

EFFECTS OF POULTRY MANURE AND MORINGA LEAF EXTRACT ON THE GROWTH AND YIELD OF MAIZE (*Zea mays*)

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ABSTRACT

Field experiment was conducted during 2024 growing season at the Teaching and Research Farm, Department of Agricultural Technology, Federal Polytechnic Mubi, Adamawa State (latitude 10° 8' N and 10° 30' N to longitude 13° 10' E and 13° 25' E at an altitude of 696 m above sea level) to assess the effects of poultry manure and moringa leaf extract on the growth and yield of maize. The treatments comprised of four levels of

Introduction

Maize (*Zea mays*) is one of the most important cereal crops in the world agricultural economy both as food for man and feed for animals (Singh *et al.*, 2006; Mashamaite *et al.*, 2022). Maize is the most versatile crop having a wide adaptability under different agro climatic conditions and has a highest genetic yield potential among the cereals which qualified it to be called as queen of cereals (Reddy and Reddi, 2021). Maize ranks third following wheat and rice in the world cereal production (Williams *et al.*,

poultry manure: 0 (control), 4, 6 and 8 tones/ha and four spraying regimes of Moringa leaf extract (MLE): 0 (control), once, twice and thrice. The treatments were laid out in a split-plot design replicated three times. The moringa leaf extract was assigned to the main plots, while poultry manure to sub-plots. Data were collected on plant height (cm), number of leaves/plant, cobs diameter (mm), cobs length (cm), number of grains/cob, number of grains/column, 1000 grain weight (g) and grain yield (ton/ ha). Data collected were subjected to Analysis of Variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability using statistical analysis soft ware system (SAS, 2010) package. The study showed that growth and yield parameters of maize were significantly influenced by poultry manure and moringa leaf extract. All the growth and yield parameters increased with increasing rates of poultry manure applications and spraying regimes of moringa leaf extract. Application of poultry manure at a rate of 8 tons/ha recorded the highest grain yield (8.12 tons/ha). Similarly, foliar spray of MLE at three (3) regimes recorded highest grain yield (7.44 tons/ha). There was significant interaction between poultry manure and moringa leaf extracts on grain yield (7.76 tons/ha). Their combinations were found to be promising and are hereby recommended for the study area.

Keywords: Poultry manure, Moringa Leaf Extract, Maize, Growth, Yield.

2018; Asfaw, 2022). On an average, maize grain contained 80 % carbohydrates, 10 % protein, 4.5 % oil, 3.5 % fibre and 2 % minerals. Maize has several uses; it serves as a food for man and for livestock. The grain is transformed into flour for preparation of breads, biscuits, cookies or transformed into corn flakes, soups and other preparations. Grains can be roasted or popped for direct consumption, the grains, bran and straw can also be used as cattle feed, fodder and silage for cattle feed. Maize is also a good

feed for poultry, piggery and other animals (Singh *et al.*, 2006; Reddy and Reddi, 2021).

The depletion of soil nutrients due to continuous cropping reduces the soil organic matter, cause significant acidification and reduction in crop yields (Saidu *et al.*, 2012). Inorganic fertilizer is a major source of plant nutrients for plant growth and yields, but excessive use has been associated with various problems, such as degradation of soil physical and organic matter status, increases soil acidity, nutrient imbalance and environmental pollution; and coupled with high cost and scarcity (Shehu and Okafor, 2017). Therefore, there is a need for alternative source of fertilizer which is organic in nature. Poultry manure and MLE are one of the alternative sources necessary for sustainable agriculture that can ensure food production with high quality.

