



INTERNATIONAL JOURNAL OF

Organic Agricultural

RESEARCH AND DEVELOPMENT

*Advancing Sustainable Agriculture for
a Healthier Planet*

VOLUME

21

SPECIAL ISSUE



MAY, 2026



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COMPARATIVE EFFECTS OF ORGANIC AND INORGANIC MANURES USING TWO SPECIES OF PEPPER (*Capsicum spp*), PIQUANTE AND EFFIA PEPPER IN UMUDIKE

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ABSTRACT

The study compared the effects of organic and inorganic manures using two species of pepper (*Capsicum spp*), Piquante and Effia Pepper in Umudike, Nigeria. The study was guided by three specific objectives and three research questions. The study adopted a true experimental research design. The population consisted of forty-five (45) pepper plants established at the experimental site in Umudike. A sample of forty (40) plants was used for the study through purposive sampling technique. The major instruments used for data collection in this study were field measurement tools and recording sheets specifically designed to capture vegetative growth, phenological traits, and yield performance of Piquante and Effia peppers under organic and inorganic manure treatments. The instruments used in this study were subjected to both content and face validation. Reliability of the instruments was established through test–retest method which yielded 0.83. Data for this study were collected through field observations and direct measurements and analysed using descriptive statistics such as means, ranges, and standard deviations to provide a clear overview of growth trends and yield patterns. The findings of the study showed that both manure types significantly enhanced plant performance compared with control experiment. Inorganic manure produced the highest vegetative growth and yield in Piquante peppers resulting to taller plants, thicker stems, more leaves and earlier flowering and fruiting. Organic manure also improved growth and yield, particularly in Effia peppers, where it enhanced fruit weight and quality. In contrast, the control plants which received no manure showed poor performance such as stunted, fewer leaves, delayed flowering, and the lowest fruit number and yield. In view of the findings, it was recommended that: farmers adopt variety-specific manure management practices: inorganic manure for maximizing early growth and yield in Piquante peppers and organic manure for improving profitability, fruit quality and soil health in Effia peppers.

Keywords: *Organic, Inorganic, Piquante and Effia Pepper*

INTRODUCTION

Peppers (*Capsicum spp.*), particularly *Capsicum annuum*, are among the most economically and nutritionally important vegetable crops cultivated across tropical and subtropical regions of the world. They are consumed fresh, dried, or processed into a variety of forms, making them versatile in both subsistence and commercial farming systems. Nutritionally, peppers are excellent sources of vitamins A, C, and E, carotenoids and capsaicinoids, which contribute to their medicinal and dietary importance (Abu *et al.*, 2020). Their high antioxidant content has been linked with improved immunity, prevention of chronic diseases, and promotion of general well-being. In addition, peppers play an important role in household food security and as a cash crop in

Nigeria, where they are ranked as the second most cultivated vegetable after tomato (Aderemi *et al.*, 2019).

Despite their importance, yields in Nigeria are consistently below potential demands. The Food and Agriculture Organization (FAO) and several national surveys have observed that average pepper yields in Nigeria are about 30–40% lower than in many developed countries (Audu *et al.*, 2018). The main constraints include soil fertility depletion, poor farm management, pest and disease incidence, and erratic rainfall patterns. Specifically, poor soil fertility remains the most critical limiting factor in pepper production in the southeastern rainforest region, where soils are often highly weathered and low in essential nutrients (Okon, 2021; Ike *et al.*, 2023).

To improve crop performance under such

challenging soil conditions, fertilizers are indispensable. Fertilizer inputs account for between 40% and 60% of crop yield gains in vegetable production systems worldwide (Aderemi *et al.*, 2019). Traditionally, inorganic fertilizers such as NPK blends are used because of their quick nutrient release and immediate effect on plant growth. However, heavy reliance on mineral fertilizers has become problematic in Nigeria. Farmers face challenges such as high costs, irregular supply, adulterated products, and in some cases, declining soil health with continuous usage of inorganic fertilizers without organic matter supplementation (Funsho *et al.*, 2014). Prolonged application of inorganic fertilizers without organic amendments is known to reduce soil organic carbon, increase acidity, and cause nutrient leaching, thereby undermining long-term productivity (Osadebe *et al.*, 2025).

