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COMBINED EFFECTS OF POULTRY MANURE AND NPK FERTILIZER ON THE GROWTH, YIELD AND QUALITY OF TOMATO (*Solanum lycopersicum*) IN MAIDUGURI

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Abstract: *This study investigates the combined effect of poultry manure (PM) and NPK fertilizer on the growth, yield, and quality oftomato cultivated under the semi-arid conditions of Maiduguri, Nigeria. Given the challenges associated with exclusive reliance on either organic or inorganic fertilizers, such as the high cost and environmental impact of NPK and the limited nutrient content of PM, an integrated fertilization approach was explored. A factorial experiment, arranged in a RandomizedCompletely Block Design (RCBD) with six replications, acrossednine fertilizer treatments including NPK (150 kg/ha), PM (20 t/ha), and their combinations. Results showed that treatments combining NPK and PM significantly enhanced plant growth parameters, such as vine length, leaf area index (LAI), and number of branches, compared to individual applications. Furthermore, the combined application improved yield indicators, including fruit weight (3200 kg/ha), number of fruits, and reduced flower abortion. Tomato quality was also enhanced, with higher lycopene content (2.00 mg/g) and juice content (90%), alongside improved nitrogen, phosphorus, and potassium levels in fruits. These findings demonstrate that integrated fertilization using moderate levels of both NPK and PM optimizes nutrient availability, improves soil health, and promotes sustainable tomato production in resource-constrained environments. This study highlights the potential of integrated soil fertility management (ISFM) to enhance agricultural productivity while minimizing environmental risks, making it a viable solution for semi-arid regions like Maiduguri.*

Keywords: *Poultry manure, NPK fertilizer, tomato yield, integrated fertilization, soil fertility, semi-arid agriculture.*

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INTRODUCTION

The synergistic effect of organic and inorganic sources on mineralization and the sustained provision of essential nutrients increased soil chemical characteristics and nutrient uptake, resulting in higher crop yields (Adeniyan & Ojeniyi, 2005). By transforming inorganic nitrogen into organic forms, complementary applications of organic and inorganic fertilisers improve nutrient synchronicity and reduce losses (Kramer et al., 2002). However, it has been noted that solely using organic manures to support cropping is insufficient, as they are required in very large quantities to meet crop nutritional requirements due to their comparatively low nutrient content (Palm et al., 1997). Fertilizers are required to restore nutrients removed from the soil by harvest crops and to supplement additional nutrients to increase output (Olatunji et al., 2012). When

compared to the control in both years, Isitekhale & Osemwota (2010) found that application of 4 and 6 t PM/ha, combined application of 6 t PM/ha plus 50 or 100kg NPK/ha, and 4 t PM/ha plus 100 NPK/ha in the year of use and their residual effects generated higher exchangeable Mg, K, Ca, and ECEC. In the first year, poultry manure application and the combined application considerably improved soil pH, organic carbon, total N, and accessible. Alsafar (2009) applied 75 kg N ha-1 to Menthe longifolia L., which resulted in a considerable increase in total dry matter.

Tomato cultivation in Maiduguri, like in many other regions, faces challenges related to soil fertility, climate variability, and resource constraints. Despite the availability of synthetic fertilizers such as NPK, their exclusive use may not be sustainable due to high costs and potential environmental impacts. On the other hand, organic fertilizers like poultry manure offer an eco-friendly alternative, but their effectiveness in isolation may not meet the high nutrient demands of modern tomato varieties. To address these challenges, there is a need to explore the combined use of poultry manure and NPK fertilizer. This approach could potentially leverage the benefits of both organic and inorganic fertilizers, leading to improved soil health, enhanced nutrient availability, and increased tomato yields. However, there is limited research on the synergistic effects of these fertilization methods on different tomato varieties in Maiduguri. Thus, the objectives of this study are to determine; the effects of combine NPK and poultry fertilizer on growth and yield of tomato and to determine the effects of combine NPK and poultry fertilizer on the quality of tomato.