Organic fertilizers improve soil physical properties and provide basic plant nutrients for higher yield because they are environmentally friendly, easily accessible and affordable means for increasing crop yields to meet the demand for food all over the world (Williams *et al.*, 2018). Poultry manure is an important excellent organic fertilizer, as it contains high amount of nitrogen, phosphorus, potassium and other essential nutrients (Dikinya and Mufwanzala, 2010 and Hasanuzzaman *et al.*, 2010). Poultry manure contains 13 of the essential nutrients that are needed by plants. These include nitrogen, potassium, phosphorus, calcium, magnesium, sulphur, manganese, copper, zinc, chlorine, boron, iron and molybdenum (Orluchukwu and Ujwu, 2018). The application of poultry manure to the soil is a favorable strategy for sustainable long term agricultural production with minimal detrimental effects to the soil (Hossaen *et al.*, 2011).

Moringa (Drum stick or Radish tree) is native to India which belongs to the family *Moringaceae* due to its economic and medicinal importance is known as a “Miracle Tree” and also as a “Mother’s best friend” (Osman and Abuhassan, 2015). Extract from fresh Moringa leaves increased crops yield by 25 – 30 % (Muhamman *et al.*, 2013). The extract obtained from the leaves of

Moringa is 80% ethanol contains growth enhancing substances (i.e. hormones of the cytokinine type) (Jhilik *et al.*, 2018). Application of moringa leaf extract is cheap and environment friendly, it increases growth of most vegetables and field crops (Biswas *et al.*, 2016).

The objective of the study is therefore, to investigate the effects of poultry manure, moringa leaf extract and their interactions on the growth and yield of maize.

MATERIALS AND METHODS

Experimental Site

Field experiment was conducted in 2024 raining season at the Teaching and Research Farm, Department of Agricultural Technology, Federal Polytechnic Mubi, Adamawa State (latitude 10° 8' N and 10° 30' N and longitude 13° 10' E and 13° 25' E at an altitude of 696 m above sea level) to assess the effects of poultry manure and moringa leaf extract on the growth and yield of maize.

Soil Analysis

A composite soil samples were collected from five different points within the experimental area at a depth of 0 -15 cm and 15 - 30 cm using soil auger. The collected samples were sun dried ground and sieved with 2 mm mesh sieve. This was used to analyze the soil to determine the physical and chemical properties of the soil.

Treatments and Experimental Design

The treatments consisted of four levels of Poultry manure: 0 (control), 4, 6 and 8 tones/ha and four spraying regimes of Moringa leaf extract (MLE): 0 (control), once, twice and thrice. The treatments were laid out using a split-plot design replicated three times. The Moringa leaf extract was assigned to the main plots, while Poultry manure was assigned to sub-plots. The gross plot

size was 4.5 x 2 m (9 m²) and net plot size was 2.25 m x 1.2 m (2.7 m²), with 1m pathway between replications and 0.5 m between plots.

Land Preparation

The experimental site was cleared, ploughed and harrowed to obtain a fine tilt before sowing; later the land was leveled using simple hand hoe and laid out according to experimental design. The maize seeds variety (SAMMAZ 15) obtained from premier-seed Nig Ltd was used for this study. Two seeds were sown per hole at a spacing of 75 x 25 cm at a depth of 3 – 4 cm by dibbling method and later thinned to one plant per stand at two (2) weeks after sowing (WAS). Manual weeding using hoes was employed to control weeds at 2, 4 and 6 WAS.

Preparation of Moringa Leaf Extract (MLE) and Poultry Manure Application

Fresh and young leaves of Moringa were collected from mature plants for preparation of MLE. Young leaves of 100 g was grinded using a mortar and pestle with a small amount of water (10 ml /100 g fresh leaves) as reported by Jhiliket *et al.* (2018). The leaf juice was filtered through a cheese cloth and extracted by hand pressure followed by re-filtering through Whatsman filter paper No. 2, following the method developed by Fugile (2000), the extract was diluted with table water at a ratio of 1:32 (v/v). The prepared MLE was then sprayed directly on to the maize plants at 2 weekly intervals based on the treatments. Special attention was given for complete coverage of plants with MLE, and the control plots remain unsprayed. While for Poultry manure were applied as per treatments by incorporating into the soil one week before sowing in order to allow for proper decomposition and mineralization.

