International Journal of Manures and Fertilizers Vol. 2 (11), pp. 418-423, November, 2013. Available online at www.internationalscholarsjournals.org

Full Length Research Paper

Effects of poultry manure enhanced with NPK 15:15:15 fertilizer on cucumber (*Cucumis sativus L.*) manufacture in Uyo state (Nigeria)

Fola R. Akpabio,Udoh Akinjoba and Femi Dele

Department of Crop Science, Faculty of Agriculture, Unversity of Uyo, Uyo state, Nigeria.

Accepted 12 October, 2013

Cucumber (*Cucumis sativus L.*) is a newly introduced exotic crop in Port Harcourt (Nigeria) that is in high demand, but due to inadequate production and distance from areas of mass production, the supply is highly limited. Replicate field plots were employed in the experiments aimed at determining the effects of poultry manure supplemented by NPK 15:15:15 on cucumber for a period of two seasons. Three poultry manure (PM) levels; 0, 5 and 10 t/ha, two levels of NPK 15:15:15 60 and 120 kg/ha and the combination of the different levels of poultry manure and NPK fertilizer were used, respectively. The pertinent growth, yield and soil parameters were then determined. Results of the analysis show that various combined nutrients treated plots significantly influenced vine length and leaf area than the plots that were treated with single nutrients and control. The best result of the fruit yield were obtained from plots treated with 5 t/ha of poultry manure supplemented with 120 kg/ha of NPK and 10 t/ha PM supplemented with 60 kg/ha NPK (18.24 and 19.30 t/ha) for wet and dry seasons, respectively. Soil analysis result show that treatments applied at various levels increased soil fertility. The result of the study showed that the best crop yield was obtained on cucumber during dry season farming.

Key words: Cucumber, vine length, leaf area, fruit yield, NPK 15:15:15, poultry manure, exotic crop.

INTRODUCTION

Fertilizers are substances which when added to the soil supply one or more plant nutrients. Inorganic fertilizers are chemical compounds made in factory or obtained from mining, while organic fertilizer are composed mainly of wastes and residues from plants and animal life (Cooke, 1982). Organic manure (OM) improves soil structure, water, air and nutrient retention in the soil, buffers soil chemical imbalances, supports living organisms, etc (I.F.A.S, 2005). Combined use of both organic and inorganic sources of nutrients results in higher nutrient uptake and increased fruit production (Hedge and Srinvas, 1989). The basic concept underlying the principles of integrated nutrient management is the maintenance and improvement of soil fertility for sustaining crop productivity on a long term basis and can be achieved through the use of mineral fertilizers.

Cucumber on the other hand is a major fruit vegetable that is eaten raw, cooked or used in salad. Although the crop serves as a major source of vitamins, still this crop is low in productivity owing to several factors, with nutrient/water observed to be the limiting factor (Ayotamuno et al., 2007). Currently, with improved standard of living and increasing population, there is high demand for exotic food materials of which cucumber is one of them and northern Nigeria remains the major producers. However, the quantity been produced cannot meet the consumers demand, hence there is need to evaluate the possibility of production of cucumber in Port Harcourt since the environmental factors of Port Harcourt favor its growth.

Moreover, much works have not been done in the

*Corresponding author. E-mail: Fola2000@gamil.com

tropics, especially in Nigeria and in particular Port Harcourt, on both the production of cucumber and soil nutrients management practices for better productivity. Integrating both nutrient sources can help boost the production of cucumber and meet up with the quantity demanded by the society as cucumber is a short gestation crop that requires fast release of nutrients in the field, which conventional fertilizer can do better than organic manure (Marjan, 2005). Therefore, the objectives of the study were to assess the effects of poultry manure supplemented by NPK 15:15:15 fertilizer on cucumber production, and on soil properties.

MATERIALS AND METHODS

Study area

The study was conducted at the Teaching and Research Farm of the Rivers State University of Science and Technology, Port Harcourt, Nigeria. Port Harcourt is situated at latitude 4.5°N and longitude 7.01°E and on an elevation of 18 m above sea level, with bimodal rainfall pattern with peaks in June and September which ranged from 2,400 to 3,600 mm per annum. Mean daily temperature varied from 25.6 to 29.1°C (SERC, 1993; NMA, 2009). The experimental area was manually cleared of the existing vegetation with cutlasses and hoes.

Duration of the experiment

The experiment was conducted for a period of two cropping seasons; March to June 2009 with a total rainfall of 663.8 mm, and September to December with a total rainfall of 601.1 mm respectively.

