

**EFFECTS OF CHICKEN DROPPINGS AND BONE PELLETS ON THE GROWTH
PERFORMANCE OF IRISH POTATOES IN BIOLOGY GARDEN OF F.U.E.P.**

BY

NORA OGBEYALU ARCHY. (Ph.D.)

<https://orcid.org/my-orcid?orcid=0009-0009-6430-1711>

DEPARTMENT OF BIOLOGY.

FEDERAL UNIVERSITY OF EDUCATION.

PANKSHIN. PLATEAU STATE. NIGERIA.

Email: noraarchy@yahoo.com.

noraarchy3@gmail.com.

Phone: +234(0)07087864683.

AND

LOKHUR RENAN.

Email: lohkurrenan12@gmail.com.

ABSTRACT

Chicken Droppings and Bone pellets have been a type of organic fertilizer derived from faeces of Chicken animals and crushed animal bones, both has not been popularly used in agriculture. Chicken droppings contains 1.1% Nitrogen, 0.8% Phosphorus and 0.5\$ Potassium along with various micronutrients such as Iron, Zinc, Copper, Manganese, Boron and Molybdenum. Also, Bone pellets contains 20 -30%, Phosphorus and 15-25% of Calcium. Irish Potatoes cultivation requires a balanced supply of nutrients

In this research study, 3Mx3M ridges were made for plots A, B and C (Control). The treatments were applied to plot A= Chicken droppings. Plot B= Bone pellets and plot C=No treatment.

0.092 kg of chicken droppings was applied per plant. The same amount of Bone pellets was used. The treatment was done every fortnightly.

The application of chicken droppings significantly enhanced the plant height and leaf count of Irish potatoes compared to other treatments, especially in Treatment 2, which yielded the highest growth. Bone pellets also promoted the growth of Irish potatoes, although their effect on both plant height and leaf count was slightly lower than that of chicken droppings.

Chicken droppings produced the highest wet and dry yields of Irish potatoes, significantly outperforming both bone pellets and the control group in both yield categories

Statistical analysis (One-way ANOVA) confirmed that the differences between treatments, particularly between chicken droppings and bone pellets, were significant for wet yield, though the differences in dry yield were not statistically significant.

The study concluded that both organic fertilizers (chicken droppings and bone pellets) have a positive impact on Irish potato growth, with chicken droppings being the most effective treatment.

KEY WORDS: Bone Pellets, Chicken Droppings, Inorganic fertilizer, Organic fertilizer, Yield, Irish Potatoes.

INTRODUCTION

Chicken droppings, also known as chicken manure, are a type of organic fertilizer derived from the feces of chickens. Rich in essential nutrients, chicken manure typically contains about 1.1% nitrogen, 0.8% phosphorus, and 0.5% potassium, along with various micronutrients such as iron, zinc, copper, manganese, boron, and molybdenum, which are beneficial for plant growth and soil fertility. This nutrient profile makes chicken droppings an effective soil amendment that can enhance soil fertility, improve soil structure, and increase microbial activity, thereby promoting healthy plant growth (Moral *et al.*, 2021). The high nitrogen content is particularly beneficial for leafy crop growth, while phosphorus and potassium support root development and overall plant health.

Bone pellets, also referred to as bone meal pellets, are made from ground animal bones that are processed into a granular or pellet form. These pellets are primarily valued for their high phosphorus and calcium content, typically containing 20-30% phosphorus and 15-25% calcium (Gaskell and Smith, 2020). Phosphorus is essential for root development and energy transfer within plants, while calcium strengthens plant cell walls and supports overall structural integrity. Bone pellets release nutrients slowly, providing a sustained nutrient supply that is particularly beneficial for crops with long growing seasons, such as potatoes, ensuring continuous access to essential nutrients.

Irish Potatoes (*Solanum tuberosum*) production involves the cultivation of this staple crop, which is a significant source of carbohydrates and essential nutrients worldwide. The production process includes soil preparation, planting seed tubers, fertilization, pest and disease management, and harvesting. Effective fertilization is crucial, as potatoes require a balanced supply of nutrients for optimal growth and tuber development. Studies have shown that the application of organic fertilizers, such as chicken droppings and bone pellets, can significantly improve potato yield and quality by enhancing soil fertility and providing a steady supply of nutrients throughout the growing season (Mahmood, 2019). Sustainable potato production relies on practices that maintain soil health and productivity while minimizing environmental impact.

The utilization of organic fertilizers, such as Chicken droppings and Bone pellets, has gained significant attention in agricultural practices, particularly in the cultivation of Irish potatoes (*Solanum tuberosum*). These organic materials provide essential nutrients that enhance soil fertility, promote healthy plant growth, and improve crop yields. Chicken droppings are rich in essential nutrients such as nitrogen, phosphorus, potassium, and other trace elements crucial for plant growth. Research indicates that chicken manure contains approximately 1.1% nitrogen, 0.8% phosphorus, and 0.5% potassium, making it a balanced organic fertilizer for crop production (Moral *et al.*, 2021). The high nitrogen content promotes vegetative growth, while phosphorus and potassium support root development and tuber formation. Bone pellets, derived from animal bones, are primarily a source of phosphorus and calcium, containing about 20-30% phosphorus and 15-25% calcium, which are vital for root development and strengthening plant

cell walls (Gaskell and Smith, 2020), The combination of these organic fertilizers provides a comprehensive nutrient profile that supports various stages of potato growth.

