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Full Length Research Article

STUDIES ON THE PERFORMANCE OF ORGANIC AND INORGANIC FERTILIZER ON THE GROWTH AND YIELD OF CUCUMBER (*CUCUMIS SATIVUS L.)*

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ABSTRACT
Experiments were conducted in the Botanical Garden of the Department of Biology of Kaduna State University to study the effects of Organic and Inorganic Fertilizer on the growth and yield of *Cucumis sativus* L. The seeds for the experiment were locally sourced. Four (4) days after transplanting, a rate of 2ton/ha, 4ton/ha, 6ton/ha poultry manure was applied. Similarly, a rate of 25g/ha, 50g/ha, 75g/ha of NPK was also applied and a control. Seeds of cucumber were planted by broadcasting on the seed bed the seedlings were transplanted after germination. The plants were subjected to irrigation by watering morning and evening. The results of Analysis of Variance (ANOVA) indicated significance difference among the treatments with respect to the parameters studied ($p \leq 0.05$). Highest plant height of 33cm was recorded with 6ton/ha compared to the control which had 11.5cm. However, highest number of leaves was recorded with 4ton/ha and was followed by the 6ton/ha. The best stem girth of 1.8cm, was observed with 4ton/ha while the control had 0.88cm stem girth. Excellent vigour was produced by the 6ton/ha, while the lowest vigour was observed with the 2ton/ha. The best plant yields of was observed with 6ton/ha compared with the control which had the least performance. On the other hand, 25kg/ha of NPK had the highest plant height of 20.5cm while the lowest plant height of 13cm was observed with 75kg/ha, compared to the control which had 11.5cm. The 25kg/ha gave the highest number of leaves followed by the 50kg/ha and 75kg/ha which both had the lowest number of five (5) leaves. Similarly, 50kg/ha had the highest stem girth of 1.2cm while the lowest stem girth was observed with the control which had 0.7cm stem girth. The best vigour was recorded with the 25kg/ha compared to the control which had the least vigour. Also, highest plant yields was recorded with 25kg/ha and the lowest plant yield was observed in the control. The application of poultry manure in the propagation of *Cucumis sativus* remarkably influenced the growth and yield of Cucumber.

Keywords: Organic, Inorganic, Fertilizer, Growth, Yield, Cucumber

INTRODUCTION

Cucumis sativus is a widely cultivated plant in the gourd family, Cucurbitaceae. It is a creeping vine that bears cucumiform fruits that are used as vegetables. There are three main varieties of cucumber: slicing, pickling, and seedless. Within these varieties, several cultivars have been created. The cucumber is originally from South Asia, but now grows on most continents. Many different types of cucumber are traded on the global market (Nonneck, 1989; Wells, 2016).

The cucumber is a creeping vine that roots in the ground up trellises or other supporting frames, wrapping around supports with thin, spiraling tendrils. The plant may also root in a soilless medium and will prowl along the ground. The vine has large leaves that form a canopy over the fruits. The fruit is roughly cylindrical, but elongated with tapered ends, and may be as large as 60 centimetres (24 in) long and 10 centimetres (3.9 in) in diameter. Cucumber fruit consist of 95% water. They are vine crops and grown on the ground or on poles or trellises to suspend to fruit (Nonneck, 1989; Wells, 2016)
Cucumbers come in three different types: seedless, seeded, and mini. They have a wide variety of skin colours ranging from yellow, resembling lemons, but they are sweet, have thin skins, and contain seeds. (Nonneck, 1989). The soils where cucumber is cultivated require moderate to high nutrient levels so as to achieve high yields. Infertile soils result in bitter and misshapen fruits which are often rejected by consumers thereby reducing farmers' income. (Jannick *et al*., 2007)
Most soils as a result of cultivation over time, have suffered nutrient depletion such that high yields can only be attained through the judicious application of inorganic fertilizers. Many studies of various crops have shown significant advantages of applying inorganic fertilizers (Akinrinde, 2006).
Many varieties of cucumber exist with varying shapes and sizes, skin colour and carotene content (Simon, 1992). The variation in the performance of cucumber varieties has been widely documented by many scholars (Axelson *et al*., 1980; Manyvong, 1997), which could be as a result of genetic composition or environmental factors. Some people use cucumber to soothe sunburn. Cucumber contains lignin, which may help fight cardiovascular disease. Cucumber is a versatile food that can be added to variety of dishes. (Axelson *et al.,* 1980, Adewole and Fakore, 2011)
Application of organic waste including manure, sewage sludge, municipal compost in soil is a suitable method for the maintenance of soil organic matter, improve soil quality and supply nutrients needed by plants (Boller and Hani, 2004; Cheery and Mcforley, 2005 and Dauda *et al,* 2005). Excessive use of chemical fertilizers and pesticides in agricultural ecosystems create some problems such as environmental pollution, soil erosion, food chain restriction, pest resistance to pesticides. Unprincipled use of agricultural pesticides and nitrogen fertilizer and harmful effects on humans and environments, are the critical issues of today's world. Use of organic fertilizers and biological control, plays an important role in this context (Greer and Diver, 2000).
Cucumis sativus is grown by small scale farmers who cannot apply recommended rates of nutrients; hence net negative nutrient balances, this leads to low production and contributes to food