Experimental design

The design of the experiment was 3 × 3 factorial arrangement fitted into randomized complete block design with three replications. The experimental total land area was 53.4 m × 18.8 m (0.1 ha), and treatment plots were measured as 3.6 m × 3.6 m and 1 m alley which separated the blocks and treatment plots, respectively.

Treatment application

Well treated poultry manure was incorporated into the appropriate experimental plots at the rates of 5 and 10 t/ha two weeks before sowing of seeds commenced while NPK 15:15:15 inorganic fertilizer at 60 and 120 kg/ha were applied to the appropriate plots at two weeks after emergence of seeds.

Planting and weeding

For the two planting seasons, the test crop cucumber (*poinsett*) was planted at 70 cm × 70 cm plant spacing with three seeds per hole. This was later thinned down to two plants per hole which gave a total plant population of 20,408 plants per hectare adopted for the two planting seasons.

Weeds were controlled by cultural methods through hoeing and hand pulling of weeds. The first weeding was carried out two weeks after applying poultry manure, while the second weeding was done two weeks after sowing. This was followed by the last weeding three weeks later.

Laboratory methods of soil analysis

Soil samples were collected from all the plots before and after the commencement of the field experiment. Properties determined included organic carbon, total nitrogen, available phosphorus, soil pH and exchangeable cations (Black et al., 1965; Knudsen et al., 1982; Thomas, 1982; Olsen and Sommers, 1999). In order to achieve the above, soil samples were agured randomly from different depth spots on the plots at two depths 0 to 15 and 15 to 30 cm. The samples were transferred to the laboratory for analysis. The chemical properties of the poultry manure were also determined. The chemical properties of soil are shown in Tables 7 and 8.

Growth parameters

Five plants were randomly selected and tagged from the inner rows of each treatment plot on which all observations were made throughout the experimental periods. The following parameters were measured:

Vine length

The vine lengths for the two seasons of planting were determined with a measuring tape (cm) and the mean determined for computation.

Leaf area

Three leaflets from each of the five sampled plants were used for leaf area determination using rectangular method. The length and the maximum width of leaflet from top, middle and bottom of plants tagged for data collection were measured. Each treatment plot was computed using the equation described by Ramanujam and Indira (1978).

Number of leaves per plant

Counting of number of leaves per plant was adopted for the two seasons of cropping and the mean recorded.

Yield parameters

Average yield per hectare

Harvested fruits were weighed per plot and converted to hectare. This was determined by multiplying average yield per plant population per hectare for two seasons; average yield per hectare (yield/ha) = Average yield/plant × Plant population/ha (Anene, 1987).

Data analysis

Statistical analysis was performed using the SAS software version 8 (SAS, 1999). Tests for significant differences between means were made using the procedure of analysis of variance (ANOVA) and the Duncan's multiple range test (DMRT) at 0.05 probability level.

RESULTS AND DISCUSSION

The influence of organic, inorganic fertilizers and their

Table 1. Effect of poultry manure supplemented by NPK 15:15:15 fertilizer on cucumber vine length for wet season crops (cm).

Treatment	2 WAP	4 WAP	6 WAP	8 WAP
Control	9.4 ± 0.18^{e}	22.23 ± 0.24^{i}	42.27 ± 0.18^{g}	43.60 ± 0.21^{g}
NPK_1	11.93 ± 0.89^{d}	69.37 ± 0.54^{f}	94.60 ± 2.76^{f}	95.27 ± 2.50^{f}
NPK_2	11.50 ± 0.25^{bc}	75.83 ± 0.37^{e}	119.13 ± 0.87^{d}	119.90 ± 1.84^{d}
PM_1	21.50 ± 0.25^{bc}	47.37 ± 0.15^{h}	100.47 ± 2.63^{e}	100.57 ± 2.63^{e}
PM_2	22.13 ± 0.33^{ab}	63.70 ± 0.10^{g}	126.00 ± 0.36^{c}	126.07 ± 0.38^{e}
NPK_1 PM_1	21.17 ± 0.33^{c}	112.37 ± 0.24^{d}	120.60 ± 0.15^{d}	120.80 ± 0.15^{d}
NPK_1 PM_2	21.77 ± 0.1^{abc}	126.67 ± 0.35^{b}	147.13 ± 2.95^{a}	147.63 ± 2.78^{a}
NPK_2 PM_1	22.33 ± 0..29^{a}	134.90 ± 0.61^{a}	137.43 ± 0.76^{b}	138.33 ± 0.20^{b}
NPK_2 PM_2	22.47 ± 0.18^{a}	119.00 ± 0.21^{c}	149.30 ± 0.25^{a}	150.80 ± 1.45^{a}
Overall mean	18.25 ± 1.02^{b}	85.94 ± 7.29^{b}	115.15 ± 6.04^{b}	115.85 ± 6.20^{b}

