ACTA BIOLOGY FORUM

Research Article: 16 to 23 (2024)
ISSN: 2583-7419
biologyforum.actabotanica.org

Comparative effect of organic fertilizers on the growth performance of maize (*Zea mays*) plants

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Citation: Liamngee Kator, Agbatar Bob Lubem, Fayinminu Akintade Ojo, Ugbaha Anyebe, Iyaji Alex Aduojo, Francis Onaji Onazi and Yankyaa Patrick (2024). Comparative effect of organic fertilizers on the growth performance of maize (*Zea mays*) plants. *Acta Biology Forum*. **DOI: https://doi.org/10.51470/ABF.2024.3.1.16**

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Received 8 March 2024 | Revised 24 April 2024 | Accepted 11 May 2024 | Available Online June 07 2024

Authors Contribution: *This work was carried out in collaboration between all authors. Author Yankyaa Patrick conducted laboratory experiments and recorded laboratory observations; Agbatar Bob Lubem wrote the protocol and first draft of the manuscript. Author Liamngee Kator conceived the experimental idea and equally supervised it; Author Francis Onaji Onazi wrote the concept and discussion. Author Fayinminu Akintade Ojo managed the analyses of the study and guided the laboratory technician and Author Ugbaha Anyebe, Who conducted manuscript proofreading before submission. Author Iyaji Alex Aduojo managed the literature searches and performed data analysis. All authors read and approved the final manuscript.*

Conflict of Interest: *The authors have declared that there are no competing conflicts of interest.*

ABSTRACT

Background and Objective: *Maize is an important crop that has the potential to alleviate hunger and ensure food security in Nigeria. Organic fertilizers have been used by farmers based on choice and availability. Nevertheless, the comparative efficiency of each organic manure in improving crop yield is lacking. Therefore, the comparative effect of organic fertilizers on the growth of maize was investigated. Materials and Methods Twenty-four (24) bags were filled with about 4000g of soil of uniform properties. Six bags each, cow dung, goat dung, and poultry while six bags were left as control. Two varieties of maize namely the Local variety and Sammaz 15 were sown into the soils according to the experimental design.*

Results*: Results showed significantly greater height and number of leaves for Sammaz 15 (11.88 and 65.24) compared to the local variety (11.33 and 60.61) while stem diameter and leaf area were higher for the local variety (4.66 and 378.00) compared to Sammaz 15 (4.21 and 347.02). Goat dung produced a significantly higher number of leaves and height (12.21 and 68.62) compared to poultry (12.02 and 59.31) cow dung (11.60 and 68.26) and control (10.58 and 55.50). Significantly higher stem diameter and leaf area were however recorded for poultry droppings (5.08 and 406.83) compared to goat dung (4.73 and 370.66), cow dung (4.19 and 360.80), and control (3.75 and 311.76 respectively). Interaction between Sammaz 15 and poultry droppings produced a significantly higher number of leaves than the other interactions.*

Conclusion: *Goat dung improves plant height and number of leaves better than cow dung and poultry droppings while leaf area and stem diameter are enhanced more by poultry droppings. The use of organic manure should be promoted in preference to inorganic fertilizers.*

Keywords: *Maize (Zea mays), Comparative, Performance, Goat dung, Poultry droppings, Cow dung.*

1.0 INTRODUCTION

Background of the Study: Maize (*Zea mays* L.) is the most important cereal crop in sub-Saharan Africa and an important staple food for more than 1.2 billion. All parts of the crop can be used for food and non-food products. In addition to being consumed directly by humans often in the form of masa, maize is used for corn ethanol, animal feed, and other maize products, such as corn starch and corn syrup [1]. The economic importance of maize cannot be over-emphasized as a good source of minerals, vitamins, fiber, and oil it is used for cooking and soap-making companies and is also very famous in the pharmaceutical industry as diluents and used in the cosmetic industry. An average type of maize has 65% carbohydrates, 10% to 2% proteins, and 4–8% fat [2]. Mineral salts and complexes containing important trace elements are also present in maize grain [1].

While chemically manufactured inorganic fertilizers were only widely established during the Industrial Revolution, organic fertilizers have been utilized for many millennia. Although soil fertility reduces crop productivity, particularly in urban and peri-urban areas, the majority of vegetable growers in tropical Africa are small-scale producers who cannot afford the cost of inorganic fertilizers [3].

Importance of the study: Physical and chemical aspects of the soil that are crucial for plant growth are improved by organic manure. They boost plant growth by increasing the population of microorganisms, and they also have a good effect on root

growth by enhancing root roster conditions (structure, humidity, etc.). Organic acid produced during decomposition enhances the nutritional value of foods [4].

