

Comparative study on the growth response of scarlet eggplant (*Solanum aethiopicum*) to organic and inorganic fertilizers

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ABSTRACT

Fertilizer use is a key factor in soil fertility management and yield increase in crop production. Globally, organic manures are being used to avert the problems arising from the use of inorganic fertilizer, ensure sustainability of the agriculture and enhance health. The aim of this study was to compare the effect of organic and inorganic fertilizers on the growth and yield of scarlet eggplant. The research was conducted at the Faculty of Agriculture Teaching and Research Farm, University of Port Harcourt. The experimental design was Randomized Complete Block Design (RCBD) with each treatment (Poultry droppings, NPK 15:15:15 and control) replicated four (4) times. At ten weeks after transplanting, there was no significant difference ($p>0.05$) in the growth parameters measured both for organic and inorganic fertilizers. However, organic fertilizer (Poultry droppings) gave highest result for leaf fresh weight; while inorganic fertilizer (NPK) gave highest result for fruit fresh weight with control the least for both leaf fresh weight and fruit fresh weight. This study showed that growth parameters and leaf yield were higher with the use of organic manure (Poultry droppings) than inorganic fertilizer; however, fruit yield for the inorganic fertilizer (NPK) was higher than organic manure.

Keywords: Organic manure, inorganic fertilizer, growth, yield, *Solanum aethiopicum*

INTRODUCTION

Scarlet eggplant (*Solanum aethiopicum*) comes from the family solanaceae and it is grown in West Africa as a commercial crop for domestic consumption and also for export (Daunay *et al.*, 2001). The leaves of scarlet eggplant are eaten as a leafy vegetable and are actually more nutritious than the fruit. The fruit of the plant can be eaten raw or cooked into sauce and is becoming more popular as a cultivated crop. This vegetable is a diet-doctor's dream: low in sodium, low in calories, high in dietary fiber, and a good source of potassium

(Opeyemi *et al.*, 2016). Scarlet eggplant contains a high level of carotenoids (Kamga *et al.*, 2013), vitamin B and C. Fruits can be used to mitigate weight gain, obesity and type II diabetes (Opeyemi *et al.*, 2016), asthma, bronchitis, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease and swollen joint pains, gastro-esophageal reflux disease, constipation and dyspepsia (Bello *et al.*, 2005).

Fertilizer application is a key factor in the management of soil fertility and increase in

the yield of crops (Akinrinade, 2006). Some of the negative impacts of inorganic fertilizers on the environment include destruction of soil micro-organisms, pollution of ground water, rivers, lakes and oceans through leaching effect (Mercola, 2013). There is a global awareness on the production of foods and vegetables through the use of organic fertilizers, to avert the problems and diseases resulting from the use of inorganic fertilizers thereby improving the health of mankind and reducing cost of production input. Organic fertilizers apart from being environmentally friendly are of different types and composition which would affect their influence on soil fertility, water holding capacity, structure and texture. Comparing the effect of different organic fertilizers on growth and yield of scarlet eggplant is relevant for determining the most suitable one for scarlet eggplant production.

Thus, this study compared the effect of Poultry droppings with NPK on the cultivation of scarlet eggplant.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Faculty of Agriculture Teaching and Research Farm, University of Port Harcourt, Abuja campus, Choba. The land area of the experimental plot was 90m² located at latitude 4.42°N and longitude 4.51°E with an elevation of 1800m above sea level and temperature of 28-33°C, with rainfall ranging between 2000-2680mm per annum (GEM, 2012).

Prior to planting, samples of poultry droppings and soil samples from the site were collected for routine analysis.

Experimental Design

A plot size of 90m² (9m x 10m) was marked into blocks, and blocks into beds in a Randomized Complete Block Design (RCBD). The experimental treatment included two organic fertilizers: poultry droppings and spent mushroom substrate; one inorganic fertilizer; NPK 15:15:15, and a control (where no fertilizer or manure was applied). Each treatment was replicated four (4) times in beds of dimension of 2m x 2m with 0.5m alley between the beds but appearing once in each block making a total of sixteen beds. Poultry manure was thoroughly worked into appropriate beds to incubate for one week at a rate of 4kg/bed. NPK 15:15:15 was applied at a rate of 80g/bed at one week after transplanting (WAT). Results for spent mushroom substrate were not reported in this article.

Planting operation

Seeds were sown in the nursery and seedlings transplanted to the permanent site at five weeks. Transplanting of seedlings was done at a spacing of 50cm x 50cm between and within rows respectively, each replicate had nine stands and trenches were dug at the edge of the plot to reduce run-off. After transplanting, plot was watered regularly. Hoe weeding was done four weeks after transplanting (WAT). Insect pest control was done using DD force at a rate of 9ml in 4L of water per experimental plot (90m²) at four weeks after transplanting (WAT).

