Open Access Library Journal
2024, Volume 11, e12632
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Evaluating the Influence of Two Organic Manures on the Productivity of Five Tomato Varieties

Julius Kizito

Department of Production, Kalangala District Local Government, Kalangala, Uganda
Email: juliuskizito21@gmail.com

How to cite this paper: Kizito, J. (2024) Evaluating the Influence of Two Organic Manures on the Productivity of Five Tomato Varieties. *Open Access Library Journal*, **11**: e12632.
https://doi.org/10.4236/oalib.1112632

Received: November 14, 2024
Accepted: December 27, 2024
Published: December 30, 2024

Abstract

Tomato (*Lycopersicon esculentum* mill) is a significant vegetable crop cultivated globally, second only to potatoes in acreage yet leading as a crop processed for various products. The global hectares under tomato production is 4.9 million producing 186.1 million tonnes annually and Uganda has 6606 hectares with a production of 37637.2 tonnes. Although 90.9% of Ugandan farmers use fertilizers to increase tomato yields, the yields are still very low at 4 $t \cdot ha^{-1}$ even with varieties that have the potential of producing 16 $t \cdot ha^{-1}$. This study evaluated the yields of five tomato varieties in two organic manures. The field plots were made using a randomized complete block design, and yields were analyzed using a generalized linear model. The varieties had a statistically significant increase in the fruit weight and number ($p < 0.001$). The highest mean fruit number and weight were recorded in Rambo and Nouvella varieties respectively and fruit weight and number were higher in poultry manure than in cow dung manure. Differences in mean fruit weight and mean fruit number between poultry and cow dung manure were statistically significant ($p < 0.01$). Poultry manure must be applied to increase yield outputs of the tomatoes and varieties Nouvella and Rambo need to be made available to farmers since they experimentally produced higher yields.

Subject Areas

Agricultural Science, Agronomy

Keywords

Cow Dung Manure, Fruit Number, Fruit Weight, Poultry Manure, Tomato Variety

1. Introduction

Tomato (*Lycopersicon esculentum* mill) is a significant vegetable crop cultivated globally, second only to potatoes in acreage yet leading as a crop processed for various products [1]. In 2022, the global hectares under tomato production were 4.9 million producing 186.1 million tonnes with China and India as leading producers [2]. Africa produced a total of 22.9 million tonnes from an area of 1.5 million hectares and in the East African region, the annual production was 3.8 million with Uganda producing 37637.2 tonnes from 6606 hectares [2].

For sustainable agricultural tomato production, the use of organic manure is pivotal in increasing tomato yields among different varieties [3] [4], and the use of organic manure results in higher tomato crop yields and quality [4]. Organic manure improves soil fertility by providing nutritional requirements to plants and increasing microbial activity in the soil [5]-[8].

In Uganda, 90.9% of the tomato farmers are reported to use fertilizers to increase tomato productivity but the yields are still low at 4 $t \cdot ha^{-1}$ even with varieties with the potential of producing 16 $t \cdot ha^{-1}$ yields [9]. Although it is known that organic manure increases tomato yields [4] [10], there was a need to conduct a study on different tomato varieties to evaluate the effectiveness of different organic manures on their productivity. Five varieties: Assila, Nuru, Rambo, Nouvella, and Fortune maker were used in the study. The study evaluated the yield outputs of the tomato varieties, and how each of the five tomato varieties responds to cow dung manure and poultry manure treatment in terms of 1. Fruit number and 2. Fruit weight. I hypothesized that the productivity of five distinct tomato varieties is differentially influenced by the application of different organic manures, with each variety exhibiting unique yield outputs under the different organic manure treatments.

2. Methods and Materials

The study was conducted in 2020 between February and August at Hope Christian High School located in Lugazi, situated at coordinates 00˚22'08" N and 32˚56'25" E, within the Buikwe district (**Figure 1**). The study site lies at an altitude of 1204 meters above sea level and receives a bimodal pattern of rainfall, averaging 11,000 mm annually distributed over 106 rain days with peaks occurring from March to May, and from September to November, with January being the driest month with 69 mm precipitation and April with the highest precipitation of 193 mm. The temperatures range between 16˚C and 28˚C throughout the year.

