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GROWTH AND FRUIT YIELD OF TOMATO AS INFLUENCED BY COMBINED USE OF ORGANIC AND INORGANIC FERTILIZER IN KABBA, NIGERIA

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ABSTRACT: *Field experiments were conducted to investigate the effects of integrated use of chemical and organic fertilizers on growth and fruit yield of tomato in Kabba College of Agriculture. The experiment involved five treatments which are as follows: 125kh/ha NPK+3t/ha poultry manure, 125kg/ha NPK+3t/ha cow dung, 125kg/ha NPK+3t/ha kitchen waste, 125kg/ha NPK 15:15:15 and Control. The treatments were laid out in a Randomized Complete Block Design (RCBD) and replicated four times. The parameters taken on soil chemical properties are soil pH, total nitrogen, available phosphorus and soil organic matter. Growth and yield parameters taken are as follows: plant height (cm), number of leaves, and stem girth (cm), number of fruit per plant, fruit length (cm), fruit diameter (cm) and yield per land area (kg/ha). Result obtained from parameters studied (Plant height, leaf numbers, branch number, stem girth, fruit number per plant and fruits weight) revealed that tomato performed better (P<0.05) with the application of 125kg/ha NPK+3t/ha poultry manure application. The also, study showed that use of inorganic and organic fertilizer had better effects on growth and yield of tomato. Therefore, for good yield and better productivity of tomato, a combination of 125kg/ha NPK fertilizer + 3t/ha poultry waste is recommended for tomato production in the study area.*

KEYWORDS: Tomato, Growth, Yield, Organic, Inorganic, Fertilizer

INTRODUCTION

Tomato (*Lycopersicon lycopersicum*) is one of the most important vegetables grown for their edible fruits. Tomato is cultivated in Nigeria with an annual production of six million tonnes (Idah *et al*., 2007). Tomato is an excellent source of vitamins, minerals, and antioxidants which help control cancer, health disease as well as improve the general health of man (Antonio *et al*., 2004).

Most soils in Africa are poor compared with other parts of the world (Bationo *et al*, 2006). African soil nutrient balances are often negative due to a low level of fertilizer inputs, and soil nutrient depletion is a major reason for decreasing or stagnation of agricultural productivity (Sanchez, 1997. Mbah (2006) asserts that soil fertility is a major overriding constraint that affects all aspects of crop production. As is the case in other regions in Africa, local farmers use inadequate nutrient inputs, inappropriate quality and inefficient combinations of fertilizers, which in the end prove to be very costly (Palm, 1997). A consequence of this trend is a deeply unbalanced soil nutrient composition that ultimately leads to a reduction in crop yield potential (Tonfack *et al.*, 2009). Nutrients, when in adequate quantity, increases fruit quality, fruit size, colour, and fruit taste of tomato (Azad, 2000). It also helps in increasing desirable acidic flavour.

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Tomato production cuts across Nigeria's geo-political zones and generates income to the farmers, but the production system is on a low scale in southern guinea savannah, due to improper fertilizer usage which lead increases soil acidity (Lombin, 1987) and Cheezy and Yayock (1989). The use of organic manure alone is faced with problems of bulkiness and dirt. A balanced use of organic and inorganic fertilizers could enhance soil chemical, physical, and biological properties as well as rate of nutrient turn over within the soil-plant system (Paul and Mannan, 2006). Combined use of organic and Inorganic fertilizer reduced cost and amount of fertilizer required by crops (Krupnik *et al*., 2004). It also produced highest plant growth (Alam, 2006). In vegetable production, organic fertilizer combined with inorganic has proved to be effective in combating nematodes (Olatunji *et al*., 2012).

The high cost of tomato in the Nigerian market justifies that the production is far lower than the demand. If proper nutrient management is adapted by the tomato producer, the production will certainly goes up to meet the demand. This study was therefore designed to evaluate the effect of integrated use of organic and inorganic fertilizer on growth and yield of tomato in Kabba, Southern Guinea Savanna agro-ecology of Nigeria.