Soil and Organic Manure Analysis

Soil was randomly collected using a soil auger at a depth of 0 - 15cm from each plot. The samples were mixed and air-dried for routine analysis as described by Carter (1993). Total nitrogen was determined by the kjeldahl method (Bremner and Mulvancy, 1982). Available Phosphorus was determined by Bray-1 method (Murphy and

Riley, 1962). Exchangeable potassium was extracted using ammonium acetate and was determined using the flame photo meter. The soil pH in 0.01 M calcium chloride (CaCl_2) was determined using a glass electrode. Nutrients in poultry droppings and spent mushroom substrate were extracted by dry ash method described by Piper (1944). Organic manure was air – dried, ground, sieved through 2 mm sieve and ignited at 450°C for 2 hrs. The ash was extracted with hydrochloric acid (HCl). Total nitrogen, available phosphorus, exchangeable potassium and soil pH were also determined using the methods as described above.

Data Collection and Analysis

Collection of data started two weeks after transplanting and continued till the end of the experiment. The number of leaves for each plant was counted at an interval of two weeks and this was done as a means of monitoring the vegetative growth of the plant. Growth parameters data gathered were: plant height, leaf area (the leaf length (L) and width (W) were measured and multiplied by a constant of 0.8 to get the leaf area (A). Mathematical expression; $A = L \times W \times 0.8$ (Khalid *et al.*, 2014).

Table 1: Pre-planting analytical results

Sample ID	Ph	Total nitrogen %	Available phosphorus mg/kg	Exchangeable potassium Cmolkg^{-1}
Soil	5.9	0.100	30.01	2.68
Poultry droppings	6.0	7.28	123.4	57.44

Effects of Organic Manure and Inorganic Fertilizer on the Growth Attribute of *Solanum aethiopicum* (Scarlet Eggplant)

The effects of organic manures (poultry droppings) and inorganic manure (NPK 15:15:15) on the number of leaves of scarlet

The yield parameters gathered were, leaf fresh weight and fruit fresh weight at 10 WAT. All the data was pulled together and mean values were analyzed. Yield per hectare was determined by extrapolating the yield per net plot.

$$\text{Yield/ha} = \frac{\text{Weight}}{\text{Land Area}} \times 10,000. \text{ (Oyewole } et al., 2014).$$

Data collected were subjected to analysis of variance (ANOVA) in a Randomized Complete Block Design (RCBD) using the Statistical Package for Social Sciences (SPSS) version 20 and means were separated using least significant difference (LSD) at $\alpha = 0.05$.

RESULTS

Pre-Planting Data

Table 1 shows the analytical result of soil and organic materials used. According to the pH values the soil and organic materials are shown to be slightly acidic. Poultry droppings was seen to be high in the percentage of total nitrogen, amount of available phosphorus and exchangeable potassium than the soil from the experimental plot.

eggplant are presented in Table 2. At 2 to 4 WAT, poultry droppings showed a significant difference from NPK, and control which showed no significant difference in each other. At 6 to 10 WAT there was no significant difference on the average number of leaves for all treatment. At 2 to 8 WAT

poultry droppings was seen to produce the highest average number of leaves and untreated control was the lowest, while at 10

WAT poultry droppings had the highest on the average number of leaves and NPK had the lowest.

Table 2: Effect of treatments on the number of leaves of scarlet eggplant

Treatments	Number of leaves				
	2WAT	4WAT	6WAT	8WAT	10WAT
Control (T1)	4 ^a	8 ^a	14 ^a	21 ^a	30 ^a
NPK 15:15:15 (T2)	5 ^a	8 ^a	15 ^a	22 ^a	31 ^a
Poultry droppings (T3)	7 ^b	15 ^b	21 ^a	31 ^a	38 ^a
LSD (0.05)	1.86	5.37	NS	NS	NS

Means followed by the same letter are not significantly different at 5% probability level.

Table 3 shows the effects of organic manures and inorganic manure on the mean height of scarlet eggplant. Scarlet eggplant treated with organic and inorganic fertilizers recorded greater height than that of the untreated control. At 2 to 6 WAT, poultry droppings showed a significant difference from NPK, and control which showed no significant difference from each other. At 8 WAT, NPK showed no significant

difference from both poultry droppings and control which showed a significant difference in each other with poultry droppings having the highest mean height and untreated control with the lowest mean height. At 10 WAT all treatments showed no significant difference from each other with poultry droppings having the highest mean height and control with the lowest mean height.

Table 3: Effect of treatments on the plant height of scarlet eggplant

Treatments	Plant height				
	2WAT	4WAT	6WAT	8WAT	10WAT
Control (T1)	5.08 ^a	7.78 ^a	13.89 ^a	27.68 ^a	47.40 ^a
NPK 15:15:15 (T2)	5.34 ^a	9.19 ^a	15.76 ^a	39.69 ^{ab}	48.99 ^a
Poultry droppings (T3)	8.11 ^b	18.92 ^b	30.92 ^b	51.18 ^b	67.21 ^a
LSD (0.05)	2.82	5.05	9.46	23.96	NS

Means followed by the same letter are not significantly different at 5% probability level.