The study site soil, poultry manure, and cow dung manure were analyzed for their physiochemical composition at the Makerere University soil science laboratory, the soil textural class at the study site was clay loam. The pH was determined using a pH meter in a water solution and was 7.98 which was slightly alkaline, soil organic matter was 7.16% and was determined using the Walkley-Black method, manure organic matter was 46.85% and 21.37% in poultry and cow dung manure respectively and was determined by ignition method. Soil available phosphorus

was determined using Spectrophotometry at a wavelength of 880 nm and was 44.873 ppm, available potassium, and nitrogen were determined using Bouyoucos or Hydrometer and were 0.243 cmols/kg and 0.717% respectively. Total nitrogen, phosphorus, and potassium for the manure samples were determined using the Kjeldahl method, the nitrogen was 6.50% and 2.64% in poultry manure and cow dung respectively, phosphorus was 0.313 mg/kg and 0.153 mg/kg in poultry and cow dung manure respectively and potassium in both poultry and cow dung manure was 18.60 cmols/kg and 4.82 cmols/kg respectively.

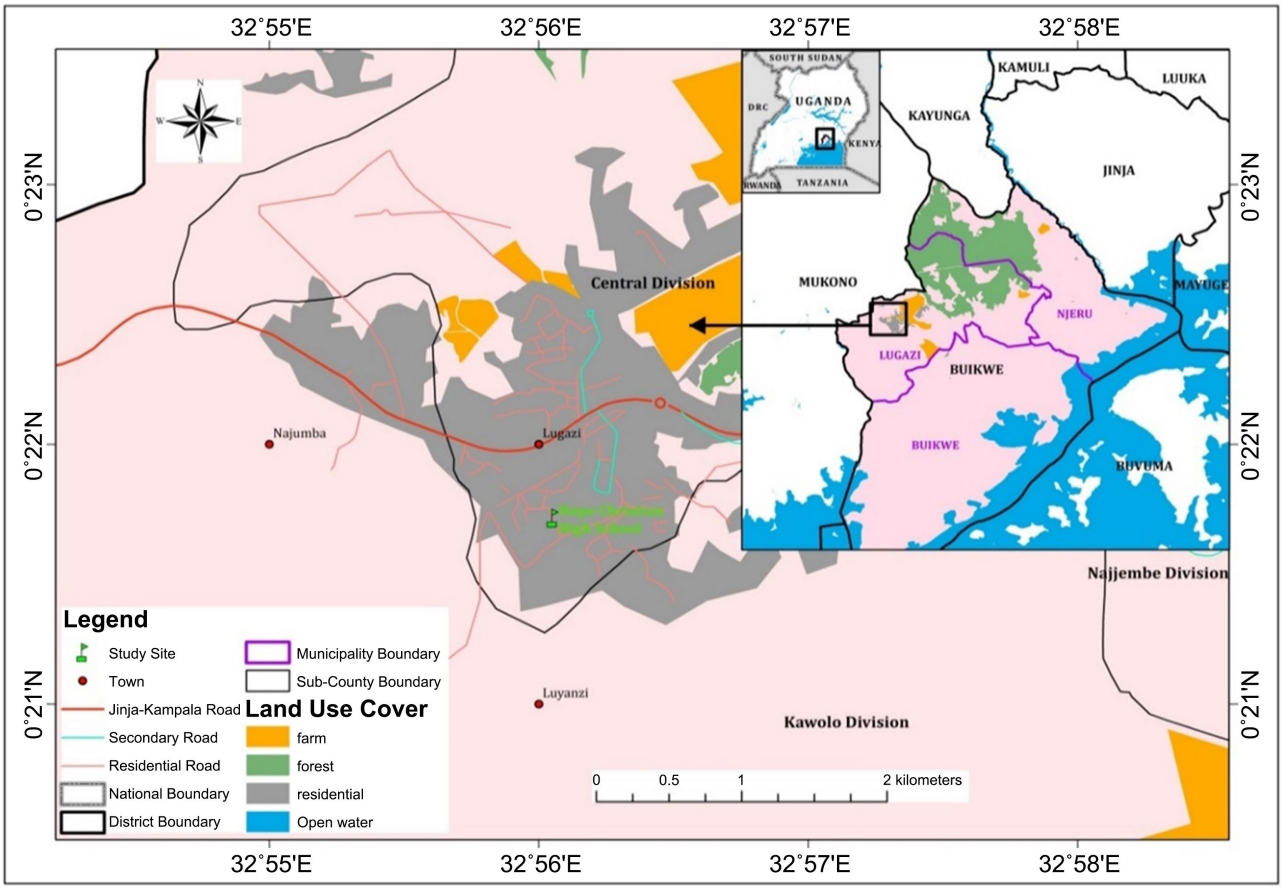

Figure 1. Map showing the study site hope Christian high school at Lugazi and neighboring areas.