MATERIALS AND METHODS

Experimental site

The experiment was carried out for two consecutive growing seasons (2011 and 2012) at the Research Site of Horticultural Section, Kabba College of Agriculture, Kabba. The site is located at latitude of 07° 35' N and longitude of 06° 08' E and is 1000 m above sea level, in Southern Guinea Savanna Agro Ecological Zone of Nigeria, where the dry seasons are dry and hot while, wet seasons are cool. The rainfall spans between April to November with peak in June. The dry season extends from December to March. The mean annual rainfall is 1570mm per annum with an annual temperature range of 18°C - 32°C. The mean relative humidity (RH) is 60% (Meterological data, 2011). The major soil order within the experimental site is Gleysol (Higgins, 1957; Babalola, 2010).

Soil sampling and analysis

In order to determine some chemical properties of the soil on per plot basis, soil samples were collected from each plot at 30 and 60days after transplanting. Soil sample was analyzed in the laboratory for N, P, K, pH, organic carbon. Total N (%) was determined by the macro-Kjeldahl method (Bremner, 1982). Available P (ppm) was found using Bray I method according to Olsen (1982). Soil pH values were obtained by using a HI9813-5 portable pH/EC/TDS/°C meter (HANNA instruments, Romania, 2002). Soil organic carbon was determined by Walkley-Black procedure (Nelson and Sommers, 1982).

Field methods

An experiment was laid out in a randomized complete block design (RCBD) with three replications to investigate the effect combined use of organic and inorganic fertilizer on growth and yield of tomato. The experiments comprised of five treatments were as follows: T1: 125kg/ha NPK + 3 t/ha Poultry manure, T2: 125kg/ha NPK + 3t/ha cow dung, T3: 125kg/ha NPK + 3t/ha kitchen waste, T4: 250kg/ha NPK 15:15:15 fertilizer, T5: NO NPK, NO organic

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residues (Control). The treatments were carried out on the same plots in 2011 and 2012 growing seasons.

In the nursery, Seeds of tomato hybrid (ROMA V) were sown on a flat bed for one month before transplanting to the field. Sites were cleared manually using cutlass and later ridged with hoes. Organic manure were uniformly spread on the flat beds and incorporated with hoes two weeks before transplanting. NPK fertilizer was applied at transplanting. The seedlings were transplanting at the rate of one-plant-per-hole at a spacing of 75cm by 50cm which make up twenty-one stands per plot. Plots were weeded manually at three weeks interval.

Determination of growth and yield of tomato

Plant height was measured from the ground level to the growing point and the observation was recorded at the end of the growing period for each treatment and was expressed in centimeters. Similarly, effective leaves were counted and the mean was calculated. The number of days to 50% flowering was counted for all treatments. The average was then calculated and recorded. The total number of fruit clusters was counted for each treatment and then the mean was calculated and recorded. The observations on fruit weight for each treatment were recorded at the time of harvest. After each harvest, the individual fruits were weighed and the data on fruit weight was summed up and expressed in gram. The observations on yield were recorded at the time of harvesting. After harvesting, the tomato fruits were weighed from each treatment plots.

Data analysis

All data collected were analyze using the analysis of variance (ANOVA) using general linear model procedure of the statistical analysis system (SAS Institute, 2003) and means were compared using Duncan Multiple Range Test at p = 0.05 probability level (Steel and Torres, 1987).

RESULT AND DISCUSSIONS

The physicochemical properties of the soil in the study area were given in the Table 1. The results showed that the texture of the soil was sand loam and was slightly acidic in nature with P^H of 6.0. The organic matter content was low (1.45 g/100g). Total N was low (0.09 g/100g). The available P and potassium were equally low with values of 2.2 mg/kg^{-1} and 0.32 $Cmol/kg^{-1}$ respectively. The cation-exchange-capacity was low. Generally, the soil fertility was low based on the above fertility indices.

The chemical composition of agricultural waste materials used is shown in Table 2. The chemical characteristics of waste materials differed significantly (p=0.05). All the materials were relatively high in the essential nutrients required for the growth and development of crop. However, their C: N ratio varied and ranges between 10.66 in poultry manure and 17.7 in cow dung.