One of the biggest obstacles to sustained agricultural output in Sub-Saharan African (SSA) nations is the issue of decreased soil fertility [5]. It is commonly acknowledged that improving soil fertility management among smallholder farmers is an essential strategy for addressing increased agricultural yields and poverty alleviation, especially in Sub-Saharan Africa, where the bulk of the population depends on smallholder farming for a living. Improved crop yield and revenue in agribusiness depend on ongoing soil fertility management [6].

Rationale of the Study: The addition of fertilizers is required due to the Nigerian soils' fragility and high sensitivity to nutrient loss and deterioration. Alternative soil regeneration techniques are now a necessity due to soil deterioration, as well as the high price and dearth of industrial fertilizers. Because fertilizer is expensive and occasionally in short supply in Nigeria, farmers may not apply enough to ensure good growth. In Nigeria, the rates of fertilizer application in intensive agriculture systems have dramatically increased in recent years. As a result, farmers rely heavily on organic fertilizers that are produced nearby to increase crop output. Cow, goat, and chicken droppings are some of the most often utilized organic fertilizers that have been shown to increase crop output [6]. The use of these organic fertilizers has been dictated by preference and accessibility. However, it is difficult to compare how effective different organic manure is at boosting crop output. Based on scientific results, the best organic manure to use is also scarce.

Therefore, the objective of this study was to compare how organic fertilizers affected the growth performance of maize plants.

2.0 MATERIALS AND METHODS

2.1 Study location and duration

This study was carried out behind the Botany Laboratory of Benue State University, Makurdi. Makurdi is located in central Nigeria along the Benue River, on latitude 07°43'N and Longitude 08°35'E; it is 104m above sea level. Makurdi lies in the tropical Guinea-Savannah of West Africa where the temperature ranges between 21.7°C-24.0°C and a maximum of 29.0°C-33.7°C. The relatively high temperature was determined to be 29.6°C. It is also an ecotone belt that separates the forested South from the true Savannah of the North. As such, the vegetation is an assortment of trees and grasses[7]. The study was carried out from August 2021 to October 2021

2.2 Collection and Analysis of Soil Sample.

Sandy loam soil samples of 4000 g collected at different sites of the fallowed land of Benue State University, Makurdi were thoroughly mixed with cow dung, poultry droppings, and goat dung respectively, and dried. The sandy loam soil without fertilizers and those with fertilizer treatments were then taken to the Department of Soil Science, Federal University of Agriculture, Makurdi for soil analysis.

2.3 Maize Sample Collection

Before planting, one improved variety of maize seed was obtained from the Institute of Agricultural Research (IAR) Zaria and one Local variety (Oba super -6) from Makurdi was obtained for planting.

2.4 Experiment II: Soil Preparation and Planting

The experiment was carried out under screen conditions. Polyethene bags measuring 50 cm (diameter) and 17 cm (height) were used for the experiment. Each bag was perforated at the bottom to control drainage and aeration. Thereafter, they were filled with 4000 g of sandy loam soil.

About 100 g of cow dung, goat dung, and poultry droppings were added to each experimental unit. Rigorous mixing was done to ensure adequate incorporation of the organic manures into the soil samples. The soil samples of the various experimental units were left for Seven (7)days to facilitate the complete mixing of soil with organic fertilizers. Two seeds of each variety of maize were sown by depressing the seeds into the soil at a depth of 2 cm, thinning was done to a plant per pot two weeks after planting.

2.5 Experimental Design

Factors in the Experiment

1. Two varieties of Maize (Sammaz 15 and Oba super -6)

2.Three organic fertilizers (cow dung, goat dung, poultry droppings) and a control (soil without fertilizer)

Experimental Design

2 x 4 factorial in a completely randomized design

Treatment combinations = 2 x 4 = 8

Replications = 3

Total number of units/lots = 24

2.6 Data Collection

Data collected during the study include;

1. Plant height (n)

The height of the plant was measured using a graduate measuring tape; the tape was stretched from ground level to the top of the plant. And the reading was taken.

2. Stem diameter (cm)

A measuring tape was placed around the stem of the maize plant and the reading was taken.

3. Number of leaves (cm)

The numbers of leaves were obtained by counting and the reading was taken.

4. Leaf area (cm^2)

The leaf area was calculated by multiplying the length of the leaf by its breadth and the reading was taken.

Leaf Area = Length x Breadth (L x B)

2.7 Statistical Analysis

The data obtained from the study were subjected to Analysis of Variance using Genstat version 19. Means were separated using Fisher's least significant difference at a 5% level of significance.