METHODOLOGY

Field experiments

Field experiment was conducted during the dry season of 2024 at the Teaching and Research Farm, Ramat Polytechnic Maiduguri (11^0 50$^{'}$ N, 13^0 10$^{'}$ E altitude 354 above sea level (ASL), Maiduguri, Borno State, Sudan Savanna Zone Nigeria. Soil samples were taken at a depth of 0 – 15 cm and 15 – 30 cm and analyzed in the Soil Science Laboratory of University of Maiduguri for their physical and chemical properties.

Treatments and Experimental Design

The comparative effects of 150kg/ha NPK 15-15-15 fertilizer, 20t/ha poultry manure (PM), six combinations of reduced levels of NPK 15-15-15 fertilizer and poultry manure, and control (no fertilizer) on tomato crop growth.The experiment was a factorial design which was laid out in a RandomizedCompletely BlockDesign (RCBD) and replicated six times. The gross plot size is 184m2,and the experimental unit was 46 units of 20” plastic bags. There was 1.5m alley between pots and 1.5m within blocks.Datawas collected on tomato crops' growth, yield and biochemical properties.

DATA ANALYSIS

Data was subjected to analysis of variance (ANOVA), and differences between means were separated using the Least Significant Difference (LSD) Test at a 5% level.

RESULTS AND DISCUSSION

Table 1 describes the chemical soil properties, which indicate low fertility, typical of semi-arid regions. The low level of nitrogen, phosphorus, and organic matter content highlights the need for fertilizer application. The combination of NPK fertilizer and poultry manure will be ideal for improving soil fertility, water retention, and overall tomato yield. This analysis justifies the experiment's focus on comparing various fertilizer and manure combinations to optimize growth conditions for tomatoes in Maiduguri's environment.

Table 1: Soil Chemical Properties

Parameter	Unit	Value	Methodology
pH (H_2O)	-	6.5	pH meter (1:2.5 soil ratio)
Organic Carbon	%	0.75	Walkley-Black Method
Organic Matter	%	1.29	Derived from organic carbon (× 1.724)
Total Nitrogen (N)	%	0.08	Kjeldahl Method
Available Phosphorus	mg/kg	7.2	Bray I Method
Exchangeable Potassium (K)	cmol/kg	0.30	Flame Photometer
Exchangeable Calcium (Ca)	cmol/kg	3.5	Atomic Absorption Spectrophotometer
Exchangeable Magnesium (Mg)	cmol/kg	1.8	Atomic Absorption Spectrophotometer
Cation Exchange Capacity (CEC)	cmol/kg	6.2	Ammonium Acetate Method
Base Saturation	%	70.4	Calculated from exchangeable bases
Electrical Conductivity (EC)	dS/m	0.15	EC meter (1:5 soil ratio)
Soil Texture	-	Sandy Loam	Hydrometer Method

EFFECTS OF POULTRY MANURE AND NPK FERTILIZER ON THE GROWTH OF TOMATO

Effects on Vine Length (cm)

Results in Table 1 showed that the control (T1) recorded the lowest vine length (35.4 cm), indicating the poor growth potential of tomatoes without any nutrient supplementation. T4 (NPK 112.5 kg/ha + PM 15 t/ha) achieved the highest vine length (75.2 cm), significantly outperforming all other treatments. The balanced nutrient supply from organic and inorganic fertilizers has been shown to enhance root development and vine elongation (Moustafa et al., 2024). Organic matter from PM also increases the water-holding capacity of the soil, contributing to better vegetative growth (Enas et al., 2024).

Effects on Number of Leaves

The highest significant number of leaves was observed in T4 (47.2 leaves)andT5 (44.3 leaves)**,** indicating superior growth with combined nutrient applications. The increased number of leaves under combined fertilizer treatments aligns with findings from other studies that organic and

inorganic fertilizers complement each other by improving nitrogen uptake, leading to increased photosynthetic activity (Anas et al., 2021). Inadequate nutrient availability, as seen in the control group, limits cell division and expansion, reducing the number of leaves produced. (Table 2).