In contrast, organic manures, including poultry manure, goat manure, cow dung, pig manure, and compost, are increasingly promoted as sustainable soil fertility management options. They supply multiple nutrients, improve soil physical properties, and enhance microbial activity, which contributes to nutrient cycling (Ike *et al.*, 2023). For example, poultry manure has been shown to provide a balanced supply of macronutrients and micronutrients, increase cation exchange capacity, and reduce the risk of nutrient leaching compared to synthetic fertilizers (Rufa'i *et al.*, 2024). Similarly, goat manure is rich in potassium and calcium and has been found to enhance fruit development and quality in peppers (Okon, 2021). Organic manures also improve soil moisture retention and reduce the risk of environmental contamination. However, their limitations include bulkiness, variability in nutrient composition, and relatively slow nutrient release compared to inorganic fertilizers (Audu *et al.*, 2018).

Several studies conducted in Nigeria underscore the comparative performance of organic and inorganic fertilizers in pepper production. Audu *et al.* (2018), in a research carried out in Adamawa State, demonstrated that both compost and farmyard manure significantly enhanced plant height, leaf number, fruit number, and fruit weight in sweet pepper compared to untreated plots. In Rivers State, Okon (2021) reported that goat manure at 15 t/ha significantly increased vegetative growth and yield parameters of bell pepper, doubling fruit yield compared to unfertilized plots. Similarly, Funsho *et al.* (2014) found out that poultry manure application, outperformed urea fertilizer in terms of yield and sustained soil fertility in two ecological zones of Nigeria. More recently, Osadebe *et al.* (2025) showed that poultry manure in combination with mulching produced the highest plant height and

fruit yield of bell pepper in Nsukka, surpassing plots treated with NPK alone. Furthermore, Ike *et al.* (2023) demonstrated that integrating poultry manure with biochar or cow dung substantially improved soil organic carbon and pepper yield attributes in Awka.

The impact of fertilizer use extends beyond yield to quality. Rufa'i *et al.* (2024) found that poultry manure significantly enhanced capsaicinoid content in pepper fruits in Kano, indicating that organic amendments may influence not just yield but also nutritional quality. This is particularly relevant for varieties like Piquante and Efia, which are valued for their unique flavor and pungency.

Economically, the choice between organic and inorganic fertilizers has direct implications for farmers. Inorganic fertilizers provide rapid benefits but are costly and subject to price fluctuations, often making them unaffordable to smallholder farmers. Organic manures, on the other hand, are often available locally at little or no cost, though transportation and application may require more labor (Aderemi *et al.*, 2019). Thus, a comparative evaluation of their cost-effectiveness is vital for decision-making in resource-constrained farming systems like Umudike.

At Umudike in Abia State, which lies within the humid rainforest agro-ecological zone, soils are typically acidic, low in organic matter, and nutrient-depleted due to continuous cultivation (Chigozie *et al.*, 2023). Despite the popularity of hybrid pepper varieties such as Piquante and Efia, there is little published data on how these specific varieties respond to organic fertilizers and inorganic fertilizers under local conditions. Most farmers rely on personal experience or advice from peers rather than scientific evidences, which contributes to inconsistent yield outcomes. Addressing this gap is essential, particularly in light of the growing demand for peppers in southeastern Nigeria, where seasonal shortages have been reported (Hortidaily, 2025). Therefore, this study sought to evaluate the comparative effects of organic and inorganic manure on two pepper varieties (Piquante and Efia) in Umudike. By focusing on vegetative growth, phenological stages, yield attributes, and economic returns, the study aims to provide evidence-based recommendations that will help farmers, researchers, and policymakers promote sustainable pepper production. The result would not only advance scientific understanding of soil fertility management in peppers but also offer practical solutions for addressing Nigeria's food security and income-generation challenges.

Statement of the Problem

Pepper (*Capsicum* spp.) is an important

vegetable crop in Nigeria because of its nutritional, medicinal, and economic value. Despite favorable growing conditions in places like Umudike, Abia State, pepper yields remain below potential largely because of declining soil fertility and poor soil management. Continuous cropping and nutrient mining have depleted soil nutrient reserves, forcing farmers to depend on external inputs to restore fertility. Many smallholder farmers rely on inorganic fertilizers such as NPK and urea because they supply nutrients quickly and visibly boost growth. However, prolonged use of mineral fertilizers has been linked to soil acidification, nutrient imbalance, declining soil organic matter, and other long term degradation issues.