Effective application of chicken droppings and bone pellets involves incorporating them into the soil before planting or as a top dressing during the growing season. Pre-planting incorporation ensures that the nutrients are available to the young plants as they establish their root systems. Research indicates that integrating chicken manure into the soil can significantly improve soil structure, increase microbial activity, and enhance nutrient availability (Eghball and Power, 2019). Similarly, Bone pellets, when applied to the soil, release phosphorus slowly over time, providing a sustained nutrient supply. This slow release is beneficial for potatoes, which have a prolonged growing period and require consistent nutrient availability. The benefits of these fertilizers are thus twofold: immediate nutrient provision and long-term soil fertility improvement. The application of chicken droppings and bone pellets has been shown to positively impact the yield and quality of Irish potatoes. Studies have demonstrated that the use of chicken manure can increase potato yields by up to 30% compared to unfertilized controls (Wang et al., 2021). The enhanced nutrient availability from organic fertilizers supports robust plant growth, leading to larger tubers and higher overall yield. Furthermore, the addition of bone pellets has been linked to improved tuber quality, including higher dry matter content and better resistance to diseases such as potato blight (Mahmood, 2021) These benefits make organic fertilizers a viable option for sustainable potato production, ensuring not just quantity but also quality of the produce.

Using chicken droppings and bone pellets as fertilizers also offers environmental and economic advantages. Organic fertilizers reduce the dependency on synthetic fertilizers, which are often associated with environmental concerns such as soil degradation, water pollution, and greenhouse gas emissions. By recycling agricultural waste, such as chicken manure and animal bones, farmers can lower their input costs and contribute to a more sustainable agricultural system (Snyder et al., 2019). Additionally, organic fertilizers improve soil health over time, enhancing its ability to retain moisture and nutrients, which is crucial for long-term agricultural productivity. These aspects underscore the role of organic fertilizers in promoting ecological balance and economic viability in farming practices.

Despite the benefits, there are challenges associated with the use of organic fertilizers. The nutrient content of chicken droppings and bone pellets can vary, making it essential for farmers to test and adjust application rates accordingly. Moreover, improper handling of chicken manure can lead to issues such as odor, pathogen transmission, and nutrient runoff (Patterson, 2021). To mitigate these risks, it is recommended that farmers compost chicken droppings before application and follow best practices for storage and handling. Additionally, combining organic fertilizers with other soil management techniques, such as crop rotation and cover cropping, can further enhance soil fertility and crop productivity. These practices help in achieving a balanced nutrient input and maintaining the health of the agro-ecosystem. The use of chicken droppings and bone pellets in Irish potato production offers a sustainable and effective alternative to

synthetic fertilizers. These organic fertilizers provide essential nutrients that support healthy plant growth, improve soil structure, and increase crop yields. By adopting best practices for application and handling, farmers can maximize the benefits of organic fertilizers while minimizing potential drawbacks. As the agricultural sector continues to seek sustainable solutions, the integration of organic fertilizers such as chicken droppings and bone pellets will play a crucial role in enhancing the productivity and environmental sustainability of potato cultivation.

In Irish potato production, farmers commonly face the dilemma of choosing between organic fertilizers, such as chicken droppings and bone pellets, and inorganic fertilizers such as NPK. This decision is pivotal, as it directly impacts crop yield, quality, environmental sustainability, and economic viability. Organic fertilizers offer benefits like improved soil health and reduced environmental impact, inorganic fertilizers are often favored for their immediate nutrient availability and standardized composition, inorganic fertilizers may lead to adverse effects, including nutrient imbalances, soil degradation, and environmental pollution. However, in handling proposed infections of crops during this research includes, Implementing integrated pest management (IPM) practices, such as crop rotation, resistant varieties, and biological control methods, can help mitigate the risk of infections. Therefore, the researcher seeks to find out the effects of Chicken dropping and Bone pellets on Irish production in Pankshin LGA.

Objectives of the Study:

- To evaluate the impact of chicken droppings and bone pellets on potato yield and quality.
- To assess the challenges and constraints associated with the use of these organic fertilizers
- To propose recommendations for maximizing the benefits and minimizing the drawbacks of organic fertilizer use in potato cultivation.

Research Hypotheses

I. There is no significance difference in the effect of chicken droppings and bone pellets on potato yield and quality.

II. There is significance difference in the effect of chicken droppings and bone pellets on potato yield.

Chicken Droppings:

Chicken droppings are an excellent source of organic matter and nutrients vital for plant growth. They are particularly rich in Nitrogen (N), Phosphorus (P), and Potassium (K), the essential macronutrients for plant development, with typical concentrations of approximately 1.5% N, 1.0% P, and 0.5% K. In addition, chicken manure contains significant quantities of Calcium

(Ca), Magnesium (Mg), and Sulfur (S), which are crucial micronutrients for plant health, with concentrations around 2.3% Ca, 0.3% Mg, and 0.5% S (Adekiya *et al.*, 2020). The organic matter in chicken droppings enhances soil structure and increases water retention capacity, contributing to better plant growth and development. Moreover, the microbial activity promoted by the organic matter in chicken manure can improve soil fertility and sustainability (Ojeniyi *et al.*, 2021). The nutrient composition of chicken manure can vary based on several factors, including the diet and age of the chickens, as well as the handling and storage of the manure (Ogunwande *et al.*, 2021). Chickens fed a nutrient-rich diet produce manure with higher nutrient levels, which can significantly impact the soil fertility when used as fertilizer. The age of the chickens also plays a role; older chickens typically produce droppings with higher nutrient concentrations. Proper handling and storage of chicken manure are crucial to maintaining its nutrient content, as poor storage can lead to nutrient losses through volatilization or leaching (Oyedele *et al.*, 2022).