insecurity. Nutrients can be supplied from either inorganic or organic sources (Savci, 2012; Kumara *et al.,* 2014).
Inorganic fertilizers are expensive, out of reach of poor farmers and the nutrients are easily leached leading to pollution of water sources. Slow release of fertilizers dissolves gradually thereby delaying nutrient release to curb pollution (Wells, 2016). The need for enhance sustainable increase in production; and per hectare yield of plant requires an understanding of the quantity/rate of nutrients to be applied per hectar. The result of a large number of experiment of organic fertilizers conducted in several countries revealed that inorganic alone cannot sustain productivity of soils under highly intensive cropping system (Khan *et al.* 2010).The short term benefits from use of inorganic sources include fast release of nutrients to meet crop demand and convenience in application (Savci, 2012). The aim of this work is to study the effect of varying quantities Organic and Inorganic Fertilizers on the growth and yield of Cucumber *Cucumis sativus*.

MATERIALS AND METHODS

Study Area
The experiment was conducted in the Botanical Garden of the Department of Biology, Kaduna State University which is located at latitude $10^0.31^1$ and north, and longitude $7^0.26^1$ and 6.14 meter above the sea level.

Source of Planting Materials
The seeds for the experiment were locally sourced from Kawo market, Kaduna State.

Treatments

Organic Manure
Poultry manure was applied in the following rates, 2ton/ha, 4ton/ha, 6ton/ha and a control as adapted by Tahir *et al.* (2014).

Inorganic Manure
The inorganic fertilizer used was NPK in the following varying rates; 25g/ha, 50g/ha, 75g/ha and a control (Tahir *et al*., 2014.)

Planting
Seeds of cucumber were planted by broadcasting on the seed bed and monitored for germination, the seedling after germination were transplanted on the permanent site (Tahir *et al*., 2014).

Transplanting
After germination, the healthy seedlings were transplanted in polythene bags containing loamy soil with an intra-raw spacing of 2mm of plant Distance between the plants (Tahir *et al*., 2014).

Cultural Practices

Fertilization Application
Both the poultry manure and NPK fertilizers were applied separately 4 days after transplanting and continued at 4 days interval for nine weeks, the fertilizer was applied 4cm away from the plant (Tahir *et al*., 2014)

Watering of the plants
Being a dry season, at the initial stages (November to January) the plants were subjected to irrigation for healthy growth by the application of water morning and evening (Tahir *et al*., 2014.)

Observation and Data collection
Data were collected 3 weeks after germination and the application of fertilizer at 4 days interval. The following parameters were studied;

Plant Height
This was determined using measuring tape. The tape was used to measure the height of the plant from the level of the soil to the top of the shoot apex (Tahir *et al*., 2015)

Number of Leaves
This was determined by counting the number of leaves per plant (Salisu**,** 2018).

Stem Girth
This was determined using measuring tape, by putting the tape round the stem of the plant (Tahir *et al*., 2015).