Effects on Leaf Area Index (LAI)

T4 (3.52) and T5 (3.25) had significantly higher LAI values, while T1 (1.21) recorded the lowest. Treatments with lower doses of both NPK and PM (T8 and T9) resulted in reduced LAI values. LAI reflects the plant's ability to intercept light for photosynthesis. Higher LAI values in combined treatments demonstrate the synergistic effects of NPK and poultry manure on canopy development. NPK provides readily available nutrients, particularly nitrogen, which enhances vegetative growth, while poultry manure gradually releases nutrients over time, promoting sustained development (Albert et al., 2020). This result is consistent with the concept of integrated soil fertility management (ISFM), which recommends using both organic and inorganic fertilizers to maximize crop productivity (Rodrigo et al., 2024). (Table 2).

Effects on Number of Branches

Results in Table 2 showed that the highest significant number of branches was found in T4 (11.3 branches)andT5 (10.6 branches)**,** while the control group recorded the fewest **(**4.2 branches**).** Branching is crucial for tomato productivity, as more branches increase the plant's capacity to bear fruit. The improved branching in treatments with combined NPK and PM reflects enhanced nutrient uptake and hormonal balance**,** stimulating lateral bud development (Roni, 2021). Poultry manure enhances soil microbial activity, which in turn promotes the availability of essential nutrients like phosphorus, known to improve branching (Agyeman et al., 2014).

Table2: Combined Effect of Poultry Manure and NPK Fertilizer on the Growth of Tomato

Treatment	Vine Length (cm)	Number of Leaves	LAI	Number of Branches
T1	35.4 ± 2.1e	18.3 ± 1.5e	1.21 ± 0.10d	4.2 ± 0.4e
T2	65.8 ± 3.2b	42.1 ± 2.3b	2.98 ± 0.15b	9.4 ± 0.8b
T3	60.5 ± 2.8b	39.4 ± 2.0b	2.74 ± 0.12b	8.9 ± 0.6b
T4	75.2 ± 3.5a	47.2 ± 2.4a	3.52 ± 0.18a	11.3 ± 0.9a
T5	70.4 ± 3.0a	44.3 ± 2.5a	3.25 ± 0.17a	10.6 ± 0.7a
T6	58.7 ± 2.7c	35.8 ± 1.8c	2.55 ± 0.14b	7.9 ± 0.5c
T7	55.9 ± 2.6c	33.5 ± 1.7c	2.40 ± 0.12c	7.2 ± 0.5c
T8	45.3 ± 2.3d	29.1 ± 1.6d	1.98 ± 0.11c	5.9 ± 0.4d
T9	42.7 ± 2.1d	26.8 ± 1.5d	1.85 ± 0.10d	5.4 ± 0.4d
LSD	3.5	2.2	0.15	0.8

Control (T1), NPK 150 kg/ha (T2), PM 20 t/ha (T3), NPK 112.5 + PM 15 (T4) , NPK 112.5 + PM 10 (T5), NPK 75 + PM 15 (T6), NPK 75 + PM 10 (T7), NPK 37.5 + PM 15 (T8), NPK 37.5 + PM 10 (T9).Means followed by the same letter within the column are not significantly different ($p < 0.05$) according to Tukey's HSD test.

EFFECTS OF POULTRY MANURE AND NPK FERTILIZER ON THE YIELD AND YIELD COMPONENTS OF TOMATO

Effects on Number of Flowers

Results in Table 3 suggest that significantly higher flower production was observed in treatments with higher NPK and PM combinations (T4: 67 ± 2.8, T5: 66 ± 2.5). These treatments are statistically superior compared to the control (T1: 45 ± 2.1). NPK fertilizer provides readily available nitrogen, phosphorus, and potassium, which are crucial for vegetative growth and flowering. Meanwhile, poultry manure releases nutrients slowly, improving soil structure and microbial activity and promoting flower production over time (Agyeman et al., 2014).

Effects on Number of Flowers Aborted

Lower flower abortion rates were observed in T4 (9 ± 0.9) and T5 (10 ± 0.7), indicating that nutrient availability improved fruit-setting efficiency. Control treatment (T1) had the highest flower abortion (12 ± 1.0), suggesting nutrient deficiency may stress the plants and limit fruit setting (Eifediyi et al., 2017). Table 3

Effects on Days to 50% Flowering

Results for Days for 50% flowering in Table 3 showed that significantly faster flowering was observed in T4 and T5 (44 ± 1.0 and 45 ± 1.4 days, respectively), significantly earlier than the control (T1: 50 ± 1.3 days). Adequate nutrient supply accelerates physiological processes, shortening the time to flowering. Treatments with combined NPK and poultry manure provided essential nutrients efficiently, promoting early flowering. This is consistent with findings byLaw-Ogbomo & Remison (2009), who reported that organic and inorganic fertilizer combinations improve plant development speed.

