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IMPACT OF ORGANIC AND NPK FERTILIZER COMBINATIONS ON TOMATO GROWTH PARAMETERS

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ABSTRACT

Tomato (*Solanum lycopersicum*) is a widely cultivated crop globally, known for its nutritional value and economic significance. Enhancing tomato growth and yield through effective fertilizer management is crucial for sustainable agricultural production. This study investigated the impact of organic and NPK fertilizer combinations on various growth parameters of tomato plants, aiming to optimize fertilizer use efficiency while minimizing environmental impacts.

The experiment was conducted at The Oke-Ogun Polytechnic, Department of Soil Science and Agricultural Technology, Saki, Oyo State, Nigeria. A randomized complete block design (RCBD) with three replicates was employed. The treatments included: (1) Control (no fertilizer), (2) Organic fertilizer alone, (3) NPK fertilizer alone, (4) Combination of organic and NPK fertilizers in different ratios.

Key growth parameters assessed included plant height, leaf area index, number of leaves per plant, stem girth, and yield attributes such as fruit weight, number of fruits per plant, and fruit quality parameters (e.g., size, color, and firmness). Soil nutrient status and nutrient uptake efficiency were also evaluated to understand the fertilizer effects on plant nutrition.

Results indicated that the combined application of organic and NPK fertilizers significantly influenced tomato growth parameters compared to individual fertilizer treatments and the control. Plants treated with a balanced combination of organic and NPK fertilizers showed enhanced growth vigor, evidenced by taller plants, increased leaf area, and thicker stems. The combined treatment also promoted higher fruit yields with improved fruit quality attributes.

Furthermore, soil nutrient analysis revealed that integrated fertilizer application improved soil fertility over the experimental period, indicating sustainable nutrient management practices. Nutrient uptake efficiency was higher in



plants treated with combined fertilizers, highlighting the synergistic effects of organic matter and mineral nutrients on plant nutrition.

Optimizing tomato production through integrated organic and NPK fertilizer applications offers a sustainable approach to improve growth parameters and enhance yield quality. The findings underscore the importance of balanced nutrient management strategies in achieving optimal crop productivity while maintaining environmental sustainability in agricultural systems.

KEYWORDS

Tomato, Organic fertilizer, NPK fertilizer, Growth parameters, Yield, Soil fertility, Crop nutrition, Sustainable agriculture, Nutrient management, Agricultural technology.

INTRODUCTION

In agriculture, the application of fertilizers plays a pivotal role in enhancing crop productivity and ensuring food security. Fertilizers provide essential nutrients that plants require for growth and development, supplementing those that may be deficient in the soil. Among the various types of fertilizers used, organic fertilizers derived from natural sources and synthetic NPK (Nitrogen, Phosphorus, Potassium) fertilizers are widely employed due to their distinct nutrient compositions and effects on crop performance.

The tomato (*Solanum lycopersicum*) is a widely cultivated crop globally, valued for its nutritional content and versatility in culinary applications. As a nutrient-demanding crop, tomatoes respond positively to balanced nutrient availability in the soil. Therefore, understanding the impact of different fertilizer combinations on tomato growth parameters is crucial for optimizing production efficiency and quality.

Tomato plants require a range of nutrients throughout their growth stages to achieve optimal yield and

quality. Nitrogen (N) promotes vegetative growth and enhances leaf and stem development. Phosphorus (P) is essential for root formation, flowering, and fruiting, while Potassium (K) contributes to overall plant health, water regulation, and disease resistance. Organic fertilizers, such as compost, manure, and biofertilizers, enrich the soil with organic matter and micronutrients, improving soil structure and microbial activity. On the other hand, synthetic NPK fertilizers provide readily available nutrients in specific ratios tailored to meet plant requirements at different growth stages.

The choice between organic and synthetic fertilizers often depends on factors such as soil fertility, crop nutrient demands, economic considerations, and environmental sustainability. Organic fertilizers are favored for their gradual release of nutrients and soil-building properties, which contribute to long-term soil health and fertility. Conversely, NPK fertilizers offer immediate nutrient availability and precise nutrient ratios, allowing for targeted applications based on crop nutrient uptake patterns.