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Table 1: Pre-planting Soil Sample of the experimental site

Particle size	***%***
Sand	730.0
Clay	70.0
Silt	200.0
Soil texture	Sand loam
pH(H_2O)	6.0
Total N(g/100g)	0.09
Available P(mg/kg)	2.2
Exchangeable cations	Cmol/kg
K	0.32
Ca	2.48
Mg	3.61
Organic carbon(g/100g)	1.25
Organic matter(g/100g)	1.45

Table 2. Chemical composition of organic waste used

properties	***Poultry manure***	***Kitchen wastes***	***Cow dung***
Organic carbon (%)	38.36	54.00	43.35
Total N (%)	3.60	2.80	3.05
C:N	10.6	15.9	17.7
Phosphorus (%)	1.34	1.08	1.02
Potassium (%)	3.12	1.81	2.06
Calcium (%)	1.23	1.19	0.96
Magnesium (%)	0.32	0.24	0.21

Effect of Combined use of NPK fertilizer and Organic residue on growth characters of Tomato

From the results observed at four weeks after transplanting, plant height, number of branches, number of leaves produced, and the stem girth of the crops were significantly affected by the treatments. There were no significant differences in terms of plant height among the treatments of 125kg/ha + 3t/ha poultry manure, 125kg/ha NPK + 3t/ha cow dung, 125kg/ha NPK + 3t/ha kitchen waste and 250 kg/ha NPK fertilizer, although all these treatments were significantly better in terms of plant height than the control. The highest mean value of plant height was observed in 125kg/ha NPK + 3t/ha poultry manure, while the lowest mean value was observed in the unamend plot.

The number of branches in the plants was significantly affected by the treatment applied. The highest branches were observed in the plot with 125 kg/ha NPK + 3t/ha poultry manure. This was significantly better than plots with 250 kg/ha NPK, however the unamend plot recorded the least value of branches. Leaves were better produced in the plot with 125kg/ha NPK + 3t/ha poultry manure (29.4 leaves). This was significantly better than the plots with cow dung, kitchen waste at 3t/ha + NPK fertilizer, plot with 250kg/ha NPK and the control. However, unamend plots recorded the least values of leaves produced. Stem girth was better in the plot

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with 125kg/ha + 3t/ha poultry manure and the plot with sole application of NPK fertilizer at 250 kg/ha. However, the stem girth of the plants with 125kg/ha NPK + kitchen waste, 250kg/ha NPK fertilizer alone and the control were not significantly different.

The better performance of crops with NPK fertilizer combined with poultry manure in all the growth characters observed infers that the plant response to NPK fertilizer and poultry manure which agrees with earlier finding of Olatunji and Oboh (2012). They reported increase in growth and yield of tomato with combined use of organic and mineral fertilizer. The finding in this experiment also corroborated the findings of Li and Mahler (1995) who obtained better vegetative development in wheat, most especially when soil was amended with inorganic and organic materials of low C:N ratio.

Table 3: Tomato growth characters as influenced by combine use of organic & inorganic Fertilizer (mean of 2011 and 2012)

treatment	*Plant Height (cm)*	*Number of Branches*	*Number of leaves*	*Stem Girth (cm)*
125Kg/ha NPK + 3t/ha PTY	61.8[a]	6.65[a]	29.4a	0.92[a]
125Kg/ha NPK + 3t/ha CWD	54.8[ab]	3.80[b]	21.0[b]	0.71[a]
125Kg/ha NPK + 3t/ha KTH	54.4[ab]	2.55[bc]	16.5[b]	0.62[a]
250 Kg/ha NPK Fertilizer	54.4[ab]	3.75[b]	19.5[b]	0.76[a]
Control	41.9[b]	1.56[c]	15.4[b]	0.56[a]

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT. NPK (NPK fertilizer), PTY (poultry manure), CWD (cow dung), KTW (kitchen wastes).

Effects of NPK and organic residues on soil and leaf nutrient of tomato

Table 3 shows the effect of application of organic residues and NPK fertilizer on soil and leaf nutrients of tomato. Soil N, P, and K were significantly affected. Plot with 125kg/ha NPK + poultry manure (3t/ha) had the highest value of soil nutrients. However, this was not significantly better than plot with 125kg/ha NPK + 3t/ha kitchen waste. Soil K was highest in plot with 125kg/ha NPK + 3t/ha cow dung, and was significantly better than plots with 125kg/ha + poultry waste (3t/ha), 250kg/ha sole application of NPK fertilizer and unamend plot (control). Soil P was not significantly affected by the treatment at 5% probability level.