*Mean in each column followed by the same letter indicate not significantly different at P<0.05. Control = no fertilizer, no poultry manure; PM_1 = 5 t/ha of poultry; PM_2 = 10 t/ha of poultry manure; NPK_1 = 60 kg/ha of NPK 15:15:15 fertilizer; NPK_2 = 120 kg/ha of NPK 15:15:15 fertilizer; NPK_1PM_1 = 60 kg/ha NPK 15:15:15 Fertilizer + 5 t/ha of poultry manure; NPK_2Pm_2 = 120 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK_1PM_2 = 60 kg/ha NPK 15:15:15 fertilizer + 10 t/ha poultry manure. Values are mean± SEM.

Table 2. Effect of Poultry manure supplemented by NPK 15:15:15 fertilizer on cucumber vine length for dry season crops (cm).

Treatment	2 WAP	4 WAP	6 WAP	8 WAP
Control	11.10 ± 0.21^{c}	26.17 ± 0.27^{c}	48.67 ± 0.24^{g}	48.93 ± 0.23^{e}
NPK_1	14.03 ± 0.09^{c}	56.97 ± 2.44^{d}	111.30 ± 3.25^{f}	112.10 ± 2.94^{d}
NPK_2	13.57 ± 0.19^{c}	89.10 ± 0.35^{c}	141.03 ± 1.02^{d}	141.40 ± 1.08^{c}
PM_1	25.00 ± 0.25^{b}	55.73 ± 0.18^{d}	118.20 ± 3.10^{e}	118.30 ± 3.10^{d}
PM_2	26.03 ± 0.38^{b}	75 07 ± 0.27^{cd}	148.20 ± 0.42^{c}	148.33 ± 0.45^{c}
NPK_1 PM_1	24.93 ± 0.04^{b}	132.20 ± 0.31^{b}	141.93 ± 0.19^{d}	142.13 ± 0.19^{c}
NPK_1 PM_2	32.27 ± 3.43^{a}	158.03 ± 2.76^{a}	179.73 ± 0.37^{a}	180.33 ± 5.66^{a}
NPK_2 PM_1	29.57 ± 3.38^{ab}	162.03 ± 2.76^{a}	165.10 ± 4.00^{b}	166.10 ± 3.15^{b}
NPK_2 PM_2	26.43 ± 0.20^{b}	140.30 ± 0.24^{ab}	175.65 ± 0.31^{a}	177.40 ± 1.72^{a}
Overall mean	22.55 ± 1.48^{a}	102.20 ± 8.86^{a}	136.83 ± 7.54^{a}	137.03 ± 7.52^{a}

*Mean in each column followed by the same letter indicate not significantly different at P<0.05. (Control = no fertilizer, no poultry manure, PM_1 = 5t/ha of poultry, PM_2 = 10t/ha of poultry manure, NPK_1 = 60kg/ha of NPK 15:15:15 fertilizer, NPK_2 = 120kg/ha of NPK 15:15:15 fertilizer, NPK_1PM_1 = 60kg/ha NPK 15:15:15 Fertilizer + 5t/ha of poultry manure; NPK_2Pm_2 = 120kg/ha NPK 15:15:15 fertilizer + 5t/ha of poultry manure; NPK_1PM_2 = 60kg/ha NPK 15:15:15 fertilizer + 10t/ha poultry manure. Values are mean± SEM.

combinations on cucumber vine length is shown in Tables 1 and 2. Final vine length at 8 weeks after planting (WAP) showed that addition of 120 kg/ha NPK + 10 t/ha and 60 kg/ha NPK + 10 t/ha PM were longest (148.47 and 177.98 cm) during wet and dry seasons, respectively. Cucumber vine length generally increased rapidly but attained its plateau at 6 WAP and gradually decline in growth rate at 8 WAP. This confirms the findings of Stephen and Cartor (1983) that the pattern of growth of many organisms takes the form of a sigmoidal (S-shaped) curved. They divided growth into three stages; initial growth which is slow, a period of rapid growth, and a plateau in which little additional growth occurs. Moreover, irrespective of seasons of planting, control plots consistently produced the shortest vines at 2, 4 and 6 WAP. The wet season crops produced shorter vine lengths than the dry season crops. This implied significant differences in vine length due to the treatment applied.

