Influence of Fertilizer Types on Growth and Yield of Pepper (*Capsicum sp.* L) Varieties in Ogbomoso, Oyo State, Nigeria.

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ABSTRACT
Pepper (Capsicum spp. L.) is a globally important vegetable valued for its nutritional, economic, and culinary uses. However, low soil fertility and poor fertilizer management hinder its production. This study evaluated the effects of organic and inorganic fertilizers on the growth and yield of four pepper varieties in Ogbomoso, Nigeria. The field trial was conducted at the Teaching and Research Farm of Ladoke Akintola University of Technology using a 3 × 4 × 2 factorial in a Randomized Complete Block Design. Treatments included two fertilizer types (NPK 15-15-15 at 60 kg N/ha and poultry manure at 500 t/ha), four pepper varieties (Cayenne, Chili, Redbell, and Super), and a control, with three replications. Growth parameters (plant height, leaf area, branches, and stem girth) and yield attributes (fruit number, weight, and length) were assessed. Results showed that fertilizers significantly improved growth and yield compared to the control. At 9 weeks after transplanting, Redbell with NPK recorded the tallest plants (55.0 cm), while Super variety had the highest yield (14.7 t/ha) and Cayenne the lowest (11.8 t/ha). NPK fertilizer generally outperformed poultry manure, with Chili + NPK achieving the highest yield (15.5 t/ha). The study concludes that integrating organic and inorganic fertilizers enhances pepper performance, with Super variety and NPK 15-15-15 recommended for optimum production in Ogbomoso.

Keywords: Fertilizer types, Growth, Yield, Pepper, Varieties

INTRODUCTION

Pepper (*Capsicum spp*. L) is one of the most economically important vegetable crops cultivated globally, particularly in tropical and subtropical regions where it plays a vital role in food security, nutrition, and income generation for smallholder farmers (Agbo *et al*., 2021). The crop is widely cultivated due to its adaptability to various agroecological conditions and its high demand for both domestic consumption and export. Peppers are valued for their culinary uses and nutritional content, particularly vitamins A, C, and E, as well as capsaicin and flavonoids (Olatunji *et al*., 2020). In many developing countries, including Nigeria, the cultivation of pepper is a significant component of rural livelihoods; however, productivity levels remain suboptimal due to several agronomic and environmental challenges (Adeniyan and Ojeniyi, 2022).

Among the various factors influencing pepper production, soil fertility and nutrient management play critical roles in determining plant growth, yield, and quality. Fertilizer type and application methods significantly affect the physiological and morphological characteristics of pepper plants (Ogunlade and Olaniyi, 2023). Fertilizers are applied to supplement essential macro and micronutrients required for optimal crop performance. However, the choice between organic and inorganic fertilizers continues to be debated, especially considering sustainability concerns, environmental health, and long-term soil fertility management (Uka *et al*., 2020).

On the other hand, organic fertilizers such as compost, poultry manure, and green manure are known to improve soil structure, water retention, and biological activity. They release nutrients more slowly but enhance soil health and fertility over time (Uka et al., 2020).
Despite these known benefits, there is limited region-specific research that systematically compares the performance of different fertilizer types on various pepper varieties under uniform agronomic conditions. This gap is particularly important because the response of pepper to fertilizer applications varies significantly among cultivars due to differences in genetic composition, nutrient uptake efficiency, and tolerance to environmental stressors (Eze et al., 2021). Understanding the interaction between fertilizer types and pepper genotypes is essential to guide effective nutrient management strategies that are both economically viable and environmentally sustainable.

Moreover, with the increasing shift towards sustainable agriculture, there is a growing emphasis on the use of organic inputs and integrated nutrient management practices that combine both organic and inorganic fertilizers for enhanced crop performance. Such practices aim to achieve high productivity without compromising soil health or ecosystem stability (Nwachukwu and Ekwe, 2023). Consequently, evaluating the influence of different fertilizer types on the growth and yield of diverse pepper varieties is necessary to generate empirical data that can inform best practices in pepper cultivation. This study, therefore, aims to investigate the effects of various fertilizer types, organic, inorganic, and their combinations, on the growth parameters and yield components of selected pepper varieties. The findings are expected to contribute valuable insights into the development of sustainable fertilization strategies and varietal selection that optimize pepper production across different agroecological zones.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The farm consists of arable, tree crops and is integrated with livestock production. The coordinate of the project site is at a latitude of 8^0 10$^{'}$ North and a longitude of 4^{o} 10$^{'}$ East. The climate of Ogbomoso is influenced by the Northeast and Southwest trade winds.

The maximum temperature is 33°C, the minimum temperature is 28 °C, and the annual rainfall is over 1000mm. The relative humidity is above 75% all year round except in January when the dry wind blows from the north (Olaniyi, 2006). Hence, this location is chosen due to its significance in pepper production and representation of typical conditions.

