNPK	30.47±4.40b	113.80±20.96b	61.58±11.64ab	145.70±17.58abc
	10 t/ha PM	26.10±2.88b	104.10±11.70b	78.47±20.62b	163.20±33.15c
Poinsett	90 kg/ha NPK +2.5 t/ha PM	33.47±5.20c	133.90±8.19bc	56.68±14.45ab	139.30±34.19ab
	60 kg/ha NPK + 5 t/ha PM	33.37±2.77c	152.30±25.42c	65.64±26.50ab	148.20±31.0abc
	Control(No amendment)	21.7±2.63a	67.60±6.92a	47.17±10.74a	133.01±9.04ab
Marketer	120 kg/haNPK	33.13±3.51b	110.20±12.65b	56.62±16.92ab	140.50±21.19ab
	10 t/ha PM	27.40±3.46b	114.20±18.89c	71.30±17.28b	159.60±17.40bc
	90 kg/ha NPK +2.5t/ha PM	30.77±3.81b	116.90±19.950b	71.19±10.12b	142.80±25.19abc
	60kg/ha NPK + 5t/ha PM	36.59±2.68c	155.20±14.70c	58.66ab	149.60±22.77abc

Means± standard deviation with the same letter on the same column are not significantly different at P > 0.05 using DMRT; PM – Poultry Manure

The number of flowers produced by the two cucumber varieties was significantly affected by the applied fertilizers. Poinsett variety produced significantly highest number of flower (21.43) in plots supplied 60 kg/ha NPK + 5 t/ha poultry manure at 8 weeks after sowing during the main cropping. The number of flowers produced during the residual cropping showed that highest number of flower was produced (31.67) by Marketer but this was not significantly different from number of flowers produced by Poinsett in plots amended with 10 t/ha poultry manure (Table 6).

Table 6: Effects of organic and inorganic fertilizers on number of flowers produced by two cucumber varieties grown on Ferruginous soil

		Main		Residual	
		Weeks after sowing			
Varieties	**Fertilizers**	**6**	**8**	**6**	**8**
	Control (No amendment)	2.00±0.89a	10.40±2.01a	19.22±1.17a	25.32±2.97ab
	120kg/haNPK	8.00±2.91abcd	15.60±2.91bc	24.22±6.55abc	26.44±3.60ab
Poinsett	10t/ha PM	6.67±2.67abcd	13.57±4.37ab	27.11±6.06bc	30.47±4.26b
	90kg/ha NPK +2.5t/ha PM	9.67±1.32bcd	17.70±1.05bcd	21.77±4.02abc	26.89±4.92ab
	60kg/ha NPK + 5t/ha PM	12.67±2.06cd	21.43±3.95d	18.67±2.40a	28.44±3.15ab
	Control (No amendment)	2.67±0.90ab	13.17±2.58ab	19.53±1.79ab	23.33±4.36a
	120kg/haNPK	10.33±1.20cd	14.93±2.91bc	22.26±6.07abc	27.00±2.18ab
Marketer	10t/ha PM	5.67±1.64abc	13.27±4.37ab	27.89±7.50c	31.67±4.09b
	90kg/ha NPK +2.5t/ha PM	13.00±1.31cd	16.70±1.05bcd	22.55±7.34abc	28.33±0.34ab
	60kg/ha NPK + 5t/ha PM	14.00±1.25d	19.10±2.75cd	23.00±7.26abc	25.560±2.14ab

Means± standard deviation with the same letter on the same column are not significantly different at P > 0.05 using DMRT; PM – Poultry Manure

Influence of organic and inorganic fertilizers on the yield components of cucumber is shown in Tables 7. Poinsett variety had significantly highest fruit length (17.03 cm) in plots supplied 10 t/ha poultry manure. Similarly, Poinsett variety had significantly highest number of fruits (7.45) in plots fertilized with 120 kg/ha NPK while it had highest fruit weight (163.60 g) in plots fertilized 10 t/ha

poultry manure. Number of fruits, fruit length, girth and weight of both cucumber varieties were poor in the control plots. The residual effects of the earlier applied fertilizer showed that Marketer had highest fruit length (19.8 cm) while Poinsett had highest values of fruit girth (118.8 cm), number of fruits (5.8 cm) and fruit weight (297.3 g) on plots previously supplied 60 kg/ha NPK + 5 t/ha poultry manure. Nonetheless, Poinsett had significantly highest (793.70 kg/ha) cumulative weight of fresh fruit harvest (t/ha) in plots fertilized with 90 kg/ha NPK + 2.5 t/ha poultry manure and least (431.403 kg/ha) in unfertilized plots.