Data Collection and Analysis

Data collected were on, plant height (cm), number of leaves/plant, cobs diameter (mm), cobs length (cm), number of grains/cob, number of

grains/column, 1000 grain weight (g) and grain yield/(ton/ ha). The data collected were subjected to Analysis of Variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) at 5 % level of probability using Statistical Analysis Software System (SAS, 2010) package.

RESULTS AND DISCUSSION

Physical and Chemical Soil Properties of the Experimental Site

The results of some physical and chemical properties of the soil experimental site are presented in Table 1. The soil was sandy clay loam in texture and the soil pH value was 6.35. The values from the soil of the experimental field indicated that the pH of the soil was slightly acidic. The pH of most agricultural soils in the tropics ranges from 5.0 to 6.8 (Akinrinde and Obigbesan, 2000). The N, P and other cations indicates low fertility status of the experimental soil (Akinrinde and Obigbesan, 2000, Chude *et al.*, 2011) and this implies that the soil could respond positively to organic manure.

Table 1: Physical and Chemical Soil Properties of the Experimental Site

Particles	Values
Physical properties	
Particle Size Analysis (%)	
Sand	42.20
Silt	32.20
Clay	25.60
Texture	Sandy clay loam
Chemical Properties	
Soil pH 1:2 (H ₂ O)	6.35
Organic Carbon (g /kg)	0.41
Available P (mg /kg)	0.73
Total N (g /kg)	0.073
Exchangeable Bases [Cmol (+)/ kg]	
Ca ²⁺	5.12
Mg ²⁺	2.90
K ⁺	1.20
Na ⁺	0.17
Al ³⁺	1.92
H ⁺	0.71

Effects of Poultry Manure and Moringa Leaf Extract on Growth Parameters of Maize

The effects of poultry manure and moringa leaf extract on plant height is presented in Table 2. There was significant difference ($P \leq 0.05$) in plant height at 3 and 9 WAS and highly significant ($P \leq 0.01$) at 6 WAS as influenced by poultry manure application. Application of 8 tons/ha of poultry manure at 3, 6 and 9 WAS had the highest mean values (70.46 cm, 146.10 cm and 167.01 cm, respectively), while the least values was observed in the control treatment (36.11 cm, 81.23 cm and 149.96 cm). The significant effect of 8 tons/ha of poultry manure on plant height could be due to supply of nutrients in poultry manure that led to increased in plant height. This study is in agreement with Asfaw (2022) who reported that application of poultry manure enhanced the functions of apical meristem, which led to an increase in plant height. This was also supported by Enujeke (2013) who noted that application of poultry manure increase plant height of maize.

The response of plant height to moringa leaf extract is also presented in Table 2. The result of the effect of MLE application shows that application of MLE was not significant ($P \geq 0.05$) at 3 WAS, but highly significant ($P \leq 0.01$) at 6 and 9 WAS. Application of moringa leaf extract thrice recorded the tallest plant heights (146.90 and 165.46 cm at 6 and 9 WAS respectively), while the least plant height was observed in the control (90.02 and 148.41 cm respectively). The significant differences in plant height might be ascribed to increase in the number of applications of MLE which might have contained more zeatin (a hormone, cytokinins) in the MLE that resulted to increase in plant height of maize. Zeatin plays an important role in cell division and cell elongation, which improves maize growth. This result is in agreement with the findings of Mvumi *et al.* (2013), Chattha *et al.* (2015) and Williams *et al.* (2018) who reported that application of MLE increase plant height of maize. Furthermore, Yasmeen *et al.* (2013); Jhilik *et al.* (2017); Abusuwar and Abohassan (2017) also supported this finding that application of MLE

significantly increased plant height of wheat, while lowest height was observed in control treatment. This study revealed that when number of applications of MLE increased, plant height also increased.