A randomized complete block design, with 3 replicas created using the Statistical Tool for Agricultural Research (STAR) containing 5 tomato varieties, Rambo, Assila, Nuru, Nouvella, and Fortune maker was used. The experimental field was a plot measuring 14.8 m × 8 m subdivided into 45 subplots, each with an area of 1.44 m^2, and each subplot contained four tomato plants, spaced at 0.60 m. A 0.5 m distance was maintained between subplots, and the seedlings were planted 0.3 m from the subplot edges. Poultry and cow dung manure was applied at a rate of 10 tonnes per hectare to the subplots three days before transplanting [11]. The five tomato varieties were transplanted from the transplant boxes containing different treatments at 21 days and agronomic practices were carried out whenever required.

Yield outputs of the five tomato varieties were obtained by continuously counting the total number of ripe tomatoes at each harvest from the different treatments of the five tomato varieties and their weights were taken immediately using a digital weighing scale.

IBM SPSS Statistics 29.0 was used to run a Generalized Linear Model (GLM) using Poisson Loglinear Regression Analysis for analyzing the yield output data from this study.

3. Results

The application of organic manure increased the yield outputs of the five tomato varieties. The fruit number was higher under poultry manure than in cow dung manure treatment (Table 1), and the fruit number of the five tomato varieties was 1.315 and 1.214 times higher when poultry manure and cow dung manure were applied respectively (Poultry[a]: coefficient estimates ± s.e = 0.274 ± 0.046, $p < 0.001$, Cow dung[a]: coefficient estimates ± s.e = 0.194 ± 0.047, $p < 0.001$). Fruit weight was also higher in poultry manure than in cow dung manure treatment, the fruit weight of the five tomato varieties was 1.074 and 1.052 times higher when poultry manure and cow dung manure were applied respectively (Poultry[a]: coefficient estimates ± s.e = 0.071 ± 0.006, $p < 0.001$, Cow dung[a]: coefficient estimates ± s.e = 0.050 ± 0.006, $p < 0.001$).

Table 1. Generalized linear model predicting the probability of poultry and cow dung manure increasing the fruit number and fruit weight of the five tomato varieties.

Explanatory variable	Coefficient estimates (B)	Exponentiated value of Coefficient estimates (B)	Standard error	p values
Fruit number				
Cow dung[a]	0.194	1.214	0.047	<0.001
Poultry[a]	0.274	1.315	0.046	<0.001
Fruit weight				
Cow dung[a]	0.050	1.052	0.006	<0.001
Poultry[a]	0.071	1.074	0.006	<0.001

[a]Reference category = no fertilizers (control).

The highest mean fruit number of 36.73 under poultry manure treatment was recorded in the Rambo Variety, and the lowest mean fruit number of 24.50 was recorded in the Nuru variety, In the cow dung treatment, the highest and lowest mean fruit number of 33.90 and 15.00 were seen in Rambo and Nuru varieties respectively. In the no fertilizer/control treatment, the highest mean fruit number was 30.00 in the Nouvella variety and the lowest was 12.43 in the Nuru Variety (Figure 2).