Soil sample collection and analysis

Topsoil (0-15cm depth) samples were collected randomly from the experimental field using equipment called an auger. For the pre-sowing analysis, the soil was bulked and mixed thoroughly, air-dried, sieved through 2 mm and 0.5 mm sieves, and sub-samples were taken to a scientific soil laboratory in Ibadan for routine chemical and particle size analysis. Soil pH was determined with the glass electrode pH meter on a 1:1 soil-solution mixture (Mclean, 1982). Organic carbon contents were determined using the Walkey-Black method (Nelson and Sommers 1982). Total Nitrogen was determined using the Kjeldahl procedure as described by Jackson (1965), and available phosphorus was extracted by the Mehlich method (Mehlich, 1984). Exchangeable K, Ca, Mg and Na were determined by extraction with ammonium acetate and the amounts of K, Ca and Na in the filtrate were determined using a flame photometer, while Mg was determined using a Perkin-Elmer Atomic Absorption Spectro photometer (AAS). Exchangeable acidity (H^+) was determined using the titration method. Effective cation exchange capacity (ECEC) was determined as the sum of the exchangeable cations, K, Na, Ca, Mg, and H^+ expressed in cmol kg^{-1} of soil (Tel and Hargerty, 1984).

Experimental Materials

The materials used for the experiment include: 4 pepper varieties, organic and inorganic fertilizers.

Pepper varieties

Four (4) varieties of pepper were used are:

(a) Super habanero (Capsicum chinenses)
(b) Red bell pepper
(c) Scotch bonnets (*Capsicum chinenses*)
(d) Cayenne (*Capsicum annuum*)

The characteristics of each of these four pepper varieties are described in Table 1.

Growth chamber

At the planting stage, seeds were planted directly into a prepared raised soil bed (2m by 2m) before being transplanted into the permanent experimental field.

Nitrogen source:

NPK (15-15-15) at 60kgN/ha was used as a source of nitrogen.

Poultry manure at 500 t/ha. **Nursery practices:**

Proper nursery practices, including frequent watering using a watering can, timely fertilizer application using urea foliar form, and effective pest and disease control using cypermethrin, were carried out to ensure healthy seedling growth and optimal field establishment.

Application of Treatment

The treatments were:

1.VARIETIES = 4

V1= Local (Cayenne/bawa); V2= Improved (Chilli /shombo); V3= Improved (Super hebernero/rodo); V4= Hybrid (Red bell pepper/tatashe).

2. FERTILIZER LEVEL

3 levels of fertilizer applications

T1= NPK15:15:15 (400kg/ha)

T2= Poultry droppings at the rate of 4tons/ha

T3= Control

NPK = 17.7g/plant

Poultry manure 80g/plant

Poultry manure was applied to the soil weeks before transplanting for optimal decomposition and effective interaction with the soil, while the NPK fertilizer was applied a week after transplanting.

Treatments combination and design

3 x 4 factorial experiment, which gave 12 treatment combinations. The treatment combinations were arranged in a split-plot design fitted into a Randomized Complete Block Design (RCBD) in 3 replicates.

Field Establishment

A well-drained loamy soil was chosen because of its ability to hold water and nutrient interaction capacity. Soil test was tested to determine nutrient levels and pH, and amend the soil as needed with organic matter, and land clearing was done manually with a cutlass. Weed control measures were done manually with hand-picking to prevent weed competition with seedlings. Transplanting was done after 28 days of planting according to a Bangladesh author (Ahmed, Q, M et al…) and ensures proper spacing of 70 cm by 50cm for inter and inter row spacing respectively and a raised bed was considered for improved drainage. Additionally, the provision of consistent water to the plants was ensured, accompanied by the application of both organic (poultry droppings) and inorganic (NPK 15-15-15) fertilizers to the plants at 2 weeks after planting (WAP). Frequent monitoring for pests and diseases using cypermethrin and the usage of integrated pest management promote healthy growth and prevent bending. Necessary data were taken and recorded at 4WAP and at a weekly interval for 4 weeks. Peppers were harvested at the mature stage when fully ripped. Proper handling of harvested pepper fruits to prevent damage and pack them for transport and storage. Records keeping of planting (IPM) techniques was employed. Training of pepper plants to encourage dates, varieties and harvest yields for future planning and improvements was considered.

The field experiment was conducted on a manually cleared plot of land, which was divided into 36 experimental plots, each measuring 2m by 2m. Pepper plants were spaced at an inter-row distance of 0.4 cm and an intra-row distance of 0.4 cm to ensure proper growth and development.

