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COMPARATIVE EFFECT OF ORGANIC AND INORGANIC FERTILIZER ON GROWTH AND YIELD OF TOMATO GENOTYPES, LYCOPERSICON *ESCULENTUM (MILL.)*

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ABSTRACT

This research was carried out to determine and to compare the effect of moringa leaf extract, poultry manure and NPK fertilizer on the growth rate and yield of the tomato genotypes. The 10 tomato genotypes utilized for this study were obtained from the tomato germplasm collection at the National Center for Genetic Resources and Biotechnology (NACGRAB), Department of Plant Genetic Resources, Ibadan, Oyo state, Nigeria. The experiment was a potted and factorial experiment whereby the tomato genotypes were subjected to 4 treatments which comprises Treatment 1 (no fertilizer), Treatment 2 (moringa leaf extract), Treatment 3 (poultry manure), Treatment 4 (NPK fertilizer). The experiment was carried out at the Teaching and Research Farm, Federal University of Technology, Akure. Data were collected on 13 agronomic characters. The application of NPK 15:15:15 fertilizer was found to greatly influence the rate of growth and yield of the tomato genotypes followed by Poultry manure and Moringa leaf extract for all the characters studied. Genotypes NGB00724, NGB00711 and NGB00695 were found outstanding among the tomato genotypes in terms of number of fruits, number of clusters, individual fruit weight and yield per plant irrespective of the type of fertilizer applied.Hence, these tomato genotypes could be improved upon and released as high yielding tomato varieties to farmers. The use of moringa leaf extract and poultry manure to produce tomato is a worthwhile alternative in place of NPK fertilizer.

Keywords: Comparative, Organic fertilizer, Inorganic fertilizer, Tomato genotypes

INTRODUCTION

Tomato, *Lycopersicon esculentum* (Mill.) is a plant in the solanaceae family known as nightshade family (Waheed *et al.*, 2020). It produces vitamin c, potassium, folate and they help to maintain strong bones (Suman *et a*l., 2023). It helps in lowering men risk of stroke and helping them to fight prostate cancer (Salehi *et al*., 2019). These nutrients perform various body functions including; reduction in constipation, reduction in high blood pressure, stimulation of body circulation, maintenance of lipid profile and body fluids, detoxification of body toxins and maintaining bone structure as well (Yahia *et al*., 2019). However, achieving optimal growth and yield of tomatoes depends heavily on the application of fertilizers to supply essential nutrients (Stoleru *et al.*, 2020). The application of inorganic fertilizers, while effective at boosting yield, have been associated with soil degradation, environmental pollution and increased production costs due to their high chemical content and non-sustainable practices (Srivastava, 2020). On the contrary, the application of organic fertilizers, though eco-friendly and sustainable is associated with a slower nutrient release which may not meet the immediate nutrient demands of high-yielding tomato genotypes (Manna *et al*., 2021). Despite this limitation, the application of organic fertilizers offer a more environmentally friendly alternative to the use of inorganic fertilizer as a result of their capability of improving soil health by enhancing soil structure, water retention and microbial activity (Singh *et al*., 2020); but their efficiency needs to be rigorously compared with inorganic fertilizers to ensure they can sustain productivity (Bhunia *et al.*, 2021).Hence, there is a need for a comparative evaluation of organic and inorganic fertilizers to determine which is more beneficial in terms of both growth and yield performance in various tomato genotypes (Aina *et al.*, 2019). A better understanding of the comparative efficacy of organic and inorganic fertilizers could then lead to a more cost-effective and sustainable farming practices thereby reducing the dependence on expensive chemical inputs (Abebe *et al.*, 2022). Animal manure especially is known to be effective in the maintenance of organic matter content in the soil thus improving the soil physical and chemical condition and thereby enhancing crop performance (Singh *et al.*, 2022). Likewise,the application of moringa leaf extract has also been investigated to ascertain its effect on growth and yield of crops and its efficacy as a substitute to inorganic fertilizer (Gad *et al.*, 2019).Similarly, long-term use of inorganic fertilizers has been found to result to soil acidification and nutrient imbalances (Pahalvi *et al*., 2021). Hence, this research is embarked upon to : i). determine the effect of moringa leaf extract (MLE) on growth and yield of tomato genotypes; ii). determine the effect of poultry manure on the growth and yield of tomato genotypes; iii). determine the effect of NPK fertilizer on growth and yield of tomato genotypes.