In the main experiment, Poinsett plots supplied 90 kg/ha NPK +2.5 t/ha poultry manure had the highest dry shoot while it accumulated highest biomass in plots fertilized with 60 kg/ha NPK + 5 t/ha poultry manure. Marketer accumulated significantly highest dry matter into root (0.84 g) in plots fertilized with 60 kg/ha NPK + 5 t/ha poultry manure. The residual effect in plots earlier supplied with 60 kg/ha NPK + 5 t/ha PM showed that Poinset had highest dry shoot (71.5 g) and highest total biomass in plot previously fertilized with 90kg/ha NPK +2.5t/ha poultry manure. Meanwhile, Marketer had significantly highest root dry matter in plots earlier supplied with 60 kg/ha NPK + 5 t/ha poultry manure (Table 8).

Application of organic and inorganic fertilizers had significant effect on uptake nutrients by the two cucumber varieties. Marketer variety had the highest nitrogen uptake (1.8 g/kg) in plots fertilized with 60 kg/ha NPK + 5 t/ha poultry manure (Table 9). Organic carbon content (17.2 g/kg) was highest in Poinsett variety that received 10t/ha poultry manure while available phosphorus (12.0 cmol/kg) was highest in Marketer variety that received 120 kg/ha NPK. Potassium concentration was highest in Poinsett variety (0.52 mg/kg) that received 60 kg/ha NPK + 5 t/ha poultry manure. Nutrient uptake was least in both varieties in the unfertilized (control) plots. Residual effect of 60 kg/ha NPK + 5 t/ha poultry manure application enhanced N uptake with highest value (1.8 g/kg) observed in Marketer while highest organic carbon (14.80 g/kg) and phosporus uptake (14.80 cmol/kg) were recorded in the same variety on plots previously fertilized with 10 t/ha poultry manure. Nonetheless, Poinsett had the highest potassium uptake (0,72 mg/kg) in field previously fertilized with 60 kg/ha + 5 t/ha poultry manure. Both varieties had least nutrient uptake in the unfertilized plots.

Post trial soil analysis showed that the soil was slightly acidic with pH range of 5.90 – 6.30. The organic carbon content of the soil increased in plots supplied poultry manure either singly or in combination with NPK fertilizer with highest (19.60 g/kg) recorded in plots supplied 10 kg poultry manure. Generally, concentrations of all the mineral nutrients (N, P, K, Ca and Mg) increased in plots fertilized with poultry manure while concentration of these mineral elements declined in plots supplied with mineral fertilizer or unfertilized plots.

Discussion

The status of plant nutrients in the soil of the plot may not support cucumber growth beyond vegetative growth stage. Cucumber requires low nitrogen but require high potassium and phosphorus. The concentration of these mineral elements in the soil of the field used for the trial fall below the required ratio of 1:1½:3 (N-P-K) as suggested for cucurbitaceous crops by Van Eerd and O'Reilly (2010). Therefore, fertility of Ferruginous soil must be improved through

Table 7: Effects of organic and inorganic fertilizers on the yield components of cucumber per plant grown on Ferruginous soil