Plant Yield
This was determined by counting the number of cucumber fruit per plant.

Vigour
This was determined based on morphological appearance. Using a scale of 1-5 (1 = excellent,
2 = very good, 3 = good, 4 = fair and 5 = poor) (Tahir *et al*., 2015)

Experimental Design
The experimental materials were arranged using Complete Randomized Design (CRD). There were 6 treatments including a control with 3 replications. The experiment was run for 9 weeks (Tahir *et al*., 2015).

Data analysis
The data generated from the work was analyzed using Analysis of Variance (ANOVA) SAS (2002) statistical package. Least Significant Different (LSD) was also used to compare treatment mean. ($P<0.005$).

RESULTS

Effects of Poultry Manure

Plant height
On the effect of poultry manure, 6ton/ha treatment had the highest plant height of 33.3cm followed by 4ton/ha treatment which had the average plant height of 29cm. The lowest plant height of 23.5cm was observed with 2ton/ha, compared to the control which had 11.5cm (Table 1 & Plate i).

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Plate i: Plant height in 9 weeks old *Cucumis sativus* using poultry manur**e**

Number of leaves

The 4ton/ha treatment had the highest number of leaves of eight (8), followed by the 6ton/ha which had seven leaves. However, the lowest number of leaves of 6 was observed with 2ton/ha, compared to control which had four (4) leaves (Table 1 & Plate ii).

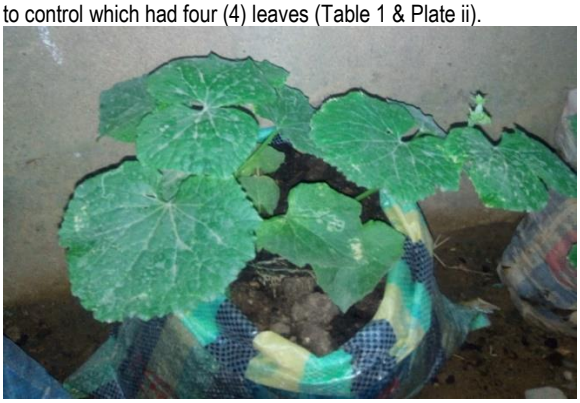

Plate ii: Number of leaves in 9 weeks old *Cucumis sativus* using poultry manur**e**

Stem Girth

Treatment with the 4ton/ha had the highest stem girth of 1.8cm, followed by 6ton/had which had the stem girth of 1.5cm, the lowest stem girth 1.3cm was observed with the 2ton/ha, compared to the control which had 0.88 stem girth (Table 1 & Plate iii).

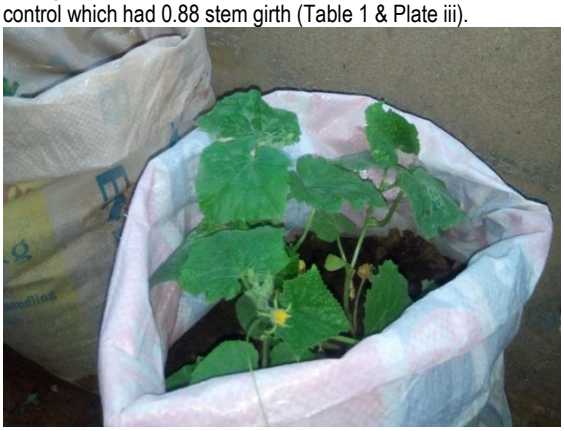

Plate iii: Stem girth in 9 weeks old *Cucumis sativus* using poultry manur**e**

Vigour:

Treatment with the 6ton/ha had the best vigour of 1(excellent), followed by the treatment with the 4ton/ha which had vigour of 2 (very good), while the lowest vigour of 3 (good) was observed with the 2ton/ha treatment compared to the control which had the least vigour of 5(poor) (Table 1 & Plate iv)

Plate iv: Vigor in 9 weeks old *Cucumis sativus* using poultry manur**e**

Plant Yield

High number of fruits was observed with 6ton/ha and 4ton/ha treatments. The highest number of plant yields of thirteen (13), followed by the treatment with 2ton/ha which had nine (9) fruit, the lowest plant yields of four was observed in control (Table 1 & Plate v).

