

## Effects Of Poultry Manure, Npk 15-15-15 Fertilizer And Their Combination On Vegetative Growth And Yield Parameter Of Tomato (*Lycopersicon Esculentum* Var. Mill.)

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**Abstract:** Fertility is known to influence crop yield, in other to investigate the effect of organic and inorganic fertilizer on growth and yield parameters of tomato. An experiment was conducted at the Teaching and Research Farm of the Federal University of Technology Akure. The experimental design was a Randomized Complete Block Design (RCBD) with three replicates. The treatments applied involved combination of reduced level of poultry manure and NPK, which gives six treatments viz: 100% Poultry Manure (PM) = (360g/plant), 100% NPK 15:15:15 = (7.2g/plant), 25% PM + 75% NPK = (90g PM + 5.4g NPK/plant), 50% PM + 50% NPK = (180g PM + 3.6g NPK/plant), 75% PM + 25% NPK = (270g PM + 1.8g NPK/plant) and Control (no fertilizer). Growth parameter were collected once every two weeks on plant height, leaf number, branch number, and stem girth. The yield was computed on fresh weight basis. Based on the research outcome the combination of 50%PM (180g) + 50%NPK (3.6g) gave the overall best result. Sole application of poultry manure is found to be the best for tomato production as against sole application of inorganic (NPK 15:15:15) fertilizer. Soil samples were collected before and during the experiment. The sample were chemically analysed for pH, OC, N, P, K, Ca, Mg, Na, H, Al, CEC, and BS.

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### Introduction

Tomato (*Lycopersicon esculentum*) is the most popular vegetable crop in Nigeria dominating the largest area under production among vegetable crops (Ramalan, 1994). Increase in demand of the commodity resulted in expanding production in both upland and low land areas. The soils in the Nigerian are generally low in fertility and enhanced crop yield is only possible through external use of organic and inorganic fertilizer (Quinn, 1980).

Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients (Oyewole and Oyewole, 2011). In contrast to chemical fertilizer, it add organic matter to soil which improves soil structures, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa *et al.*, 2008). Poultry manure more readily supplies P to plants than other organic manure sources (Garg and Bahla, 2008).

Although, organic fertilizers exist in readily available forms; cheap and easy to assess, they need to be applied in large amounts to meet the nutrient requirements of crops (Prabu *et al.*, 2003). Where large hectares are involved, this single fact play important role in the cost of organic fertilizer application; as it pushes up transportation cost. This salient factor thus introduces management component into an otherwise abundant nutrient source.

In the past years inorganic fertilizers was advocated for crop production to ameliorate low inherent fertility of soils in the tropics since it provide readily available nutrients for plant, their use has not always been successful in the tropics, due to enhancement of soil acidity, easy leaching of nutrients, nutrient imbalanced, low organic matter status, reduced crop yield, and degradation of soil physical properties. In addition is expensive and not readily available when needed. Owing to the various short comings associated with the use of both sources of fertilizers, Thus, a combination of organic and mineral nutrients has been advocated (Prabu *et al.*, 2003). As the integration of organic sources and synthetic sources of nutrients not only supply essential nutrients but also have some positive interaction with chemical fertilizers to increase their efficiency and thereby reduce environmental hazards (Bocchi and Tano, 1994; Ahmad *et al.*, 1996). Titiloye (1982) reported that the most satisfactory method of increasing maize yield was by judicious combination of organic wastes and inorganic fertilizers. Murwira and Kirchman (1993) observed that nutrient use efficiency might be increased through the combination of manure and inorganic fertilizer. Owing to the above scenario, there is a need for peasant or subsistence farmers who form the bulk of tomato know the best type of fertilizer or combination to be use at different

rate, if they are to continue providing enough food to feed the increasing human populations in an economical way. Therefore the objective of this study is to determine the response of tomato to poultry manure, NPK 15:15:15 fertilizer and its combination on the growth and yield performances of tomato in Southwestern Nigeria.

## Materials and Methods

### Experimental area

The experiment was conducted at the Teaching and Research Farm, Federal University of Technology Akure, Ondo State Nigeria. The farm was located northwest of the University campus. The area lies within the tropical rainforest belt between (latitude 5°N and longitude 15°E). The rainfall pattern of Akure is bimodal with a wet season of about 8 months occurring in April to October/November through February/March. The mean daily temperature ranges from 25°C and 37°C. The predominant weeds on this experiment site included: *Chromolena odorata*, *Mariscus alternifolius*, *Euphobia heterophyllum*, *Paspalumscro biculatum*, *Chochorus olitorus*, *Talinum triangulare*. The main field was divided into 3 block of 10.9m x 1.4m with each block been divided into 6 sub plot of size 1.4 x 1.4m with 0.5m intra space (within the blocks) and 1m inter space (between blocks), with planting distance of 0.6m (2feet).