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Table 3 also presents the effect of combined use of organic waste and NPK fertilizer levels on leaf N, P, and K. This result shows that leaf P only was significantly affected by the treatment application. Though leaf nitrogen was not affected significantly, its highest value was observed in plot with poultry manure. Leaf nutrients (N and P) improved with the application of organic residues combined with NPK fertilizer. The finding agrees with the findings of Ogundare (2011) who investigated on effect of combined use of organic and inorganic manure on leaf nutrient of maize. The increase could be attributed to the influx of nitrogen and phosphorus from both organic and inorganic sources to the crop.

Table 4: Soil and Tomato leaf nutrient as affected by combine use of organic and Inorganic fertilizer (mean of 2011 and 2012)

treatment		***soil***	***Nutrient (%)***	***Leaf***	***Nutrient (%)***	
	N	P	K	N	P	K
125Kg/ha NPK + 3t/ha PTY	2.63a	0.84a	2.86a	0.37a	7.2a	0.26c
125Kg/ha NPK + 3t/ha CWD	2.37a	0.87a	2.84a	0.21b	8.6a	0.41ab
125Kg/ha NPK + 3t/ha KTH	2.53a	0.62b	2.90a	0.28ab	8.2a	0.43a
250 Kg/ha NPK Fertilizer	2.31a	0.59a	2.83a	0.22b	8,3a	0.26c
Control	2.34a	0.58b	2.91a	0.23b	7.4a	0.31bc

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT. NPK (NPK fertilizer), PTY (poultry manure), CWD (cow dung), KTW (kitchen wastes).

Yield and yield component of tomato

Number of fruits per plant, fruit yield per plant, fruit yield per plot and tomato yield were significantly affected by combined use of organic and inorganic fertilizer. Plants with 125kg/ha NPK + 3t/ha poultry waste produced the highest number of fruits (14), although not significantly better than plots with 125kg/ha NPK + cow dung (3t/ha), 125kg/ha + 3t/ha kitchen waste and plot with 250kg/ha NPK. All these were better than the control. Yield per plant, yield per plot and yield in tonnes per hectare were highest in plot with 125kg/ha NPK fertilizer + 3t/ha poultry manure. In all the treatments, unamend plot recorded the least values of fruit yield per plant, fruit yield per pot and yield in tonnes per hectare with values of 0.18kg, 2,6kg and 5.8t/ha per hectare respectively. The better performance of plot with poultry manure + NPK fertilizer corroborated the result of Kang and Balasubramanian (1990), Ogundare (2011) and (Asadu and Unagwu, 2012). The better performance of crop in terms of growth and yield was observed when poultry manure was combined with NPK fertilizer.

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Table 5: Effect of the combined use of organic and inorganic fertilizer on the yield characters of tomatoes (mean of 2011 and 2012)

Treatment	*Number of fruits per plant*	*Fruit yield per plot (kg)*	*Fruit yield per plot (kg)*	*Yield (t/ha)*
125Kg/ha NPK + 3t/ha PTY	14[a]	0.42[a]	8.8[a]	19.6[a]
125Kg/ha NPK + 3t/ha CWD	11[ab]	0.33[a]	8.2[a]	18.2[a]
125Kg/ha NPK + 3t/ha KTW	13[a]	0.39[a]	8.6[a]	19.1[a]
250 Kg/ha NPK Fertilizer	10[ab]	0.30[ab]	6.4[b]	14.1[ab]
Control	06[b]	0.18[b]	2.6[c]	5.8[c]

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT. NPK (NPK fertilizer), PTY (poultry manure), CWD (cow dung), KTW (kitchen wastes).

CONCLUSION

The study showed that use of inorganic and organic fertilizer had better effects on growth and yield of tomato. Also, a combination of 125kg/ha NPK fertilizer + 3t/ha poultry waste perform best among the combination of treatment applied.

RECOMMENDATIONS

For good yield and better productivity of tomato, a combination of 125kg/ha NPK fertilizer + 3t/ha poultry waste is recommended for tomato production in the study area.

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