Plate v: Plant yield in 9 weeks old *Cucumis sativus* using poultry manure.

Table 1: The Effect of Poultry Manure the Growth and Yield of *Cucumis sativus*

Parameters	Manure (Ton/ha)			Control	p value
	2	4	6		
Plant height (cm)	18.4±3.28^{a}	23.7±3.16^{a}	25.1±3.52^{a}	11.0^{a}	0.2275
Number of leaves	5.67±0.33^{bc}	4.66±0.33^{cd}	6.33±0.33^{ab}	4.00^{d}	0.0267*
Stem girth (cm)	0.99±0.01^{b}	1.11±0.01^{a}	1.01±0.01^{b}	0.76^{c}	0.0003*
Root length (cm)	7.09±0.54^{a}	7.93±0.94^{a}	8.03±0.55^{a}	5.65^{a}	0.3852*
Vigour	3.36±0.23^{b}	2.27±0.26^{c}	1.36±0.23^{c}	5.00^{a}	0.0011
Days to flowering	5.60±0.00^{b}	5.30±0.00^{c}	4.40±0.06^{d}	7.90^{a}	<0.0001*
Plant yield (%)	6.67±1.20^{a}	9.00±2.00^{a}	11.3±0.88^{a}	4.00^{a}	0.1199

The values are expressed as mean ± standard error of mean (SEM). In each row, mean values with different superscripts have statistically significant difference ($p < 0.05$).

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The highest height was obtained in 6ton/ha of poultry manure followed by 4ton/ha. Similarly control treatment showed poor height (Fig. 1).

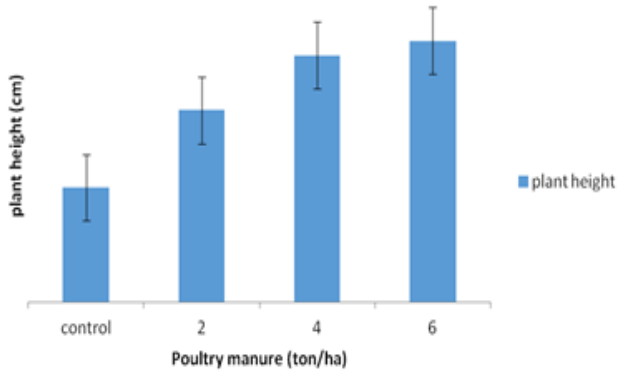

Figure 1: The effect of poultry manure on plant height

The highest number of leaves was obtained in 6ton/ha, followed by 2ton/ha. Similarly control treatment shows poor number of leaves (Fig. 2).

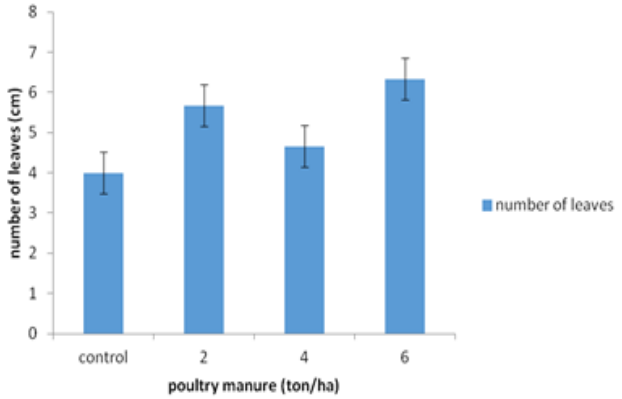

Figure 2: The effect of poultry manure on number of leaves

The highest number of stem girth was obtained in 4ton/ha, followed by 6ton/ha and 2ton/ha. Similarly control treatment shows poor stem girth (Fig. 3)