Wider leaf area is required for light interception, for photosynthesis and transpiration (Ma et al., 1992). The plants showed increasingly values of leaf area in plot either supplemented with organic or inorganic manures and plots treated with 10 t/ha of poultry manure than in single nutrient treated plots and control plots. Application of 120 kg/ha NPK + 10 t/ha PM consistently produced the largest leaf area at 6 and 8 WAP (443.12 and 553.96 cm^2) during wet season (Tables 3 and 4). This was in line with Stephen and Cartor (1983) report that as plant reaches vegetative stage, its demand for N increases. The dry season cropping plots that received combinations of 120 kg/ha NPK + 10 t/ha PM and 60

Table 3. Effect of poultry manure supplemented by NPK 15:15:15 fertilizer on cucumber leaf area for wet season crops (cm^2).

Treatment	2 WAP	4 WAP	6 WAP	8 WAP
Control	20.87 ± 0.03^{e}	40.50 ± 0.00^{e}	329.59 ± 0.57^{f}	330.17 ± 0.32^{h}
NPK$_1$	20.87 ± 0.03^{e}	171.10 ± 0.15^{dcd}	292.17 ± 0.03^{g}	392.23 ± 0.57^{e}
NPK$_2$	20.90 ± 0.00^{e}	278.07 ± 0.41^{bcd}	376.23 ± 1.13^{e}	486.17 ± 0.17^{d}
PM$_1$	41.57 ± 0.12^{c}	158.93 ± 0.12^{de}	262.50 ± 0.1^{h}	330.87 ± 0.03^{g}
PM$_2$	53.07 ± 0.03^{a}	170.00 ± 0.20^{cde}	292.07 ± 0.03^{g}	350.70 ± 0.06^{f}
NPK$_1$ PM$_1$	41.77 ± 0.13^{b}	318.47 ± 0.33^{ab}	608.43 ± 0.01^{b}	722.23 ± 0.09^{c}
NPK$_1$ PM$_2$	41.37 ± 0.03^{d}	436.27 ± 0.07^{a}	584.07 ± 0.03^{c}	816.00 ±0.21^{a}
NPK$_2$ PM$_1$	53.10 ± 0.00^{a}	341.43 ± 0.27^{ab}	575.50 ± 0.00^{d}	741.60 ± 0.15^{b}
NPK$_2$ PM$_2$	53.23 ± 0.03^{a}	313.27 ± 1.34^{abc}	666.93 ± 0.13^{a}	815.87 ± 0.38^{a}
Overall mean	38.53 ± 2.62	247.56 ± 25.60	443.12 ± 29.97	553.96 ± 39.91

*Mean in each column followed by the same letter indicate not significantly different at P<0.05. Control = no fertilizer, no poultry manure; PM$_1$ = 5 t/ha of poultry; PM$_2$ = 10 t/ha of poultry manure; NPK$_1$ = 60 kg/ha of NPK 15:15:15 fertilizer; NPK$_2$ = 120 kg/ha of NPK 15:15:15 fertilizer; NPK$_1$PM$_1$ = 60 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK$_2$Pm$_2$ = 120 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK$_1$PM$_2$ = 60 kg/ha NPK 15:15:15 fertilizer + 10 t/ha poultry manure. Values are mean± SEM.

Table 4. Effect of poultry manure supplemented by NPK 15:15:15 fertilizer on cucumber leaf area for dry season crops (cm^2).

Treatment	2 WAP	4 WAP	6 WAP	8 WAP
Control	24.57 ± 0.03^{c}	47.67 ± 0.03^{e}	387.30 ± 0.25^{b}	388.67 ± 0.68^{h}
NPK$_1$	24.57 ± 0.03^{c}	201.33 ± 0.19^{cde}	343.77 ± 0.03^{b}	461.47 ± 0.63^{e}
NPK$_2$	24.60 ± 0.00^{c}	326.77 ± 0.20^{bcd}	442.63 ± 1.34^{b}	571.97 ± 0.17^{d}
PM$_1$	48.77 ± 0.03^{b}	187.00 ± 0.15^{de}	308.80 ± 0.10^{b}	389.27 ± 0.03^{g}
PM$_2$	62.43 ± 0.07^{a}	199.97 ± 0.23^{cde}	344.37 ± 0.09^{b}	412.60 ± 0.06^{f}
NPK$_1$ PM$_1$	48.73 ± 0.03^{b}	374.67 ± 0.03^{ab}	715.83 ± 0.01^{a}	849.67 ± 0.12^{c}
NPK$_1$ PM$_2$	48.67 ± 0.03^{b}	359.23 ± 1.53^{bc}	687.13 ± 0.07^{a}	960.00 ± 0.26^{a}
NPK$_2$ PM$_1$	62.50 ± 0.00^{a}	401.43 ± 0.28^{ab}	473.90 ± 0.20^{a}	872.43 ± 0.19^{b}
NPK$_2$ PM$_2$	62.53 ± 0.03^{a}	526.53 ± 0.03^{a}	784.67 ± 0.02^{a}	959.83 ± 0.45^{a}
Overall mean	45.25 ± 3.0^{e}	291.62 ± 30.27^{e}	498.82 ± 38.50^{e}	651.66 ± 46.97^{b}