3.0 RESULTS

The soil analysis used in this experiment contained cow dung, poultry dung, and goat dung with a specific control. However, the soil sample with poultry dung had the highest pH value of (6.69), while that of goat dung(6.55), cow dung (6.33), and control(6.38), the result showed the pH of all parameters were slightly acidic(Table 1). The result of the organic carbon of this study recorded soil with cow dung (1.66), poultry dung (1.30), goat dung (1.20), and control (1.14). The result of organic matter in this study recorded high organic matter in cow

dung(2.86), poultry dung (2.24), and goat dung (2.07), with their critical level being medium and that of control having the least critical level of (1.97), respectively. The result for nitrogen in all three soil samples and control showed less variation ranging from poultry droppings (0.098), cow dung (0.083), goat dung (0.079), and control (0.072).

From this experiment, low phosphorus(p) content was recorded in all treatments with poultry dung (4.46), cow dung (4.25), and Goat dung(4.21) with control (4.13). Potassium (k) had medium critical levels in all treatments with poultry dung (0.41), cow dung (0.36), goat dung (0.31), and control(0.33) respectively. Sodium (Na) recorded medium critical levels in all treatments with cow dung (0.45), goat dung (0.43), control (0.42), and poultry dung (0.36) respectively. Magnesium (mg) recorded medium critical levels in all treatments with cow dung (1.44), goat dung (1.40), control (1.38), and poultry dung (1.32). Calcium (c) recorded low critical levels in all treatments with cow dung (3.32), goat dung (3.30), poultry droppings (3.15), and control (2.75) respectively.

Table 1: Soil Analysis of Sandy-Loam Soil

S/N	SAMPLE ID	pH	% SAND	% CLAY	% SILT	% O.C	% O.M	% N	Ppm P	K	Na	Mg	Ca	TAB	EA	CEC	% BS
1	**(SOIL)**	6.38	78.96	13.92	7.12	1.14	1.97	0.072	4.13	0.33	0.42	1.38	2.75	4.88	1.46	6.34	76.97
2	**(SOIL + COW DUNG)**	6.33	80.96	17.92	1.12	1.66	2.86	0.083	4.25	0.36	0.45	1.44	3.32	5.57	0.68	6.25	89.12
3	**(SOIL + POULTRY DUNG)**	6.69	80.96	17.92	1.12	1.30	2.24	0.098	4.46	0.41	0.39	1.32	3.15	5.27	1.04	6.31	83.52
4	**(SOIL + GOAT DUNG)**	6.55	78.96	13.92	7.12	1.20	2.07	0.079	4.21	0.31	0.43	1.40	3.30	5.24	1.12	6.36	82.39

Key:

pH: 5.3-6.0 moderately acid, 6.0-7.0 slightly acid,7.0-8.5 moderately alkaline
Organic matter (OM): <1 very low, 1-2 low 2-4.2 medium, 4.2-6 high >6 very high
Calcium(ca) cmol+kg <2 very low, 2-5 low, 5-10 medium, 10-20 high, >20
Magnesium(mg) cmol+kg <0.5 very low, 0.5-1.5 low, 1.5-3 medium, 3-8 high, >8
Potassium (k) cmol+kg <0.1 very low, 0.1-0.3 low, 0.3-0.6 medium, 0.6-1.2 high, >1.2
Sodium (Na) cmol+kg <0.1 very low, 0.1-1.0 low, 0.3-0.7 medium, 0.7-2.0 high, >2.0
Cation Exchange Capacity (CEC) cmol+kg <0-20 very low, 21-40 low, 41-46 medium, 61-80 high, >81-100
Base Saturation (BS)(%)<50 Low,50-80 Medium. >80 High
Available Phosphorus (mg/kg) <10 Low,10-20 Medium,>20 High.
Organic Carbon(g/kg) <10 Low, 10-15 Medium,>15 High.
Total Nitrogen (g/kg) <0.5 Very Low,0.5-1.25 Low, 1.25-2.25 Medium, 2.25-3.0 High, >3.0 Very High.
Exchangeable Acid (EA)(mg/kg); <10 low, 10-15 Medium, >15 High.

The main and interaction effects of organic fertilizer on the height of the maize Plant were statistically significant on weeks 1, 2, 3, 4, 5 6, 7, and 8 ($P<0.05$) as shown in Tables 2 and 3. Results obtained showed that greater heights were significantly recorded for Oba super -6 on weeks 1 and 2 (12.00cm, and 30.08cm respectively) compared to Sammaz 15 (11.35cm and 27.75cm) which however recorded significantly higher values (45.25cm, 61.51cm, and 74.46cm, 81.04cm, 101.75am, and 118.83cm) for weeks 3, 4, 5, 6, 7, and 8 respectively compared to Oba super -6 (44.23cm, 55.82cm, 65.71cm, 75.94cm, 90.42cm, and 110.67cm). Greater heights were recorded for maize treated with cow dung on weeks 1, 2, 3, 4, and 6 (13.33cm, 32.17cm, 48.15cm, 62.75cm, and 83.28cm respectively) and this was significantly higher than other treatments combinations involving poultry dung, goat dung, and control. However, greater height was recorded for maize treated with goat dung on weeks 7 and 8 (109.00 cm and 128.17cm respectively) than poultry dung (85.17cm and 105.17 respectively), cow dung (105.17cm and 126.83cm respectively) and control (85.00cm and 98.83cm respectively) (Table 2).