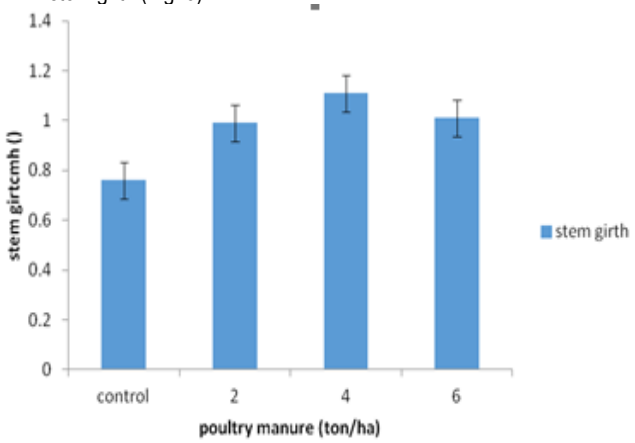

Figure 3: The effect of poultry manure on stem girth.

The highest number of root length was obtained in 6ton/ha, followed by 4ton/ha, followed by 2ton/ha and then control (Fig. 4).

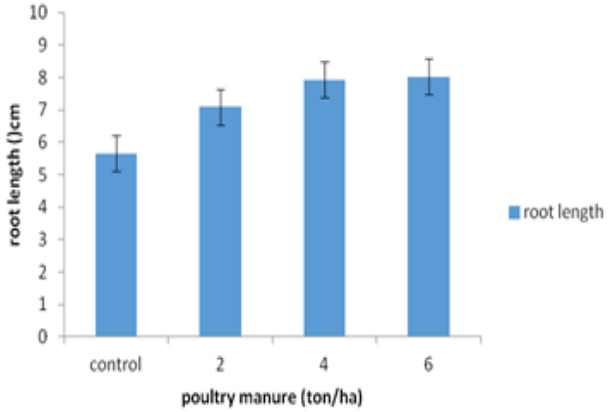

Figure 4: The effect of poultry manure on root length.

The highest number of plant yield was obtained in 6ton/ha, followed by 4ton/ha, followed by 2ton/ha, and compared to control with the least significant figure (Fig.5).

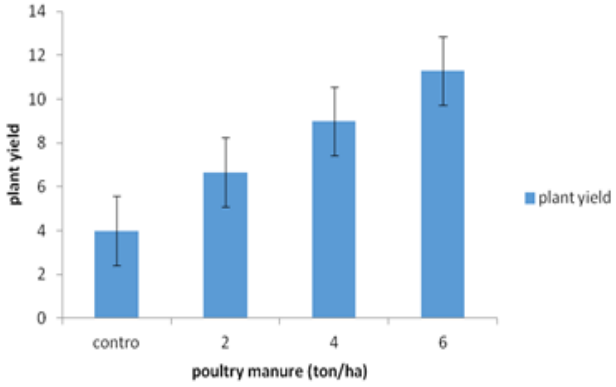

Figure 5: The effect of poultry manure on plant yield.

The best vigour was obtained in 6ton/ha compared to control which had the poorest vigour (Fig.6).

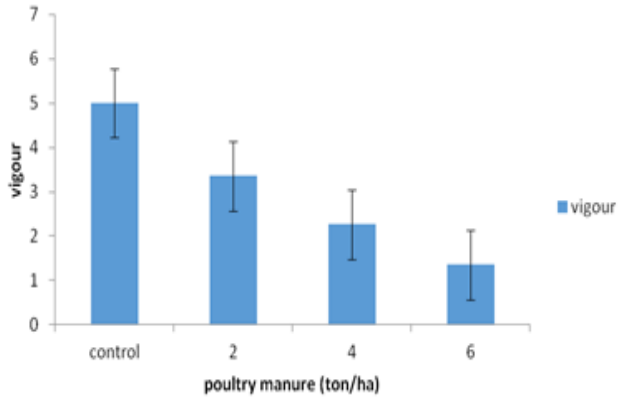

Figure 6: The effect of poultry manure on plant vigour.