### Experimental Design and Treatment Application

The experimental design was a Randomized Complete Block Design (RCBD) with three replications. The treatment comprises of a combination of poultry manure and inorganic NPK 15:15:15 Fertilizer. The treatments are six and includes; (i) 100% Poultry Manure PM = (360g)/plant, (ii) 100% NPK 15:15:15 = (7.2g)/plant, (iii) 25% PM + 75% NPK = (90g PM + 5.4g NPK) /plant, (iv) 50% PM + 50% NPK = (180g PM + 3.6g NPK) /plant, (v) 75% PM + 25% NPK = (270g PM + 1.8g NPK) /plant and (vi) Control (no fertilizer). The standard rate used for applying poultry manure was 10t/ha, and 200kg/ha of NPK 15:15:15 fertilizer.

### Soil analysis

Prior to land preparation, pre-planting soil samples was randomly collected using soil auger per replicate within the depth of 0–15 cm; likewise at harvest soil sample were collected on each plot of different treatments and blocks. Soil samples were air-dried, ground and sieved to pass through a 2-mm sieve. The following chemical analyses were done on the soil samples and the manure, using standard laboratory methods: soil pH (soil/water ratio of 1:1) was determined using a glass/calomel electrode system (Ogunwale and Udo, 1998). The organic carbon was determined by the (AOAC, 1990). Total total nitrogen was determined using the microkjedahl

method (Ogunwale and Udo, 1998). Available P was extracted using Bray-1 extractant and the extract was measured with the Murphy-Riley blue method (AOAC, 1990) on a spectronic 20 instrument at 882 nm., The soil K, Ca Mg and Na were extracted with 1M NH<sub>4</sub>OAC, pH 7 and thier amounts determined on the flame photometer using appropriate element filters. The Mg content was read on an atomic absorption spectrophotometer (Igwe *et al.*, 2005). The exchangeable acidity (H<sup>+</sup> and Al<sup>3+</sup>) was measured from 0.01M KCl extracts by titrating with 0.1M HCl (Blakes and Hartge, 1986). Particle size analysis was determined on the soil using hydrometer method (Gee and Bauder, 1986).

### Crop Establishment and Management

The land was cleared using slash method, the debris were packed and beds constructed to a height of about 30cm to reduce compaction and increase water infiltration (Owuru *et al.*, 2010). Tomato Roma variety was sown in the nursery which have been sterilized; where intensive care was provided for the optimum growth of the seedlings. The seedlings were later transplanted at 4 weeks after sowing (WAS) when the seedlings are 15-20cm tall into a well-watered seedbed at a spacing of 75 x 45 cm (Komolafe *et al* 1980). Poultry manure (PM) were applied to the marked plots two weeks before transplanting of the seedlings by evenly spreading within the appropriate experimental plots and incorporated to a depth of 15cm (Suge *et al* 2011), while NPK fertilizer was applied two weeks after transplanting. The normal routine field management practices such as weeding, pest control, staking needed for tomato production under open field condition were followed as recommended by National Horticultural Research Institute (NIHORT), Ibadan, Nigeria.

### Data Collection and Analysis

Data on plant height, number of branches, number of leaves and stem girth were taken once in every two weeks from 4, 6 and 8 weeks after planting from five randomly selected and tagged from middle row. The height was measured using a meter rule, while stem girth were determined using digital vernier caliper. Number of leaves was assessed by visual count of the green leaves. The yield was computed on fresh weight basis as sum of all harvested fruits from each plot were counted and weighed. The data collected were subjected to analysis of variance, and treatment means were compared using Duncan's Multiple Range Test (DMRT) at (p ≤ 0.05).

## Results and Discussion

### Pre-cropping soil analysis

Table 1 shows the soil chemical properties of the experimental field before planting. This reveals that

soil pH of the site is slightly acidic, the soil organic carbon (OC), phosphorus P, and Mg are moderate, while the percentage of nitrogen and potassium K are moderately high and low respectively. Poultry manure directly in providing nutrients of plants and indirectly at improving physical and biological soil properties increased plant growth (Ewulo *et al.*, 2008).