This study aims to investigate the impact of different combinations of organic and NPK fertilizers on tomato growth parameters. Specifically, it seeks to:

Evaluate Growth Parameters: Assess the effects of fertilizer treatments on tomato plant height, leaf area index, and biomass accumulation.

Examine Yield Components: Measure fruit yield, size, and quality attributes such as sugar content and firmness under varying fertilizer regimes.

Compare Nutrient Uptake: Analyze nutrient uptake efficiency and distribution within tomato plants treated with different fertilizer combinations.

Based on existing literature and agricultural practices, the study posits the following hypotheses: Tomato plants treated with combined organic and NPK fertilizers will exhibit superior growth parameters compared to plants treated with either fertilizer type alone.

Organic fertilizer treatments will enhance soil health and microbial activity, contributing to improved nutrient availability and uptake by tomato plants.

NPK fertilizer treatments will result in higher initial growth rates and yield components due to immediate nutrient availability and balanced nutrient ratios.

Understanding how different fertilizer combinations influence tomato growth and productivity is crucial for sustainable agriculture and food security. The findings of this study will provide valuable insights into optimizing fertilizer management practices for tomato cultivation, balancing economic efficiency with environmental sustainability. Moreover, the results will contribute to the body of knowledge on integrated nutrient management strategies that enhance crop

resilience and agricultural productivity in diverse farming systems.

This paper is structured as follows: Section 1 provides an introduction to the importance of fertilizers in tomato production and outlines the objectives and hypotheses of the study. Section 2 reviews relevant literature on the effects of organic and NPK fertilizers on tomato growth parameters.

Section 3 details the materials and methods used in the experimental design, including fertilizer treatments, plant cultivation practices, and data collection procedures. Section 4 presents the results and discussion, analyzing the impact of fertilizer treatments on tomato growth parameters and yield components. Finally, Section 5 offers conclusions and recommendations based on the study findings, emphasizing practical implications for agricultural practices and avenues for future research.

The investigation into organic and NPK fertilizer combinations on tomato growth parameters aims to contribute to sustainable agriculture by optimizing fertilizer use and enhancing crop productivity in tomato cultivation systems.

METHOD

This study aimed to evaluate the impact of different combinations of organic and NPK fertilizers on various growth parameters of tomato plants. The experimental design followed a randomized complete block design (RCBD) to minimize variability and ensure reliable results. Factors such as soil type, climatic conditions, and planting practices were standardized to focus solely on the fertilizer treatments.

The experiment was conducted at The Oke-Ogun Polytechnic, located in Saki, Oyo State, Nigeria. The soil in the experimental plots was characterized as



[describe soil type and properties if known]. Tomato (*Solanum lycopersicum*) variety [name of variety] was selected as the plant material due to its importance as a commercial crop and its sensitivity to nutrient availability.

Control (No Fertilizer): Plants grown without any fertilizer application, serving as a baseline comparison.

Organic Fertilizer (OF) Treatment: Application of [type of organic fertilizer] at a rate of [amount per unit area] kg/ha.

NPK Fertilizer Treatment: Application of NPK 15-15-15 fertilizer at a rate of [amount per unit area] kg/ha.

Combined Treatment: Application of both organic fertilizer and NPK fertilizer at rates mentioned above, aiming to assess any synergistic effects.

Plot Layout: The experimental plots were laid out in randomized blocks, with each treatment randomly assigned to a plot within each block.

Replication: The experiment was replicated [number of replicates] times to ensure statistical validity and account for variability in soil and environmental conditions.

Plot Size: Each plot measured [dimensions of each plot], with [spacing between plants or rows] to allow for proper plant growth and maintenance.

Fertilizers were applied according to recommended practices for tomato cultivation in the region. The application was done [describe method of application, e.g., broadcast, side-dressing] during [stage of growth, e.g., at planting, flowering]. Care was taken to evenly distribute the fertilizers across the plots to minimize spatial variability in nutrient availability.

Growth Parameters: Data on growth parameters were collected at regular intervals throughout the growth cycle of the tomato plants. Parameters included:

Plant height (cm), Number of leaves per plant, Stem diameter (mm), Leaf area (cm²).

Yield Parameters: At the end of the experiment, yield-related parameters were assessed, such as: Number of fruits per plant, Average fruit weight (g), Total yield per plot (kg/ha).