*Mean in each column followed by the same letter indicate not significantly different at P<0.05. Control = no fertilizer, no poultry manure; PM$_1$ = 5 t/ha of poultry; PM$_2$ = 10 t/ha of poultry manure; NPK$_1$ = 60 kg/ha of NPK 15:15:15 fertilizer; NPK$_2$ = 120 kg/ha of NPK 15:15:15 fertilizer; NPK$_1$PM$_1$ = 60 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK$_2$Pm$_2$ = 120 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK$_1$PM$_2$ = 60 kg/ha NPK 15:15:15 fertilizer + 10 t/ha poultry manure. Values are mean± SEM.

kg/ha NPK + 10 t/ha PM produced similar but highest leaf area than other plots. This agrees with Dainello (2005) who advised the use of both inorganic and organic fertilizers for relatively high levels of soil nutrient necessary for successful vegetable production. The dry season crop produced generally observable higher leaf areas than wet season crops. One observable feature in this study was that growth in relation to leaf area was still continued up till 8 WAP. Data on leaf area show highly significant difference between treated plots and control plots. Number of leaves per plant of cucumber showed the same trend in combined nutrient plots and 120 kg/ha of NPK plots for the two seasons. Furthermore, plots that received 60 kg/ha NPK + 10 t/ha PM, 120 kg/ha NPK + 5 t/ha, 120 kg/ha + 10 t/ha and NPK plots alone, all produced similar but highest number of leaves during the wet season cropping. This result was repeated by same plots, but highest number of leaves per plant was obtained during the dry season cropping. Relatively, high level of soil nutrients is necessary for successful vegetable production; farmers are advised to maintain their nutrient level by adding both mineral and organic fertilizers (Moore, 2000). The data also show that plots that received higher doses of NPK and organic manure supplemented with NPK at different levels produced highest leaf numbers. Ahn and Peter (1979) implied that nitrogen encourages vegetative growth of plants and gives leaves good green colour required by plants as a constituent of protein.

Generally, the dry season crop produced higher leaf number than the wet season crop. Fruit yield (t) is shown in Table 5 for the wet and dry season respectively. The wet season fruit yield data showed that application of 120 kg/ha NPK + 5 tons/ha PM and 60 kg/ha NPK + 10 tons/ha PM significantly increased the fruit yield, but they were not different from plots that received 120kg/ha +

Table 5. Effects of poultry manure supplemented by NPK 15:15:15 fertilizer on number of cucumber leaves (per plant).

Treatment	Wet season crop (mean ± SEM)	Dry season crop (mean ± SEM)
Control	29.80 ± 3.08^{d}	35.00 ± 3.61^{d}
NPK_1	49.30 ± 1.70^{cd}	58.00 ± 2.00^{cd}
NPK_2	133.47 ± 20.52^{ab}	157.00 ± 24.13^{ab}
PM_1	56.10 ± 2.60^{cd}	66.00 ± 3.61^{cd}
PM_2	73.67 ± 1.50^{c}	86.07 ± 1.76^{c}
NPK_1 PM_1	124.43 ± 19.73^{b}	146.00 ± 23.01^{b}
NPK_1 PM_2	160.67 ± 4.38^{a}	189.00 ± 5.13^{a}
NPK_2 PM_1	153.40 ± 0.76^{ab}	180.33 ± 0.33^{ab}
NPK_2 PM_2	142.30 ± 2.72^{ab}	176.00 ± 3.00^{ab}
Overall mean	102.57^{b} ±	120.56 ± ^{a}

*Mean in each column followed by the same letter indicate not significantly different at P<0.05. Control = no fertilizer, no poultry manure; PM_1 = 5 t/ha of poultry; PM_2 = 10 t/ha of poultry manure; NPK_1 = 60 kg/ha of NPK 15:15:15 fertilizer; NPK_2 = 120 kg/ha of NPK 15:15:15 fertilizer, NPK_1PM_1 = 60 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK_2Pm_2 = 120 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK_1PM_2 = 60 kg/ha NPK 15:15:15 fertilizer + 10 t/ha poultry manure. Values are mean± SEM.

Table 6. Effect of Poultry manure supplemented by NPK 15:15:15 fertilizer on cucumber fruit yield (tons per hectare).