Furthermore, the interaction between cow dung and Oba super 6 produced significantly greater height (14.17cm and 48.50cm respectively) on weeks 1 and 3, and this was significantly higher than all other treatment combinations considered, also the interaction between Oba super -6 and goat dung produced greater height on week 2 (36.00). However, greater height was recorded by the interaction between Sammaz 15 and goat dung on week 4 (66.37cm). The interaction between Sammaz 15 and cow dung produced significantly greater height on weeks 5, 6, 7, and 8 (83.00cm, 90.50cm, 118.00cm, and 132.33 respectively) compared to the control (65.00cm, 70.83cm, 85.36cm and 103.00cm respectively), goat dung (79.83cm, 86.17cm, 117.00cm and 127.33cm respectively) and poultry dung (70.00cm, 76.67cm, 86.33cm, and 112.67cm respectively) (Table 3).

Table 2: Main Effect of Variety and organic fertilizers on the Height of maize plant

	Plant height							
Variety	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8 (weeks)**
Oba super -6	12.00	30.08	44.23	55.82	65.71	75.94	90.42	110.67
Sammaz 15	11.35	27.75	45.25	61.51	74.46	81.04	101.75	118.83
FLSD(0.05)	**1.63**	**3.01**	**3.89**	**3.70**	**3.69**	**4.65**	**6.83**	**8.36**
Fertilizer								
Control	9.28	23.17	39.92	51.42	64.33	72.08	85.00	98.83
Cow dung	13.33	32.17	48.15	62.75	74.42	83.28	105.17	126.83
Goat dung	11.58	32.17	47.80	62.60	74.67	83.00	109.00	128.17
Poultry dung	12.50	28.17	43.10	57.88	66.92	75.60	85.17	105.17
FLSD(0.05)	**2.30**	**4.26**	**5.50**	**5.33**	**5.22**	**6.57**	**9.66**	**11.83**

Key; FLSD- Fisher's Least Significant Difference

Table 3: Interaction Effect of Variety and organic fertilizers on height of maize plant

		Plant height							
Variety	**Fertilizer**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8(weeks)**
Oba super -6	**Control**	9.17	23.00	37.83	47.83	63.67	73.33	84.33	94.67
	Cow dung	14.17	33.00	48.50	59.17	65.83	76.07	92.33	121.33
	Goat dung	13.17	36.00	47.60	58.83	69.50	79.83	101.00	129.00
	Poultry dung	11.50	28.33	43.00	57.43	63.83	74.53	84.00	97.67
Sammaz15	**Control**	9.40	23.33	42.00	55.00	65.00	70.83	85.36	103.00
	Cow dung	12.50	31.33	47.80	66.33	83.00	90.50	118.00	132.33
	Goat dung	10.00	28.33	48.00	66.37	79.83	86.17	117.00	127.33
	Poultry dung	13.50	28.00	43.20	58.33	70.00	76.67	86.33	112.67
FLSD(0.05)		**3.26**	**6.03**	**7.78**	**7.54**	**7.39**	**9.30**	**13.66**	**16.73**

Key; FLSD- Fisher's Least Significant Difference

The main and interaction effect of Organic fertilizers and variety on the number of leaves of Maize was statistically significant on weeks 1, 2, 3, 4, 5, 6, 7, and 8 ($P<0.05$) as shown in Table 4. A significantly higher number of leaves were recorded for Sammaz 15 on week 1, 2, 3, 4, 5, 6, 7, and 8 (3.92, 6.83, 9.17, 11.08, 12.83, 14.50, 17.92, and 18.75 respectively) than Oba super -6 (3.75, 6.67, 8.50, 10.50, 12.42, 13.42, 17.25, and 18.17 respectively) Higher number of leaves was recorded for Maize treated with goat and poultry dung on weeks 1, 6, 7, 8, (4.00, 14.50, 18.17, and 19.00 each), also, higher number of leaves was recorded for maize plant treated with goat dung on weeks 2, 3, 4, and 5 (7.33, 9.50, 11.67, and 13.50 respectively) this was significantly higher than other treatment combinations involving cow dung, poultry dung and control.