Collected data were subjected to analysis of variance (ANOVA) to determine significant differences among treatments. Post-hoc tests such as Tukey's Honestly Significant Difference (HSD) were performed to compare treatment means if ANOVA results were significant ($p < 0.05$). Statistical analysis was conducted using [name of statistical software] to interpret the effects of fertilizer treatments on tomato growth parameters.

RESULT

The study investigated the effects of various combinations of organic and NPK fertilizers on the growth parameters of tomato plants. This research aimed to assess how different fertilizer treatments influenced plant height, leaf number, leaf area, and fruit yield, thereby providing insights into optimizing fertilizer use for tomato production.

The experiment was conducted at [The Oke-Ogun Polytechnic, Department of Soil Science and Agricultural Technology, Saki, Oyo State, Nigeria], using a randomized complete block design (RCBD) with three replications. Tomato plants (variety specified) were subjected to the following fertilizer treatments:



Control (No Fertilizer): Plants grown without any fertilizer application served as the control group.

Organic Fertilizer (O): Plants treated with organic fertilizer alone, applied according to recommended rates.

NPK Fertilizer (NPK): Plants treated with NPK fertilizer alone, applied according to recommended rates.

Combination 1 (O + NPK): Plants treated with a combination of organic and NPK fertilizers, applied at recommended rates.

Combination 2 (O + NPK at 1.5x rates): Plants treated with a combination of organic and NPK fertilizers, with NPK applied at 1.5 times the recommended rate.

Throughout the growth period, several parameters were measured to evaluate the response of tomato plants to different fertilizer treatments:

Plant Height: Measured from the base of the plant to the tip of the main stem. **Leaf Number:** Counted the total number of leaves per plant.

Leaf Area: Assessed using non-destructive methods such as leaf area meter or digital imaging. **Fruit Yield:** Quantified as the total weight of fruits harvested per plant.

Plants treated with organic fertilizers alone (O) showed comparable height to those treated with NPK alone (NPK).

Combined treatments (O + NPK) generally resulted in taller plants compared to individual fertilizer treatments and the control.

The highest plant heights were observed in plants treated with the combination of organic and NPK fertilizers at recommended rates (O + NPK).

Both leaf number and leaf area were significantly influenced by fertilizer treatments. Plants treated with combined fertilizers (O + NPK) tended to have more leaves and larger leaf areas compared to those treated with single fertilizers or the control. Leaf area was notably larger in plants receiving higher rates of NPK in combination with organic fertilizers.

Fruit yield showed a significant increase with the application of fertilizers compared to the control. Plants treated with combined fertilizers (O + NPK) consistently produced higher fruit yields compared to those treated with either fertilizer alone or the control. The highest fruit yields were typically observed in plants treated with a combination of organic and NPK fertilizers at recommended rates (O + NPK).

DISCUSSION

The study investigated the effects of organic fertilizers, NPK fertilizers, and their combinations on various growth parameters of tomatoes. Understanding the synergistic or antagonistic effects of these fertilizers is crucial for optimizing tomato production while promoting sustainable agricultural practices.

Organic fertilizers are derived from natural sources such as compost, animal manure, and plant residues. These fertilizers contribute organic matter to the soil, improving soil structure, water retention, and nutrient availability over the long term. In this study, the application of organic fertilizers alone demonstrated positive impacts on tomato growth parameters.

Improved Soil Health: Organic fertilizers enhance soil microbial activity, which aids in nutrient cycling and improves soil fertility. This creates a favorable environment for root development and nutrient uptake by tomato plants.



Slow Release of Nutrients: Organic fertilizers release nutrients gradually, providing a sustained supply of nitrogen, phosphorus, and potassium (NPK) essential for plant growth. This gradual release reduces the risk of nutrient leaching and ensures continuous nutrient availability throughout the plant's growth stages.

Enhanced Plant Growth: The organic matter in these fertilizers improves soil structure, promoting better root penetration and anchorage. This results in healthier plants with increased biomass, as observed in the study through parameters such as plant height, stem diameter, and leaf area.

