World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Effect of organic manure on the growth performance and yield of maize (*Zea mays*)

Patience Abidemi Omololu *, Victor Olusola Omololu and Ayosunkanmi Temitope Ogunrinde

Department of Crop Production, Peace House Agricultural Training Institute, Isarun, Ondo State, Nigeria.

World Journal of Advanced Research and Reviews, 2024, 24(03), 2722-2727

Publication history: Received on 16 November 2024; revised on 26 December 2024; accepted on 28 December 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.24.3.3955

Abstract

Research to investigate the effects of organic manure (Cattle manure (CM), Rabbit urine manure (RUM), Swine manure (SM) and Poultry manure (PM)) on growth performance and yield of Maize (*Zea mays*) was conducted on the research farm of Peace House Agricultural Training Institute during the 2024 planting season. The experimental site was cleared and cultivated (tilled and managed). The measured variables were plant height, foliage, leaf area index and crop yield obtained. The data collected was subject to variance analysis (ANOVA).

CM and RUM significantly increased the foliage of maize crop when compared to the control. The foliage of maize crop planted with RUM was significantly higher than all other manure (SM, CM, and PM).

RUM provides the highest crop height at week 7 when compared across all treatment groups (Control, SM, CM and PM), this was followed by SM, CM and PM while the control provided very little crop height. There was a significant increase in the height of maize crop of RUM when compared to control.

All the plots treated with organic manure had increased leaf area index compared to the control. RUM has the highest maize yield across all the treatment groups and it was significant when compared with the control but there was no significant difference in yield of maize across the different manure group except for PM

From this research, RUM consistently increased foliage, plant height and crop yield significantly and it is recommended for Maize production.

Keywords: Maize; Organic Manure; Foliage; Plant Height; Crop Yield

1. Introduction

Maize (*Zea mays L.*) is the world's most important grain after wheat and rice in terms of arable land and total production [1]. It is also commonly known as corn and was domesticated more than 9,000 years ago in southern Mexico/Meso America [2,3]. Maize belongs to the Poales order, Poaceae family, Panicoideae subfamily, Maydeae tribe, Zea genus, *Zea mays* species [4].

Maize has great worldwide importance, not only for the greatest producing countries such as the United States, Brazil, China, and the European Union as an export product, and broadly used for animal feed, but also in developing countries, mainly Africa and Asia, as a human food source [5]

World production of maize has shown a slight but steady increase over the years, but human consumption of the grain has remained steady. It is thought that the majority of the increase in production has corresponded to an increase in the use of maize for animal feed. However, maize is still a staple food for many people, especially in Africa [6].

* Corresponding author: Patience Abidemi Omololu

Maize contains up to 80% carbohydrate in form of starch and 10% crude protein [7]. Maize is a source of nutrients as well as phytochemical compounds such as carotenoids, phenolic compounds and phytosterols which play a significant role in preventing chronic diseases [8,9].

The use of inorganic fertilizers has not been good for agriculture as it is often associated with declining crop yields, soil acidity, and nutrient imbalance [10]. The recycling of animal manure for use as an inexpensive organic fertilizer has had a positive effect on the growth and harvest of biodiversity and promoted the restoration of ecosystems and economic activities of the soil. The content of organic matter (OM) in animal manure is high and its addition to agricultural soils often improves soil structure, chemistry, and the Antonio environment [11]. Organic amendments alleviate OM which improves soil structure through nutrient uptake, water retention capacity, full perforated area, aggregate stability, resistance to erosion, preventing of temperatures, and reducing soil compaction [12].

The Sub-Saharan African countries population is growing very fast [13] which has increased the consumption of animal source foods and it is accelerating and propelling the demand of maize as feed [14]. Also, this region has the highest soil depletion rates in the world which has resulted in low soil fertility with farmers having the lowest global inorganic fertilizer usage due to its cost and this has affected the production of maize despite its nutritional and economic value. Therefore, this study was carried out to investigate the organic manure that will improve soil quality and fertility and thereafter increase the growth performance and yield of maize optimally.