Table 1: Soil chemical properties of the experimental site before planting tomato

Soil Property	Soil Sample Value
p H (Water)	6.72
Organic carbon (%)	1.28
Nitrogen (%)	0.21
Phosphorus (mg kg <sup>-1</sup> )	10.81
Potassium (cmol kg <sup>-1</sup> )	0.25
Calcium (cmol kg <sup>-1</sup> )	2.5
Magnesium (cmol kg <sup>-1</sup> )	1.3
Sodium (cmol kg <sup>-1</sup> )	0.21
Hydrogen (cmol kg <sup>-1</sup> )	0.36
Aluminum (cmol kg <sup>-1</sup> )	0.44
CEC (meq 100 <sup>-1</sup> )	5.06
% Base saturation	84.2

### Growth and Development

The table 2 shows the effect of PM, NPK 15:15:15 fertilizer and its combination on plant height of tomato is significantly different ( $P < 0.05$ ). 50% PM (180g) + 50% NPK (3.6g) had the highest plant height and it significantly differs from 25% PM (90g) + 75% NPK (5.4g), 100% NPK (7.2g), 100% PM (360g), control and 75%PM (270g) + 25% NPK (1.8g). There was no significant difference between 25% PM (90g) + 75%NPK (5.4g), 100% NPK (7.2g) and 100% PM (360g).

Number of leaves produced by the tomato plants differs significantly ( $P < 0.05$ ) with the application of PM, NPK 15:15:15 fertilizer and its combination. 50% PM (180g) + 50% NPK (3.6g) and control had the highest and least leaf number of 11.21 and 8.14 respectively.

Number of branches of the tomato plants with PM, NPK 15:15:15 fertilizer and its combination significantly differs from each other. 50%PM (180g) + 50% NPK (3.6g) produced the highest branch number of 14.95 and it significantly differs from 75% PM (270g) + 25% NPK (1.8g), 100% PM (360g), 25% PM (90g) + 75% NPK (5.4g), 100% NPK (7.2g) and control which have 13.06, 12.34, 11.29, 9.79 and 9.12 number of branches respectively.

Significant difference ( $P < 0.05$ ) was observed for stem girth with application of poultry manure, NPK

15:15:15 fertilizer and its combination. 50% PM (180g) + 50% NPK (3.6g) and 100% PM (360g) had the highest stem girth which significantly differs from 75% PM (270g) + 25% NPK (1.8g), 25% PM (90g) + 75% NPK (5.4g), 100% NPK (7.2g) and control. There was no significant difference between 75% PM (270g) + 25%NPK (1.8g), 25% PM (90g) + 75% NPK (5.4g) and 100% NPK (7.2g) on the stem girth of tomato.

N, P and K are needed for plant growth, flower and fruit formation; therefore, their low concentrations will lower the yield of plant (Zekri and Obreza, 2003). Proper amount of good organic manures are required to supply the nutrients for crop growth and development. Ayoola and Adeniyani (2006) reported that nutrient from mineral fertilizers enhance the establishment of crop while organic manure promotes yield when both fertilizers were combined. The combined use of organic manure and inorganic fertilizer could narrow down the negative nutrient balance substantially in many cropping systems (Singh and Yadav 1994).

50% PM (180g) + 50% NPK (3.6g) significantly differ in plant height from 75% PM (270g) + 25% NPK (1.8g). Equal proportion of organic and inorganic fertilizer show that NPK fertilizer provides plant with immediate plant nutrition while slow mineralization of PM supplies plant subsequent plant nutrient. More plant height due to better usage of sunlight in competing with weeds have positive effect on fruit yield and total dry matter (Duman, 2006).

More plant height due to better usage of sunlight in competing with weeds have positive effect on fruit yield and total dry matter (Duman, 2006). PM directly in providing nutrients of plants and indirectly at improving physical and biological soil properties increased plant growth (Ewulo *et al.*, 2008). Number of leaves produced with 50% PM (180g) + 50% NPK (3.6g) (11.29) was significantly higher than the control (8.14). 100% PM (360g) also gives high number of leaves which agrees with the report by Ayeni *et al.*, 2010 that 30 t ha<sup>-1</sup> PM gave highest values of the growth in terms of number of leaves and number of branches for tomato in the early and late season. 50% PM (180g) + 50% NPK (3.6g) also produce higher number of branches than the control.