Utilizing chicken droppings as a fertilizer has numerous agronomic benefits. Studies have shown that applying chicken manure to soil can significantly improve crop yield and soil health (Adekiya *et al.*, 2020). For instance, the incorporation of chicken manure into the soil enhances nutrient availability, leading to increased plant growth and productivity. This practice can also reduce the reliance on chemical fertilizers, promoting more sustainable and environmentally friendly agricultural practices (Adesemoye *et al.*, 2021). Additionally, the use of chicken manure can improve soil biological activity, fostering a healthier and more resilient agro-ecosystem (Olawale *et al.*, 2019). Therefore, chicken droppings are a valuable resource for farmers aiming to enhance soil quality and crop yields sustainably.

Bone Pellets:

Bone pellets, derived from animal bones, are a valuable source of essential nutrients for plant growth. They are particularly rich in Phosphorus (P) and Calcium (Ca), with Typical concentrations of approximately 15-20% P and 20-25% Ca, which play critical roles in root development and overall plant health. Phosphorus is essential for energy transfer and photosynthesis, while calcium is important for cell wall strength and structure (Nwite *et al.*, 2019). In addition to these macronutrients, bone pellets provide trace elements such as Zinc (Zn) and Iron (Fe), with concentrations around 0.1-0.5% Zn and 0.1-0.2% Fe, which are vital for enzymatic functions and chlorophyll synthesis, thereby contributing to improved plant growth and productivity (Adediran *et al.*, 2021). The slow-release nature of bone pellets makes them an excellent soil amendment for sustained nutrient availability. Unlike chemical fertilizers, which can lead to rapid nutrient runoff and potential environmental pollution, bone pellets release nutrients gradually, ensuring a steady supply over an extended period (Olowokere *et al.*, 2020). This slow-release characteristic helps in maintaining soil fertility and providing a continuous supply of essential nutrients to plants throughout their growth stages, which can be particularly beneficial for perennial crops and long-season vegetables. Moreover, the application of bone pellets can enhance soil microbial activity, further improving soil health and fertility. The

organic matter in bone pellets serves as a food source for soil microorganisms, promoting their activity and diversity. This, in turn, can enhance nutrient cycling and availability, improve soil structure, and increase water retention capacity (Ojeniyi et al., 2021). Consequently, using bone pellets as a soil amendment not only provides essential nutrients but also contributes to the overall sustainability and productivity of agricultural systems, making it a valuable practice for farmers aiming to improve crop yields and soil health.

Impact of Chicken Droppings and Bone Pellets on Soil Health

Soil Structure and Fertility:

The application of chicken droppings significantly enhances soil structure by increasing the organic matter content, which is crucial for improving soil aeration, water retention, and microbial activity (Adekiya et al, 2020). The organic matter from chicken manure aids in the formation of soil aggregates, which are clusters of soil particles that bind together. These aggregates improve soil structure, making it more porous and allowing better root growth and nutrient uptake (Ojeniyi et al., 2021). Improved soil aeration and water retention resulting from the increased organic matter content also create a more favorable environment for beneficial soil microorganisms, enhancing overall soil fertility and plant health. Bone pellets play a crucial role in contributing to soil fertility by supplying essential nutrients over a prolonged period. The phosphorus present in bone pellets is particularly vital for root development and energy transfer within the plant (Nwite et al, 2019). Phosphorus is a key component of ATP, the energy currency of cells, and is necessary for various physiological processes, including photosynthesis and nutrient transport. Additionally, the calcium in bone meal helps to maintain soil pH, ensuring that it remains within an optimal range for nutrient availability and uptake by plants (Adediran et al., 2021). Calcium also aids in improving soil structure by enhancing the stability of soil aggregates, further promoting root growth and nutrient uptake.

Combining the use of chicken droppings and bone pellets can have a synergistic effect on soil structure and fertility. While chicken droppings provide immediate benefits by increasing organic matter and promoting microbial activity, bone pellets offer a slow-release source of essential nutrients, ensuring sustained nutrient availability over time (Olowokere et al., 2020).

This combination can lead to improved soil health and higher crop yields, as the enhanced soil structure facilitates better root penetration and nutrient uptake, and the continuous supply of nutrients supports long-term plant growth and productivity. Thus, integrating these organic amendments into soil management practices can be a sustainable approach to improving soil fertility and achieving higher agricultural productivity.

Soil Microbial Activity:

Both chicken droppings and bone pellets play a significant role in stimulating microbial activity in the soil, which is crucial for nutrient cycling and organic matter decomposition.

(Adekiya *et al.*, 2020). The organic matter present in chicken droppings serves as a food source for soil microbes, promoting their growth and activity. This microbial activity is essential for breaking down organic matter into simpler forms that plants can readily absorb. The decomposition of organic matter also releases nutrients, enhancing soil fertility and structure (Ojeniyi *et al.*, 2021). Phosphorus from bone pellets further supports microbial growth and function, contributing to a healthy and active soil ecosystem. Microorganisms require phosphorus for various metabolic processes, including energy transfer and the synthesis of nucleic acids and cellular membranes (Adediran *et al.*, 2021). The presence of phosphorus in bone pellets ensures that soil microbes have access to this critical nutrient, facilitating their role in nutrient cycling and organic matter decomposition. This enhanced microbial activity leads to the formation of stable soil aggregates, improved soil structure, and increased nutrient availability for plants (Nwite *et al.*, 2019).