Also presented in Table 2 are the effects of poultry manure and moringa leaf applications on number of leaves. Poultry manure had no significant effect ($P \geq 0.05$) on number of leaves at 3 WAS but significant ($P \leq 0.05$) at 6 WAS, and highly significant at 9 WAS. Application of 8 tons/ha of poultry manure produced the highest number of leaves with mean values of 17.33 and 28.12 at 6 and 9 WAS respectively, while the control treatment recorded the least number of leaves (12.11 and 21.56). The non significant effect in number of leaves at 3 WAS might be due slow minerazation of poultry manure which might have affected the release of nutrients for early vegetative plant growth. This corroborates with the findings of Lukman *et al.*(2016) and Emede *et al.*(2018) who reported that poultry manure is characterized by slow minerazation that affects the release of nutrients. The significant effect in number of leaves at 6 and 9 WAS may be due to the increasing rates of poultry manure, because higher rates might have more nutrients content for the plant growth that resulted in production of more number of leaves. This is in uniformity with the report of Enujeke (2013), who reported that number of leaves increased as poultry manure applications increased from 4 - 8 tons/ha. Similar result was also obtained by Asfaw (2022) who reported that number of leaves per plant is associated with increasing poultry manure rates. The increasing application rates may release more nutrients necessary for plant growth.

Similarly, there was no significant variation ($P \geq 0.05$) on number of leaves at 3 WAS, while a highly significant variation ($P \leq 0.01$) at 6 and 9 WAS due to moringa leaf extract applications was observed. Application of moringa leaf extract thrice recorded the highest mean values of 18.00 and 27.01 at 6 and 9 WAS respectively, while the least number of leaves was observed in the control plots (11.98 and 20.94). The significant increase in number of leaves

of maize in response to MLE might be connected with the increase in height, as plant height increased; more leaves may be found which might have been influenced by a growth hormones (cytokinins) presence in MLE. This finding corroborates with the findings of Williams *et al.* (2018) and Alubiagba *et al.* (2021) who reported that significant differences were in the number of leaves of maize treated with MLE compared with the control. This is also supported by Shehu and Okaafor (2017) that number of leaves of maize was highest in plots applied with MLE. There was no interaction effect between poultry manure and moringa leaf extract on growth parameters of maize.

Table 2: Effects of Poultry Manure and Moringa Leaf Extract on Growth Parameters of Maize (*Zea mays* L.) in Mubi, During 2024 Growing Season

Poultry manure (tones/ha)	PH WAS	3 PH WAS	6 PH WAS	9 PH WAS	NL WAS	3 NL WAS	6 NL WAS	9 NL WAS
0 (Control)	36.11 ^d	81.23 ^c	149.96 ^d	6.95	12.11 ^d	21.56 ^c		
4	41.16 ^c	119.46 ^b	158.97 ^c	6.72	13.92 ^c	24.10 ^b		
6	65.14 ^b	146.00 ^a	163.72 ^b	7.01	15.07 ^b	26.93 ^a		
8	70.46 ^a	146.10 ^a	167.01 ^a	7.12	17.33 ^a	28.12 ^a		
Level of sig.	*	**	*	NS	*	**		
SE $\pm$	0.34	0.27	0.53	0.32	0.67	0.53		
Moringa leaf extract (Number of applications)								
0 (Control)	36.04	90.02 ^d	148.41 ^d	7.91	11.98 ^d	20.94 ^c		
Once	36.09	130.34 ^c	154.22 ^c	7.77	13.86 ^c	23.56 ^b		
Twice	36.90	145.07 ^b	162.21 ^b	6.99	16.01 ^b	27.68 ^a		
Thrice	37.01	146.90 ^a	165.46 ^a	7.08	18.00 ^a	27.01 ^a		
Level of sig.	NS	**	**	NS	**	**		
SE ($\pm$)	0.68	0.74	0.53	0.68	0.74	0.53		
Interaction (PM x MLE)	NS	NS	NS	NS	NS	NS		

Means in the same column followed by the same letter (s) are not significantly different at 5% level of probability using DMRT, WAS = weeks after sowing, PH = plant height, NL= number of leaves, NS =not significant, * = significant at 5% and ** = highly significant at 1%

Effects of Poultry Manure and Moringa Leaf Extract on Yield and Yield Components of Maize