Ewulo *et al.* (2008) proved the effects of PM on increasing number of sub-branches in tomato. 50% PM (180g) + 50% NPK (3.6g) and 100% PM (360g) shows no significant difference ( $P < 0.05$ ) in its effect on the stem girth of tomato.

Table 2: Effects of poultry manure, NPK 15:15:15 and their combinations on growth parameters of tomato

Treatments	Plant height (cm)	Number of leaves	Number of branches	Stem girth (cm)
100% PM (360g)	35.02b	10.17b	12.34b	1.30a
100% NPK (7.2g)	35.67b	8.22d	9.79cd	1.06b
25%PM(90g)+75%NPK(5.4g)	36.99b	9.35c	11.29bc	1.09b
50%PM(180g)+50%NPK(3.6g)	40.42a	11.21a	14.95a	1.31a
75%PM(270g)+25%NPK(1.8g)	27.14d	9.77bc	13.06ab	1.14b
Control	31.41c	8.14d	9.12d	0.90c

### Yield attributes

Results presented in table 3 shows that application of PM, NPK and its combination significantly ( $p \leq 0.05$ ) influenced total number of harvested tomato and weight of tomato harvested. Application of 50% PM (180g) + 50%NPK (3.6g)/plant gave the best yield, and was significantly different from application of 25% PM (90g) + 75%NPK (5.4g)/plant and other rates investigated, but there were no significant different in fruit number and fruit weight produced by the application of 100% PM (360g)/ plant, 100%NPK (7.2g)/ plant, 75%PM (270g) + 25% NPK (1.8g)/ plant and the Control treatment. All the combine application treatments of PM and NPK gave the highest fruit yield in terms of fruit number and fruit weight compared with sole nutrient application, except for the application of 75%PM (270g) + 25% NPK (1.8g)/ plant which gave the least number of fruit and second to the last in term of fruit weight after the control treatment. The application of sole organic nutrients 100% PM (360g)/ plant gave better yield performances compared with sole mineral fertilizer application of 100% NPK (7.2g)/plant in both fruit number and fruit weight respectively.

The manures and inorganic fertilizers provide source of all necessary macro-and micro-nutrients in available forms, thereby improving the physical and biological properties of the soil (Abou El-Maged *et al.*, 2005) which must have accounted for the better yield performance obtained in nutrient treated plots as against the control. (Akanbi *et al.*, 2005) also observed great increase in crop yield with fertilizer treatment. However, the best response to fertilizer use is obtained if the soil has a high inherent fertility level (Adeniyani and Ojaniyi 2005). This could be attributed to increased nutrient use efficiency, following the inclusion of the NPK fertilizer. The observation from this study shows the trend of the effect of fertilizer on plant growth parameters as PM + NPK > PM > NPK fertilizer > no fertilizer.

Ayoola and Adeniyani (2006) also reported better performance of maize, cassava and melon under PM + NPK fertilizer. The trend observed was NPK fertilizer + poultry manure > NPK fertilizer > PM > no fertilizer. Ayoola and Adeniyani (2006) reported that nutrients from mineral fertilizers enhance the establishment of crops, while those from

mineralization of organic manure promoted yield when both fertilizers were combined. The combined application of pig manure and NPK fertilizer also increased tomato fruit yield compared with pig manure or NPK fertilizer treatments alone (Giwa, 2004). Also, Adeniyani and Ojaniyi (2005) found that integrated application of PM and NPK fertilizer increased maize yield compared with PM or fertilizer applications alone.

The higher yields from PM + NPK fertilizer treatments than sole NPK treatment is an indication that integrated use of organic and organic nutrient sources of N is advantageous over the use of inorganic fertilizer alone. Vanlaure *et al* (2001) reported that combination of organic and inorganic fertilizer results into synergy and improved conservation and synchronization of nutrient release and crop demand, leading to increased fertilizer efficiency and higher yield.