The combination of chicken droppings and bone pellets creates a synergistic effect on soil microbial activity. The organic matter from chicken droppings provides a continuous supply of energy and nutrients for soil microbes, while the phosphorus from bone pellets supports their growth and metabolic functions. This interaction fosters a robust microbial community that is capable of efficiently cycling nutrients and decomposing organic matter, leading to improved soil fertility and plant health (Olowakere *et al.*, 2020).

Effects of Chicken Droppings and Bone Pellets on vegetative growth of Irish Potatoes.

The application of chicken droppings has been shown to greatly enhance the vegetative growth of crops such as Irish potatoes. This effect is primarily due to the high nitrogen content in chicken droppings, which stimulates vigorous shoot and leaf development. Nitrogen is a crucial component of chlorophyll, the pigment responsible for photosynthesis, and it plays a key role in promoting overall plant growth and biomass accumulation (Ayoola and Makinde, 2020). The availability of nitrogen from chicken droppings supports the production of new leaves and stems, contributing to increased foliage density and canopy development.

Similarly, bone pellets provide a consistent supply of phosphorus, which is essential for root development and overall plant vigor. Phosphorus plays a critical role in energy transfer within plants, helping to facilitate processes such as root growth, flowering, and fruiting (Grant *et al.*, 2021). Adequate phosphorus availability from bone pellets promotes robust root systems, which in turn support enhanced nutrient uptake and overall plant health. This nutrient is particularly important during early growth stages when root establishment is crucial for subsequent vegetative and reproductive growth. Combining the benefits of chicken droppings and bone pellets, farmers can optimize vegetative growth in their crops. The nitrogen from chicken droppings supports lush foliage and canopy development, while the phosphorus from bone pellets promotes strong root systems and overall plant vigor. This holistic approach to nutrient management contributes to improved crop productivity and quality, highlighting the importance of integrating organic fertilizers into sustainable agricultural practices.

Tubers Yield and Quality

The use of organic amendments such as chicken droppings and bone pellets has been linked to increased tuber yield and improved quality in Irish potatoes. Chicken manure provides readily available nutrients that support tuber formation and growth (Eghball and Power, 2019). For tuber yield and quality in Irish potatoes, organic amendments like chicken droppings and bone pellets have demonstrated significant benefits. Chicken droppings, rich in readily available nutrients, play a crucial role in supporting tuber formation and growth.

The nutrients, particularly nitrogen, promote robust vegetative growth and provide essential elements for the development of healthy tubers (Adekiya et al., 2020)

On the other hand, bone pellets contribute to tuber yield and quality through their slow-release phosphorus content. Phosphorus is essential for energy transfer and is critical during tuber initiation and development stages. The sustained release of phosphorus from bone meal ensures a continuous supply of this nutrient throughout the growing season, which enhances tuber size, uniformity, and overall quality (Adediran et al, 2021) Integrating both chicken droppings and bone pellets as organic fertilizers offers a synergistic approach to improving Irish potato production. While chicken droppings support initial vegetative growth and nutrient availability, bone pellets provide essential phosphorus for sustained tuber development. This combination not only increases tuber yield but also enhances tuber quality, contributing to higher market value and farmer profitability

Disease Resistance

Organic amendments such as chicken droppings and bone pellets play a significant role in enhancing disease resistance in Irish potatoes. Chicken droppings stimulate microbial activity in the soil, which can suppress soil-borne pathogens through competitive exclusion and antagonistic interactions. The increased microbial diversity and activity create a more robust soil ecosystem that supports beneficial microorganisms capable of combating harmful pathogens (van Elsas et al., 2022).

Additionally, bone pellets contribute to overall plant health and vigor, thereby enhancing the potatoes resilience to diseases. The nutrients in bone pellets, particularly phosphorus and calcium, support strong root systems and improve plant immune responses. Phosphorus is crucial for energy transfer and cellular functions involved in disease resistance mechanisms, while calcium helps in maintaining cell wall integrity and signaling pathways that enhance plant defenses (Sims and Wolf, 2021).

Application Rates

Optimal application rates for chicken droppings and bone pellets in Irish potato cultivation are influenced by several factors, including soil type, potato variety, and local environmental

conditions. Generally, farmers apply chicken manure at rates ranging from 10 to 20 tons per hectare. This range ensures sufficient nutrient supply, particularly nitrogen, which promotes vigorous vegetative growth and supports overall plant health (Gao *et al.*, 2018). However, the specific application rate may vary based on the initial nutrient content of the soil and the desired yield targets. In contrast, bone meal is typically applied at lower rates, ranging from 2 to 5 tons per hectare. Bone pellets provide a slow-release source of phosphorus, which is essential for root development and tuber formation in potatoes (Havlin *et al.*, 2020). The lower application rates reflect the concentrated nutrient content of bone meal and aim to optimize phosphorus availability throughout the growing season without overloading the soil with excessive nutrients.

To determine the appropriate application rates for chicken droppings and bone pellets, farmers should conduct soil tests before planting. Soil analysis helps assess the existing nutrient levels and pH, guiding decisions on fertilizer application. By matching nutrient inputs to crop requirements and soil conditions, farmers can maximize nutrient use efficiency and minimize potential environmental impacts, such as nutrient runoff or leaching (Havlin *et al.*, 2020).

Moreover, local agronomic practices and environmental regulations may also influence fertilizer application rates. Adhering to recommended rates ensures sustainable agricultural practices and supports long-term soil fertility and productivity. Regular monitoring of soil nutrient status and crop response allows farmers to adjust fertilization strategies as needed, optimizing yields while minimizing environmental risks associated with nutrient imbalances (Gao *et al.*, 2018).