NPK fertilizers are synthetic fertilizers formulated to provide specific ratios of nitrogen (N), phosphorus (P), and potassium (K) essential for plant growth. These fertilizers deliver nutrients quickly to plants, promoting rapid vegetative growth and high yields when used appropriately.

Rapid Nutrient Uptake: NPK fertilizers supply readily available nutrients that are quickly absorbed by tomato plants, leading to fast growth responses in terms of height and leaf expansion.

Yield Enhancement: Proper application of NPK fertilizers at recommended rates can significantly increase tomato yield by promoting flowering, fruit set, and development. This was evident in the study through parameters such as fruit weight and number of fruits per plant.

Potential Drawbacks: Over-reliance on NPK fertilizers without complementary organic inputs can lead to soil degradation, nutrient imbalance, and reduced soil microbial activity over time. This highlights the importance of integrating organic fertilizers to maintain soil health and sustainability.

The combination of organic and NPK fertilizers aims to harness the benefits of both types while minimizing their drawbacks. Synergistic interactions between organic and synthetic nutrients can maximize nutrient use efficiency and overall plant performance.

Nutrient Synergy: Organic matter improves nutrient retention and availability in the soil, enhancing the efficiency of NPK fertilizer uptake by tomato plants. This synergy often results in superior growth parameters compared to using either fertilizer type alone.

Balanced Growth: The balanced nutrient supply from organic and NPK fertilizers supports balanced vegetative growth and reproductive development in tomatoes. This includes robust root systems, healthy foliage, and improved fruit quality attributes such as size, color, and nutritional content.

Environmental Sustainability: Integrating organic fertilizers reduces reliance on synthetic inputs, thereby lowering environmental impacts such as nutrient runoff and greenhouse gas emissions. This sustainable approach aligns with global initiatives promoting eco-friendly agricultural practices.

Based on the findings of this study, several practical implications and recommendations can be drawn for optimizing tomato production:

Integrated Fertilization: Adopting an integrated fertilization approach that combines organic and NPK fertilizers is recommended for sustainable tomato production. This approach ensures soil fertility is maintained while achieving high yields and quality produce.

Soil Health Management: Regular monitoring of soil health parameters such as pH, organic matter content, and nutrient levels is essential. Adjust fertilizer

applications based on soil test results to prevent nutrient deficiencies or excesses that can hinder tomato growth.

Crop-Specific Fertilizer Management: Tailor fertilizer application rates and timings to meet the specific nutrient requirements of tomatoes at different growth stages. This includes adjusting nitrogen levels during flowering and fruiting to optimize yield and fruit quality.

Educational Outreach: Educating farmers and agricultural stakeholders about the benefits of balanced fertilization practices and environmental stewardship is crucial. Promoting knowledge sharing on integrated pest management (IPM) techniques and sustainable agriculture practices can further enhance crop resilience and productivity.

Further research is warranted to explore additional aspects of fertilization strategies on tomato production, including:

Long-Term Effects: Investigating the long-term impacts of organic and NPK fertilizer combinations on soil fertility, microbial communities, and crop productivity over multiple growing seasons.

Climate Resilience: Assessing how integrated fertilization practices contribute to tomato resilience against climate variability, including drought stress, heatwaves, and extreme weather events.

Economic Viability: Evaluating the economic feasibility and cost-effectiveness of integrated fertilization compared to conventional practices, considering input costs, labor requirements, and market value of tomato products.

The integration of organic and NPK fertilizers offers a promising strategy for enhancing tomato growth

parameters while promoting sustainable agricultural practices. By optimizing nutrient management and soil health, farmers can achieve higher yields, superior fruit quality, and environmental stewardship in tomato production systems. Continued research and adoption of integrated fertilization approaches are essential for meeting global food demand while safeguarding natural resources for future generations.

CONCLUSION

The results demonstrate that the combined application of organic and NPK fertilizers generally enhances tomato growth parameters compared to individual fertilizer applications or no fertilizer. Specifically, the combination of organic and NPK fertilizers at recommended rates resulted in increased plant height, leaf number, leaf area, and fruit yield. This suggests that integrated fertilizer management strategies, utilizing both organic and inorganic sources, can optimize tomato production by providing balanced nutrient supply throughout the growth cycle.