The early days to flowering was obtained in 6ton/ha, followed by 4ton/ha, compared to control with late days to flowering (Fig. 7)

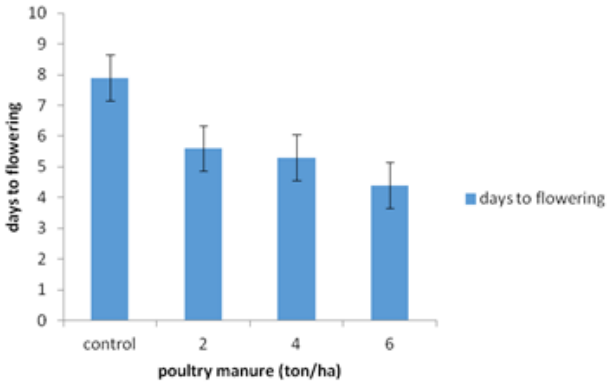

Figure 7: The effect of poultry manure on days to flowering.

Effects of NPK fertilizer on Plant Height

On the effect of NPK fertilizer, 25kg/ha treatment had the highest plant height of 20.5cm, followed by the 50kg/ha, which had the average plant height of 14.5cm, the lowest plant height of 13cm was observed with 75kg/ha, compared to the control which had 11.5cm. (Table 2 & Plate vi)

Plate vi: Plant height in 9 weeks of *Cucumis sativus* using NPK fertilizer

Number of leaves

The 25kg/ha treatment had the highest number of leaves of six, followed by the 50kg/ha and 75kg/ha which both had the lowest number of five leaves, compared to control which had four number of leaves.(Table 2 & Plate vii)

Plate vii: Number of leaves in 9 weeks old of *Cucumis sativus* using NPK fertilizer

Stem Girth

Treatment with the 50kg/ha had the highest stem girth of 1.2cm, followed by 75kg/ha which had the stem girth of 0.9cm, the lowest stem girth of 0.8 was observed with the treatment of 25g/ha, compared to the control which had 0.7cm stem girth. (Table 2 & Plate viii)

Plate viii: Stem girth in 9 weeks old of *Cucumis sativus* using NPK fertilizer

Vigour

Treatment with the 25kg/ha had the best vigour of 2 (very good), followed by the treatment with the 50kg/ha which had the vigour of 3 (good), while the lowest vigour of 4 was observed with the 75kg/ha treatment, compared to control which had the least vigour of 5 (poor). (Table 2 & Plate ix)

Plate ix: Vigor in 9 weeks old of *Cucumis sativus* using NPK fertilizer

Plant yield

Fruit was observed with treatment of 25kg/ha with the highest plant yields of eight, followed by treatment with 50kg/ha which had six fruit, followed by treatment 75kg/ha which had five fruit, the lowest plant yield of four was observed in control (Table 2 & Plate x)

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Plate x: Plant vigour in 9 weeks of *Cucumis sativus* using NPK fertilizer

Table 2: Effect of NPK Fertilizer on the Growth and Yield of *Cucumis sativus*

Parameters	Fertilizer (kg/ha)			Control	*p value*
	25	50	75		
Plant height (cm)	16.4±2.35[a]	12.0±1.17[a]	12.5±0.48[a]	11.0[a]	0.3101
Number of leaves	5.00±0.58[a]	4.33±0.33[a]	3.67±0.67[a]	4.00[a]	0.4410
Stem girth (cm)	0.99±0.01[b]	1.11±0.01[a]	1.02±0.00[b]	0.76[c]	<0.0001*
Root length (cm)	6.09±0.54[a]	6.72±0.85[a]	7.03±0.55[a]	5.65[a]	0.6612
Vigor	4.37±0.23[a]	3.37±0.23[a]	2.99±0.84[a]	5.00[a]	0.2195
Plant yield (%)	6.33±0.06[a]	4.33±0.88[a]	4.33±0.33[a]	4.00[a]	0.3657
Days to flowering	6.90±0.06[a]	7.53±0.03[a]	6.53±1.27[a]	7.90[a]	0.0369*

The values are expressed as mean ± standard error of mean (SEM). In each row, mean values with different superscripts have statistically significant difference ($p < 0.05$).