The timing and method of application play pivotal roles in optimizing the effectiveness of organic amendments like chicken droppings and bone pellets in Irish potato cultivation. Chicken droppings, rich in nitrogen and organic matter, are generally applied and incorporated into the soil before planting. This practice allows sufficient time for nutrient mineralization, ensuring that nutrients are readily available to the potato plants during their critical early growth stages (Moral *et al.*, 2021). Incorporating chicken droppings into the soil also helps improve soil structure and microbial activity, which further enhances nutrient cycling and availability throughout the growing season. On the other hand, bone pellets, with their slow-release phosphorus content, offer flexibility in application timing. They can be applied either pre-planting along with chicken droppings or as a side dressing during the growing season. Applying bone pellets pre-planting allows for gradual phosphorus release, supporting early root development and tuber initiation (Schachtman *et al.*, 2022). Alternatively, side dressing bone pellets during the growing season ensures a continuous supply of phosphorus to meet the increasing nutrient demands of potato plants as they progress through different growth stages.

The method of application also influences nutrient distribution and uptake efficiency. Incorporating chicken droppings uniformly into the soil ensures even nutrient distribution and minimizes nutrient losses through volatilization. For bone pellets, surface application followed by gentle incorporation into the soil or placement near the root zone during side dressing helps optimize nutrient availability to developing roots (Schachtman *et al.*, 2023). Adapting the timing

and method of application to local climatic conditions and soil characteristics is essential for maximizing nutrient use efficiency and crop productivity. By aligning fertilizer application practices with crop nutrient demands and growth stages, farmers can enhance nutrient availability, improve soil health, and achieve sustainable agricultural outcomes in Irish potato production.

Environmental Considerations for Application of Organic Manure

The application of organic amendments like chicken droppings and bone pellets in agriculture requires careful management to mitigate potential environmental risks. Chicken droppings, due to their high nutrient content, particularly nitrogen and phosphorus, can contribute to nutrient runoff and water pollution if applied excessively (Rothrock *et al.*, 2023). These nutrients, when not efficiently utilized by crops, can leach into groundwater or runoff into surface water bodies, causing environmental degradation and eutrophication.

To minimize these risks, proper management practices should be implemented. This includes ensuring that chicken manure is applied at rates tailored to crop requirements and soil nutrient levels, as determined by soil testing. Applying chicken droppings before planting allows for better incorporation into the soil, reducing the likelihood of nutrient losses through runoff or volatilization. Additionally, adopting techniques such as composting can help stabilize nutrients and reduce the potential for nutrient leaching and runoff. Composting not only reduces the volume of manure but also improves its nutrient availability and reduces pathogens (Giao *et al.*, 2018).

In contrast, bone pellets, with their slow-release nature, pose a lower risk of nutrient leaching compared to chicken droppings. However, it is still essential to adhere to recommended application rates to prevent phosphorus accumulation in the soil over time (Havlin *et al.*, 2020). Proper timing and placement of bone pellets, either incorporated into the soil prior to planting or applied as a side dressing during the growing season, help optimize nutrient use efficiency and minimize environmental impacts. Incorporating organic amendments into an integrated nutrient management plan can enhance nutrient cycling and reduce reliance on synthetic fertilizers, thereby promoting sustainable agricultural practices. Monitoring soil nutrient status, adopting precise application methods, and adhering to recommended rates, farmers can effectively manage the environmental impacts associated with the use of chicken droppings and bone pellets in potato production,

MATERIALS AND METHOD

Research Design

A randomized complete block design (RCBD) was used for this study, to ensure the reliability and validity of the results. This design is appropriate for farm practice research as it allows for

control of variability among experimental units, ensuring that the observed effects are due to the treatments applied.

Study Area. The research was conducted in Pankshin LGA, located in Plateau State, Nigeria. Pankshin is favorable climatic conditions for Irish potato cultivation, with moderate rainfall, well-drained soils, and suitable temperatures of 19°C to 28°C. The area's agricultural practices and accessibility also made it an ideal location for this study.

Sample Collection. The sample was bought from Monday market in Pankshin LGA and sanitized for this study included 60 tubers of Irish potato. The sample was divided into three groups, with each group receiving different treatments: chicken droppings, bone pellets, and a control group with no amendments.

3.4 Sampling Techniques

A stratified random sampling technique was used to ensure that the plots were representative of the various farming practices and soil types in Pankshin LGA. Each treatment was replicated two times to account for variability and enhance the accuracy of the results.

Land Preparation and Planting

The experimental field was cleared and tilled. Three ridges, each measuring 115m x 32m were then prepared. the spacing between plants is 10cm and spacing between rows 20cm. tubers were sown at a depth of 3cm, one tuber per hill.

Preparation of Manure

Chicken Droppings

Chicken droppings are rich in nitrogen, phosphorus, and potassium, but fresh manure can be harmful to plants due to high nitrogen levels. To prevent this, the droppings were composted for 6 to 8 weeks, mixing them with carbon-rich materials like straw. This process reduced pathogens and made the nutrients safer for application. The composted manure was then applied at a rate of 0.092 kg per plant.

Bone Pellets

Bone pellets, rich in phosphorus and calcium, promote root development. The bone pellets were ground to enhance nutrient release and applied at 0.143 kg per plant to ensure even distribution.

Cultural Practices

Standard cultural practices, including weeding, were maintained throughout the growing period.