Crop Management

a. Watering of plants as required by the treatment; water was applied to the plants equally.

b. Weeding is done as they emerge; weeding was done manually to control and avoid competition with the plant.

c. Pest and disease control; cypermethrin was applied at the rate of 40ml/15lit. of water inside a sprayer to control insect pests and application of benlate at 10g/15 liters.of water to control fungi whenever the signs are sighted.

Fertilizer Application

Inorganic (NPK 15-15-15) and organic (poultry manure) fertilizers were used as the fertilizer type at the recommended rate practices for pepper cultivation. Using the following rates; accordingly, 1: 60kgN/ha for inorganic

2: 720gm of inorganic fertilizer per bed.

Data collection

Data were collected on plant height and stem girth, number of leaves and number of branches, leaf area, plant dry matter, and fruit yield.

Growth parameters: Three plants were randomly chosen among others. For the assessment of growth parameters, the measurements were taken at 4, 6 and 8 weeks after transplanting WAT for:

Plant height (cm): Plant heights from the soil to the tip of the primary shoot were measured in centimetres using a ruler or measuring tape.

Stem girth (cm): The pepper plant girth was taken with a venier caliper from China in centimetres above the ground.

Leaf/plant: It was achieved by counting open green leaves/plants at each sampling time.

Number of branches: It was determined by counting the branches of each plant (branches/plants) at each sampling time.

Leaf area /plant (cm^2): This was obtained using the techniques described by Togun *et al.* (2003). It is L X B X 0.68.

Days to 50% flowering: It was taken from the day when the open flowers are brought in a field, when at least half the total plants are collected.

Opened flowers/plant: It was obtained through the summation of the total number of opened flowers counted per plant at each sampling time. Double counting was avoided by using a permanent marker to mark the open flowers.

Fruits per plant: The total number of fruits percentage obtained from each plant was estimated, and an average fruit quantity was recorded by each crop.

Data Analysis

Data were subjected to analysis of variance (ANOVA) to determine significant differences among treatment combinations, and comparison was done by Duncan Multiple Range Test DMRT at 5% probability level. If significant differences exist, post-hoc tests were conducted to identify specific treatment effects.

RESULTS

Main effects of fertilizer types on the plant height of pepper varieties

Pepper plant height was significantly influenced by both fertilizer types and pepper varieties (Table 1). At 3 and 5 WAT, plants treated with NPK fertilizer were significantly taller than those under poultry manure and control, reflecting the quick release of nutrients from NPK. By 7 and 9 WAT, however, differences among treatments were no longer significant, as poultry manure caught up and the control also improved, suggesting nutrient release from organic matter and soil reserves. Among varieties, Red Bell and Chilli consistently recorded the tallest plants across growth stages, indicating strong genetic vigor and responsiveness to fertilizer, in line with (Ogunlade and Olaniyi, 2023). Fertilizers are applied to supplement essential macro and micronutrients required for optimal crop performance. Cayenne showed intermediate growth, while Super Habanero remained the shortest, confirming clear varietal differences in growth potential. Also, these findings imply that NPK is best for rapid early growth, while poultry manure provides sustained fertility and long-term soil benefits. Integrating both could balance immediate growth with soil health. For varietal choice, Red Bell and Chilli are more promising for vigorous growth and higher yield potential, whereas Cayenne and Super Habanero may be preferred where market demand values other traits such as pungency.

Table 1: Main effects of fertilizer types on plant height of pepper varieties

TREATMENT	3 WAT	5 WAT	7 WAT	9 WAT
FERTILIZER EFFECT				
NPK	29.56a	34.53a	39.64a	44.72a
POULTRY	27.00b	32.31ab	38.36a	44.72a
CONTROL	24.92b	30.26b	35.17a	39.56a
VARIETAL EFFECT				
RED BELL	31.56a	36.33a	41.07a	45.77a
CHILLI	29.59a	34.70a	41.07a	47.15a
CAYENNE	24.52b	30.15b	35.74ab	41.37ab
SUPER HABANERO	23.26b	28.26b	33.00b	37.70b

Means with the same letter(s) along the column are not significantly different (DMRT, 0.05)
WAT: Weeks after transplanting

Main effects of fertilizer types on the number of flowers of pepper varieties. Fertilizer application showed a positive but non-significant effect on flower production at 5 and 7 WAT. NPK consistently recorded the highest leaf numbers (14.64 and 17.89), followed by poultry manure (13.53 and 16.83), while the control had the lowest (12.61 and 15.75). This trend suggests that NPK, with its readily available nutrients, promotes more vigorous vegetative growth compared to the slower nutrient release from poultry manure and the nutrient deficiency in the control. Varietal differences were also observed: Cayenne, Chili, and Super produced higher flower counts across stages, whereas Red Bell consistently recorded the lowest, reflecting genotypic variation in vegetative growth potential.