MATERIALS AND METHODS

The experimental materials for this project consist of ten genotypes of tomato, Lycopersicon esculentum (Mill.). the tomato genotypes were obtained from the tomato germplasm collection of National Center for Genetic Resources and Biotechnology (NACGRAB), Ibadan, Oyo – State, Nigeria. The names of the tomato genotypes are: NGB00695, NGB00696, NGB00708, NGB00711, NGB00713, NGB00714, NGB00715, NGB00721, NGB00724 and NGB00725.

This research was carried out in two phases. The first phase is the nursery preparation while the second phase is the field evaluation of the tomato seedlings.

Nursery Preparation

The tomato genotypes were planted in nursery trays filled with sterilized topsoil. Each of the trays consists of 120 holes and a seed of each of the tomato genotypes was planted per hole. the seeds after emergence were adequately cared for and

at 4 weeks after emergence, the seedlings were transplanted to the field for field evaluation.

Field Evaluation

The experiment is a potted experiment consisting of polythene bags filled with 5kg topsoil. 8 bags were allotted to each of the tomato genotypes. 4 weeks old tomato seedlings were planted in each of the pots at one seedling per pot. 4 treatments of fertilizer application were applied to the tomato genotypes: T1 = No fertilizer applied; T2 = application of Moringa leaf extract as a foliar spray; T3 = application of poultry manure; T4 = application of NPK 15:15:15

Preparation of Moringa Leaf Extract (MLE)

200g of airdried tender leaves of moringa were collected and blended. The powdered moringa leaves were soaked in 1Litre, 80% aqueous solution of ethanol allowed to stand for 24hours. The moringa solution was then filtered using a muslin cloth to have the MLE. The MLE was further diluted at ratio 1: 5 with distilled water and then applied to the tomato plants at 4 weeks after transplanting (4WAT) till maturity at 50mls / plant on forthnight basis.

Poultry Manure

The poultry manure utilized for this project were obtained from the poultry manure dunghill of the Teaching and Research Farm of the Federal University of Technology, Akure, Ondo – State, Nigeria. The poultry manure was put under the shed for additional two weeks to allow the manure to completely decompose before applying to plants so as not to cause injury to the plants. The poultry manure was then sieved to remove the pebbles. The poultry manure was then applied to the plants at 4WAT and subsequently on forth night basis till maturity at the rate of 50grams per plant.

Data Collection

Data collection was carried out on the following agronomic characters: - Plant height at flowering (PHTF), Number of leaves per plant at flowering (NLPF), Number of branches per plant at flowering (NBPF), Plant height at maturity (PHM), Final plant height (FPH), Number of clusters per plant (NCP), Number of fruit per plant (NFP), Individual Fruit weight per plant (IFWt/P), Fruit yield per plant (FYP), Stem girth (SG) and Yield per hectare (YD/Ha)

RESULTS AND DISCUSSION

The estimates of the effects of the different fertilizer application on the agronomic characters in the tomato genotypes are presented in Table 1. The tallest plants at flowering with the application of NPK fertilizer were recorded in G10 (53.40cm) followed by G2 (50.40cm) followed by G6 (49.40) cm. application of poultry manure also resulted into tall plants at flowering as recorded in G10 (49.80cm) and G1 (46.00cm). the highest number of leaves per plant at flowering, was recorded with the application of NPK fertilizer followed by application of moringa leaf extract followed by poultry manure. Number of leaf at flowering was maximum in G1(36.20, 29.00 and 28.80) with the application of NPK, moringa leaf extract and poultry manure respectively. The lowest number of leaves per plant at flowering was recorded in G5 (28.40 and 22.60) with the application of fertilizers. The tallest plant at maturity was recorded in G10 (186.40cm and 176.32cm) with the application of NPK and poultry manure respectively. G10 and G2 (145.50cm) with the application of moringa leaf extract. As regards the stem girth, it was maximum with the application of NPK fertilizer in G9 (5.82cm) followed by the application of poultry manure in G9 (4.76cm) and the application of moringa leaf extract in G9 (3.94cm).