Effects on Chlorophyll Content

Highest chlorophyll content was found in T4 (48 ± 1.8) and T5 (46 ± 1.2). In contrast, the control (T1) recorded the lowest chlorophyll content (35 ± 2.2). Chlorophyll synthesis depends heavily on nitrogen availability (Kariya & TsUNoDA, 1972). NPK fertilizer provides immediate nitrogen, while poultry manure contributes to sustained nutrient release, improving leaf greenness over time.

Effects on Number of Fruits

The highest significant number of fruits was recorded in T4 (37 ± 2.3 fruits) and T5 (35 ± 1.9), with the control (T1) yielding significantly fewer fruits (22 ± 1.5). Enhanced nutrient availability in the combined treatments ensures healthy flower-to-fruit conversion. This aligns with previous research byMassri & Labban (2014), indicating that combined organic and inorganic fertilizers improve fruit yield.

Effects on Weight of Fruit (Kg/Ha)

Highest fruit yield was observed in T4 (3,200 ± 100 kg/ha) and T5 (3,000 ± 150 kg/ha), followed closely by T2 and T3 (2,800 ± 200 and 2,700 ± 150 kg/ha, respectively). The control (T1) produced the lowest yield (1,800 ± 100 kg/ha). Balanced fertilization optimizes both vegetative and

reproductive growth, contributing to higher fruit production. According to Massri & Labban (2014), poultry manure improves soil health over time, enhancing water retention and nutrient availability. Inorganic fertilizers provide quick-acting nutrients, ensuring rapid plant response.

Table 3:Combined Effect of Poultry Manure and NPK Fertilizer on the Yield of Tomato

Treatment	Number of Flowers	Number of Flowers Aborted	Days to 50% Flowering	Chlorophyll Content	Number of Fruits	Weight of Fruit (Kg/Ha)
T1	45 ± 2.1 b	12 ± 1.0 a	50 ± 1.3 a	35 ± 2.2 c	22 ± 1.5 d	1,800 ± 100 d
T2	65 ± 3.5 a	10 ± 1.2 b	45 ± 1.8 c	45 ± 1.0 b	35 ± 2.0 b	2,800 ± 200 b
T3	62 ± 3.2 a	11 ± 1.1 a	46 ± 1.5 b	44 ± 1.5 b	33 ± 1.8 b	2,700 ± 150 b
T4	67 ± 2.8 a	9 ± 0.9 b	44 ± 1.0 c	48 ± 1.8 a	37 ± 2.3 a	3,200 ± 100 a
T5	66 ± 2.5 a	10 ± 0.7 b	45 ± 1.4 c	46 ± 1.2 a	35 ± 1.9 a	3,000 ± 150 a
T6	60 ± 3.0 a	10 ± 1.0 b	47 ± 1.7 b	42 ± 2.3 b	32 ± 2.1 b	2,600 ± 120 b
T7	58 ± 2.6 b	11 ± 1.2 a	48 ± 1.5 b	41 ± 2.0 b	30 ± 1.8 c	2,500 ± 100 c
T7	55 ± 2.9 b	12 ± 1.0 a	49 ± 1.2 a	39 ± 1.5 c	29 ± 1.7 c	2,400 ± 120 c
T9	52 ± 2.4 b	13 ± 1.1 a	50 ± 1.0 a	37 ± 2.0 c	27 ± 1.8 c	2,300 ± 130 c
LSD	5.2	2.1	1.8	3.5	2.5	150

Control (T1), NPK 150 kg/ha (T2), PM 20 t/ha (T3), NPK 112.5 + PM 15 (T4) , NPK 112.5 + PM 10 (T5), NPK 75 + PM 15 (T6), NPK 75 + PM 10 (T7), NPK 37.5 + PM 15 (T8), NPK 37.5 + PM 10 (T9).Means followed by the same letter within the column are not significantly different ($p < 0.05$) according to Tukey's HSD test.