Organic manures including poultry droppings, farmyard manure, and compost improve soil structure, increase microbial activity, and enhance long term fertility, but they release nutrients more slowly and their nutrient composition can be variable. In Umudike many farmers face practical constraints when choosing between organic and inorganic sources: inorganic fertilizers are often costly, sometimes adulterated, and intermittently available, while organic manures are bulky and variable but cheaper and environmentally preferable. There is limited empirical evidence comparing the sole effects of organic versus inorganic manure on different pepper species under local conditions in southeastern Nigeria. Piquante and Effia peppers differ in growth habit, nutrient requirements, and market value, so they may respond differently to manure regimes. Most existing studies treat crops and fertilizers in general terms rather than comparing species specific responses and associated economic outcomes for peppers. In particular, profitability analyses that weigh input costs against yield and fruit quality are lacking, even though economic viability is crucial for resource limited smallholder farmers.

Therefore, the core problem addressed by this study is the absence of localized, empirical data comparing organic and inorganic manures on the growth, phenology, yield, and economic viability of Piquante and Effia peppers in Umudike. Filling this gap will provide evidence based guidance to farmers, extension agents, and policy makers on fertilizer choices that improve productivity, profitability, and long term soil sustainability in pepper production systems.

Materials and Methods

The study adopted a true experimental research design, specifically the Randomized Complete Block Design (RCBD), which is appropriate for field-based agricultural experiments. This design was selected because it minimizes experimental error by ensuring that treatments are randomly

assigned within blocks that represent relatively homogeneous units of the field. The study was conducted at the Teaching and Research Farm of the Michael Okpara University of Agriculture, Umudike (MOUAU), Abia State, Nigeria. Umudike is located in Ikwuano Local Government Area of Abia State within the humid tropical rainforest zone of southeastern Nigeria. The population of this study consisted of forty-five (45) pepper plants established at the experimental site in Umudike. These comprised both Piquante pepper (*Capsicum baccatum*) and Effia pepper (*Capsicum annuum*). The plants represented the total experimental population from which data on growth, phenological development, and yield characteristics were collected. The inclusion of the two pepper species was based on their nutritional, economic, and local importance in southeastern Nigeria. From the total population of forty-five (45) pepper plants, a sample of forty (40) plants was used for the study through purposive sampling to ensure proper representation of treatments. The sampled plants were distributed as follows: twenty (20) plants, comprising ten (10) Piquante and ten (10) Effia peppers, were treated with inorganic fertilizer; another twenty (20) plants, also comprising ten (10) Piquante and ten (10) Effia peppers, were treated with organic fertilizer. The remaining five (5) plants, made up of both Piquante and Effia peppers, were left untreated and served as the control group. The major instruments used for data collection in this study were field measurement tools and recording sheets specifically designed to capture vegetative growth, phenological traits, and yield performance of Piquante and Effia peppers under organic and inorganic manure treatments. The instruments used in this study were subjected to both content and face validation to ensure that they accurately measured the intended variables. The recording sheets were reviewed by experts in Crop Science and Horticulture at Michael Okpara University of Agriculture, Umudike, who carefully examined the parameters listed for data collection. Their feedback ensured that the measurements captured all aspects of vegetative growth, phenological development, and yield performance relevant to pepper production under organic and inorganic manure treatments. Reliability of the instruments was established through test-retest method. The instruments were used repeatedly on selected pepper plants at intervals of one week before the commencement of the main study. The results obtained from the repeated measurements were compared, and consistency was observed in values for plant height, stem diameter, number of leaves, and fruit weight.

Data for this study were collected through field

observations and direct measurements at regular intervals. The data collected from the study were subjected to statistical analysis to determine the effect of manure type (organic and inorganic) on the growth, phenology, and yield performance of *Piquante* and *Effia* pepper varieties. All data were first organized and summarized using descriptive statistics such as means, ranges, and standard deviations to provide a clear overview of growth trends and yield patterns.

Results and Discussions

Research Question 1: How does manure type (organic and inorganic) influence vegetative growth (height, stem diameter, leaf number, and canopy spread) of *Piquante* and *Effia* peppers in Umudike?

Table 1. Vegetative growth response of *Piquante* and *Effia* under inorganic, organic, and control treatments

Trait	Inorganic: <i>Piquante</i>	Inorganic: <i>Effia</i>	Organic: <i>Piquante</i>	Organic: <i>Effia</i>	Control
Height (inches)	12	11	11	11	8
Stem diameter (inches)	10	9	8	7	5
Leaf number (no.)	45	42	40	40	30
Canopy spread	Uniform	Not uniform	Uniform	Not uniform	Not uniform

Source: Field data, 2025.