Varieties	Fertilizers	Fruit length (cm) /plant		Fruit girth (cm) /plant		No of fruits /plant		Fruit weight (g) /plant		Cummlative fresh fruit weight (kg/ha)
		Main	Residual	Main	Residual	Main	Residual	Main	Residual	
Poinsett	Control (No amendment)	14.17±1.46a	14.57±1.69a	13.40±0.36a	14.87±1.42ab	5.44±0.51a	3.60±0.20a	116.00±30.16a	142.00±16.55a	431.40a
	120kg/haNPK	14.57±1.07a	16.20±1.25abc	14.17±0.51a	15.40±2.13ab	7.45±0.69b	4.80±0.23ab	130.40±5.80abc	179.00±43.64ab	723.40abc
	10t/ha PM	17.03±0.21b	17.60±2.08bcd	14.50±0.78a	16.13±1.62abc	7.00±1.53ab	3.93±0.90ab	163.60±11.97c	197.90±45.10abc	572.50abc
	90kg/ha NPK +2.5t/ha PM	15.40±1.22ab	18.90±1.42cd	13.93±0.75a	18.53±1.29c	6.56±0.51ab	4.73±1.31ab	129.40±9.87abc	261.3±45.01bc	793.70c
	60 kg/ha NPK + 5t/ha PM	15.53a±1.50b	17.20±0.50abcd	14.43±0.49a	18.80±0.72c	6.67±0.34ab	5.80±1.32b	159.90±30.57c	297.30±24.11c	752.20ab
Marketer	Control (No amendment)	13.93±2.29a	14.70±1.25a	14.77±2.63a	14.60±0.85ab	6.33±1.85ab	4.63±0.61a	121.90±8.81ab	145.90±17.50a	443.10a
	120kg/haNPK	15.43±0.67ab	14.30±2.07a	14.27±0.91a	13.93±0.93a	6.56±0.96ab	4.37±1.85ab	144.40±9.74abc	164.50±38.76a	644.10abc
	10t/ha PM	15.23±0.70ab	16.10±1.42abc	14.20±0.26a	15.20±0.61ab	6.44±0.77ab	3.40±0.12ab	160.80±14.09c	175.20±35.55ab	465.00bc
	90kg/ha NPK +2.5t/ha PM	14.53±1.00a	15.90±1.64ab	13.43±0.32a	15.33±1.53ab	6.78±1.07ab	4.40±1.20ab	140.40±28.31abc	239.60±104.46abc	728.0abc
	60kg/ha NPK + 5t/ha PM	14.70±0.26a	19.80±2.06d	13.93±0.57a	17.47±2.40bc	7.00±1.20ab	5.5±0.50b	155.50±12.56bc	293.10±107.88c	711.40abc

Means± standard deviation with the same letter on the same column are not significantly different at P > 0.05 using DMRT; PM – Poultry Manure.

Table 8: Effects of organic and inorganic fertilizers on dry weight of cucumber grown on Ferruginous soil

Varieties	Fertilizers	Dry weight (g)					
		Shoot		Root		Total	
		Main	Residual	Main	Residual	Main	Residual
Poinsett	Control (No amendment)	40.55±1.46a	32.48±1.42a	0.29±0.13a	0.35±0.13a	32.80±1.84a	40.87±2.14a
	120kg/haNPK	63.73±4.34b	54.88±6.86b	0.62±0.10c	0.64b±0.11cd	55.40±7.21b	64.37±5.26b
	10t/ha PM	69.00±6.28b	61.33±7.28bcd	0.41±0.03ab	0.43±a0.03bc	61.70±6.81bcd	64.07±6.58b
	90kg/ha NPK +2.5t/ha PM	71.13±7.45b	63.27b±4.56cd	0.63±0.09c	0.56±0.45abcd	63.90±4.69bcd	71.69±4.56b
	60kg/ha NPK + 5t/ha PM	69.57±5.46b	71.49±7.00d	0.42±0.04ab	0.58±0.07abcd	71.90±7.31d	70.14±5.24b
Marketer	Control (No amendment)	42.09±3.89a	31.69±5.67a	0.40±0.02ab	0.41±0.06ab	32.10±7.21a	42.49±2.14a
	120kg/haNPK	65.13±4.24b	58.34±4.85bc	0.64±0.07c	0.67±bcd	59.01±6.81bc	65.81±2.56b
	10t/ha PM	65.30±3.12b	58.17±10.89bc	0.55±0.18bc	0.71±0.19cd	58.7±12.30bc	66.01±4.38b
	90kg/ha NPK +2.5t/ha PM	65.50±6.78b	57.36±5.45b	0.58±0.16c	0.72±0.18cd	57.90±3.80b	66.22±5.42b
	60kg/ha NPK + 5t/ha PM	64.66±3.78b	70.61±8.79cd	0.84±0.07d	0.79±0.08d	71.40±9.84d	70.14±6.81b

Means± standard deviation with the same letter on the same column are not significantly different at P > 0.05 using DMRT.