The analyzed data on cob length, cob diameter, number of columns/cob, number of grains/column, 1000 grains weight and grain yield are presented in Table 3. The results shows that there were significant differences ($P \leq 0.05$) in cob length, number of columns/cob and number of grains/column and highly significant differences ($P \leq 0.01$) in cob diameter, 1000 gains weight and grains yield as influenced by application of poultry manure. Application of 8 tons/ha of poultry produced higher cob length (24.11 cm), cob diameter (59.93 mm), number of columns/cob (16.76), number of grains/column (40.86), 1000 grains weight (233.26 g) and grains yield (8.12 tons/ha) respectively, while control treatments recorded the lowest cob length (20.02 cm), cob diameter (40.36 mm), number of columns/cob (11.30), number of grains/column (33.42), 1000 grains weight (220.71 g) and grains yield (3.99 tons/ha). The significant variations in the yield parameters could be attributable to the increasing rates of poultry manure which might have resulted to more vegetative growth of maize that resulted to significant increased in yield components. The results obtained in this study agreed with the previous works of Boateng *et al.* (2006); (Enujeke 2013) and Asfaw (2022) who in a similar works reported an increased yields in maize by applying poultry manure. Similar results was also obtained by Ibeawuchi *et al.* (2007) and Hasanuzzaman *et al.* (2010); who reported that 1000 grain weight and grain yield of rice increased with increasing poultry manure application rates. This study reveals that as poultry manure rates increased, yield parameters also increased.

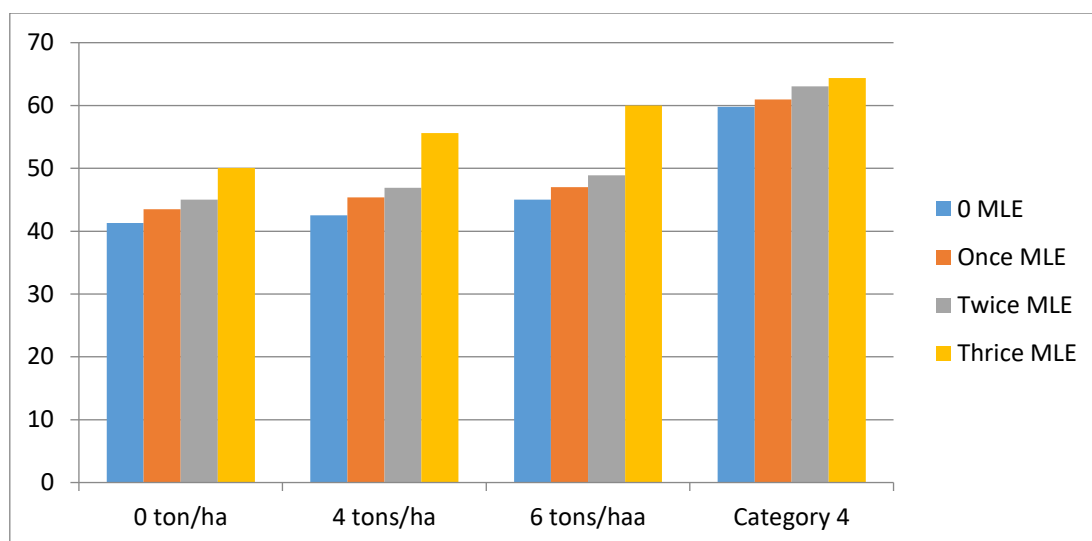
Cob length, cob diameter, number of columns/cob, number of grains/column, 1000 grain weight and grain yield were also significantly affected by the applications of moringa leaf extract (MLE). Applications of MLE thrice gave the maximum cob length (23.15 cm), cob diameter (60.17 mm), number of columns/cob (14.98), number of grains/column (39.01), 1000 grain weight