The interaction effect of variety and organic fertilizers on several leaves was higher for the interaction between Oba super -6 and Sammaz 15 treated with goat and poultry dung (4.00 each) on week 1 (7.33 each) on week 2 and (19.00 each) on week 8. Also, a higher number of leaves was produced by the interaction between Oba super -6 and Sammaz 15 treated with poultry and goat dung on week 7 (18.33 each) compared to other treatment combinations involving cow dung and control. A significantly higher number of leaves was however recorded for the interaction between Sammaz 15 treated with goat and poultry dung on week 3 (10.00 each) compared to control (7.67) and cow dung (9.00). Also, a higher number of leaves was recorded for the interaction between Sammaz 15 and goat dung on weeks 4, 5, and 6 (12.33, 14.33, and 15.67 respectively) compare to poultry dung (11.33, 13.00, and 14.67 respectively), cow dung (11.00, 13.00, and 14.00 respectively) and control (9.67, 11.00, and 13.67 respectively) (Table 5).

Table 4: Main Effect of Variety and organic fertilizers on the Number of Leaves of maize plants

	Number of leaves (n)							
Variety	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8 (weeks)**
Oba super -6	3.75	6.67	8.50	10.50	12.42	13.42	17.25	18.17
Sammaz 15	3.92	6.83	9.17	11.08	12.83	14.50	17.92	18.75
FLSD(0.05)	**0.30**	**0.55**	**0.68**	**0.58**	**0.63**	**0.55**	**0.39**	**0.35**
Fertilizer								
Control	3.67	5.50	7.83	9.67	11.33	13.00	16.33	17.33
Cow dung	3.67	7.17	8.67	10.67	12.67	13.83	17.67	18.50
Goat dung	4.00	7.33	9.50	11.67	13.50	14.50	18.17	19.00
Poultry dung	4.00	7.00	9.33	11.17	13.00	14.50	18.17	19.00
FLSD(0.05)	**0.43**	**0.79**	**0.96**	**0.82**	**0.90**	**0.79**	**0.55**	**0.50**

Key; FLSD- Fisher's Least Significant Difference

Table 5: Interaction Effect of Variety and organic fertilizers on Number of leaves of maize plants

		Number of leaves (n)							
Variety	**Fertilizer**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8(weeks)**
Oba super -6	**Control**	3.33	5.33	8.00	9.67	11.67	12.33	15.33	16.33
	Cow dung	3.67	6.67	8.33	10.33	12.33	13.67	17.33	18.33
	Goat dung	4.00	7.33	9.00	11.00	12.67	13.33	18.00	19.00
	Poultry droppings	4.00	7.33	8.67	11.00	13.00	14.33	18.33	19.00
Sammaz 15	**Control**	3.67	5.67	7.67	9.67	11.00	13.67	17.33	18.33
	Cow dung	3.67	7.00	9.00	11.00	13.00	14.00	18.00	18.67
	Goat dung	4.00	7.33	10.00	12.33	14.33	15.67	18.33	19.00
	Poultry droppings	4.00	7.33	10.00	11.33	13.00	14.67	18.00	19.00
FLSD(0.05)		**0.61**	**1.11**	**1.36**	**1.17**	**1.27**	**1.11**	**0.79**	**0.70**

Key; FLSD- Fisher's Least Significant Difference

The main and interaction effect of Organic fertilizers and variety on stem diameter of Maize Plants were statistically significant on Weeks 1, 2, 3, 4, 5, 6, 7, and 8 ($P<0.05$). Significantly greater stem diameters were recorded for Oba super -6 on Weeks 1, 2,3, 4, 5 6, 7, and 8 (1.93, 3.28, 4.39, 4.89, 5.28, 5.53, 5.95, and 6.03 respectively) compared to Sammaz 15 (1.82, 3.04 3.74, 4.20, 4.59, 5.03, 5.46, and 5.83 respectively) Also, significantly greater stem diameters were obtained from maize plants treated with goat dung on Week1 (2.22) than cow dung (2.05), poultry dung (1.48) and control (1.75). however, greater stem diameters were recorded for maize plants treated with poultry dung on weeks 2, 3, 4, 5, 6, 7, and 8 (3.57, 4.83, 5.47, 5.80, 6.15, 6.58, and 6.75 respectively) (Table 6).

The interaction effect between Oba super -6 and goat dung produced significantly higher stem diameters (2.27 and 3.73 respectively) on weeks 1 and 2 compared to cow dung (2.10 and 3.03 respectively), Poultry dung (1.67 and 3.67 respectively) and Control (1.67 and 2.70 respectively). Greater stem diameter was however produced by an interaction between Sammaz 15 and poultry dung on weeks 3, 4, 5, 6, 7, and 8 (5.60, 6.33, 6.67, 6.83, 7.17, and 7.17) compared to other treatment interactions involving goat dung, cow dung and control (Table 7).