Table 9: Effects of organic and inorganic fertilizers on nutrient uptake of cucumber grown on Ferruginous soil

		Nutrient uptake concentration							
		Nitrogen (g/kg)		Organic carbon (g/kg)		Available P (cmol/kg)		Potassium (mg/kg)	
Varieties	**Fertilizers**	**Main**	**Residual**	**Main**	**Residual**	**Main**	**Residual**	**Main**	**Residual**
	Control (No amendment)	0.80	0.6	10.40	9.50	5.20	4.80	0.24	0.22
	120kg/haNPK	1.40	1.2	14.80	12.80	8.60	7.90	0.46	0.40
	10t/ha PM	1.20	1.5	17.20	19.20	6.40	7.80	0.45	0.53
Poinsett	90kg/ha NPK +2.5t/ha PM	1.30	1.4	13.60	14.40	8.10	9.10	0.40	0.42
	60kg/ha NPK + 5t/ha PM	1.50	1.4	14.80	15.00	9.20	9.60	0.52	0.72
	Control (No amendment)	1.00	0.8	11.20	10.20	6.00	5.20	0.30	0.34
	120kg/haNPK	1.40	1.3	14.40	11.20	12.00	12.10	0.50	0.46
	10t/ha PM	1.42	1.6	16.60	18.00	9.90	14.80	0.50	0.62
Marketer	90kg/ha NPK +2.5t/ha PM	1.60	1.7	14.80	15.00	8.40	11.40	0.48	0.50
	60kg/ha NPK + 5t/ha PM	1.80	1.8	10.20	15.40	10.20	12.20	0.51	0.57

Data are means of two samples; PM – Poultry Manure

Table 10: Post trial soil analysis

		Soil physical and chemical parameters							
Varieties	**Fertilizers**	**pH**	**Organic Carbon (g/kg)**	**Soil organic matter**	**N (g/kg)**	**Ca (mg/kg)**	**Mg (mg/kg)**	**P (cmol/kg)**	**K (mg/kg)**
	Control (No amendment)	6.20	8.50	13.17	0.58	9.40	1.00	10.80	0.35
	120kg/haNPK	5.90	10.40	16.12	1.46	9.40	1.00	12.80	0.47
	10t/ha PM	6.50	19.40	30.08	1.58	10.60	1.30	14.00	0.56
Poinsett	90kg/ha NPK +2.5t/ha PM	6.03	15.50	24.01	1.42	10.20	1.10	14.20	0.48
	60kg/ha NPK + 5t/ha PM	6.20	17.40	26.92	1.52	10.30	1.20	14.80	0.54
	Control (No amendment)	6.00	9.60	14.90	0.62	10.00	0.80	12.60	0.34
	120kg/haNPK	6.00	12.90	20.01	1.40	9.80	1.20	16.80	0.43
	10t/ha PM	6.25	19.60	30.37	1.59	10.60	1.10	17.20	0.56
Marketer	90kg/ha NPK +2.5t/ha PM	6.1	14.40	22.30	1.11	11.40	0.90	15.40	0.50
	60kg/ha NPK + 5t/ha PM	6.3	16.80	26.10	0.42	12.20	1.20	16.10	0.49

Data are means of two samples; PM – Poultry Manure

applying soil amendments rich in essential minerals for sustainable cucumber production in southwestern Nigeria. The concentration of the plant nutrients in the poultry droppings used in this experiment appeared sufficient to supply the required nutrients for optimal growth of cucumber.

Combination of organic and inorganic fertilizer enhanced growth of cucumber on soil low in plant nutrients. This suggests likelihood of synergy between organic matter in the poultry manure and mineral nutrient in the inorganic fertilizer. This could perhaps lead to increase in nutrient retention capacity and improvement of structure and soil biological quality which eventually improved soil fertility. These observations correspond with the result of Dutta *et al.* (2003) who reported that the use of organic fertilizers together with chemical fertilizers had higher positive effect on microbial biomass and hence soil fertility.