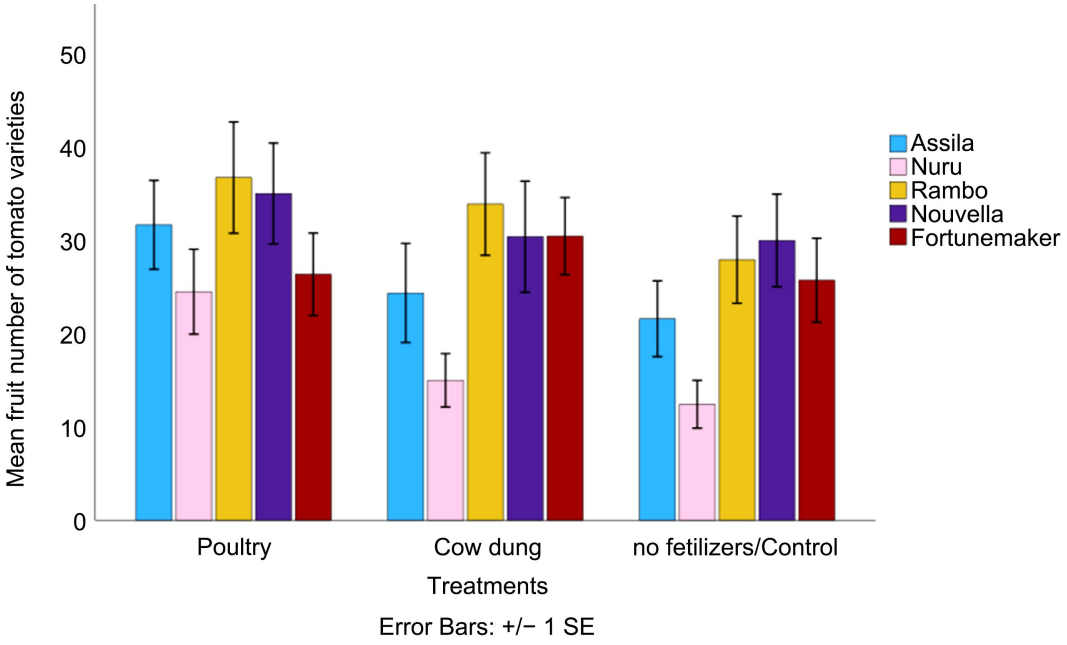

Figure 2. Mean fruit number of the five tomato varieties under different organic manure treatments.

The highest mean fruit weight of 2363.63 g was recorded in the Nouvella variety and the lowest of 1713.27 g in the Fortune maker variety under poultry manure treatment. In the cow dung manure treatment, the highest and lowest mean fruit weights were 2140.97 g and 1119.00 g in the Nouvella and Nuru varieties respectively. Under no fertilizers/control treatment, the highest mean fruit weight of 2077.00 g was recorded in the Nouvella variety, and the lowest mean fruit weight of 867.70 g in the Nuru Variety (**Figure 3**).

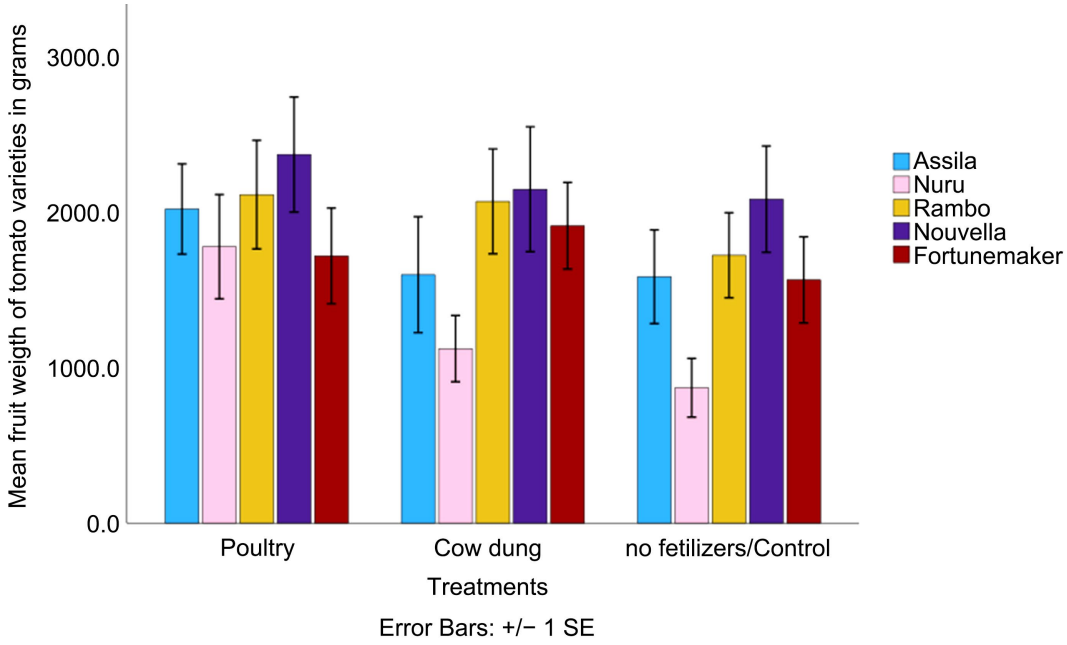

Figure 3. Mean fruit weight of the five tomato varieties under different organic manure treatments.