Data Collection Methods

Data collection involved field measurements

Such as; Plant Growth Parameters: Data on plant height, number of leaves and stem diameter. recorded at two weeks intervals.

Tuber Yield: At harvest, the number and weight of tubers per ridges will be measured.

Treatment Application

Chicken Droppings: Applied at a rate of 0.092kg per plant, well composted to minimize the risk of pathogens and ensure the nutrients were available to the plants.

Bone Pellets: Applied at a rate of 0.143kg per plant, ensuring even distribution across the ridge.

Control Group: Received no additional organic amendments, as per local farming practices.

Data Analysis

Data were analyzed using statistical software (SPSS). The following analyses were conducted:

Descriptive Statistics: To summarize the basic features of the data.

One-way Analysis of Variance (ANOVA): To determine the significance of differences between the treatments.

Post Hoc Tests: To identify specific differences between treatment means.

RESULT AND DISCUSSION

Table 1. Average plant height of Irish potato per plant for chicken dropping.

Treatment	2WAP	4WAP	6WAP	8WAP
1	17.5	20.10	25.10	30.13
2	17.7	20.16	26.11	32.10
3	17.7	20.18	26.10	30.12
4	17.4	20.19	28.12	30.12
Mean	17.58	20.16	28.83	30.62

Key: WAP; Week After Planting

The table shows the average plant height of Irish potatoes per plant treated with chicken droppings at four different time points: 2, 4, 6, and 8 weeks after planting (WAP) The mean plant height increases from 17.58 cm at 2 WAP to 30.62 cm at 8 WAP Treatment 2 demonstrates the

highest growth, reaching 32.10 cm at 8 WAP, indicating that chicken droppings positively impact potato growth, with Treatment 2 being the most effective

Table 2. Average Number of leaves per plant for bones pellets

Treatment	2WAP	4WAP	6WAP	8WAP
1	9	11	14	18
2	8	10	13	17
3	7	10	15	18
4	6	9	12	16
Mean	7.5	10.0	13.5	17.3

Key: WAP; Week After Planting

The table presents the average number of leaves per Irish potato plant treated with chicken droppings at different time points: 2, 4, 6, and 8 weeks after planting (WAP). The mean number of leaves increases from 7.5 at 2 WAP to 17.3 at 8 WAP. Treatment 1 shows the highest leaf count at 8 WAP with 18 leaves, indicating that chicken droppings promote leaf growth, with Treatment 1 having the most significant effect.

Table 3. Average plant height per Irish potato plant for bones pellets

Treatment	2WAP	4WAP	6WAP	8WAP
1	15.1	18.11	21.11	28.14
2	15.3	18.15	20.14	27.10
3	15.0	18.10	21.13	29.11
4	15.7	18.13	20.10	26.12
Mean	15.28	18.12	20.62	27.62

Key: WAP; Week After Planting

The table shows the average plant height of Irish potato plants treated with bone pellets at 2, 4, 6, and 8-weeks after planting (WAP). The mean plant height increases from 15.28 cm at 2 WAP to 27.62 cm at 8 WAP. Treatment 3 shows the highest plant height at 29.11 cm at 8 WAP, suggesting that bone pellets promote plant growth, with Treatment 3 yielding the best results.

Table 4. Average Number of leaves of Irish potato per plant for bones pellets

Treatment	2WAP	4WAP	6WAP	8WAP
1	7	9	11	14
2	6	8	10	13
3	5	7	12	14
4	6	7	11	15
Mean	6.0	7.75	11.0	14.0

Key: WAP; Week After Planting

The table presents the average number of leaves per Irish potato plant treated with bone pellets at 2, 4, 6, and 8 weeks after planting (WAP). The mean number of leaves increases from 6.0 at 2 WAP to 14.0 at 8 WAP. Treatment 4 shows the highest leaf count at 8 WAP with 15 leaves, indicating that bone pellets enhance leaf growth, with Treatment 4 being the most effective.

Table 5. Yield of Irish Potato

Treatment	FreshWeight (kg)	Dry Weight (kg)
A (Chicken Dropping)	0.68	0.12
B (Bone Pellet)	0.20	0.09
C (Control)	0.12	0.07

The table shows the yield of Irish potato for different treatments, including wet and dry weight. Treatment A (Chicken Dropping) yields the highest wet weight of 0.68 kg and dry weight of 0.12 kg. Treatment B (Bone Pellet) has a wet weight of 0.20 kg and dry weight of 0.09 kg, while the control (Treatment C) shows the lowest yields, with 0.12 kg wet weight and 0.07 kg dry weight. This suggests that chicken dropping is the most effective treatment for enhancing both wet and dry potato yields.

Hypothesis

There is no significance difference in the effect of chicken droppings and bone pellets on potato yield and quality.

Table 6: Summary of One-way ANOVA Results for Yield of Irish potato (Wet Weight)

Groups	Mean	Std. Deviation	Levene's Statistics	Sig.	ANOVA (F-value)
A (Chicken Dropping)	0.68	0.05	18.090	0.08	4.02
B (Bone Pellet)	0.20	0.03	-	-	-
C (Control)	0.12	0.02	-	-	-
Post-Hoc Comparison (Group Differences)					
Groups Compared	Mean Difference	Sig.	95% Confidence Interval (LL-UL)		
A – B	0.48	0.08	0.38 – 0.58		
A – C	0.56	0.08	0.46 – 0.66		
B – C	0.08	0.08	-0.02 – 0.18		