EFFECTS OF POULTRY MANURE AND NPK FERTILIZER ON THE QUALITY OF TOMATO

Effects on Nitrogen (N) Content

The treatment T4 (NPK 112.5 kg/ha + PM 15 t/ha) produced the highest nitrogen content (3.45 mg/g), followed by T5 (3.35 mg/g).The combination of moderate NPK and poultry manure enhances nitrogen availability by providing a balance of fast-releasing synthetic nutrients and slow-releasing organic matter(Chadwick et al., 2000).

Effects on Phosphorus (P) Content
Treatments T4 and T5 had significantly higher P levels compared to other treatments (0.70–0.68 mg/g), indicating that combining reduced levels of NPK with PM improves phosphorus uptake.Poultry manure is known to enhance the soil's phosphorus availability due to its organic acids, which mobilize phosphorus for plant use(Lory et al., 2019). NPK fertilizer further ensures quick phosphorus availability during early growth stages.

Effects on Potassium (K) Content
The highest potassium levels were observed in T4 (2.80 mg/g) and T5 (2.70 mg/g), significantly differing from the control and PM-only treatments.This confirms that the synergistic effect of NPK and PM ensures a more consistent potassium supply. NPK fertilizers are high in available K, while poultry manure helps retain soil moisture, improving K uptake (Paderson et al, 2022).

Effects on Magnesium (Mg) Content
Treatments with NPK + PM combinations generally increased Mg levels compared to the control. However, the effect was not as pronounced as for N, P, and K.The improvement in Mg levels could be attributed to the organic matter from PM, which improves nutrient retention and cation exchange capacity(Zhang et al., 2002).

Effects on Zinc (Zn) Content
Treatments involving NPK fertilizer alone or in combination with PM (T4, T5) had significantly higher Zn content than the control.The increased availability of zinc in NPK and PM treatments may be due to the complexing effect of organic acids in PM, which improves micronutrient uptake(Aghili et al., 2014).

Effects on Iron (Fe) Content
The Fe content increased significantly in T4 (1.25 mg/g) and T5 (1.20 mg/g).Iron uptake can be enhanced in soils amended with PM due to improved organic matter content and microbial activity, improving Fe availability(Ahmed et al., 2013).

Effects on Lycopene Content
The combination of NPK and PM (T4) produced the highest lycopene levels (2.00 mg/g).Lycopene, a key antioxidant in tomatoes, increases with improved nutrient availability. The balanced supply of NPK and PM promotes better fruit development, which leads to higher lycopene content (Giardini et al., 1992).

Effects on Juice Content
The juice content was significantly higher (90.0%) in treatments combining reduced NPK with PM (T4).The combination of synthetic and organic fertilizers improves soil structure and water retention, leading to better fruit development and higher juice content (Alda et al., 2009).

Effects on pH
Treatments with NPK + PM (T4, T5) slightly increased the fruit pH compared to the control (4.90).PM can buffer soil pH, which might lead to fruits with slightly higher pH compared to those from purely synthetic fertilizers(Ahmed et al., 2013).

Effects on BRIX (%) Content

The highest BRIX content (8.0%) was observed in T4, indicating enhanced sugar accumulationin fruits.High sugar accumulation is associated with optimal nutrient availability during fruit development. The combination of PM and NPK seems to provide the best conditions for sugar accumulation(Singh et al., 2017).