Table 6: Main Effect of Variety and organic fertilizers on Stem Diameter of maize plants

	Stem diameter (cm)							
Variety	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8 (weeks)**
Oba super -6	1.93	3.28	4.39	4.89	5.28	5.53	5.95	6.03
Sammaz 15	1.82	3.04	3.74	4.20	4.59	5.03	5.46	5.83
FLSD(0.05)	**0.31**	**0.27**	**0.36**	**0.13**	**0.26**	**0.23**	**0.24**	**0.22**
Fertilizer								
Control	1.75	2.70	3.42	3.83	4.20	4.40	4.83	4.87
Cow dung	2.05	2.93	3.60	4.15	4.57	5.02	5.43	5.78
Goat dung	2.22	3.45	4.42	4.73	5.17	5.55	5.97	6.32
Poultry dung	1.48	3.57	4.83	5.47	5.80	6.15	6.58	6.75
FLSD(0.05)	**0.43**	**0.38**	**0.51**	**0.18**	**0.37**	**0.33**	**0.49**	**0.32**

Key; FLSD- Fisher's Least Significant Difference

Table 7: Interaction Effect of Variety and organic fertilizers on Stem diameter of maize plants

Variety	**Fertilizer**	Stem diameter (cm)							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8(weeks)**
Oba super -6	**Control**	1.67	2.70	3.43	3.87	4.17	4.30	4.83	4.73
	Cow dung	2.10	3.03	3.83	4.40	4.83	5.30	5.73	5.90
	Goat dung	2.27	3.73	4.70	4.97	5.43	5.70	6.07	6.30
	Poultry dung	1.67	3.67	5.60	6.33	6.67	6.83	7.17	7.17
Sammaz 15	**Control**	1.83	2.70	3.40	3.80	4.23	4.50	4.83	5.00
	Cow dung	2.00	2.83	3.37	3.90	4.30	4.73	5.13	5.67
	Goat dung	2.17	3.17	4.13	4.50	4.90	5.40	5.87	6.33
	Poultry dung	1.30	3.47	4.07	4.60	4.93	5.47	6.00	6.33
FLSD(0.05)		**0.62**	**0.54**	**0.72**	**0.26**	**0.53**	**0.47**	**0.49**	**0.45**

Key; FLSD- Fisher's Least Significant Difference

The main and interaction effect of variety and organic fertilizer on the leaf area of Maize were statistically significant on weeks 1, 2, 3, 4, 5, 6, 7, and 8 ($P<0.05$) as shown in Tables 7 and 8. Significantly greater leaf area was obtained for Oba super -6 on weeks 1, 2, 3, 4, 5, 6, 7, and 8 (37.51, 156.81, 293.16, 373.18, 455.68, 516.67, 588.00, and 603.02 respectively) than Sammaz 15(30.60, 101.16, 251.07, 353.38, 439.23, 484.56, 536.38, and 579.82 respectively) Significantly higher leaf area were recorded for maize plants treated with goat dung on weeks 1, 2 and 3 (42.48, 158.47, and 310.52 respectively) than any other treatment combinations. However, significantly higher leaf areas were recorded for Maize plants treated with Poultry dung (403.27, 505.17, 553.85, 643.00, and 683.05 respectively) compared to goat dung (362.88, 445.97, 496.93, 556.75, and 591.28), cow dung (377.88, 444.75, 500.58, 549.67, and 572.42 respectively) and control (309.10, 393.93, 451.10, 499.33, and 518.92 respectively) (Table 8).

The interaction effect of organic fertilizer and variety on leaf area showed that Oba super -6 treated with goat dung produced significantly higher leaf area on Weeks 1, 2, and 3 (50.97, 214.93, and 325.30 respectively) compared to other treatment combinations with cow dung (38.37, 155.90, and 294.27 respectively), poultry dung (31.00, 165.00, and 355.27 respectively) and Control (29.70, 91.40, and 197.80 respectively). Also, higher leaf area was recorded for Oba super -6 treated with poultry dung fertilizer on weeks 4, 5, 6, 7, and 8 (462.87, 580.33, 637.10, 727.33, and 739.96 respectively compared to any other treatment combinations involving goat dung, cow dung, and control (Table 9).