The difference in the mean fruit number between poultry and cow dung manure treatment was statistically significant in the Assila, Nuru, Nouvella, and Fortune maker varieties. In the Rambo variety, the mean difference was not statistically significant. The highest and lowest mean fruit number difference of ±9.50 and ±2.83 was recorded in the Nuru and Rambo varieties respectively. For the mean fruit number difference between poultry manure and the no fertilizer/control, it was only the Fortune maker variety whose mean difference was not statistically significant. The other varieties had a statistically significant mean difference with the highest and lowest of ±12.07 and ±0.63 recorded in the Nuru and Fortune maker varieties respectively. The Assila, Rambo, and Fortune maker varieties had a statistically significant mean fruit number difference between cow dung manure and no fertilizer/control treatment while for Nuru and Nouvella varieties were not statistically significant with the highest and lowest of ±5.99 and ±0.40 recorded in Rambo and Nouvella varieties respectively.

The mean fruit weight difference between poultry manure and cow dung manure treatment was statistically significant in all the varieties, with the highest and lowest of ±653.47 g and ±43.23 g recorded in the Nuru and Rambo varieties respectively, all the varieties had statistically significant mean fruit weight difference between poultry manure and soil/control treatment with the highest and lowest mean fruit weight difference of ±904.77 g and ±144.50 g in Nuru and Rambo varieties respectively, for the mean difference in the fruit weight between cow dung manure and soil/control treatment was statistically significant in all the varieties except for Assila variety and the highest and lowest mean fruit weight difference of ±346.97 g and ±13.20 g was recorded in Fortune maker and Assila varieties respectively (Table 2).

Table 2. Variation in the mean differences in the fruit number and fruit weight of the five tomato cultivars under different organic manure treatments.

Tomato Variety	Mean fruit number difference (treatment*Variety)			Mean fruit weight difference in grams (treatment*Variety)		
	PT and CT	PT and ST	CT and ST	PT and CT	PT and ST	CT and ST
Assila	±7.30**	±10.07**	±2.77*	±421.13**	±434.33**	±13.20
Nuru	±9.50**	±12.07**	±2.57	±653.47**	±904.77**	±251.30**
Rambo	±2.83	±8.80**	±5.99**	±43.23**	±144.50**	±101.27**
Nouvella	±4.63*	±5.03**	±0.40	±222.67**	±288.63**	±63.97**
Fortune maker	±4.10*	±0.63	±4.73**	±193.57**	±153.40**	±346.97**

PT = Poultry manure treatment: CT = Cow dung manure treatment and ST = no fertilizer/control treatment. *Mean difference statistically significant where (**) = $p < 0.01$ and (*) = $P < 0.05$, ± is the difference in mean fruit number or fruit weight (highest - lowest or vice versa)

4. Discussions

Application of organic manure increases the productivity of different cultivated

crops [12]-[14]. There was higher productivity of all five tomato varieties under organic manure treatments, similar results were also obtained by [12] [15] [16]. The increase in the productivity of the tomato varieties is due to the organic manure improving the soil organic matter, and plant soil water interactions hence improving the soil fertility and porosity [8] [16]. It also enhances the microbial activities of the soil improving water retention and minimizes the leaching of essential mineral salts in the soil [5] [6] [16].

The productivity of the tomato varieties was higher in the poultry manure treatment than in cow dung manure treatment except for the Fortune maker variety which had higher productivity in cow dung manure treatment. Variations in the yield outputs of different tomato varieties were also reported by [12] [15] and they obtained higher yields in poultry manure treatment than in cow dung manure treatment. The higher productivity in poultry manure can be attributed to higher organic matter, nitrogen, phosphorus, and potassium concentration in the poultry manure than in the cow dung manure [17] [18]. This makes essential nutrients for tomatoes to be readily available since tomatoes require large quantities of nutrients [19].

