EFFECT OF POULTRY MANURE AND MINERAL FERTILIZER ON THE GROWTH PERFORMANCE AND QUALITY OF CUCUMBER FRUITS

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KEYWORDS

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Yield

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ABSTRACT

Effect of poultry manure and organic fertilizer (NPK 20:10:10) on the growth and quality of cucumber fruits was studied at the experimental site of the Teaching and Research Farm of the Department of Crop Science and Horticulture, Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Igbariam campus. The experiment was laid out in a randomized complete block design (RCBD) with four levels of treatments consisting of 4tha⁻¹ poultry manure (PM), 900 kgha⁻¹ NPK in a ratio of 20:10:10 (NPK), 2 tha⁻¹ poultry manure + 450 kgha⁻¹ NPK fertilizer (PM + NPK) and 0 tha⁻¹ control (CO), where no treatment was applied. Data collected were tested using analysis of variance and significant differences among treatment means were separated using LSD at 0.05 probability level. The results obtained from the study indicated that the numbers of leaves of cucumber increased as weeks after planting (WAP) increased. The highest leaves numbers was observed in the plots treated by PM. The order of leaves increases from 2 to 6 weeks were PM > PM+NPK > NPK > CO. The length of fruits, number of fruits, the quality of marketable fruits and weight of fruits increased proportionately in PM treated plots and were significantly (P=0.05) different among the other treatments except for quality of marketable fruits. The highest value of 171.25cm (length of fruits), 10.75 (number of fruits) and 2.38kgha⁻¹ (weight of fruits) were obtained in PM treated plots. Based on the results obtained it is evident that poultry manure as organic manure and its mixture (PM + NPK) is a good source of soil amendment, since it influenced the growth and yield components of cucumber.

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1 Introduction

Production of cucumber in Nigeria has increased probably due to awareness being created by its market demand and economic returns, short duration in maturity or due to its nutritional and medicinal values. Hence it has become a popular vegetable crop in Nigeria. Both older and young people enjoy the cucumber fruit of which many in their leisure time usually eat with fried groundnut in their offices, homes, and market place or recreational areas. When given proper care and protection, cucumber tends to produce well. It is a crop that grows well in a well drained fertile soil with good moisture retention ability. This crop required high amount of soil nutrients from seedling stage to maturity and highly sensitive to excessive water or waterlogs environment and adequate soil tillage for easy fragile root penetration, is required prior to sowing or planting (Nweke et al., 2014). Water logging usually causes or trigger off leaf problem in cucumber. Increase in cucumber production can be achieved either by putting more land area under its cultivation or by using improved varieties with appropriate cultural practices. However, manure application either in form of organic or mineral fertilizer is found to be the quickest and easiest ways of increasing the yield of cucumber per unit area (Nweke et al., 2014, Nweke & Nsoanya, 2015).

Mineral fertilizers were used to provide soil nutrients in order to maintain optimum soil fertility conditions and healthy growth of plants and quality yield. Chemical fertilizers help the growing crops to withstand stress conditions and in some cases these were used to correct plant nutrients deficiencies. According to Leonard (1986), maximum net returns in crop production can adequately be sustained with adequate fertilizer program that will supply the amounts of plants nutrients needed. Similar type of observation was reported by Akinrinde (2006) in various crop production studies. There are also various reports on the preferences of mineral fertilizer in the growth and productivity of crops (Adediran & Banjoko, 2003; Akinrinde, 2006; Nweke & Nsoanya, 2013a; Nweke & Emeh, 2013). NPK fertilizers are required greatly by crops for healthy development and crop quality. Furthermore, Ologunda (1987) reported that Nitrogen is the most limiting factor for production of crops on soils around the world. Hence Djokoto & Stephen (1961), argued that Nitrogen is the most important element in the nutrition of compositing micro flora since it is required for the simulation of carbon substrate in organic waste. The next element after N that limits the crop production in the tropical regions and indeed most regions of the world is phosphorus (Holford, 1997). According to HUE, (1995) inadequate P supply will result in a decreased synthesis of RNA, the protein maker, leading to decreased growth. Grain yield is often severally reduced with P deficiency (Jones et al., 2003). Potassium is required in least amount but in soil it is required in large amount by many crops and it is important for maintaining the osmotic potential and rigidity of plant cells; hence it plays a vital role in water relations in the plant. Marschner (1995) observed that K is involved in water uptake

from the soil, water retention in the plant tissue and long distance transport of water in the xylem and of photosynthetic in the phloem. With adequate K, cell walls are thicker, thereby improving plant resistance to lodging, pests and diseases (Bergmann, 1992).

It was based on the few highlighted qualities these three elements are formulated into NPK – fertilizer with different grade ratios. Some of the attendant problems of these elements when applied as fertilizer in a tropical humid environment like Nigeria is the development of soil acidity, fixation of P, making it virtually unavailable for plant uptake, due to the presence of large amount of iron and aluminum – oxides or amorphous alumina silicate clays in tropical soils. Holford (1997) estimated that as much as 90% added fertilizer phosphorous in all its natural forms including organic solution are fixed at any one time, while, Bergmann (1992), and Singh & Prehan, (1997), observed that if K is not taken up by plants, it might be lost by leaching as K is mobile and its retention by the negative charges on Clay surface is temporal as the application of Ca^{2+} or Mg^{2+} containing dolomite or gypsum displace it into the soil solution. Furthermore, Owen (2008) reported that synthetic fertilizers do not have good characteristics in aggregating soil particles. White (2006), in his own study, reported that potassium fertilizers have antagonistic effects on magnesium and directly, on the phosphorus content in some plants, hence conventional crops would contain toxic heavy metals such as cadmium.