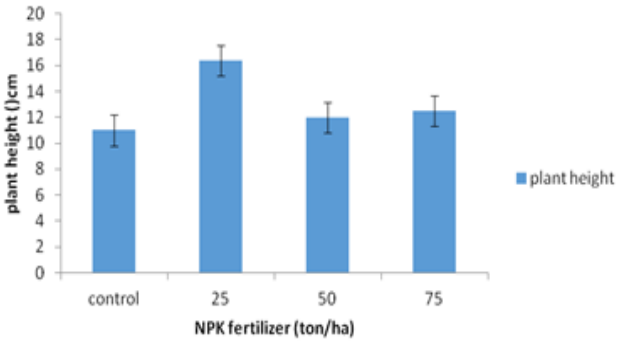

Figure 8: The Effect of NPK Fertilizer on Plant Height

The best plant height was obtained in 25kg/ha of NPK fertilizer, followed by 75kg/ha, compare to control which had poor height.

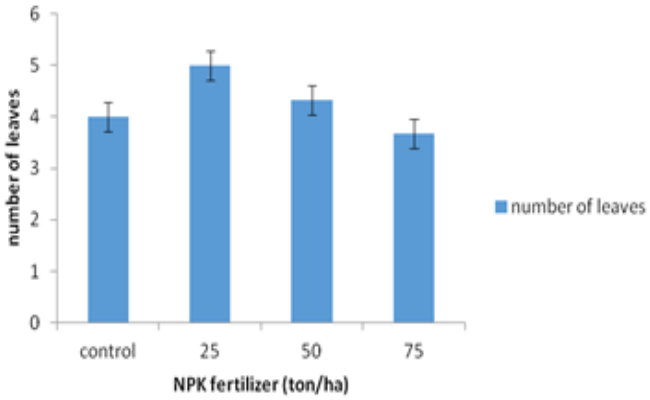

Figure 9: The Effect of NPK Fertilizer on Number of Leaves

The highest number of leaves was obtained in 25kg/ha, followed by 50kg/ha, compared to control with poor number of leaves.

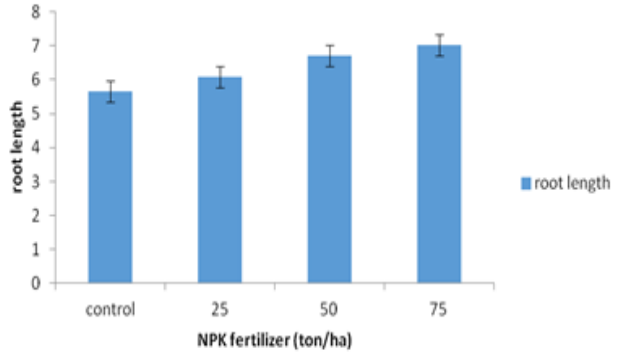

Figure 10: The Effect of NPK Fertilizer on Root Length

The best root length was obtained in 75kg/ha, followed by 50kg/ha, compare to control with poor root length.

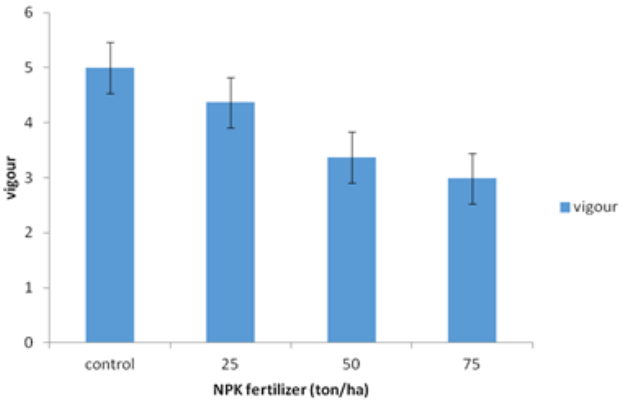

Figure 11: The Effect of NPK Fertilizer on Plant Vigour

Best vigour was obtained in 75kg/ha, followed by 5okg/ha, compare to control with poor vigour.