The mean differences in both fruit number and fruit weight recorded differed between the five tomato varieties with the Rambo variety having the highest mean fruit number in both poultry and cow dung manure treatment and the Nouvella variety having the highest mean fruit weight in both poultry manure treatment and cow dung manure treatment. These productivity differences can also be a result of the genetic composition differences and yield potential between the different tomato varieties. [16] [18] also recorded differences in fruit numbers with different varieties under different organic manure treatments.

When productivity was compared in all three treatments, the Nuru variety had the highest mean difference in both fruit number and fruit weight between poultry manure treatment and no fertilizers/control treatment, implying that the variety best responded to the application of poultry manure. Between the cow dung manure and no fertilizer/control treatment highest mean difference in fruit number was recorded in the Rambo variety, and the highest difference in the mean fruit weight was recorded in the Fortune maker variety indicating that though there was a higher increase in the mean fruit number in the Rambo variety, the overall mean fruit weight difference of yields of Fortune maker variety was far higher than in Rambo variety regardless of its lower mean fruit number difference. These results agree with those of [20] for the different tomato varieties.

5. Conclusions

From this study, farmers are advised to use poultry manure to increase tomato productivity for the four varieties: Assila, Nuru, Rambo, and Nouvella except for the Fortune maker variety which had a better performance with cow dung manure. The Nuru variety had the best performance in terms of mean difference in fruit number in poultry manure and no fertilizer/control treatment and the Ram-

bo variety had the best performance in terms of mean difference in fruit number in cow dung manure and no fertilizer/control treatment. For mean fruit weight differences, it is the Nuru variety that had better performance in poultry manure and no fertilizer/control treatment, and the Fortune maker had better performance in cow dung manure and no fertilizer/control treatment.

Rambo and Nouvella varieties had higher mean fruit numbers and mean fruit weight therefore farmers should opt for these tomato varieties for increased tomato yields per hectare.

Conflicts of Interest

The author declares no conflicts of interest.

References

[1] Mehdizadeh, M., Darbandi, E.I., Naseri-Rad, H. and Tobeh, A. (2013) Growth and Yield of Tomato (*Lycopersicon esculentum* Mill.) as Influenced by Different Organic Fertilizers. *International Journal of Agronomy and Plant Production*, **4**, 734-738.

[2] Food and Agriculture Organization of the United Nations (2024) Food and Agriculture Data. FAOSTART Statistics Database. https://www.fao.org/faostat/en/#home

[3] Afsun, J., Khatun, K., Mostarin, T., Haq, M.E., Islam, M.N., Biswas, B.R., *et al.* (2019) Effect of Micronutrients in Presence of Different Levels of Organic Manure on Growth and Yield of Tomato (*Solanum lycopersicum* L.). *Asian Journal of Agricultural and Horticultural Research*, **4**, 1-13. https://doi.org/10.9734/ajahr/2019/v4i230018

[4] Solaiman, A., Nishizawa, T. and Roy, T. (2015) Efficacy of Organic Manures on the Productivity, Shelf-Life and Economic Efficiency of Tomato Varieties in a Long-Term Fertilized Field by Chemical Fertilizers. *American Journal of Experimental Agriculture*, **6**, 181-188. https://doi.org/10.9734/ajea/2015/14679

[5] Aydi Ben Abdallah, R., Jabnoun-Khiareddine, H., Ayed, F. and Daami-Remadi, M. (2023) A Three-Year Study of Comparative Effects of Four Organic Amendments on Soil Health Dynamics, Tomato Production, and Rhizosphere Microbial Community. *Communications in Soil Science and Plant Analysis*, **54**, 2439-2458. https://doi.org/10.1080/00103624.2023.2223675

[6] Gore, N.S. and Sreenivasa, M.N. (2011) Influence of Liquid Organic Manures on Growth, Nutrient Content and Yield of Tomato (*Lycopersicon esculentum* Mill.) in the Sterilized Soil. *Karnataka Journal of Agricultural Sciences*, **24**, 153-156.

[7] Nanwal, R.K., Sharma, B.D. and Taneja, K.D. (1998) Role of Organic and Inorganic Fertilizers for Maximizing Wheat (*Triticum aestivum*) Yield in Sandy Loam Soils. *Crop Research*, **16**, 159-161.