Although differences were not statistically significant, the patterns indicate that both organic and inorganic fertilizers can sustain leaf development in pepper, with NPK being more efficient in nutrient uptake. The poor performance of the control underscores the importance of nutrient supplementation. The stronger vegetative growth observed in Cayenne and Super suggests their potential for higher canopy development and photosynthetic capacity, which may enhance yield. These results emphasize the need for appropriate fertilizer management combined with varietal selection to optimize pepper productivity.

Table 2: Main effects of fertilizer types on the number of flowers of pepper varieties

TREATMENT	5 WAT	7 WAT
FERTILIZER EFFECT		
POULTRY	13.53a	16.83a
NPK	14.64a	17.89a
CONTROL	12.61a	15.75a
VARIETAL EFFECT		
CAYENNE	14.41a	17.81a
CHILI	14.00a	17.42a
REDBELL	11.93a	14.22a
SUPER	14.04a	17.85a

Means with the same letter(s) along the column are not significantly different (DMRT, 0.05). WAT:Weeks after transplanting

Main effects of fertilizer types on the number of fruits of pepper varieties

The number of fruits was significantly affected by fertilizer type and variety at 7 and 9 WAT (Table 3). NPK fertilizer produced the highest fruit counts (13.22 and 16.19 fruits/plant), while the control gave the lowest (9.36 and 12.33 fruits/plant), underscoring the importance of readily available nutrients for reproductive growth. Among the varieties, Super recorded the highest fruit numbers (12.59 and 15.56 fruits/plant), whereas Red Bell consistently produced the lowest (10.19 and 12.81 fruits/plant), indicating genotypic variation in fruiting potential. These results highlight the superiority of NPK for maximizing fruit set and the promise of the Super variety for higher yield, suggesting that integrated fertilizer management and varietal selection are key strategies for improving pepper productivity.

Table 3: Main effects of fertilizer types on the number of fruits of pepper varieties

TREATMENT	7 WAT	9 WAT
FERTILIZER EFFECT		
POULTRY	10.45b	12.83b
NPK	13.22a	16.19a
CONTROL	9.36b	12.33b
VARIETAL EFFECT		
CAYENNE	10.30b	12.63b
CHILI	10.96ab	14.15ab
REDBELL	10.19b	12.81b
SUPER	12.59a	15.56a

Means with the same letters along the column are not significantly different (DMRT, 0.05)
WAT: Weeks after transplanting

Main effects of fertilizer types and varieties on the yield of pepper

Pepper yield was significantly influenced by fertilizer type and variety (Table 4). NPK fertilizer produced the highest yield (15.8 t/ha), while the control had the lowest (10.2 t/ha), confirming the importance of nutrient supplementation for optimum productivity, as supported by Nwachukwu and Ekwe (2023). Super recorded the highest yield (14.7 t/ha), whereas Cayenne produced the lowest (11.8 t/ha), indicating genotypic differences in yield potential. These results highlight the superiority of NPK for enhancing yield and the promise of the Super variety as a high-yielding genotype. Integrating balanced fertilizer management with appropriate varietal selection can therefore improve pepper productivity and profitability.

Table 4: Main effects of fertilizer types on the yield of pepper varieties

Treatment	Yield (t/ha)
Fertilizer Effect	
Poultry	12.5b
NPK	15.8a
Control	10.2c
Varietal Effect	
Cayenne	11.8b
Chili	13.2a
Redbell	12.5b
Super	14.7a

Means with the same letters along the column are not significantly different (DMRT ,0.05)
WAT: Weeks after transplanting

CONCLUSIONS

NPK fertilizer, owing to its balanced nutrient availability, was most effective in promoting vegetative growth and fruit yield. Poultry manure improved growth through soil organic matter enrichment but was limited by slower nutrient release. Also, the control's poor performance highlights the necessity of nutrient supplementation for pepper production. Chilli and Red Bell excelled in vegetative traits, while the Super variety was most promising for high-yield production.

REOMMENDATIONS

NPK mineral fertilizer is recommended for optimal growth and yield of pepper plants, as it significantly improves plant height, leaf production, stem girth and fruit yield. However, poultry manure can serve as a suitable alternative for farmers who prefer organic fertilizers, as it also enhances plant performance, though to a lesser extent than NPK. Among the pepper varieties tested, CHILI and SUPER varieties demonstrated superior growth and yield potential. Farmers aiming for higher fruit yield should prioritize the cultivation of the SUPER variety, while those seeking early flowering and maturity should consider CHILI. A combination of organic and inorganic fertilizers could be explored to maximize both soil fertility sustainability and crop productivity, and future studies should investigate the optimal blending ratios of NPK and poultry manure for improved pepper production.

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