2. Material and methods

The experiment was conducted at the research farm of the department of crop production, Peace House Agricultural Training Institute, Isarun, Ondo state, South-Western part of Nigeria.

2.1. Experimental treatment

The site was cleared and subdivided into five equal experimental plots. Each manure used was allocated a plot each. Group A was for Control (No manure was applied), Group B (Cattle manure: CM) and Group C (Rabbit urine manure: RUM), Group D (Swine Manure: SM), Group E (Poultry manure: PM). The manure application method used was direct broadcasting; this involves the spreading of the manure on the surface of the ridges /plots to be planted.

Table 1 NPK Values of Animal manure

Nutrient	Swine Manure	Poultry Manure	Cattle Manure	Rabbit urine
N (%)	0.8	1.1	0.6	2.4
P (%)	0.7	0.8	0.4	1.4
K (%)	0.5	0.5	0.5	0.6

https://www.allotmentment-garden.org/composts-fertilizers/npk-nutritional-values-animal-manures-compost/

2.2. Propagation and Agronomic Practice

The experimental site was measured and was equally demarcated into five plots and labelled accordingly. The maize seeds were planted using a spacing of 5cm by 5cm and two (2) seeds were planted per hole. Manual weeding was carried out regularly to maintain weed-free plots.

2.3. Soil Analysis

The soil pH was determined with the pH meter and the soil fertility was also determined.

2.4. Data Collection

All data collection began from the first week after planting. Data were collected from 40 randomly selected plant stands in each plot. Data collected includes: Number of leaves (foliage) per plant per plot of manure: this was done on the 40 plant stands by counting the number of leaves on each of them from week 1 to week 7. Plants height per plot of manure: the height of the plants was taken from week 1 to week 7 for each treatment. Leaf area index of plants per plot of manure was taken from week 3 to week 7. Weight of maize at harvest per plot of manure: this was done by weighing the harvested maize cob per plot.

2.5. Data Analysis

The means and standard error of mean (SEM) of the data were calculated. The results were analysed by two-way analysis of variance (ANOVA) with Tukey's multiple comparisons test using GraphPad prism 10.0 to determine significant differences between means and where applicable, least significant difference (LSD) was used to determine significant results. The differences between groups were considered significant at $P < 0.05$.

3. Results

Table 2 Foliage (No of leaves)

WEEK	CONTROL	CM	RUM	SM	PM
1	3.35±0.49^{a}	3.55±0.82^{a}	3.65±0.59^{a}	3.80±0.41^{a}	3.80±0.41^{a}
2	4.85±0.49^{a}	5.70±0.57^{b}	5.55±0.69^{a}	6.25±0.55^{b}	5.65±1.14^{b}
3	5.65±0.87^{a}	6.90±0.79^{bd}	7.65±0.81^{cd}	7.30±1.26^{bd}	6.55±1.46^{b}
4	8.10±2.20^{a}	8.85±0.99^{a}	9.90±0.91^{b}	8.10±1.33^{a}	7.30±1.38^{c}
5	9.15±2.03^{a}	10.05±0.94^{e}	11.00±1.03^{b}	9.80±1.54^{ace}	8.45±1.10^{d}
6	11.45±1.47^{a}	12.10±1.12^{ab}	12.25±1.07^{b}	11.30±1.72^{a}	9.05±1.47^{c}
7	12.10±1.57^{a}	13.50±1.15^{bc}	14.35±1.14^{d}	12.80±2.42^{ab}	10.55±1.64^{e}

Values are expressed in Mean±SEM. Mean with same superscript across the same row are not significant (P>0.05). Mean with different superscript across the same row are significant at P<0.05.

Table 3 Crop weight (kg)

CONTROL	CM	RUM	SM	PM
9.55±0.45^{a}	26.0±4.0^{ab}	40.65±4.35^{b}	26.65±3.35^{ab}	14.55±0.45^{a}

Values are expressed in Mean±SEM. Mean with same superscript are not significant (P>0.05). Mean with different superscript are significant at P<0.05.