(232.42 g) and grain yield (7.44 tons/ha). The significant increase in yields components might be connected to cytokinins present in the MLE that enhanced growth of maize which might have resulted to significant increased in yields. This study corroborates with the findings of Biswas *et al.* (2016); Shehu and Okafor (2017) and Williams *et al.* (2018) who reported that yield components of maize improved with more number of MLE applications. Furthermore, Mvumiet *et al.* (2013); Mustapha *et al.* (2019) and Mashamaite *et al.* (2022) also showed that frequent applications of MLE to maize plant significantly increased growth and yield components. Similar result was obtained by Bashir *et al.* (2017) who reported that the growth and yield of sorghum increased with the applications of MLE. There was no significant interactions between poultry manure and moringa leaf extract on cob length, number of columns/cobs, number of grains/column and 1000 grain weight. However, there was significant interactions between poultry manure and moringa leaf extract on cob diameter and grain yield of maize.

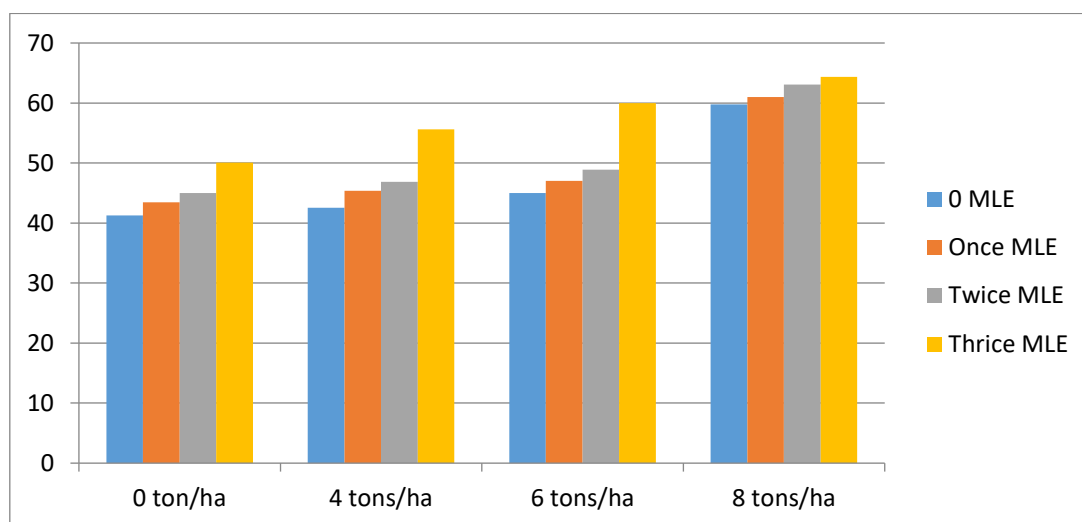
Table 3: Effects of Poultry Manure and Moringa Leaf Extract on Yield Parameters of Maize (*Zea mays* L.) in Mubi During 2024 Growing Season

Treatments	Cob length (cm)	Cob diameter (mm)	Number of columns/cob	Number of grains/column	1000 grains weight (g)	Grain yield (ton/ha)
Poultry manure (ton /ha)						
0 (Control)	20.02 ^c	40.36 ^d	11.30 ^c	33.42 ^c	220.71 ^c	3.99 ^c
4	21.00 ^b	43.08 ^c	13.97 ^b	34.96 ^c	220.92 ^c	5.10 ^b
6	22.05 ^b	51.22 ^b	13.82 ^b	37.01 ^b	225.13 ^b	7.91 ^a
8	24.11 ^a	59.93 ^a	16.76 ^a	40.86 ^a	233.26 ^a	8.12 ^a
Level of sig.	*	**	*	*	**	**
SE	1.87	2.11	1.11	2.19	1.94	2.34
Moringa leaf extract (Number of applications)						
0 (Control)	19.31 ^c	39.99 ^d	10.56 ^d	33.72 ^d	209.34 ^d	4.12 ^c
Once	20.04 ^b	42.01 ^c	11.34 ^c	33.93 ^c	224.17 ^c	5.11 ^b
Twice	23.11 ^a	57.10 ^b	13.46 ^b	36.44 ^b	230.92 ^b	7.03 ^a
Thrice	23.15 ^a	60.17 ^a	14.98 ^a	39.01 ^a	232.42 ^a	7.44 ^a
Level of sig.	*	**	**	*	**	**
SE (±)	1.96	1.67	2.41	1.12	2.11	1.99
Interaction (PM x MLE)	NS	*	NS	NS	NS	*