The improved growth observed in cucumber plots supplied with combined organic and mineral fertilizers could be linked to efficient nutrient supply which propably enhanced efficiency of soil micro-organisms in dissolving plant nutrients and made them available for cucumber use. Bokhtiar and Sakurai (2005) showed that application of organic and inorganic fertilizer improves N, P absorption of sugarcane leaf tissue. Organic fertilizers have been identified as essential soil amendments for improving efficiency of applied fertilizer, increasing soil fertility and crop productivity in sustainable farming system (Abbasi and Yousra, 2012). The performance of cucumber on plots supplied with combined amendments may not be unconnected to availability of the applied nutrients for optimal perfomance. This assertion is similar to that of Sundara *et al.* (2002) where they reported that growth, yield and quality of sugarcane improved with combined application of mineral fertilizer and phosphorus solubilizing bacteria, *Bacillus megatherium* var *phosphaticum*.

The significant performance of Marketer over Poinsett variety may be ascribed to genetic variations. It has been reported that response of curcubits to N rates vary depending on species, soil type and rates of fertilizer applied (Mohammad, 2004, Esme *et al.,* 2006 and Ferrante *et al.,* 2008).

Combination of organic and inorganic fertilizer enhanced growth, yield and quality of cucmber on poor soil better than poultry manure or inorganic fertilizer alone. Combination of poultry manure and mineral fertilizer has been shown to improve soil fertility thereby optimizing yield of cucumber. This suggests that application of poultry manure increased the efficiency of mineral fertilizer thus increasing cucumber fruit yield. This is in agreement with observations of Abbasi and Yousra (2012) on synergistic effects of biofertilizer with organic and chemical N sources on growth and yield of wheat grown under green house.

Eifediyi and Remison (2010) in their various studies on nutrient requirements of cucumber reported that cucumber responded positively to organic, inorganic or combined nutrient applications. Quansah *et al*. (1998) also obtained significant increase in crop yields when a combination of organic and mineral fertilizers was applied compared with sole application of organic or mineral fertilizer.

The two varieties of cucumber performed better during the residual trial than the main planting. Application of organic manure either singly or in combination with mineral fertilizer to soil with marginal native nutrients tends to benefit subsequent cropping. This may be due to the fact that organic manure releases their constituents gradually for plant use (Tittarelli *et al*., 2007). Hence, the slow release of these nutrients could have been responsible for the increase in fruit yield of cucmber in the succeeding year better than the first year. Residual effects of organic matter added to soil in farmyard manure often have carry-over benefit on the succeeding crop. According to Ramamurthy and Shivashankar (1996), nutrients present in organic matter are not fully available to the crops in the season of its application. It therefore means that supplying Ferruginous soil with 60 kg/ha NPK + 5 t/ha poultry manure would be beneficial to cucumber production for two cropping seasons. This is advantageous in area where growers face the challenge of scarcity or timely supply of soil amendments owing to high cost, unavailability and bulkiness of these materials.

Application of organic manure to cucumber plot contributed remarkably to improving soil physical and chemical properies better than mineral fertilizer. Poultry manure contributed greatly to improving fertility of Ferruginous soil both in short and long time as it supplies a wide range of macro and micro nutrients required for plant growth. Shah *et al.* (2003) reported similar observation in legume-cereal rotation. Besides, poultry manure enhanced the physical, chemical and biological properties of the soil by supplying organic matter which was lacking in mineral fertilizer. This observation agrees with that of Roca-Pérez *et al.* (2009).

Application of inorganic fertilizer to soil deficient in plant nutrient had negative effect on the physical and chemical properties such soil. Our observations in this study showed that plant mineral nutrients declined with continuous cropping. This suggests that mineral fertilizer unlike poultry manure has no positive residual effect on the soil properties. Bharadwaj and Omanwar (1994) reported that supplying soil with organic manures improve availability of macro nutrient especially N, P, K; increased soil organic matter (Tabibian *et al*., 2012) and ultimatley soil fertility better than inorganic fertilizers (IFAS, 2005; Mkhabela and Warman, 2005; Karami *et al*., 2009).

Conclusions

Application of varying rates of inorganic and organic fertilizers used singly or in combination enhanced growth, yield and yield components of Marketer and Poinsett cucumber varieties on nutrient deficient soil. Highest growth, yield and nutrient uptake by the two varieties of cucumber was observed in plot that received combination of 60 kg/ha NPK 15:15:15 and 5 t/ha poultry manure. Cucumber benefited from residual effect of the previously applied combined poultry and NPK fertilizer. Application of organic fertilizer contributed immensely to improving soil fertility unlike plots supplied inorganic fertilizer where decline in soil nutrients was clearly evident.

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