Therefore, one of the major ways to reduce these problems is to add organic matter inform of organic manure to the soil. Organic manures are an excellent fertilizer containing nitrogen, phosphorus, potassium and micro-nutrients for healthy growth of plants. According to Magkos et al. (2003), poultry manure supply macro and trace elements not contained in the organic manure. It is a reservoir of nutrients, released during humidification that is eventually made available to the growing plants. Organic manure such as poultry manure can be used to ameliorate the amount of toxic compound produced by the chemical fertilizers. Poultry manure increase the organic matter (OM) content of soil and in turn releases the plant nutrients in available form for the use of the plants. Deskissa et al. (2008) emphasized that manure enable a soil to hold more water, improve the drainage, organic acids that help to dissolve soil nutrients and then made available for the crops. Poultry contained essential nutrient elements association with high photosynthetic activities and thus promotes root and vegetable growth (John et al., 2004).

The integration of inorganic fertilizer and organic manure has also been reported to be more beneficial than the use of either mineral fertilizer or organic manure alone especially in intensive agricultural production. Nweke et al. (2013), Nweke & Nsoanya (2013b) and Nweke & Nsoanya (2015) observed that nutrient use efficiency are been increased through the combination of organic manure and mineral fertilizer. It was against this backdrop that this work was conceptualized to

evaluate the effect of poultry manure and mineral fertilizer on the growth performance and quality of cucumber fruits.

2 Materials and Methods

2.1 Experimental setup

The experiments were conducted at the Teaching and Research Farm of the Department of Crop Science and Horticulture, Chukwuemeka Odumegwu Ojukwu University (formerly Anambra State University), Igbariam Campus, Anambra State, Nigeria. The area lies between latitude $06^{\circ} 14' N$ and longitude $06^{\circ} 45' E$. The rain fall pattern is bimodal and it occurred between April and October with a mean annual rainfall of about 1575mm. Annual temperature ranges from $25 - 35$ degree centigrade and the relative humidity of the study area is moderately high all year round with highest (85%) during the wet season and lowest (64%) during the dry season.

A land area of size $176m^2$ was manually cleared and debris removed. After cleaning, the plots were laid out as randomized complete block design (RCBD) with four replicates. Plot size was $3.25m \times 2m$ and a pathway of $1m$ apart. The level of treatment were no treatment or control (CO), $4tha^{-1}$ poultry manure (PM), $900kgha^{-1}$ NPK in recommended ratio 20:10:10 (NPK), $2tha^{-1}$ poultry manure + $450kgha^{-1}$ at same ratio NPK fertilizer (PM + NPK). The poultry manure treatment was applied to their respective plots one week before planting in order to enable proper decomposition and release of nutrients, while the NPK fertilizer and the mixture (PM + NPK) were applied two weeks after planting by ring method. Two seeds of cucumber were planted per hole which was later thinned down to one plant per hole, two weeks after germination. The seeds were sown to the depth of about 4cm deep and planting spacing of $50 cm \times 50cm$ was used. Field borders were properly cleared to avoid insects and rodents attacks. The field was kept relatively weed free till harvest, while insects and pests were controlled effectively using ZAP broad spectrum insecticide. Data on growth parameter were collected at 2, 4 and 6 weeks after planting (WAP) on the number of leaves.

Yield parameters were collected on length of fruit (cm), number of fruits, number of marketable fruits and fruit weight (kg).

2.2 Statistical Analysis

The data were collected from various parameters subjected to analysis of variance according to Steel & Torrie (1980). Treatment means were separated using the least significant difference at 5% probability level.

3 Results

Effect of the individual or combined application of the poultry manure and organic fertilizers on the growth and yield of Cucumber is represented in Table 1. The result showed that the effect of individual or combined application of poultry manure and NPK fertilizer on the number of leaves were significantly ($P = 0.05$) different at 4th weeks of data collection. Results of the study revealed that the values recorded for each treatment increased as the weeks after plant increased from 2 weeks to 6 weeks and the highest value for each stage was obtained from plots treated with poultry manure (PM) and the order of increase from 2 weeks to 6 weeks were $PM > PM + NPK > NPK > CO$. Data collected at the 4th week showed that values recorded for PM, and PM + NPK are statistically similar but significantly better than the control.

The results of fruit length, number of fruits, marketable fruits and weight of fruits are presented in Table 2 and it showed that the effect of poultry and mineral fertilizer were significantly ($P = 0.05$) difference among the treatment except for marketable fruits. The plots treated with PM gave the highest value in all the selected parameter measured, this was followed by PM + NPK and the least value were gotten from CO plots. The order of increase in all the yield parameter measured were $PM > PM + NPK > CO$. The result equally revealed that the values obtained from PM and PM +NPK plots were statistically similar, but significantly better than the control plots in length of fruits, number of fruits and weight of fruits.