Treatment	Wet season crop	Dry season crop
	Yield/ha (t)	Yield/Ha (t)
Control	9.87± 0.36^{f}	10.3± 0.66^{f}
NPK_1	14.07 ± 1.02^{d}	13.08± 0.12^{de}
NPK_2	15.94± 0.52^{bc}	15.38 ± 0.25^{c}
PM_1	11.79 ± 0.26^{e}	12.53 ± 0.28^{e}
PM_2	13.88 ± 0.28^{d}	13.84 ± 0.37^{d}
NPK_1 PM_1	14.87± 0.47^{cd}	18.59± 0.53^{ab}
NPK_1 PM_2	18.07 ± 0.56^{a}	19.30 ± 0.26^{a}
NPK_2 PM_1	18.24 ± 0.68^{a}	18.35± 0.19^{ab}
NPK_2 PM_2	16.73± 0.70^{ab}	17.91 ± 0.32^{b}
Overall mean	14.81 ± 0.53^{b}	15.48 ± 0.60^{a}

*Mean in each column followed by the same letter indicate not significantly different at P<0.05. Control = no fertilizer, no poultry manure; PM_1 = 5 t/ha of poultry; PM_2 = 10 t/ha of poultry manure; NPK_1 = 60 kg/ha of NPK 15:15:15 fertilizer; NPK_2 = 120 kg/ha of NPK 15:15:15 fertilizer; NPK $_1PM_1$ = 60 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK_2Pm_2 = 120 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK_1PM_2 = 60 kg/ha NPK 15:15:15 fertilizer + 10 t/ha poultry manure. Values are mean± SEM.

10tons/ha PM in the wet season. The least fruit yield was obtained from untreated plots, while the dry season plots treated with 60 kg/ha NPK + 10 tons/ha PM caused significance increase in fruit yield (Table 6). However, untreated plots suppressed fruit yield. Hector et al. (2005) reported that over 80% of the total crop nutrient removed took place during the fruiting stage of the crop growth. Moreover, dry season cucumber crops produced higher fruit yield than the wet season crops. Generally, plot treated with PM supplemented with NPK fertilizer produced the highest yield in the field trial. Jose et al. (1988) integrated that the use of both organic and inorganic sources results in higher uptake and increase fruit production.

Effect of manure on soil properties

The chemical properties of the soil are shown in Tables 7 and 8. The initial pH of the experimental plot was 7.10 at 0 to 15 cm depth but dropped to a mean of 5.39 across all treatments (Table 8). This drop in pH was as result of crop uptake of the exchangeable cations and also leaching losses. However, the high fruit yield of cucumber across all treatments at near neutral pH of 7.10 agrees with the findings of Li et al. (2005) that cucumber requires a soil pH of between 6.0 to 6.5. Total nitrogen of the experimental plots was considerably low before and after both cropping seasons. The C: N ratio were higher in poultry manure plots and plots that were supplemented

Table 7. Physico–chemical properties of soils of experimental site before planting.

Sample number	Soil pH	Total N (%)	Org C (%)	Available P (mg/kg)	Cmol/kg K	Cmol/kg Na	Cmol/kg Ca	Cmol/kg Mg	Sand	Silt (%)	Clay (%)	Textural Cl
0 – 15 cm	7.10	0.12	0.98	13.05	0.24	0.20	0.28	0.11	88	7	5	Ls
15 – 30 cm	7.20	0.05	0.85	9.8	0.30	0.23	0.22	0.09	83	10	7	Ls

Table 8: Effects of Poultry manure supplemented with NPK 15:15:15 fertilizer on chemical properties of soils of experimental site after planting dry crops.