The estimates of the effects of the different fertilizer application on yield and its related characters in the tomato genotypes are presented in Table 2. The highest number of clusters was recorded in G6 (10.40) followed by G4 and G9 (9.60) with the application of NPK. Application of Poultry manure resulted into highest number of clusters in G1(9.80) followed by G9 (7.20). The highest number of clusters with the application of moringa leaf extract was recorded in G1(7.80). The highest number of fruits was recorded in G6 (64.80) followed by G9 (62.80) followed by G4 (60.40) with the application of NPK. With the application of poultry manure, the highest number of fruits was recorded in G9 (59.60) followed by G6 (56.40). The application of moringa leaf extract resulted into the highest number of fruits in G6 (44.60). the biggest tomato fruits were recorded in G9 (7.31g, 7.23g and 6.94g) with the application of NPK, poultry manure and moringa leaf extract respectively. The highest yield per plant was recorded in G6 (461.08g) followed by G9 (459.02g) followed by G4 (420.08g) with the application of NPK fertilizer. The application of poultry manure resulted into the highest fruit yield in G9(430.42g) followed by G6 (403.32g) followed by G4 (379.31g). The application of moringa leaf extract resulted into maximum fruit yield in G6 (307.00g) followed by G9 (292g) and G4 (278g). On the average, the application of the different fertilizers resulted in an increase in the characters studied compared to the control.

Table 1: Mean Values of Agronomic Characters in Tomato Genotypes

GENOTYPE	TRT1						TRT 2					
	PHTF(cm)	PHTM(cm)	FPH (cm)	NLPF	NBP	SG(cm)	PHTF(cm)	NLPF	NBP	PHTM(cm)	FPH (cm)	SG(cm)
G1	32.40a	111.50a	125.20a	26.00a	8.40a	2.86a	38.10a	29.00a	8.40a	145.13a	159.00a	3.68a
G2	30.40a	110.80a	133.20a	24.40a	7.60ab	2.86a	38.20a	25.40ab	7.60ab	145.50a	161.00a	3.26a
G3	28.20a	102.40a	121.20a	24.00a	7.40ab	2.68ab	36.60a	23.80ab	8.00a	139.50ab	155.00a	3.02a
G4	25.00ab	90.50ab	115.00ab	23.40a	7.20ab	2.62ab	30.40ab	26.20a	8.40a	116.25b	140.00ab	2.94a
G5	25.00ab	90.70ab	110.40ab	19.40ab	7.40ab	2.80a	29.40ab	22.60b	8.00a	112.50b	136.00ab	3.82a
G6	26.00ab	94.30ab	112.00ab	22.00a	8.00a	2.66ab	36.20a	25.60ab	8.60a	138.00ab	156.00a	3.38a
G7	23.40ab	84.50b	103.00b	22.40a	8.80a	2.18b	27.00b	24.20ab	7.80ab	99.70bc	123.00b	3.36a
G8	26.40ab	95.80ab	112.00ab	23.00a	8.60a	2.04b	31.20ab	26.20a	8.40a	119.40b	137.00ab	3.54a
G9	28.00a	101.70a	123.10a	25.40a	7.20ab	3.38a	35.80a	26.00a	8.40a	136.50ab	154.00a	3.94a
G10	32.20a	117.40a	133.10a	23.20a	10.80a	2.78ab	38.20a	26.60a	8.40a	145.50a	162.00a	3.23a

GENOTYPE	TRT 3						TRT 4					
	PHTF(cm)	NLPF	NBP	PHTM(cm)	FPH(cm)	SG(cm)	PHTF(cm)	NLPF	NBP	PHTM(cm)	FPH (cm)	SG(cm)
G1	46.00a	28.80a	7.80ab	170.08a	180.40a	4.46	48.00a	36.20a	8.60a	176.60a	188.60a	5.32a
G2	43.80a	25.60a	7.20ab	156.82ab	166.60ab	4.16	50.40a	32.20ab	7.60ab	175.90a	190.20a	5.06a
G3	41.60a	26.20a	7.20ab	149.80ab	160.70ab	4.22	45.60a	31.20ab	7.40ab	159.10ab	171.20a	4.88ab
G4	42.60a	26.80a	6.80b	141.22b	154.60ab	3.80	43.80ab	33.40a	7.00ab	152.80ab	167.40ab	5.00a
G5	38.20ab	22.60ab	6.60b	138.88b	151.60ab	4.40	43.60ab	28.40b	6.60b	152.10ab	163.80ab	5.62a
G6	44.00a	25.60a	8.40a	163.84ab	177.00a	4.32	49.40a	32.80ab	8.00a	172.40a	185.00a	5.18a
G7	36.00ab	23.40ab	7.60ab	124.06bc	143.60b	3.92	39.40b	31.00ab	7.40ab	137.40	154.60b	5.42a
G8	41.80a	25.00a	8.60a	145.12ab	156.60ab	3.78	46.60a	32.60ab	8.40a	162.60ab	175.80a	5.30a
G9	45.60a	26.40a	7.40ab	159.94ab	173.60a	4.76	44.80ab	34.40a	6.40b	156.30ab	169.00ab	5.82a
G10	49.80a	23.80ab	9.00a	176.32a	185.60a	4.08	53.40a	31.00ab	8.20a	186.40a	197.40a	4.98ab