Table 4 shows the effect of organic and inorganic manure on the leaf area of scarlet eggplant. At 2 to 6 WAT, poultry droppings showed a significant difference from NPK and control which showed no significant difference from each other. At 8 WAT, NPK showed no significant difference from both poultry droppings and control which showed

a significant difference in each other with poultry droppings having the highest leaf area and control with the lowest leaf area. At 10 WAT all treatments showed no significant difference from each other with poultry droppings having the highest mean leaf area and control with the lowest leaf area.

Table 4: Effect of treatments on the leaf area of scarlet eggplant

Treatments	Leaf area				
	2WAT	4WAT	6WAT	8WAT	10WAT
Control (T1)	8.17 ^a	26.89 ^a	133.73 ^a	237.02 ^a	351.17 ^a
NPK 15:15:15 (T2)	7.08 ^a	19.24 ^a	167.76 ^a	320.75 ^{ab}	390.24 ^a
Poultry droppings (T3)	28.77 ^b	66.14 ^b	346.89 ^b	440.19 ^b	417.84 ^a
LSD (0.05)	5.37	26.26	154.85	184.30	NS

Means followed by the same letter are not significantly different at 5% probability level.

Table 5 shows the effect of organic and inorganic manure on the mean yield parameters of scarlet eggplant. From this table, the treatment with poultry droppings had the highest mean weight of harvested leaves of scarlet eggplant; however, NPK 15:15:15 had the highest mean weight for harvested fruits. Weight of both leaves and fruits was lowest for control. There was no significant difference in the yield of scarlet eggplant leaves and fruits between the treatments applied to the plant. The effect of the different fertilizer treatments on fresh

edible leaves and fruits varied but these variations were without any significant difference. Thus, in the yield of edible leaves, the treatment subjected to poultry droppings showed a significant high mean of 1906.88kg/ha and this was followed by NPK 15:15:15 and then control with the lowest mean of 850.63kg/ha. While in the fruit yield, treatment subjected to NPK showed the highest mean of 714.37kg/ha and this was followed by poultry droppings, and then control with the lowest mean of 143.13kg/ha.

Table 5: Effect of treatments on the Yield of scarlet eggplant

Treatment	Yield of harvested leaves	Yield of harvested fruits
	(kg/ha)	(kg/ha)
Control (T1)	850.63 ^a	143.13 ^a
NPK 15:15:15 (T2)	1423.13 ^a	823.75 ^a
Poultry droppings (T3)	1906.88 ^a	714.37 ^a
LSD (0.05)	NS	NS

Means followed by the same letter are not significantly different at 5% probability level.

DISCUSSION

The result observed in this study indicated that the height of scarlet eggplant at different stages of growth was highly influenced by the treatments. The fact that at two, four, six and eight weeks after

transplanting, there was significant difference between the treatments, with the highest mean height in treatment obtained with poultry droppings, indicated that poultry manure released more nutrients for the growth of scarlet eggplant. This agrees with the observation of John *et al.* (2004) that poultry manure contains essential

nutrient elements associated with high photosynthetic activities and thus promotes root and vegetative growth.

The lowest mean height was observed in the control where no fertilizer was applied and this was due to the lack of nutrient required by the plant. This observation corroborates the report of Olaniyan and Nwachukwu (2003) and S kara and Bieniasz, (2008).

The observation about leaf area in which poultry droppings had the highest mean in the leaf area of scarlet eggplant, followed by control, and then NPK 15:15:15 with the lowest mean may be due to the release of more nutrients. Poultry droppings advances overwhelming development, increments in meristematic and physiological activities in the plant because of supply of plant supplement or nutrient and enhancement of soil properties (Dauda *et al.*, 2008).

Leaves of scarlet eggplant are edible and widely used in preparation of a variety of dishes. Its fruits are used in preparation of soups and play a vital role in the tradition of people especially the Igbos as it is an essential food in ceremonies. Yield of leaves and fruits is relevant as it is the income generating part of the plant being sold in markets of which farmers would prefer maximizing. The results of the yield of the test plant in this study is similar to the observation of Owolabi *et al.*, (2013) who reported yield performance of garden egg (*Solanum gilo*) to be in the order Poultry droppings + NPK 15:15:15 > Poultry droppings > Sawdust > NPK 15:15:15 > Control.

CONCLUSION

In conclusion, this study showed that, organic fertilizer was more effective than inorganic fertilizer where plants treated with poultry droppings gave the best result for

growth parameters and leaf yield while those with NPK 15:15:15 had higher fruit yield.