Treatment	Soil pH 1:2.5	Available P (mg/kg)	OC (%)	OM (%)	TN (%)	C:N ratio	K^{+}	Na^{+}	Ca^{2+} (Cmol kg^{-1})	Mg^{2+}
Control	5.23 ± 0.20^{a}	35.65 ± 1.26^{c}	0.10 ± 0.03^{C}	0.18 ± 0.05^{d}	0.04 ± 0.09^{e}	2.80 ± 1.27^{De}	0.12 ± 0.01^{b}	0.61 ±0.02^{b}	1.26 ± 0.02^{ab}	1.02 ± 0.11^{a}
NPK_1	5.31 ± 0.12^{a}	69.76 ± 10.50^{b}	0.08 ± 0.01^{C}	0.14 ± 0.01^{d}	0.20 ± 0.03^{c}	2.42 ± 0.07^{E}	0.17 ± 0.01^{b}	0.71 ± 0.01^{ab}	1.80 ± 0.30^{d}	1.21 ± 0.14^{a}
NPK_2	5.37 ± 0.23^{a}	76.26 ± 7.89^{bc}	0.36 ± 0.24^{C}	0.62 ± 0.41^{d}	0.13 ± 0.01^{d}	2.97 ± 1.62^{De}	0.27 ± 0.2^{ab}	0.76 ± 0.01^{a}	2.5 ± 0.30^{d}	1.46 ± 0.33^{a}
OM_1	5.43 ± 0.18^{a}	75.02 ± 11.62^{bc}	1.41 ± 0.44^{B}	2.79 ± 0.30^{c}	0.10 ± 0.00^{d}	13.72 ± 0.76^{A}	0.21 ± 0.06^{ab}	0.6 ± 0.04^{ab}	2.30 ± 0.06^{ab}	1.31 ± 0.14^{a}
OM_2	5.40 ± 0.21^{a}	76.58 ± 2.79^{bc}	2.85 ± 0.04^{A}	4.92 ± 0.06^{ab}	0.23 ± 0.01^{c}	12.30 ± 0.70^{A}	0.26 ± 0.05^{ab}	0.68 ± 0.05^{ab}	2.90 ±0.02^{a}	1.80 ±0.32^{a}
NPK_1 OM_1	5.43 ± 0.17^{a}	69.86 ± 1.71^{c}	1.36 ± 0.11^{B}	2.34 ± 0.19^{c}	0.32 ± 0.01^{b}	4.32 ± 0.47^{Cd}	0.25 ± 0.6^{ab}	0.69 ± 0.52^{ab}	2.60 ± 0.01^{b}	1.76 ± 0.27^{a}
NPK_1 OM_2	5.40 ± 0.15^{a}	99.39 ± 0.86^{abc}	2.77 ± 0.03^{A}	5.90 ± 1.01^{a}	0.32 ± 0.04^{b}	9.6 ± 0.86^{B}	0.38 ± 0.11^{a}	0.71 ± 0.00^{ab}	2.82 ± 0.32^{a}	1.94 ± 0.12^{a}
NPK_2 OM_1	5.40 ± 0.21^{a}	102.67 ±3.91^{ab}	1.62 ± 0.17^{B}	2.80 ± 0.30^{c}	0.42 ± 0.01^{a}	3.92 ± 0.48^{Cd}	0.30 ±0.08^{ab}	0.74 ± 0.03^{a}	2.45 ± 0.06^{ab}	1.82 ± 0.02^{a}
NPK_2 OK_2	5.53 ± 0.22^{a}	107.33 ±21.21^{a}	2.67 ± 0.19^{A}	4.42 ± 0.51^{b}	0.43 ± 0.02^{a}	6.25 ± 0.38^{C}	0.35 ± 0.2^{ab}	0.71 ± 0.03^{ab}	2.98 ± 0.07^{a}	2.0 ± 0.33^{a}
Overall mean	5.39 ± 0.18	79.17 ± 4.89	1.47 ± 0.14	2.68 ± 0.32	0.24 ± 0.02	6.12 ± 0.71	0.23 ± 0.05	0.70 ± 0.08	**3.77** ± 0.13	**1.90** ± 0.31

Mean in each column followed by the same letter indicate not significantly different at P<0.05. (Control = no fertilizer, no poultry manure; PM_1 = 5t/ha of poultry; PM_2 = 10 t/ha of poultry manure; NPK_1 = 60 kg/ha of NPK 15:15:15 fertilizer; NPK $_2$ = 120 kg/ha of NPK 15:15:15 fertilizer; NPK_1PM_1 = 60 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK $_2PM_2$ = 120 kg/ha NPK fertilizer + 10 t/ha of poultry manure; NPK_2PM_1 = 120 kg/ha NPK 15:15:15 fertilizer + 5 t/ha of poultry manure; NPK_1PM_2 = 60 kg/ha NPK 15:15:15 fertilizer + 10 t/ha poultry manure. Values are mean± SEM.

with PM and NPK. However the C: N ratio fell within the range required for easy release of N for plants despite the addition of high nitrogen based organic and inorganic fertilizers. This can be attributed to plant uptake as evidenced by large total leaf area of cucumber (Tables 3 and 4).

In addition, Tisdale and Werner (1975) observed that if organic matter has a C: N ratio less than 10, there is usually a release of mineral nitrogen early in the decomposition process resulting in N depletion. Available phosphorus (P) was higher in combined treated plots with fertilizer and poultry manure, a very essential nutrient to cucumber. The higher fruit yield recorded in dry season cropping suggests better mineralization and availability of P from the organic matter with time. This agrees with earlier reports by Cooke (1982) and Marjan and Lippert (2005) which stated that organic matter tend to take more time to release their principal nutrients at the time the plants needs it for best growth.

Generally, all the exchangeable cations appreciated after the experiment except in the control plots. This can be attributed to treatment's effects. This was also in-line with the findings of Brady and Weil (1999) who observed that calcium and magnesium are supplied through plant residue, animal dungs, commercial fertilizers or soil mineralization.