Table 4: Combined Effect of Poultry Manure and NPK Fertilizer on the Quality of Tomato

Treatment	N (mg/g)	P (mg/g)	K (mg/g)	Mg (mg/g)	Zn (mg/g)	Fe (mg/g)	Lycopene (mg/g)	Juice Content (%)	pH	BRIX (%)	LSD (0.05)
T1	2.31 ± 0.12 a	0.45 ± 0.05 a	1.90 ± 0.07 a	0.32 ± 0.03 a	0.12 ± 0.02 a	0.85 ± 0.07 a	1.20 ± 0.06 a	75.0 ± 2.5 a	4.50 ± 0.10 a	5.2 ± 0.3 a	0.30
T2	3.15 ± 0.15 b	0.65 ± 0.04 b	2.55 ± 0.08 b	0.45 ± 0.04 b	0.18 ± 0.01 b	1.15 ± 0.08 b	1.80 ± 0.05 b	85.0 ± 3.0 b	4.80 ± 0.15 b	7.0 ± 0.4 b	0.12
T3	2.85 ± 0.13 b	0.50 ± 0.06 a	2.10 ± 0.06 a	0.35 ± 0.03 a	0.15 ± 0.02 b	0.95 ± 0.07 a	1.50 ± 0.07 b	80.0 ± 2.0 b	4.60 ± 0.12 a	6.0 ± 0.3 b	0.08
T4	3.45 ± 0.10 c	0.70 ± 0.03 b	2.80 ± 0.09 c	0.50 ± 0.05 b	0.20 ± 0.02 c	1.25 ± 0.09 b	2.00 ± 0.04 c	90.0 ± 2.5 c	4.90 ± 0.14 b	8.0 ± 0.5 c	0.06
T5)	3.35 ± 0.11 c	0.68 ± 0.05 b	2.70 ± 0.10 c	0.48 ± 0.05 b	0.18 ± 0.02 b	1.20 ± 0.08 b	1.85 ± 0.05 b	88.0 ± 3.0 c	4.85 ± 0.15 b	7.5 ± 0.4 c	0.12
T6	2.90 ± 0.10 b	0.58 ± 0.06 a	2.25 ± 0.08 b	0.40 ± 0.03 a	0.14 ± 0.02 a	1.05 ± 0.07 b	1.60 ± 0.06 b	82.0 ± 2.5 b	4.70 ± 0.12 a	6.5 ± 0.3 b	0.10
T7	2.75 ± 0.12 b	0.55 ± 0.04 a	2.15 ± 0.07 a	0.38 ± 0.04 a	0.13 ± 0.02 a	0.90 ± 0.06 a	1.40 ± 0.05 a	78.0 ± 2.0 a	4.65 ± 0.10 a	5.8 ± 0.3 a	0.15
T8	2.60 ± 0.08 a	0.52 ± 0.05 a	2.00 ± 0.05 a	0.35 ± 0.04 a	0.12 ± 0.01 a	0.88 ± 0.05 a	1.30 ± 0.04 a	76.0 ± 2.0 a	4.55 ± 0.09 a	5.5 ± 0.2 a	0.18
T9	2.55 ± 0.09 a	0.50 ± 0.04 a	1.95 ± 0.04 a	0.32 ± 0.03 a	0.12 ± 0.02 a	0.87 ± 0.04 a	1.25 ± 0.05 a	74.0 ± 2.5 a	4.52 ± 0.10 a	5.3 ± 0.2 a	0.18

Control (T1), NPK 150 kg/ha (T2), PM 20 t/ha (T3), NPK 112.5 + PM 15 (T4) , NPK 112.5 + PM 10 (T5), NPK 75 + PM 15 (T6), NPK 75 + PM 10 (T7), NPK 37.5 + PM 15 (T8), NPK 37.5 + PM 10 (T9).Means followed by the same letter within the column are not significantly different ($p < 0.05$) according to Tukey's HSD test.

CORRELATION OF THE STUDY

Results for the correlation study is presented as a matrix in Table 5, which reveals that Fruit Weight vs Juice Content (r = 0.90), presented a strong positive correlation shows that heavier fruits tend to have more juice content, likely due to better nutrient availability. Lycopene vs BRIX (r = 0.88) shows a high positive correlation, indicating that as sugar content (BRIX) increases, lycopene content also improves, contributing to better fruit quality. Fruits vs Juice Content (r = 0.88) suggests that treatments resulting in higher fruit numbers tend to have fruits with more juice. LAI vs Lycopene (r = 0.80) shows that a larger leaf area, promoting photosynthesis, can enhance lycopene accumulation in fruits.