[8] Duumlrdane, Y., Naif, G., Yusuf, Y., Mine, A. and Perihan, C.A. (2011) Effect of Different Organic Fertilizers on Yield and Fruit Quality of Indeterminate Tomato (*Lycopersicon esculentum*). *Scientific Research and Essays*, **6**, 3623-3628. https://doi.org/10.5897/sre10.1083

[9] Ddamulira, G., Isaac, O., Kiryowa, M., Akullo, R., Ajero, M., Logoose, M., *et al.* (2021) Practices and Constraints of Tomato Production among Smallholder Farmers in Uganda. *African Journal of Food, Agriculture, Nutrition and Development*, **21**, 17560-17580. https://doi.org/10.18697/ajfand.97.19905

[10] Isah, A.S., Amans, E.B., Odion, E.C. and Yusuf, A.A. (2014) Growth Rate and Yield

of Two Tomato Varieties (*Lycopersicon esculentum*mill) under Green Manure and NPK Fertilizer Rate Samaru Northern Guinea Savanna. *International Journal of Agronomy*, **2014**, Article ID: 932759. https://doi.org/10.1155/2014/932759

[11] Ibrahim, K.H.M. and Fadni, O.A.S. (2013) Effect of Organic Fertilizers Application on Growth, Yield and Quality of Tomatoes in North Kordofan (Sandy Soil) Western Sudan. *Greener Journal of Agricultural Sciences*, **3**, 299-304. https://doi.org/10.15580/gjas.2013.3.021813471

[12] Mayele, J.M. and Abu, F.R. (2023) Determining the Effects of Selected Organic Fertilizer on Growth and Yields of Tomato (*Lycopersicon esculentum*: Var. Rio Grande Tomatoes) in Mundri West County, Western Equatoria State, South Sudan. *Agricultural Sciences*, **14**, 1343-1374. https://doi.org/10.4236/as.2023.149089

[13] Raghunauth, R., Chandranauth, R., Bacchus, Z., Chibi, S. and Singh, J. (2023) Evaluating Two Varieties of Sweet Pepper Using Different Nutrient Sources to Increase Productivity. *Agricultural Sciences*, **14**, 751-766. https://doi.org/10.4236/as.2023.146050

[14] Hammad, E.I., Al-Agha, M.R. and El-Nahhal, Y. (2018) Enhancing Biogas Production: Influence of Mixing Caw and Chicken Manures. *Energy and Power Engineering*, **10**, 383-397. https://doi.org/10.4236/epe.2018.108024

[15] Usman, M. (2015) Cow Dung, Goat and Poultry Manure and Their Effects on the Average Yields and Growth Parameters of Tomato Crop. *Journal of Biology, Agriculture and Healthcare*, **5**, 7-10.

[16] Yousafzai, S.K., Khan, S.M., Khan, J., Khan, S.A., Hussain, I. and Naz, I. (2016) Response of Tomato Cultivars to Different Organic Fertilizers under Agroclimatic Conditions of Mingora, Swat. *Pakistan Journal of Agricultural Research*, **29**, 60-67.

[17] Adeyeye, A.S., Olalekan, K.K., Lamidi, W.A., Aji, P.O., Othman, H.J. and Ishaku, M.A. (2018) Comparative Effect of Organic and Inorganic Fertilizer Sources on the Growth and Fruits Yield of Tomato (*Lycopersicum esculentum* mill.). *International Journal of Agricultural Policy and Research*, **6**, 122-126. https://doi.org/10.15739/IJAPR.18.014

[18] Falodun, E.J. and Ogedegbe, S.A. (2020). Response of Tomato (*Lycopersicon esculentum* Mill.) Varieties to Different Animal Manure. *Agriculturae Conspectus Scientificus*, **85**, 311-316. https://hrcak.srce.hr/245969

[19] Ortas, I. (2013) Influences of Nitrogen and Potassium Fertilizer Rates on Pepper and Tomato Yield and Nutrient Uptake under Field Conditions. *Scientific Research and Essays*, **8**, 1048-1055.

[20] Akand, M.H., Mazed, H.E.M.K., Abdullah, A.H., Pulok, M.A.I. and Moonmoon, J.F. (2015) Combined Effect of Organic Manures on Growth and Yield of Tomato Varieties. *International Journal of Multidisciplinary Research and Development*, **2**, 653-656.