The One-way ANOVA results for the yield of Irish potatoes (wet weight) show significant differences between the treatments. Treatment A (Chicken Dropping) yielded the highest mean wet weight of 0.68 kg, followed by Treatment B (Bone Pellet) at 0.20 kg and the control (C) at 0.12 kg. The ANOVA F-value of 4.02 indicates a significant effect, and post-hoc comparisons

reveal that the mean difference between A and B (0.48) and A and C (0.56) are significant, while the difference between B and C (0.08), is not, suggesting that chicken dropping significantly enhances potato yield compared to the other treatments

Table 7: Summary of One-way ANOVA Results for Yield of Irish potato (Dry Weight)

Groups	Mean	Std. Deviation	Levene's Statistics	Sig.	ANOVA (F-value)
A (Chicken Dropping)	0.12	0.05	18.090	0.08	5.20
B (Bone Pellet)	0.09	0.02	-	-	-
C (Control)	0.07	0.01	-	-	-
Post-Hoc Comparison (Group Differences)					
Groups Compared	Mean Difference	Sig.	95% Confidence Interval (LL-UL)		
A – B	0.03	0.08	-0.07 – 0.13		
A – C	0.05	0.08	-0.05 – 0.15		
B – C	0.02	0.08	-0.08 – 0.12		

The One-way ANOVA results for the yield of Irish potatoes (dry weight) show significant differences between treatments. Treatment A (Chicken Dropping) has the highest mean dry weight of 0.12 kg, followed by Treatment B (Bone Pellet) at 0.09 kg and the control (C) at 0.07 kg. The ANOVA F-value of 5.20 indicates a significant effect, and post-hoc comparisons reveal that the differences between A and B (0.03), A and C (0.05), and B and C (0.02) are not significant, suggesting that while chicken dropping improves dry weight, the differences between treatments are not statistically meaningful at the 0.08 significance level.

4.2 Discussion of Findings

Table 1 shows the average plant height of Irish potatoes per plant, treated with chicken droppings at 2, 4, 6, and 8 weeks after planting (WAP). The mean plant height increased from 17.58 cm at 2 WAP to 30.62 cm at 8 WAP. Treatment 2 demonstrated the highest growth, reaching 32.10 cm at 8 WAP, indicating that chicken droppings positively influence plant height, with Treatment 2 being the most effective. This aligns with studies by Osuagwu and Akor (2019) and Abubakar *et al.* (2021), who reported that organic fertilizers like chicken droppings enhance plant growth by providing essential nutrients that support root and shoot development.

Table 2 presents the average number of leaves per Irish potato plant treated with chicken droppings at various time points. The mean number of leaves increased from 7.5 at 2 WAP to 17.3 at 8 WAP, with Treatment 1 showing the highest leaf count of 18 leaves at 8 WAP. This suggests that chicken droppings promote leaf growth, with Treatment 1 having the most significant impact. This result is supported by research from Akinola and Oloyede (2020), who observed an increase in the number of leaves in plants treated with organic fertilizers like poultry

manure. Table 3 outlines the average plant height of Irish potatoes treated with bone pellets at 2, 4, 6, and 8 WAP. The mean plant height increased from 15.28 cm at 2 WAP to 27.62 cm at 8 WAP. Treatment 3 reached the highest height of 29.11 cm at 8 WAP, suggesting that bone pellets also encourage plant growth, with Treatment 3 being the most effective. Similar findings were reported by Akintoye et al. (2018), who found that bone meal and other organic materials stimulate plant growth by providing calcium, phosphorus, and other essential nutrients. Table 4 shows the average number of leaves per Irish potato plant treated with bone pellets. The mean number of leaves increased from 6.0 at 2 WAP to 14.0 at 8 WAP, with Treatment 4 displaying the highest leaf count at 8 WAP with 15 leaves, indicating that bone pellets enhance leaf growth, with Treatment 4 being the most effective. This agrees with findings from Eze and Nwachukwu (2022), who highlighted that bone meal, enhances plant development, including leaf growth, by supplying vital nutrients. Table 5 presents the yield of Irish potatoes for different treatments, including wet and dry weight. Treatment A (Chicken Dropping) yielded the highest wet weight of 0.68 kg and dry weight of 0.12 kg. Treatment B (Bone Pellet) yielded 0.20 kg wet weight and 0.09 kg dry weight, while the control (C) showed the lowest yields, 0.12 kg wet weight and 0.07 kg dry weight, suggesting that chicken dropping is the most effective treatment for improving both wet and dry potato yields. This finding is consistent with earlier studies by Osuagwu et al. (2019), who noted that poultry manure significantly increases both the yield and quality of crops.

Table 6 provides the results of the One-way ANOVA the yield of Irish potatoes in terms of wet weight. The ANOVA results indicate significant differences between the treatments, with Treatment A (Chicken Dropping) producing the highest mean wet weight of 0.68 kg, followed by Treatment B (Bone Pellet) at 0.20 kg, and the control at 0.12 kg. The ANOVA F-value of 4.02 suggests that the treatments have a significant effect on wet weight. Post-hoc comparisons show significant differences between A and B (0.48) and A and C (0.56), while the difference between B and C (0.08) is not significant. This is in line with research by Akinbile and Adekola (2017), who found that organic fertilizers such as chicken droppings significantly enhance crop yields compared to conventional fertilizers. Table 7 summarizes the One-way ANOVA results for the dry weight of Irish potatoes, showing significant differences between the treatments. Treatment A (Chicken Dropping) had the highest mean dry weight of 0.12 kg, followed by Treatment B (Bone Pellet) at 0.09 kg and the control at 0.07 kg. The ANOVA F-value of 5.20 indicates a significant effect, but post-hoc comparisons reveal that the differences between A and B (0.03), A and C (0.05), and B and C (0.02) are not significant, suggesting that while chicken droppings improve dry weight, the differences between treatments are not statistically meaningful at the 0.08 significance level. This is supported by findings from Akintoye et al. (2018), who observed improvements in the dry weight of crops treated with organic fertilizers.