Table 5: Correlation Matrixfor the Combined Effect of Poultry Manure and NPK Fertilizer on The Growth Yield and Quality of Tomato

	Vine Length	No. of Leaves	LAI	Branches	No of Fruits	Fruit Weight	Juice Content	Lycopene	BRIX (%)
Vine Length	1.00								
No. of Leaves	0.85	1.00							
LAI	0.87	0.90	1.00						
Branches	0.80	0.88	0.84	1.00					
No. of Fruits	0.82	0.83	0.86	0.85	1.00				
Fruit Weight	0.76	0.81	0.79	0.83	0.92	1.00			
Juice Content	0.70	0.77	0.74	0.76	0.88	0.90	1.00		
Lycopene	0.75	0.78	0.80	0.77	0.85	0.84	0.82	1.00	
BRIX (%)	0.72	0.75	0.78	0.74	0.83	0.86	0.85	0.88	1.00

CONCLUSION

The study demonstrates that the combined application of poultry manure (PM) and NPK fertilizer significantly enhances the growth, yield, and quality of tomatoin Maiduguri compared to individual applications. Treatments with moderate doses of both fertilizers (i.e., T4: NPK 112.5 kg/ha + PM 15 t/ha) achieved the highest significant vine length, leaf area index (LAI), and fruit yield. The synergy between organic and inorganic fertilizers optimized nutrient availability, improved soil structure, and promoted better fruit quality by increasing chlorophyll content, lycopene, and BRIX levels. This combination also reduced flower abortion, accelerated flowering, and enhanced nutrient content in fruits, demonstrating the value of integrated soil fertility management (ISFM) in semi-arid regions like Maiduguri.

RECOMMENDATION

Integrated fertilizer use should be promoted for maintaining soil health and fertility over time, minimizing the environmental risks associated with exclusive use of synthetic fertilizers.Additional studies are recommended to explore optimal combinations of organic and inorganic fertilizers across different crop varieties and environmental conditions to fine-tune the approach.

REFERENCES

Adeniyan, O.N., &Ojeniyi, S.O. (2005). Effect of organic and inorganic fertilizers on soil chemical properties and yield of okra. African Journal of Biotechnology, 4(2), 129-133. DOI: 10.5897/AJB2005.000-2520

Aghili, F., Gamper, H. A., Eikenberg, J., Khoshgoftarmanesh, A. H., Afyuni, M., Schulin, R., Jansa, J., &Frossard, E. (2014). Green manure addition to soil increases grain zinc concentration in bread wheat. PloS One, 9(7), e101487.

Ahmed, Y. M., Shalaby, E. A., &Shanan, N. T. (2013). The use of organic and inorganic cultures in improving vegetative growth, yield characters, and antioxidant activity of roselle plants (Hibiscus sabdariffa L.). African Journal of Biotechnology, 10(11), 1988-1996. DOI: 10.5897/AJB10.876

Agyeman, K., Osei-Bonsu, I., Berchie, J. N., Osei, M. K., Mochiah, M. B., Lamptey, J. N., Osei, K., &Bolfrey-Arku, G. (2014). Effect of poultry manure and different combinations of inorganic fertilizers on growth and yield of four tomato varieties in Ghana. Agricultural Science, 2(4), 27-34. DOI: 10.12735/as.v2i4p27

Albert, Berdjour., I. Y., Dugje, Nurudeen, Abdul Rahman., Daniel, AsomaningOdoom., Alpha, Y., Kamara., S. O., Ajala. (2020). Direct estimation of maize leaf area index as influenced by organic and inorganic fertilizer rates in Guinea Savanna. The Journal of Agricultural Science, 12(6), 66-. DOI: 10.5539/JAS.V12N6P66

Alda, L. M., Gogoa, I., Bordean, D., Gergen, I., Alda, S., Moldovan, C., & Ni, L. (2009). Lycopene content of tomatoes and tomato products. Journal of Agroalimentary Process and Technologies.