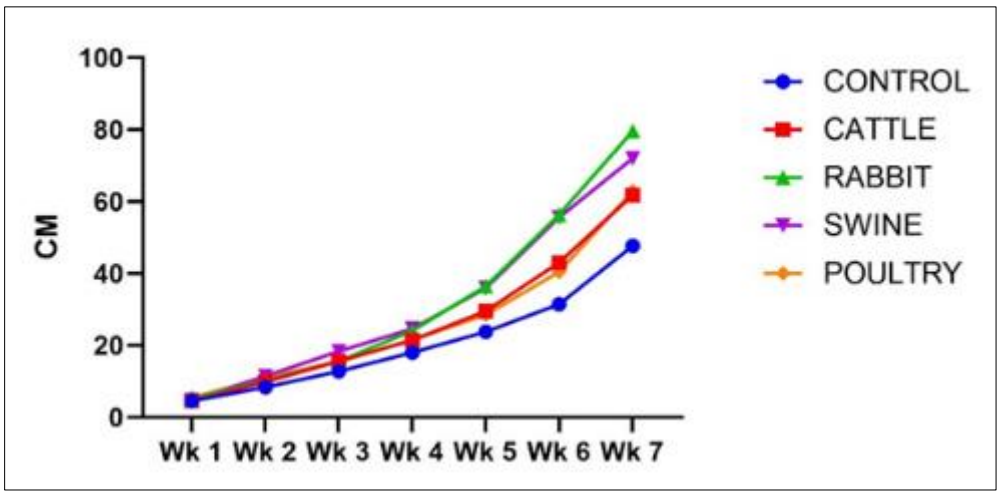

Figure 1 Height of Maize plant

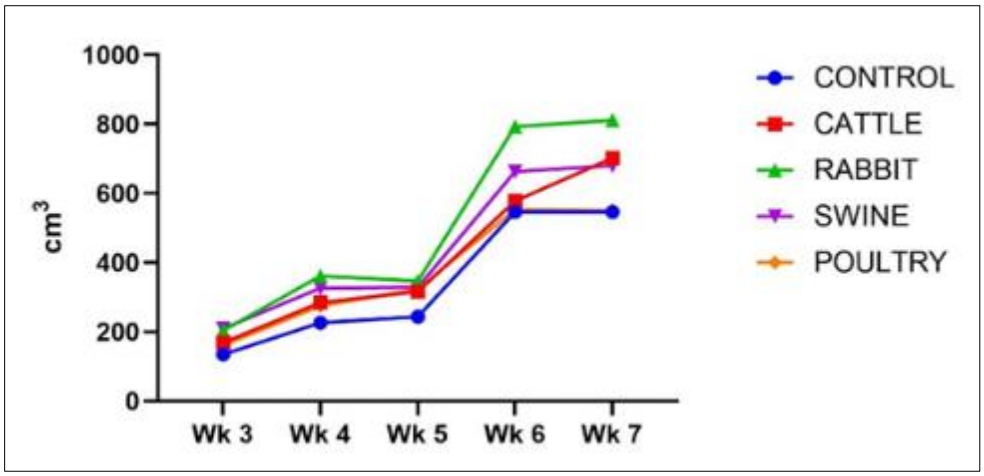

Figure 2 Leaf Area Index

4. Discussion

Soil physico-chemical analyses results revealed that the texture of the soil was sandy and naturally acidic (pH 5.9), after manuring, the soil was slightly neutral (7.8) which shows that it is supportive for vegetative and reproductive stages of the commonly grown arable crops.

Application of CM and RUM significantly increased the foliage of maize crop than the control which is shown in table 2. The foliage of maize crop planted with RUM was significantly higher than all other manure (SM, CM, and PM). This finding reveals that nutrient availability, especially nitrogen, phosphorus and potassium determines plant vegetative growth and development. [15] also confirms this finding.