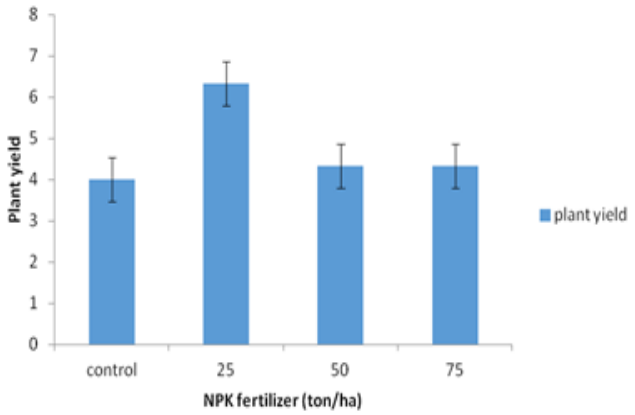

Figure 12: The Effect of NPK on Plant Yield

The best plant yield was obtained in 25kg/ha, followed by 75kg/ha and 50kg/ha, compared to control with poor plant yield.

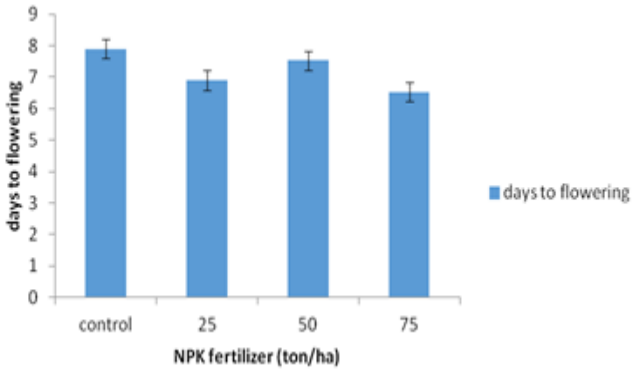

Figure 13: The Effect of NPK Fertilizer on days to Flowering

From the figure above, early days to flowering was obtained in 75kg/ha, followed by 25kg/ha, compared to control with delayed flowering.

DISCUSSION

The highest plant height observed in 6ton/ha poultry manure treatment and the lowest plant height observed in 50kg/ha NPK treatment were contrary to the findings of Makinde *et al.,* (2010) who worked on the effect of organic, organominerals and NPK fertilizer on the quality of *Amaranthus cruentus*. on two soil type in Lagos, Nigeria. They found out that the precise requirement of inorganic fertilizer and its possible substitute is yet to be validated for the production of *A. cruentus.* However, according to Michael (2010), the quality of application of organic manure has effects on crop yield and nutrient uptake. This is also consistent with the work of (Xu *et al.,* 2005), who showed that vegetables grown with higher level of organic manure grew better and in a final higher total yield than those grown on lower amount together with those grown using synthetic fertilizer.

The highest number of leaves observed in cucumber treated with 4ton/ha of poultry manure with the level of 4ton/ha and the lowest number of leaves observed in 75kg/ha NPK was in agreement with the work of Adeyemi *et al.,* (1987) who studied the effect of poultry manure and cutting height on performance of *Cucumis sativus* reported that, adequacy of manure increase the number of leaves.

Similarly, Ibude *et al.,* (1988) observed that, plant grown on unfertilized plots produced the shortest plant and poor leaves as they have to rely on the native fertility of the soil.

According to Al farhad *et al*., (2009), herbage yield is the function of growing condition and crop management practice. However, in this study, it was observed that poultry manure did not significantly affect herbage yield. Aliyu (2000) made similar observation on garden egg and okra plant respectively.

The highest stem girth was observed in 4 ton/ha poultry manure treatment with the lowest girth observed in 25kg/ha NPK treatment. Okokoh (2011) obtained the highest stem girth in *Cucumis sativus* when he applied 4ton/ha of poultry manure.

The best vigour was observed in 6ton/ha poultry manure treatment while the lowest vigour was observed in 75kg/ha NPK fertilizer treatment, this is in consistence with the work of Xu *et al*., (2005), who reported that, Cucumber grown in organic manure grew better and produced higher yield than those grown using synthetic fertilizer.

Conclusion

Application of 6ton/ha of poultry manure is a good rate that enhances the growth and yield of *Cucumis sativus.* The highest plant height and seedling vigour were obtained in poultry manure treated plants. Therefore the application of poultry manure in the propagation of *Cucumis sativus remarkably* influences the growth and yield of the plant

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