Alsafar, A. S. (2009). Effects of nitrogen fertilizer application on the growth and yield of Mentha longifolia L. Journal of Agricultural Science and Technology, 11(4), 271-280. DOI: 10.1177/0972150910011004

Anas, Iqbal., Liang, He., Izhar, Ali., Saif, Ullah., Aziz, Khan., Kashif, Akhtar., Shangqin, Wei., Shah, Fahad., Rayyan, Khan., Ligeng, Jiang. (2021). Co-incorporation of manure and inorganic fertilizer improves leaf physiological traits, rice production, and soil functionality in a paddy field. Scientific Reports, 11(1), 10048-10048. DOI: 10.1038/S41598-021-89246-9

Chadwick, D. R., John, F., Pain, B. F., Chambers, B. J., & Williams, J. (2000). Plant uptake of nitrogen from the organic nitrogen fraction of animal manures: A laboratory experiment. Journal of Agricultural Science, 134(2), 159–168. DOI: 10.1017/S0021859699007510

Eifediyi, E. K., Remison, S. U., Ahamefule, H. E., Azeez, K. O., &Fesobi, P. O. (2017). Performance of watermelon (Citrullus lanatus L.) in response to organic and NPK fertilizers. Acta Universitatis Sapientiae, Agriculture and Environment, 9(1), 5–17. DOI: 10.1515/ausae-2017-0001

Enas, Soliman., Mostafa, M., & Mansour. (2024). Enhancing soil organic carbon content and water retention using polyvinyl alcohol cross-linked with chitosan and pectin. Journal of Soil Science and Plant Nutrition, 1-13. DOI: 10.1007/s42729-023-01584-x

Giardini, L., Pimpini, F., Borin, M., &Gianquinto, G. (1992). Effects of poultry manure and mineral fertilizers on the yield of crops. The Journal of Agricultural Science, 118(2), 207–213. DOI: 10.1017/S0021859600068805

Isitekhale, H. H. E., &Osemwota, I. O. (2010). Residual effects of poultry manure and NPK fertilizer on soil physical properties in the forest and derived savanna soils of Edo State, Nigeria.

Kariya, K., &Tsunoda, S. (1972). Relationship of chlorophyll content, chloroplast area. Tohoku Journal of Agricultural Research, 23(1).

Kramer, P. J., et al. (2002). Integrating organic and inorganic fertilizers for sustainable nutrient management. Soil Science Society of America Journal, 66(2), 678-687. DOI: 10.2136/sssaj2002.678

Law-Ogbomo, K. E., &Remison, S. U. (2009). Growth and yield of maize as influenced by sowing date and poultry manure application. NotulaeBotanicaeHortiAgrobotanici Cluj-Napoca, 37(1), 199–203. DOI: 10.15835/nbha3713140

Lory, J. A., Massey, R., &Joern, B. (n.d.). Using manure as a fertilizer for crop production.

Massri, M., &Labban, L. (2014). Comparison of different types of fertilizers on growth, yield, and quality properties of watermelon (Citrullus lanatus). Agricultural Sciences, 05(06), 475–482. DOI: 10.4236/as.2014.56048

Palm, C. A., et al. (1997). Nutrient replenishment in the humid tropics: The role of organic matter. Nutrient Cycling in Agroecosystems, 48(1), 5–16. DOI: 10.1023/A:1009774200052

Pederson, G. A., Brink, G. E., & Fairbrother, T. E. (2002). Nutrient uptake in plant parts of sixteen forages fertilized with poultry litter: Nitrogen, phosphorus, potassium, copper, and zinc. Agronomy Journal, 94(4), 895-904.

Rodrigo, Nogueira, de, Sousa., Lílian, Angélica, Moreira. (2024). Plant nutrition optimization: Integrated soil management and fertilization practices. DOI: 10.5772/intechopen.114848

Roni, Aloni. (2021). Importance of NO_3^- and PO_4^- for development, differentiation, and competition. 97-99. DOI: 10.1007/978-3-030-53202-4_4

Singh, V., Prasad, V. M., Kasera, S., Singh, B. P., & Mishra, S. (2017). Influence of different organic and inorganic fertilizer combinations on growth, yield, and quality of cucumber (Cucumis sativus L.) under protected cultivation. Pharmacognosy and Phytochemistry, 6(4), 1079–1082.

Zhang, H., Hamilton, D. W., & Britton, J. G. (2002). Using poultry litter as fertilizer. Mans.edu.eg.