Conclusion

The results obtained from this study showed that various treatment combinations applied to cucumber significantly influenced vine length, leaf area, number of leaves, number of fruits/treatment and yield/ha both at wet and dry season. The study also reveals that irrespective of treatment combinations imposed, the dry season crops performed better than the wet season crops in all parameters monitored except on leaf area at 4 WAP. Furthermore, it was observed that plots that received the various treatments performed better when compared to the control plots in all parameters assessed. Consequently, it was recommended that cucumber farmers in the area should apply 60 kg/ha NPK + 10 tons/ha of poultry manure during the wet cropping season and 60 kg/ha NPK + 5 tons/ha poultry manure during the dry season to sustain cucumber production and to also maximize economic returns. Finally, irrigation facilities should be provided for dry season farming.

REFERENCES

Ahn M, Peter A (1979). West African hAgric. African Soils, Oxford, Glass grows, 3 (1): 34-45.

Anene C (1987). The effect of attack by the flea beetle *Podagrica spp* on seed yield of two okra cultvars at Zaria Nig. J. Entomol. (8): 95-98.

Ayotamuno JM, Zoufa K, Ofori SA, Kogbara RB (2007). Response of maize and cucumber intercrop to soil moisture control through irrigation and mulching during the dry season in Nigeria. Afr. J. Biotechnol. 6 (5): 509

Black CA, Evans DD, Whils JL, Ensminger LE, Clerk FE (1965). Methods of soil analysis. Part 2. Am. Soc. Of Agron. Inc. Madison. Wisconsin, 1147-1573.

Brady NC, Weil RR (1999). The Nature and properties of soils. 12^{th} ed. Prentice-Hall Inc. Upper Sadde River. New Jersey, 07458: 552-554.

Cooke GW (1982). Fertilizing for maximum yield. Chaucer Press Ltd. Bungay Suffok, 81-277.

Dainello FJ (2005). Commercial organic vegetable production guide. Ext Hort. Dept. of Horticultural Science, Texas A & M University. 1-4.

Hector V, Randall T and Steve F (2005). Field cucumber production guidelines. Hawaii Cooperative Ext. Agent. 1-17.

Hedge DM, Srinvask (1989). Growth and yield analysis of tomato in relation to soil metric potential and nitrogen fertilization. Indian found of Agron. 34: 157-162.

IFAS (2005). Cucumber production in Miami-Dade Country, Florida U.S. Department of Agric Cooperative Extension Services University of Florida IFAS Florida.pp. 5-8

Jose D, Shanmugavelu KG, Thomburaj S (1988). Studies on the efficiency of organic matter vs inorganic form of nitrogen in Brinjal Indian J. Horticulture. 45: 100-103.

Knudsen D, Peterson GA, Pratt PF (1982). Lithium, Sodium and Potassium in methods of soil. 2: 225-246.

Li YC, Bryan W, Lamberts M, OLC2YK T (2005). Cucumber Production in Miami-Dade County, Florida.p. 69.

Ma L, Gardner EP, Selamat A (1992). Estimation of leaf area and total mass measurement in peanut: J. Crop Sci. 32: 46-470.

Marjan K (2005). Fertilizers South Califonia Master Gardener Training Manual. E.C. 678: 1-8

Marjan K, Lippert B (2005). Home and Garden Information Centre adopted from South Carolina Gardener Training Manual. 678: 98-118.

Moore FD (2000). Fertilizing the vegetable Garden. Quick Facts. CSU Cooperative J. Extension Horticulture J. 7: 611.

NMA (2009) Nigerian Meteorological Agency. P.M.B 5040, Port Harcourt Nigeria.

Olsen SR, Sommers LE (1999). Determination of available phosphorus. In methods of Soil Analysis part 2. Chemical and micro biological properties. Agron. Monograph, 9 (2): 403-430.

Ramanujam T, Indira P (1978). Linear measurement and weight method for estimation of leaf area in cassava and sweet potato root crops J. 4 (2): 47-50.

SAS (1999). Statistical Analytical System User's Guide Version 8 Ed. Cary, NCSAS institute.

SERC (1993). Summit Engineering and Research Crops. Final report, (IV) B: 1-15.

Stephen RC, Cartor LR (1983). Crop production principles and machines. W.H. Freehand and company: p. 559.

Thomas GW (1982). Exchangeable Cations methods of Soil Analysis J. Agronomy . 9: 159 -161.

Tisdale SL, Werner NL (1975). Soil fertility and fertilizers. Macmillan Publishing Co. Inc. New York. 3: 411.