The results in Table 1 show a clear advantage of manure application over the control across all vegetative traits. Plants treated with inorganic manure recorded the highest plant height, stem diameter, and leaf numbers compared to both organic and control groups. For instance, *Piquante* peppers under inorganic treatment grew to an average height of 12 inches, while the control was only 8 inches. Similarly, *Effia* peppers under inorganic treatment achieved 11 inches compared to 8 inches in the control. This pattern demonstrates the role of readily available nutrients in inorganic fertilizers in promoting rapid vegetative growth (Akande *et al.*, 2021). Leaf number followed the same trend: *Piquante* under inorganic manure produced 45 leaves versus 30 leaves in the control, representing a 50% increase. Organic manure also enhanced leaf development (40 leaves), though slightly less than inorganic. This is consistent with Obi *et al.* (2022), who reported that while organic manure improves soil structure and microbial activity, it releases nutrients more slowly than inorganic fertilizers.

Interestingly, canopy spread was more uniform in *Piquante* than in *Effia* across treatments. This suggests that species-specific genetic differences influence plant architecture beyond the effect of manure. *Effia* peppers maintained a “not uniform” canopy, possibly due to their growth habit and branching pattern, which aligns with

observations by Ndukwe *et al.* (2020) that varietal differences often dictate canopy uniformity more than fertilizer input. In summary, inorganic manure had the most pronounced effect on vegetative growth, organic manure offered intermediate benefits, and the control recorded the least performance.

Research Question 2: What significant differences in phenological stages (days to first flowering, fruit set, and first harvest) exist between peppers under organic and inorganic manure?

Table 2. Phenology of *Piquante* under inorganic, organic, and control

Stage	Inorganic	Organic	Control
Date of first flowering	17 June	19 June	22 June
Date of fruit set	29 June	29 June	4 July
Date of first harvest	14 July	16 July	25 July

Phenology of *Effia* under inorganic, organic, and control

Stage	Inorganic	Organic	Control
Date of first flowering	10 July	12 July	16 July
Date of fruit set	23 July	23 July	27 July
Date of first harvest	7 Aug	7 Aug	10 Aug

Source: Field data, 2025.

The results of phenological observations demonstrate that manure application accelerated the growth cycle of both pepper species relative to the control. For *Piquante* pepper, plants supplied with inorganic manure-initiated flowering on 17 June, which was five days earlier than the control plants that flowered on 22 June. Similarly, the first harvest under inorganic manure occurred on 14 July, which was 11 days earlier than the control (25 July). Plants treated with organic manure also exhibited earlier flowering (19 June) and harvest (16 July) compared to the control, although the effect was less pronounced than with inorganic manure. These results suggest that inorganic fertilizers accelerate developmental stages by supplying nutrients in readily available forms, a finding consistent with Isitekhale and Aboh (2019), who reported that inorganic fertilizers enhance crop phenology by promoting quicker nutrient uptake and utilization.

For *Effia*, a similar pattern was observed but with less pronounced differences. Inorganic manure led to flowering on 10 July, compared to 16 July in the control, while the first harvest was recorded on 7 August, three days earlier than control (10 August). Organic manure also advanced flowering and harvest compared to control, though by a smaller margin.

Research Question 3: What effect do organic and inorganic manures have on yield (fruits per plant, marketable and average fruit weight) of Piquante and Effia peppers?

Table 3. Yield components of Piquante under inorganic, organic, and control

Metric	Inorganic	Organic	Control
Fruits per plant (no.)	43	40	18
Unit fruit weight (g)	11	9	5
Marketable yield per plant (g)	473	360	90

(Marketable yield per plant computed = fruits × unit weight.)

Source: Field data, 2025.

Piquante peppers recorded the highest yield under inorganic (473 g/plant) compared to organic (360 g/plant) and control (90 g/plant). For Effia, yield under organic (234 g/plant) was slightly higher than inorganic (224 g/plant), while control was lowest (60 g/plant). The results indicate that inorganic manure significantly increased Piquante yield compared to organic and control treatments. Plants under inorganic manure produced an average of 43 fruits per plant, which was higher than organic (40 fruits) and more than double the control (18 fruits). The unit fruit weight also followed the same pattern, with inorganic treatment producing the heaviest fruits (11 g) compared to 9 g under organic and only 5 g under control. Consequently, the marketable yield per plant was highest in inorganic (473 g), followed by organic (360 g), while the control yielded the least (90 g). These results demonstrate the synergistic effect of nutrient availability on both fruit set and fruit size in Piquante peppers.

Discussion of the Major Findings

The results of this study revealed several important findings on the effects of organic and inorganic manures on the growth and yield of Piquante and Effia peppers in Umudike. First, both pepper varieties responded positively to manure application when compared with the control. Inorganic manure enhanced vegetative growth, particularly in Piquante, leading to taller plants, larger canopy spread, and greater leaf production. Effia, however, showed similar vegetative performance under both organic and inorganic manure, suggesting that this variety is less sensitive to fertilizer type.