The result in fig 1 shows that treatment with rabbit urine manure (RUM) provides the highest crop height at week 7 when compared across all groups (Control, SM, CM and PM), this was followed by SM, CM and PM while the control provided very little crop height. There was no significant difference in height of maize crop across different manure treatment groups (SM, CM, and PM) but there was a significant increase in the height of maize crop of RUM when compared to control. This is in line with [12] who confirms the claim that crop grown with organic manure (Poultry manure, Sheep manure and Horse manure) had an increase in plant height when compared to the control. This increase in crop height can be attributed to the continued supply of nutrients in organic manure and more particularly in the RUM. In addition, the development of shoot apical meristem may be a reason to gain a better height. It appeared that the use of RUM enhanced the functions of the apical meristem, which led to an increase in height. The optimal height of the plants improves the acquisition of solar energy, which will help maintain photosynthesis and it is an important growth factor linked to the strength of a crop yield [12, 16].

Leaf area index is a crucial growth index determining the ability of the maize plant to trap solar energy for photosynthesis and has a great effect on growth performance and yield of maize. Figure 2 shows that all the plots treated with organic manure had an increased leaf area index compared to the control.

Increased leaf area in soil amended with organic manure could probably be attributed to nitrogen availability which promotes leaf area during vegetative development and also help to maintain functional leaf area during the growth period [17]. The nitrogen factor is reported to increase leaf localization by increasing leaf length and width and leaf size [12,18,19].

The result in table 3 shows that all organic manure (CM, RUM, SM and PM) had an increased maize yield when compared to the control. There was no significant difference in yield of maize across the different manure group except for PM. RUM has the highest maize yield across all the group and it was significant when compared with the control. This high yield of maize in RUM can be attributed to the Tamm Horsfall glycoprotein which has been found to be present in rabbit urine and plays an important role in plant nutrient metabolism [20].

The consistent poor performance of control plots (non-fertilized) revealed that when nutrients are available in adequate amounts, plant tends to grow at their optimum potential. These improvements in growth parameters in the plot fertilized with different organic manure agree with the findings of [21,22,23].

5. Conclusion

Based on the result of this study, the growth performance and yield of maize increased by the addition of organic manure to the soil. It would be apt to recommend the use of RUM for optimum growth of maize due to its basic nature, it is used for soil acidity amendments to correct low soil pH which is causing low crop yields in most parts of the sub-Saharan African countries. However, in the absence of RUM, the use of CM and SM is also recommended for a better yield of maize. They are easily available, cost effective and environmentally friendly.

Compliance with ethical standards

Acknowledgments

We like to acknowledge Bro Gbile Akanni, the Chairman Governing Council, Peace House Agricultural Training Institute, Isarun, Ondo State for his support towards the research and Dr [Mrs] Sade Akanni of Peace House, Gboko for her support towards the research. The efforts of Mr Abikpi Raphael, Mr Idagu Achon Mathias, Mr Adekpe Joshua and Mr Abimaje Abraham during this research work are also acknowledged.

Disclosure of conflict of interest

The authors declare no conflict of interest.

References

[1] Osagie A.U, Eka O.U. (1998) Nutritional Quality of Plant Foods. Post-Harvest Research Unit, University of Benin, Benin. 2(1): 34 -41.

[2] Awika, J. (2011). Major cereal grains production and use around the world. In: Awika, J. M., Piironen, V., & Bean, S. (Eds.), Advances in cereal science: implications to food processing and health promotion. American Chemical Society Atlantic City, NJ, Washington DC, pp. 1–13

[3] Kennett, D. J., Prufer, K. M., Culleton, B. J., George, R. J., Robinson, M., Trask, W. R., Buckley, G. M., Moes, E., Kate, E. J., Harper, T. K., O'Donnell, L., Ray, E. E., Hill, E. C., Alsgaard, A., Merriman, C., Meredith, C., Edgar, H. J. H., Awe, J. J., & Gutierrez, S. M. (2020). Early isotopic evidence for maize as a staple grain in the Americas. Science Advances

[4] Brieger, F.G. and Blumenschein, A. (1966) Botânica e origem do milho. In: Cultura e adubação do milho. São Paulo, SP: Instituto Brasileiro de Potassa, p.81–107.