G1=NGB00695; G2= NGB00696; G3= NGB00708; G4= NGB00711; G5= NGB00713; G6=NGB00714; G7 =NGB00715; G8 =NGB00721; G9 =NGB00724; G10 =NGB00725; PHTF = Plant height at flowering; NLPF= Number of leaves per plant at flowering; NBP=Number of branches per plant; PHTM = Plant height at maturity; FPH = Final plant height at harvesting; SG = Stem girth; TRT 1 = NO FERTILIZER; TRT 2 = MORINGA LEAF EXTRACT; TRT 3 = POULTRY MANURE; TRT 4 = NPK FERTILIZER

Table 2: Mean Values of Yield Related Characters in Tomato Genotypes

GENOTYPES	TRT 1					TRT2				
	NCP	NFP(g)	INFWT(g)	YD/P(g)	YD/Ha (ton)	NCP	NFP	INFWT(g)	YD/P(g)	YD/Ha (ton)
G1	5.60a	32.80a	4.09ab	135.61ab	5.02ab	7.80a	42.40a	4.43b	187.00ab	6.94b
G2	5.40a	30.80a	4.14ab	126.44b	4.68b	7.60a	40.00a	4.44b	178.00b	6.59b
G3	4.60ab	25.60ab	5.06ab	129.53b	4.80b	5.60b	34.00ab	5.15ab	175.00b	6.48b
G4	4.80ab	31.80a	6.54a	208.53a	7.72a	5.40b	43.60a	6.40a	278.00a	10.29a
G5	6.20a	29.20ab	5.18ab	151.25ab	5.60ab	6.80ab	36.60ab	5.35ab	196.00ab	7.26ab
G6	5.60a	34.00a	6.59a	224.17a	8.30a	6.80ab	44.60a	6.90a	307.00a	11.39a
G7	5.00a	24.20b	4.39ab	107.35	3.98bc	5.40b	31.20b	4.71b	148.00bc	5.47bc
G8	5.20a	25.60ab	5.70ab	147.10	5.45ab	5.80b	31.80b	5.74ab	182.00ab	6.75b
G9	6.00a	35.20a	7.35a	259.50a	9.61a	6.20ab	42.00a	6.94a	292.00a	10.80a
G10	5.40a	27.20ab	6.20a	169.05ab	6.26ab	6.20ab	32.00b	6.25a	201.00ab	7.43ab

GENOTYPES	TRT 3					TRT 4				
	NCP	NFP	INFWT(g)	YD/P(g)	YD/Ha (ton)	NCP	NFP	INFWT(g)	YD/P(g)	YD/Ha(ton)
G1	9.80a	52.20a	4.23bc	219.98b	8.15ab	8.80ab	59.20a	4.69b	278.10ab	10.30ab
G2	6.60ab	48.40ab	4.10bc	195.23b	7.23b	9.00a	50.80ab	4.30b	217.90ab	8.07b
G3	6.20ab	42.60b	5.27b	224.74ab	8.32ab	7.20b	46.40b	5.60ab	259.60ab	9.61b
G4	5.40b	55.20a	6.87ab	379.31a	14.05a	9.60a	60.40a	6.94a	420.08a	15.56a
G5	6.60ab	43.80ab	5.58b	245.34ab	9.09ab	8.20ab	49.20ab	6.07ab	299.50ab	11.09ab
G6	7.00ab	56.40a	7.15a	403.32a	14.94a	10.40a	64.80a	7.09a	461.08a	17.08a
G7	5.20b	40.80b	4.39bc	180.36	6.68bc	7.60b	48.00ab	4.58b	219.92ab	8.15b
G8	5.40b	41.20b	5.97b	245.88ab	9.11ab	8.00ab	49.60ab	6.34ab	313.60a	11.62ab
G9	7.20ab	59.60a	7.23a	430.42a	15.94a	9.60a	62.80a	7.31a	459.02a	17.00a
G10	5.00b	41.80b	6.40ab	268.35ab	9.94ab	9.20a	50.80ab	6.42ab	325.30a	12.05ab