Means in the same column followed by the same letter (s) are not significantly different at 5 % level of probability using DMRT, NS = Not significant,* = significant at 5 % ** = highly significant at 1% and WAS = Weeks after sowing.



Cob diameter (mm)



Poultry manure (tons/ha)

Figure 1: Interaction between poultry manure and moringa leaf extract on cob diameter of maize

Grain yield (tons/ha)

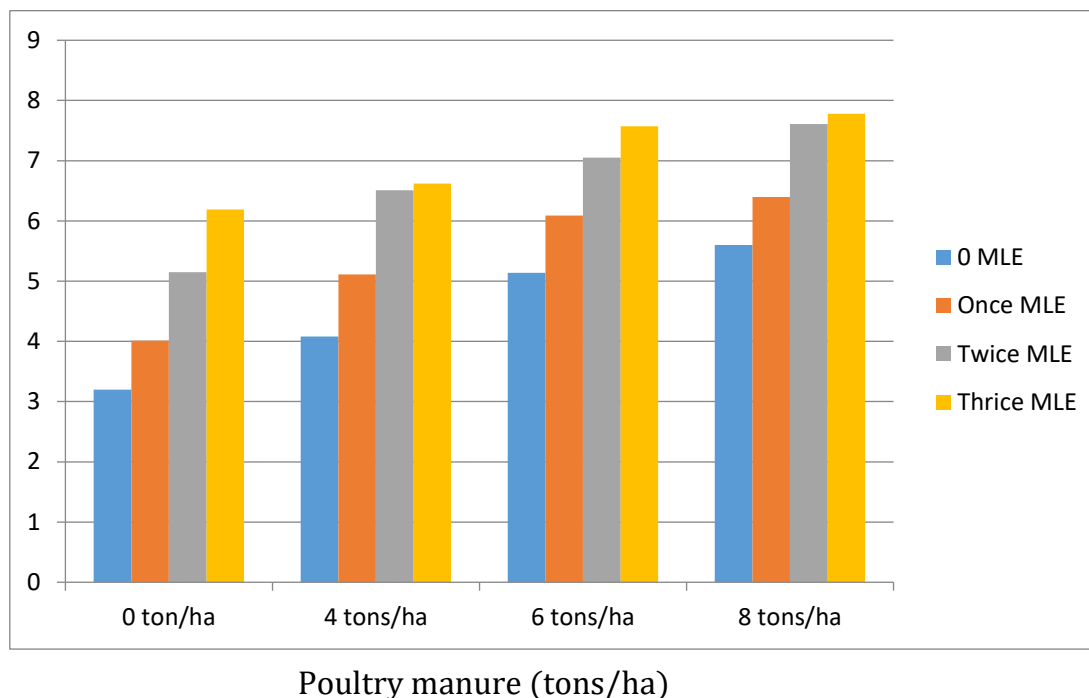


Figure 2: Interaction between poultry manure and moringa leaf extract on grain yield of maize

CONCLUSION AND RECOMMENDATIONS

Applications of poultry manure and moringa leaf extract had significant effects on both the growth and yield components of maize plants. From the results obtained in this study, it can be concluded that application of poultry manure at the rate of 8 tons/ha produced maximum growth and yield of maize. Similarly, foliar application of moringa leaf extract (MLE) thrice gave the best growth and yield of maize. And their combination has proved to be more realistic for its maximum grain yield (7.76 tons/ha). This study recommends the applications of 8 tons/ha of poultry manure and moringa leaf extract thrice to enhance the growth and yields of maize, hence should be adopted by the farmers in the study area.

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