Although there was no significant difference between the treatments in growth at 10 weeks after transplanting, as well as leaf and fruit yield; the high mean value for organic fertilizer makes it the best choice to be considered in the production of scarlet eggplant.

RECOMMENDATION

The use of organic fertilizers should be encouraged among farmers. Further study should be carried out to compare the growth and yield effect of the organic and inorganic fertilizers on the production of other crops. Furthermore, trials using other organic manure sources such as spent mushroom substrate, kitchen waste and green manure should be conducted.

REFERENCES

- Akinriade E.A. 2006. Issues of optimum nutrient supply for sustainable crop production in tropical developing Countries. *Pakistan Journal of Nutrition* 5(4), pp. 377-387.
- Bello S.O., Muhammad B.Y., Gammaniel K.S., Abdu-Aguye I., Ahmed H., Njoku C.H., Pindiga U. H. and Salka A.M., 2005. Preliminary Evaluation of the Toxicity and Some Pharmacological Properties of the Aqueous Crude Extract of *Solanum melongena.*, *Res. J. Agric. Biol. Sci.*, 1(1), pp. 1-9.
- Bremner, J.M. and Mulvancy, C.S. (1982). Nitrogen-Total. In: *Page, Methods of soil analysis Part2, Agron Monogr. 9 (2nd edition) ASA and SSSA, Madison, Wsc*, 403-430.
- Carter, M.K. (1993). Soil sampling and methods of analysis, Canadian Society of Soil Science, Lewis Publishers, London, p. 823.

- Dauda, S.N., Ajayi, F.A. and Ndor E. 2008. Growth and Yield of Watermelon (*Citrullus lanatus*) as Affected by Poultry Manure Application. *Journal of Agriculture & Social Sciences* 4: 121–124.
- Daunay, M.C., Lester, R.N., Ano, G., 2001. Eggplant. In: Charrier, A., Jacquot, M., Hamon, S., Nicolas, D. (Eds), Tropical Plant Breeding. Science Publishers, Plymouth.
- John, L.W., Jamer, D.B. Samuel, L.T. and Warner, L.W. 2004. Soil Fertility and Fertilizers: An Introduction to Nutrient Management, Pearson Education, India, pp 106–53
- Kamga, R. T., Kouamé, C., Atangana. A. R., Chagomoka. T., Ndango. R., 2013. Nutritional Evaluation of Five African Indigenous Vegetables. *Journal of Horticultural Research*. 21(1), pp. 99-106 Doi: 10.2478/Johr-2013-0014
- Khalid, A. A., Tuffour, H.O., Bonsu, M., Adjei-Gyapong, T., Abubakar. A., Boateng, I.Y., Melenya, C. and Kpotor P. (2014). Effects of poultry manure and NPK fertilizer on growth and yield of garden eggs (*solanum melongena*) in a sandy soil in Ghana. *International Journal of Scientific Research in Knowledge*, 2(6), pp. 257-264.
- Mercola J. 2013. How organic farming could release us from the curse of fertilizer. Online: <http://articles.mercola.com/sites/articles/archive/2013/07/02/fertilizer.aspx>. [Accessed March, 2016]
- Murphy, J., Riley J.P. (1962). A modified single solution method for determination of phosphorus in natural water. *Analytical Chemical*. ACTA 27, pp. 31-36
- Olaniyan, A. B. and Nwachukwu 2003. Response of *Solanum macrocarpon* to different sources of nitrogen fertilizer. In Proceedings of the 6th Biennial Conference of the African Crop Science Society, Hilton Hotel Nairobi, Kenya October 12th -17th
- Opeyemi, C. E. and Shalom, N. C. 2016. “Effect of *Solanum aethiopicum* and *Solanum macrocarpon* Fruits on Weight Gain, Blood Glucose and Liver Glycogen of Wistar Rats.” *World Journal of Nutrition and Health*, 4, pp. 1-4. doi: 10.12691/jnh-4-1-1.
- Owolabi. J.F., Opoola. E., Taiwo. M.A., Umah. P. 2013. Comparative effects of farmyard manure, sawdust and NPK 15:15:15 fertilizer on growth and yield of garden egg (*solanum gilo*). *Chemical and Process Engineering Research* 15, pp. 28-31
- Oyewole, C. I., Akogu, E. S. and Attah, E. S. 2014. Response of eggplant (*Solanum melongena* L.) to nutrient sources and rates of application: yield components and fruit yield. *Inter J Agri Biosci*, 3(4), pp. 166-172.
- Piper, C.S. (1944) Dry Ashing. Soil and Plant Analysis. Interscience, Publishers Inc., New York, 221-222.
- Sekara A., Bieniasz M (2008). Pollination, fertilization and fruit formation in eggplant (*Solanum melongena* L.). *Acta Agrobotanica* 61, pp. 107-113.