Table 8: Main Effect of Variety and organic fertilizer on Leaf Area of maize plants

	Leaf area (cm^2)							
Variety	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8 (weeks)**
Oba super -6	37.51	156..81	293.16	373.18	455.68	516.67	588.00	603.02
Sammaz 15	30.60	101.16	251.07	353.38	439.23	484.56	536.38	579.82
LSD(0.05)	8.92	22.20	40.73	19.26	45.44	51.83	57.34	55.96
Fertilizer								
Control	26.23	92.38	203.12	309.10	393.93	451.10	499.33	518.92
Cow dung	35.53	139.43	266.13	377.88	444.75	500.58	549.67	572.42
Goat dung	42.48	158.47	310.52	362.88	445.97	496.93	556.75	591.28
Poultry dung	31.97	125.65	308.68	403.27	505.17	553.85	643.00	683.05
FLSD(0.05)	**12.62**	**31.405**	**57.61**	**27.23**	**64.27**	**73.30**	**81.10**	**79.141**

Key; FLSD- Fisher's Least Significant Difference

Table 9: Interaction Effect of Variety and organic fertilizers on Leaf area of maize plant

Variety	**Fertilizer**	**Leaf area(cm^2)**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8(weeks)**
Oba super -6	**Control**	29.70	91.40	197.80	310.17	391.87	454.33	514.67	527.33
	Cow dung	38.37	155.90	294.27	363.93	422.50	492.50	551.00	551.00
	Goat dung	50.97	214.93	325.30	355.77	428.00	482.77	559.00	593.80
	Poultry dung	31.00	165.00	355.27	462.87	580.33	637.10	727.33	739.93
Sammaz 15	**Control**	22.77	93.37	208.43	308.03	396.00	447.87	484.00	510.50
	Cow dung	32.70	122.97	238.00	391.83	467.00	508.67	548.33	593.83
	Goat dung	34.00	102.00	295.73	370.00	463.93	511.10	554.50	588.77
	Poultry dung	32.93	86.30	262.10	343.67	430.00	470.60	558.67	626.17
FLSD(0.05)		**17.84**	**44.41**	**81.47**	**38.52**	**90.89**	**103.66**	**114.69**	**111.92**

Key; FLSD- Fisher's Least Significant Difference

The overall main and interaction effect of Organic fertilizers and variety on quality parameters of maize was significant for the number of leaves, height, stem diameter, and leaf area. Significantly greater number of leaves and height were recorded for Sammaz 15(11.88 and 65.24 respectively) than Oba super -6 (11.33 and 60.61 respectively). However, greater stem diameter and leaf area were recorded for Oba super -6 (4.66, and 378.00 respectively) and this was significantly higher than Sammaz 15 (4.21 and 347.02 respectively). Maize plants treated with goat dung produced a significantly greater number of leaves and height (12.21 and 68.62 respectively) compared to control (10.58 and 55.50 respectively) cow dung (11.60 and 68.26 respectively) and poultry dung (12.02 and 59.31 respectively). Also, Maize plants treated with poultry dung produced significantly higher stem diameter and leaf area (5.08 and 406.83 respectively) compared to other treatment interactions involving cow dung, goat dung, and control (Table 10).

The overall interaction effect of organic fertilizer on quality parameters of the Maize plant showed that greater stem diameter and leaf area were recorded by Oba super -6 treated with poultry dung (5.64 and 462.35 respectively) compared to goat dung (4.90 and 376.32 respectively), cow dung (4.39 and 358.68 respectively) and control (3.71 and 314.66 respectively). An interaction between Sammaz 15 and goat dung produced a higher number of leaves (12.63) compared to cow dung (11.79), poultry dung (12.17), and control (10.92). Also, Sammaz 15 treated with cow dung produced greater heights (72.73) than poultry dung (61.09), goat dung (70.38), and control (56.78) (Table 11).

Table 10: Overall main Effect of Variety and organic fertilizer on growth parameters of maize plants

Variety	Growth parameters			
	Number of leaves (n)	Height (cm)	Stem diameter(cm)	Leaf area (cm²)
Oba super -6	11.33	60.61	4.66	378.00
Sammaz 15	11.88	65.24	4.21	347.02
FLSD(0.05)	**10.25**	**1.49**	**0.19**	**28.85**
Fertilizer				
Control	10.58	55.50	3.75	311.76
Cow	11.60	68.26	4.19	360.80
Goat	12.21	68.62	4.73	370.66
Poultry	12.02	59.31	5.08	406.83
FLSD(0.05)	**0.35**	**2.10**	**0.28**	**40.80**

Key; FLSD- Fisher's Least Significant Difference

Table 11: Overall interaction Effect of Variety and organic fertilizers on growth parameters of maize plants