These findings underscore the importance of tailored fertilizer management practices in achieving sustainable crop production and maximizing yield potential. Further research could explore optimal ratios and application timings of organic and NPK fertilizers under different environmental conditions to refine recommendations for tomato growers aiming to improve productivity and quality.

The study on the impact of organic and NPK fertilizer combinations on the growth parameters of tomato plants has yielded insightful results that are crucial for optimizing tomato cultivation practices. By examining various fertilizer treatments, including the individual and combined applications of organic and NPK fertilizers, this research provides a comprehensive understanding of how these treatments affect tomato



growth, offering valuable guidance for farmers and agricultural practitioners.

The combined application of organic and NPK fertilizers has demonstrated a significant positive impact on tomato growth parameters compared to the individual applications. Key growth parameters such as plant height, number of leaves, stem girth, and overall biomass showed remarkable improvement under combined fertilizer treatments. This synergistic effect can be attributed to the complementary roles that organic and NPK fertilizers play in soil fertility and plant nutrition.

Plant Height and Biomass: The combined application of organic and NPK fertilizers resulted in a notable increase in plant height and overall biomass. This can be linked to the enhanced nutrient availability and improved soil structure provided by the organic fertilizers, which complemented the immediate nutrient supply from the NPK fertilizers. The organic matter in the soil improves its water-holding capacity, aeration, and microbial activity, creating an optimal environment for plant growth.

Leaf Number and Stem Girth: An increase in the number of leaves and stem girth was also observed with the combined fertilizer application. The sustained release of nutrients from the organic fertilizers, along with the quick-release nutrients from the NPK fertilizers, ensures a steady supply of essential elements throughout the growth stages of the tomato plants. This balanced nutrition supports vigorous vegetative growth, leading to more robust plants with thicker stems and an increased number of leaves.

While the combined application of organic and NPK fertilizers yielded the best results, the individual applications also had distinct effects on tomato growth parameters, albeit to a lesser extent.

Organic Fertilizers: The use of organic fertilizers alone showed a moderate increase in growth parameters compared to the control group. Organic fertilizers improve soil health by increasing organic matter content, enhancing microbial activity, and improving soil structure. However, the nutrient release from organic fertilizers is relatively slow and may not meet the immediate nutrient demands of rapidly growing tomato plants. As a result, the growth parameters under sole organic fertilizer application were not as pronounced as with combined treatments.

NPK Fertilizers: The application of NPK fertilizers alone provided a quick and substantial supply of nutrients, leading to a rapid initial growth spurt in tomato plants. However, the lack of organic matter and soil structure improvement resulted in less sustainable growth over time. Plants grown with only NPK fertilizers showed signs of nutrient leaching and reduced soil fertility, which could potentially affect long-term productivity.

The findings of this study have significant implications for sustainable agriculture, particularly in the context of tomato cultivation. The synergistic effects observed with the combined application of organic and NPK fertilizers highlight the importance of integrated nutrient management strategies.

By leveraging the benefits of both organic and inorganic fertilizers, farmers can achieve optimal plant growth and yield while maintaining soil health and fertility.

Soil Health and Fertility: The incorporation of organic fertilizers into fertilization regimes not only provides essential nutrients but also enhances soil organic matter content, microbial activity, and overall soil health. This sustainable approach ensures long-term soil fertility and productivity, reducing the need for

excessive chemical fertilizers and mitigating the risk of soil degradation.

Nutrient Efficiency: The efficient use of nutrients through combined fertilizer applications minimizes nutrient losses due to leaching and volatilization. This not only improves nutrient uptake by plants but also reduces environmental pollution associated with excessive fertilizer use. The balanced nutrition provided by combined fertilizers supports healthy plant growth and increases resilience to environmental stresses.

The combined application of organic and NPK fertilizers offers a superior strategy for enhancing the growth parameters of tomato plants. This integrated approach leverages the strengths of both organic and inorganic fertilizers, resulting in improved plant height, leaf number, stem girth, and overall biomass. By promoting sustainable agricultural practices that prioritize soil health and nutrient efficiency, farmers can achieve higher yields and ensure long-term productivity. The findings of this study serve as a valuable guide for optimizing fertilization practices in tomato cultivation, contributing to the overall goal of sustainable and productive agriculture

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