Table 1 Effect of individual or combined application of poultry manure and mineral fertilizer on the number of leaves per cucumber plant.

Treatment	Weeks 2	After 4	Planting 6
PM	32.25	49.25	87.50
NPK	28.00	33.25	74.30
PM + NPK	29.25	48.25	83.50
CO	28.25	26.00	39.00
LSD0.05	Ns	17.99	Ns

PM = Poultry manure, NPK = NPK 20:10:10 Fertilizer, PM + NPK = Poultry manure + NPK 20; 10:10 Fertilizer mixture; CO = Control where no treatment was applied, LSD = Least Significant Difference, NS = Non – Significant.

Table 2 Effect of individual or combined application of poultry manure and mineral fertilizer on yield components of cucumber.

Treatment	Length of fruit cm	Number of fruits	Marketable fruits	Weight of fruits kg ha ⁻¹
PM	171.25 ^a	10.75 ^a	9.0 ^a	2.38 ^a
NPK	100.00 ^{bc}	6.75 ^{bc}	3.8 ^b	1.22 ^{bc}
PM + NPK	135.75 ^{ab}	8.75 ^{ac}	6.8 ^{ab}	1.73 ^{ab}
CO	64.25 ^c	4.25 ^b	3.0 ^b	0.76 ^c
LSD0.05	57.22	3.63	4.79	0.84

Means on the same column with the same letter do not differ significantly ($P=0.05$). Note PM = Poultry manure; NPK = NPK 20:10:10 Fertilizer; PM + NPK = Poultry manure + NPK 20:10:10 Fertilizer mixture; CO = control; LSD = Least significant difference.

4 Discussions

The result of the study revealed that growth and yield components of cucumber plant were increased and the highest values were observed in poultry manure (PM) treated plots and it was followed by the treatment containing PM + NPK treated plots. The higher values recorded in PM relative to PM + NPK plots in all the parameter measured could be attributed to higher level of nutrients especially nitrogen and phosphorous in poultry manure available for plant growth and their release as well as synchronization of nutrients released within the short period of growth of the cucumber plant.

Ghanbarian et al. (2008) reported that poultry manure contains higher nitrogen and phosphorous as compared to other manures, while Garg & Bahl (2008) indicated that poultry droppings readily supply phosphorous to plants than other organic waste. The number of leaves of cucumber measured increased as the week after planting increased from 2 weeks to 6 weeks. This indicated that organic manure has a profound effect on the vegetative growth of the cucumber plant. Aliyu (2000), Nweke & Obasi (2013) made similar observation in garden egg and Okra Plant respectively. Dauda et al. (2005) and Nweke et al. (2014) reported an increase in plant growth following poultry manure application. The increase in growth observed with poultry manure compared to the integration or mixture (PM + NPK) may be mainly due to reasons of more availability and release of nutrients by poultry manure through the growing period of the cucumber plant.

The number and length of fruits increased with the application of poultry manure which was significantly different among the treatments applied. The results could be due to higher number of leaves, flowers and fruiting buds which may have increased fruit production (Nweke et al., (2014). Increase in the number and length of fruits was equally reported by Nweke et al. (2014) following poultry manure application in agricultural crops. The marketable fruits result showed that sizable fruits of good quality was observed mainly in PM treated plots, though not significantly different from the other treatments, but the result indicated that the yield of cucumber fruits size and quality as well as price development and consumers demand can be increased with the use of poultry manure in cucumber production. Poultry manure replenishes soil N and other elements and build up organic matter content of the soil that support crop yield and greater abundance of soil invertebrates

and even reduced weeds growth (Hole et al., 2005; Herencia et al., 2007). A positive effect of organic manure have been also reported by Mc Robic (1998), and Adediran et al. (1999) to produce higher and better crops that keeps longer and more nutritious than organic manure. The weight of fruit result indicated that the yield of cucumber increased significantly with the application of treatments and was highest with poultry manure. The significant high yields obtained in the present study could be said to be caused by nutrient content of poultry manure which was translated into high vegetative growth giving rise to high photosynthetic activities which culminated into high yield observed in PM. John et al., (2004) made similar observation when they reported that poultry manure contained essential nutrient elements that favour high photosynthetic activities to promote plant roots and vegetative growth. Increase in yield of agricultural crops following organic manure application was reported in the works of Nweke & Obasi (2013), Nweke & Nsoanya (2013c), Nweke (2014), Okoli & Nweke (2015).

Conclusion

The result of the present study indicated that the application of poultry manure had more effect on the vegetative growth and yield components of cucumber compared to its mixture (PM + NPK) as the highest values were recorded in PM treated plots in all the parameters measured. Poultry manure released enough nutrients which resulted in significant increase in growth and yield of cucumber; also it serves as a good source of soil amendment, and improvement of soil properties which in turn resulted in improved growth and yield.

Conflict of interest

Authors would hereby like to declare that there is no conflict of interests that could possibly arise.

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