Variety	Fertilizer	Growth parameters			
		Number of leaves (n)	Height(cm)	Stem diameter(cm)	Leaf area(cm²)
Oba super -6	**Control**	10.25	54.23	3.71	314.66
	Cow	11.42	63.80	4.39	358.68
	Goat	11.79	66.87	4.90	376.32
	Poultry	11.88	57.54	5.64	462.35
Sammaz 15	**Control**	10.92	56.78	3.79	308.87
	Cow	11.79	72.73	3.99	362.92
	Goat	12.63	70.38	4.56	365.00
	Poultry	12.17	61.09	4.52	351.30
FLSD(0.05)		**0.50**	**2.98**	**0.39**	**57.70**

Key; FLSD- Fisher's Least Significant Difference

4.0 DISCUSSION

The comparative effect of organic fertilizers on the growth and performance of maize plants was investigated. Findings from the study indicated a comparatively higher height and number of leaves in Sammaz15 than for Oba super -6 while stem diameter and leaf area were higher for Oba super -6 than Sammaz 15, these differences could be attributed to genetic modifications in hybrid species of maize compared to local variety which depends on the natural endowments to survive and grow constructively. This finding is in agreement with the report of [8]who reported significant differences in the height of maize between two varieties of maize.

The study revealed a higher number of leaves and height for maize plants treated with goat dung and poultry manure than for control plants. The Increased height as a result of poultry manure application can be attributed to the ability of poultry manure to increase the nitrogen and phosphorus content of maize since these minerals are known to promote growth in crops. The findings from this study were in concordance with [9] who reported that increased Nitrogen in NPK significantly increased the number of leaves of the plant, the height of the plant, and stem growth in the Maize *(Zea mays)* plant. This finding is in agreement with [10] who reported that maize plants treated with poultry manure resulted in higher plant height across all weeks after planting (WAP). It is also similar to the report of [8] who reported increased height and number of leaves in maize plants as a result of the application of organic fertilizers.

The interactive effect of varieties and organic fertilizers on some leaves shows that number of leaves was higher on the interaction, between Oba super -6 and Sammaz 15 treated with goat dung and poultry droppings, the ability of poultry manure which is an organic fertilizer to increase the number of leaves significantly can be attributed to its role in stimulating rapid leaf production and play an essential role in branching. In agreement with the findings [11] this study reported that poultry manure has high nitrogen that improves vegetative growth and makes the nutrient available to the plant under stressed conditions. In general, control plants in which fertilizers were absent in this study presented the least amount of growth in virtually all parameters since enhancers of growth which mostly are ions, essential and non-essential nutrients were relatively low in them. This finding collaborates with the earlier effect experienced in height. It is observed that fertilizer application impacts the amounts available to plants. These macro-nutrients determine the growth and performance of plants in the field. The ability of a local variety to harness the applied fertilizer can be said to be due to genetic capabilities which gives it a competitive advantage over the modified breeds. This agrees with the findings by [12] who mentioned that growth parameters vary while working with two varieties of DUR-3 and DUR-15 maize varieties.

The application of organic fertilizers to maize produced significantly higher stem diameter and number of leaves. This difference between control and experimental crops indicates that organic fertilizers boost the nutrient content of the soil thereby improving crop growth and productivity. This finding is in agreement with [13] who reported that organic fertilizers affected some morphological traits in crops leading to better growth outcomes. This finding is in agreement with the findings of [14] who reported higher performance of NPK fertilizers on yield of maize plants.

5.0. Conclusion

The study revealed that organic manure produces better growth performance than control plants. It provided tangible evidence that maize height, leaf area, number of leaves, and stem diameter are improved by the application of organic fertilizer to maize. Goat dung however improves plant height and number of leaves better than cow dung and poultry droppings while leaf area and stem diameter are enhanced more by poultry droppings.

5.1 Recommendations

Based on the findings of the study, the following recommendations are made:

I. Organic fertilizers should be adopted by farmers as a potent alternative to promoting growth in maize plants and other cereals.

II. Poultry droppings should be maximized by animal farmers and packaged in suitable containers for sale as compact organic fertilizers. This way the value accrued to its usage would be highly enhanced.

5.2 Implications and Applications of the Study

The study discovered that organic fertilizers such as cow dung, goat dung, and poultry droppings could be used as substitutes for chemical fertilizers to improve maize growth. The greater improvement in the growth of maize shown by goat dung over cow and poultry droppings could be beneficial to researchers for further investigation on how to improve the utilization of fertilizers from animal origin. This study will provide information to farmers on readily available organic fertilizers of animal origin as alternatives to chemical fertilizers. The study will also aid agriculturists and extension workers in determining the best organic fertilizer to make known to local farmers to improve the yield of their crops.

5.3 Limitations of the Study

The study was unable to compare the effect of the organic fertilizers used with any named inorganic fertilizers. This could have helped with a better recommendation by knowing which fertilizer performs best in enhancing the growth performance of maize.

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