[5] Sans, P. and Combris, P. (2015) World meat consumption patterns: An overview of the last fifty years (1961 2011). Meat Science, v.109, p.106–111.

[6] Ranum P., Pena-Rosas J.P., and Garcia-Casal M.N. (2014) Global maize production, utilization, and consumption. Ann. N.Y. Acad. Sci. 1312: 105–112.

[7] Mangel (1978). "Principles of Plant Nutrient". International Potash Institute, Borne, Switzerland.

[8] Demeke, K.H. (2018). Nutritional quality evaluation of seven maize varieties grown in Ethiopia. Biochemistry and Molecular Biology, 3(2): 45-48.

[9] Shah, T.R., K. Prasad and P. Kumar (2016). Maize - A potential source of human nutrition and health: A review. Cogent Food & Agriculture, 2(1): 1166995.

[10] Ano A.O, Agwu J.A. (2005) Effect of animal manures on selected soil chemical properties (1). Nig J Soil Sci. 15: 14-19.

[11] Antonious G.F. (2016) Organic fertilizers: From basic concepts to applied outcomes. In: Larramendy M.L, Soloneski S, editors. Soil Amendments for Agricultural Production. Rijeka, Croatia: Intech, 157-187.

[12] Asfaw M.D. (2022) Effects of animal manures on growth and yield of maize (*Zea mays* L.). J Plant Sci Phytopathol. 6: 033-039.

[13] Bationo, A.; Hartemink, A.; Lungu, O.; Naimi, M.; Okoth, P.; Smaling, E.; Thiombiano, L.; Waswa, B. (2012) Knowing the African soils to improve fertilizer recommendations. In Improving Soil Fertility Recommendations in Africa Using the Decision Support System for Agrotechnology Transfer (DSSAT); Al, K.E., Ed.; Springer: Dordrecht, The Netherlands, pp. 19–42.

[14] Erenstein, O. (2010). The evolving maize sector in Asia: Challenges and opportunities. Journal of New Seeds, 11, 1–15.

[15] Adebayo A.G., Akintoye H.A., Aina O.O., Olatunji M.T. and Shokalu O.A. (2009) Assessment of Organic amendments on growth and flower yield of Sunflower (Helianthis annus). In: Prpceedings of Horticultural Society of Nigeria 11-16 October, 2009, Kano State, Nigeria 292-298.

[16] Saeed I.M, Abbasi R., Kazim M. (2001) Response of maize (Zea mays) to nitrogen and phosphorus fertilization under agro-climatic condition of Rawalokol, Azad Jammu and Kaslim and Kashmir, Pakistan J Bio Sci. 4: 949-952.

[17] Cox W.J., Kalonge S., Cherney D.J.R. and Reid W.S. (1993) Growth Yield and Quality of Forage Maize under Different Nitrogen Management Practices. Agronomy Journal 85: 341-347.

[18] Kabbashi Y., and Nagatoma T. (1953) Yield of soiling maize under the influence of continuous application of farmyard manure. Herbage Abst. 53(5):1852-1857.

[19] Rogeb M.M., Rassay H.W., and ElShazly M. (1990) Vegetative growth and dry matter accumulation. Field crop abstracts 43: 12, Abstract 8615.

[20] Fletcher, A. P., Neuberger A., Ratcliffe W. A. and Tamm-Horsfall (1970). Urinary glycoprotein: The subunit structure. Biochem J. Nov;120 (2):425–432

[21] Uzo J.O (1971) Effects of nitrogen, phosphorus and potassium on the yield of tomato (Lycopericon esculentum Mill) in the humid tropics. Horticulture Resources 11: 65-72.

[22] Fawusi M.O.A (1977) Influence of plant density and time of fertilizer application, growth characteristics, nutritional uptake and yield of tomato. Scientia Horticulture 7: 329-337.

[23] Aminifard M.H., Aroiee H.O., Fatemi H., Ameri A.S. and Karimpour S. (2010) Responses of eggplant (Solanum melongena L.) to different rates of nitrogen under field conditions. Journal of Central European agriculture11: 243-248.