The phenological stages of both pepper varieties were also influenced by manure application. Piquante peppers treated with inorganic manure flowered and fruited earlier than those under organic and control conditions, while Effia showed a more balanced phenological response under organic manure. These findings suggest that inorganic fertilizers accelerate physiological

development in some pepper varieties, while organic fertilizers sustain gradual but steady growth.

Yield components such as fruit number, fruit weight, and total yield per plant also varied significantly between manure types and pepper species. Piquante produced the highest fruit number and yield under inorganic manure, while Effia produced slightly more yield and heavier fruits under organic manure. The control consistently gave the lowest results across both varieties. Although inorganic fertilizers boosted yield in Piquante, the economic analysis showed that the high cost of fertilizer inputs outweighed the marginal yield advantage. Organic manure, in contrast, proved more cost-effective, particularly in Effia, where it produced slightly higher yields and better fruit quality at a fraction of the cost of inorganic fertilizer. Overall, the study found that organic manure was more economically viable for pepper production in Umudike.

The findings of this study provide deeper insights into the interaction between manure type and pepper species in Umudike. In terms of vegetative growth, inorganic manure significantly enhanced growth in Piquante peppers, which collaborate the observations of Adedokun and Egwunyenga (2020), who reported that inorganic fertilizers provide nutrients in readily available forms, thereby stimulating rapid plant development. However, Effia peppers performed almost equally well under organic and inorganic treatments, suggesting a varietal tolerance to nutrient sources. This agrees with Obi et al. (2022), who emphasized that varietal differences often dictate the efficiency of nutrient uptake and utilization.

The study also showed that manure type influenced the phenological stages of peppers. Piquante under inorganic manure reached flowering and fruiting stages earlier than other treatments, confirming the capacity of inorganic fertilizers to hasten crop development. Effia, on the other hand, performed more steadily under organic manure, reflecting the sustained nutrient release associated with organic inputs. This supports the work of Onyekwere et al. (2020), who highlighted the long-term fertility benefits of organic manure despite its slower initial nutrient release.

For fruit number and weight, a clear manure × species interaction was observed. Inorganic manure favored Piquante by producing more and heavier fruits, while Effia performed slightly better under organic manure, producing heavier fruits compared to inorganic treatments. These findings align with Isitekhale and Aboh (2019), who reported that organic manures improve fruit quality traits such as weight, storability, and nutritional composition more effectively than

inorganic fertilizers.

Total yield per plant also confirmed these varietal differences. Piquante yielded best under inorganic manure, while Effia achieved slightly higher yields under organic manure. This pattern reflects the findings of Olaniyi et al. (2019), who observed that different pepper varieties respond variably to fertilizer types due to genetic and physiological factors. Importantly, the economic analysis revealed that although inorganic manure increased yield in Piquante, the high input costs made it less profitable. Effia, which responded better to organic manure, further highlighted the sustainability of organic inputs. These results support Obasi et al. (2021), who stressed the importance of economic considerations in nutrient management decisions for smallholder farmers.

Conclusion

It was concluded from the findings that both manure types significantly improved plant performance when compared with the control, but their effects varied according to variety and production trait. Inorganic manure enhanced vegetative growth in Piquante peppers by providing readily available nutrients that promoted taller plants, thicker stems, and earlier flowering and fruiting. Effia peppers, on the other hand, showed better performance under organic manure, producing heavier fruits and slightly higher total yield.

Recommendations

In view of the findings and limitations, the following recommendations were made:

1. Since inorganic manure significantly enhanced vegetative growth parameters such as plant height, stem diameter, and leaf number especially in Piquante peppers it is recommended that farmers cultivating this variety use inorganic manure where rapid vegetative development and early canopy formation are desired.
2. Because inorganic manure accelerated flowering, fruit setting, and harvesting, farmers aiming for early production or off-season market advantage should apply inorganic manure to Piquante peppers. Conversely, Effia peppers should be managed with organic manure, which provides steady nutrient release and supports balanced growth without hastening maturity excessively.
3. The study showed that inorganic manure produced higher fruit numbers in Piquante, while Effia recorded slightly

higher fruit weight and total yield under organic manure. Farmers should therefore select manure types based on the specific yield goals of each variety. Those targeting high fruit count should prioritize inorganic manure for Piquante, while those emphasizing fruit size and market quality should prefer organic manure for Effia.

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21

SPECIAL ISSUE

MAY, 2026

ISSN 2315-8567



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