Table 3: Effects of poultry manure, NPK 15:15:15 and their combination on yield of tomato

Treatments	Fruit number	Fruit weight (kg)
100% PM (360g)	44.33b	1.20b
100% NPK (7.2g)	37.33b	1.02b
25%PM(90g)+75%NPK(5.4g)	51.00ab	1.39ab
50%PM(180g)+50%NPK(3.6g)	76.33a	2.07a
75%PM(270g)+25%NPK(1.8g)	32.33b	0.77b
Control	34.67b	0.76b

Table 4 shows soil chemical properties after harvest of tomato. The pH of 100% NPK (7.2g)/plant and 25% PM (90g) + 75% NPK (5.4g) are slightly acidic compare to the other treatment 100% PM (360g), 50% PM (180g) + 50% NPK (3.6g), 75% PM (270g) + 25% NPK (1.8g) and control that are neutral. The organic carbon of the soil remains moderate, the percentage nitrogen of the soil treated with 100% PM (360g) and control are moderately high while all the soil treated with 100% NPK (7.2g), 25% PM (90g) + 75% NPK (5.4g), 50% PM (180g) + 50% NPK (3.6g) and 75% PM (270g) + 25% NPK (1.8g) are medium.

Low phosphorus (P) were recorded for 100% NPK (7.2g) and control, soil treated with 100% PM (360g), 25% PM (90g) + 75% NPK (5.4g) and 50% PM (180g) + 50% NPK (3.6g) shows moderate

phosphorus level this confirmed the report of (John, 2011), while 75%PM (270g) + 25% NPK (1.8g) recorded high phosphorus level. Low potassium was recorded in 100% NPK (7.2g), 25% PM (90g) + 75% NPK (5.4g), and control while other treatments are moderate.

The sodium (Na), calcium (Ca) and Magnesium (Mg) level of all the treatment soil shows no significant different from each other, both the Ca and Mg shows low level of Ca and moderate level respectively. The cation exchange capacity (CEC) of all the treatment applied shows that the soil is very low in CEC while the soil shows a very high level of base saturation (BS).

PM has a higher level of available P which influenced growth. This means there was greater root proliferation, increased rate of photosynthesis and cell division. This in turn must have increased the

absorption of other nutrients, particularly N. In all the treatments where PM was incorporated, there was more mineralization than immobilization because the manure had been stored for three weeks after removal from the poultry house (John, 2011).

Suge *et al.*, (2011) reported that organic manure as supplier of nutrients to plant growth is determine by the rate of nutrient release; the higher the rate of nutrient release the less organic matter. Also organic manure have relatively higher pH compared with soils, hence should raise the pH increasing the availability of most nutrients. Iyamuremye and Dick (1996) concluded that organic manure can reduce the P-sorption capacity of the soil, enhance P availability, improve P recovery or result in better utilization by plant. Organic manure adds carbon into the soil; provide substrate for microbial growth, and subsequent microbial activity.

Table 4: shows the post-planting soil chemical properties of tomato

Treatments	pH	OC %	N %	P mg Kg <sup>-1</sup>	K cmol Kg <sup>-1</sup>	Na cmol Kg <sup>-1</sup>	Ca cmol Kg <sup>-1</sup>	Mg cmol Kg <sup>-1</sup>	Al cmol Kg <sup>-1</sup>	H cmol Kg <sup>-1</sup>	CEC Meq 100g <sup>-1</sup>	BS %
100% PM (360g)	6.71b	1.28a	0.22b	19.50b	0.32b	0.23a	2.47a	1.23a	0.61b	0.35a	5.08ab	83.6a
100% NPK (7.2g)	6.38a	1.13a	0.18a	4.64a	0.25a	0.18a	2.30a	1.17a	0.41a	0.33a	4.64a	83.7a
25%PM(90g) + 75%NPK(5.4g)	6.32a	1.20a	0.16a	13.74b	0.26a	0.16a	2.27a	1.13a	0.45ab	0.43b	4.70ab	81.2a
50%PM(180g) + 50%NPK(3.6g)	6.70b	1.38a	0.19a	19.37b	0.32b	0.22a	2.53a	1.23a	0.41a	0.40b	5.12ab	83.9a
75%PM(270g) + 25%NPK(1.8g)	6.81b	1.22a	0.16a	24.22c	0.33b	0.24a	2.77a	1.33a	0.45ab	0.33a	5.45b	85.5a
Control	6.76b	1.20a	0.23b	3.74a	0.24a	0.21a	2.40a	1.20a	0.44a	0.35a	4.83ab	83.7a

## Conclusion

Based on the research findings the combination of 50% PM (180g) + 50% NPK (3.6g) gave the best result and is therefore concluded as the best combination of PM and NPK fertilizer for tomato production. The results indicated that integration of organic and inorganic fertilizers could be a better option in increasing fertilizer use efficiency and providing a more balanced supply of nutrients for plant growth and yield.

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