G1=NGB00695; G2= NGB00696; G3= NGB00708; G4= NGB00711; G5= NGB00713; G6=NGB00714; G7 =NGB00715; G8 =NGB00721.
G9 =NGB00724; G10 =NGB00725; NCP = Number of clusters per plant; NFP = Number of fruits per plant; INFWT = Individual fruit weight.
YD/P = Total yield per plant; YD/HA = Yield per hectare.
TRT 1 = NO FERTILIZER; TRT 2 = MORINGA LEAF EXTRACT; TRT 3 = POULTRY MANURE; TRT 4 = NPK FERTILIZER

Discussion

NPK Fertilizer consistently produces the highest values across almost all parameters, suggesting it is the most effective fertilizer for promoting growth in these genotypes. This is evident from the increases in plant height, number of leaves, and stem girth. Poultry Manure also significantly improves plant growth compared to no fertilizer, but its effect is generally lower than NPK. It still enhances plant height and leaf number but with slightly lower final heights and stem girth compared to NPK. Moringa Leaf Extract provides moderate growth improvements. It does not enhance growth as much as poultry manure or NPK, but it still shows better performance than the no-fertilizer control. Whereas the Control, resulted in plants with the lowest values in all parameters, indicating that fertilizer is crucial for optimal growth in these tomato genotypes. The significant effect of NPK fertilizer on agronomic growth parameters recorded in this study is synonymous to the findings of Amanullah *et al.,* (2010). They reported that NPK fertilizers significantly enhance plant growth by improving nutrient availability, leading to higher plant height, leaf number, and fruit yield in tomatoes. They demonstrated that a balanced supply of nitrogen, phosphorus, and potassium is essential for vegetative growth and fruit development in tomato plants. The effect of poultry manure on plant height and the other growth parameters is like the findings of Ayoola and Adeniyan (2006) and Ojeniyi *et al.,* (2012). They reported that organic fertilizers, including poultry manure, significantly increased the growth of tomato plants and fruit yield compared to unfertilized control plants. While NPK showed higher efficiency in nutrient release, organic manure like poultry manure was found to improve soil structure and longer-term soil fertility. The effect of moringa leaf extract on plant height recorded in this study corroborates the findings of Foidl *et al.,* (2001). They reported that Moringa leaf extract contains growth-promoting substances, including cytokinin, which enhances plant growth by improving nutrient uptake and photosynthesis efficiency. Although its effects are generally less potent than chemical fertilizers, Moringa leaf extract can improve plant height and yield under certain conditions. The effect of moringa leaf extract as a growth enhancer observed in this study is also like the findings of Rady *et al., (*2015). They showed that Moringa leaf extract improved growth and fruit yield in tomatoes supporting its role as a natural growth enhancer. The reduced growth rate observed in this study without fertilizer application is like the findings of Mahmood *et al.,* (2017) and Chen *et al.,* (2014). They found that tomato plants grown without any fertilizer showed stunted growth, fewer leaves, slower growth, lower productivity and reduced yields compared to fertilized treatments underscoring the importance of proper nutrient management. The significant effect of NPK recorded in this study with respect to yield and its related characters is like the findings of Khan *et al.,* (2017) and Anjum *et al.,* (2014). They reported that that the application of NPK resulted in a significant increase in tomato yield, with maximum fruit weight and yield per and overall productivity of tomatoes. The effect of the application of poultry manure recorded in this study is synonymous to the findings of Olaniyi *et al.,* (2010) and Adebayo *et al.,* (2012). They observed that the application of poultry manure significantly improved the number of fruits per plant and total yield in tomato plants. The effect of Moringa leaf extract recorded in this study is like the findings of Nouman *et al.,* (2012). They found that Moringa leaf extract acts as a growth enhancer, increasing yield, plant height, and the number of fruits per plant in tomatoes. The effect of moringa leaf extract recorded in this study corroborates the findings of Aluko *et al.,* (2021). They observed that the application of Moringa leaf extract increased tomato plant height and fruit yield compared to untreated plants.

CONCLUSION

It has been shown in this study that application of NPK 15:5:15 fertilizer greatly increased the growth performance and yield of the tomato genotypes, and this was followed by the application of Poultry manure and Moringa leaf extract. NGB00724, NGB00711 and NGB00695 were found to be outstanding in terms of number of fruits and total yield per plant irrespective of the type of fertilizer applied.

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