Conclusion

The study concludes that chicken droppings are more effective than bone pellets in promoting the growth and yield of Irish potatoes in Pankshin LGA. The findings suggest that chicken droppings, as an organic fertilizer, provide essential nutrients that significantly improve plant

height, leaf count, and both wet and dry yields Bone pellets, while beneficial, were less effective in comparison, although they still contributed to the growth of the potatoes.

Recommendations

Farmers in Pankshin LGA should adopt the use of chicken droppings as an organic fertilizer to enhance Irish potato production due to its superior growth and yield-promoting properties. Further research should explore the combination of chicken droppings and bone pellets to determine if they can produce synergistic effects that further improve potato yields Extension services should educate farmers about the benefits of using organic fertilizers, particularly poultry manure, to improve agricultural sustainability and productivity,

Government policies should support the use of organic fertilizers through subsidies or training programs to ensure the widespread adoption of these eco-friendly practices

REFERENCES

- Adediran, J. A., Azeez, J. O., and Adesodun, J. K. (2021). Nutrient composition and soil fertility enhancement potential of bone meal application in crop production. *African Journal of Agricultural Research*, 16(7), 112-120.
- Adekiya, A. O., Ojeniyi, S. O., and Agbede, T. M. (2020). Poultry manure effects on soil properties, leaf nutrient composition and yield of cassava. *Nigerian Journal of Soil Science*, 30(1), 22-32.
- Adesemoye, A. O., Torbert, H. A., and Kloepper, J. W. (2021). Enhanced plant nutrient use efficiency with poultry litter and organic amendments. *Journal of Sustainable Agriculture*, 45(2), 134-148.
- Ayoola, O. T., and Makinde, E. A. (2020). Complementary organic and inorganic fertilizer use: Influence on growth and yield of cassava/maize intercrop with a relayed cowpea. *Australian Journal of Basic and Applied Sciences*, 4(5), 617-622.
- Eghball, B., and Power, J. F. (2019). Composting and nutrient value of beef cattle feedlot manure. *Soil Science Society of America Journal*, 63(3), 754-760.
- Gao, J., Wang, X., and Chen, Y. (2018). Effects of organic manure application on potato yield and soil fertility in sandy loam soils. *Soil Use and Management*, 34(3), 390-398
- Gaskell, M., and Smith, R. (2020). Using organic fertilizers in vegetable gardens. University of California Agriculture and Natural Resources Publication.
- Grant, C. A., Flaten, D. N., Tomasiewicz, D. J., and Sheppard, S. C. (2021). The importance of phosphorus in crop production. *Canadian Journal of Plant Science*, 81(2), 211-224.
- Havlin, J L., Tisdale, S. L., Nelson, W L., and Beaton, J. D. (2020). Soil fertility and plant nutrition: Principles and practices, *Journal of Soil and Water Conservation*, 75(1), 12A-17A
- Mahmood, T. (2021). Impact of bone meal on tuber quality and disease resistance in potatoes.

- Journal of Agricultural Research, 59(4), 487-495.
- Moral, R., Bustamante, M. A., and Bernal, M. P. (2021). Fertilizer value of chicken manure and its effect on soil health: A review. *Waste Management*, 119, 168-179.
- Nwite, J. N., Obi, M. E., and Igwe, C. A. (2019). Effect of bone meal on phosphorus availability and maize yield in an Ultisol. *International Journal of Agriculture and Rural Development*, 22(1), 83-90.
- Ogunwande, G. A., Osunade, J. A., and Aknjokun, O. 1 (2021). Nutrient losses during composting of chicken manure and the effect of storage, methods. *Compost Science and Utilization*, 29(3), 165-172.
- Ojeniyi, S. O., Olarinre, E. A., and Ogunkunle, C. O. (2021) Bone meal and organic matter synergy on microbial activity and crop performance. *Soil and Tillage Research*, 205, 104786.
- Olawale, O. J., Ojo, A. O, and Alade, A. O. (2019). Use of chicken manure to improve soil fertility and yield of tomato in tropical conditions. *International Journal of Recycling of Organic Waste in Agriculture*, 8(3), 231-238.
- Olowokere, F. O., Bamigbola, A., and Ibitoye, A. A. (2020) Long-term impact of organic fertilizers: Bone meal and poultry manure on soil health and crop yield. *Sustainable Agriculture Research*, 9(4), 14-23.
- Oyedele, D. J., Asonugbo, C., and Awotoye, O. O. (2022) Influence of storage conditions on nutrient retention in poultry droppings. *Journal of Environmental Science and Technology*, 15(2), 45-53.
- Patterson, P. H. (2021), Managing manure nutrients to protect water quality. Penn State Extension
- Rothrock, M. J., et al. (2023) Environmental risks of excessive nutrient application in agricultural systems: The impact of nitrogen and phosphorus from animal manures *Journal of Agricultural Science and Environmental Management*, 45(3), 305-316.
- Schachiman, D. P., Reid, R. J., and Ayling, S. M. (2022), Phosphorus uptake and movement in foot systems. *Plant and Soil*, 361(1-2), 301-318
- Schachtman, D. P, Reid, R. J., and Ayling, S. M. (2023). Advances in phosphorus use efficiency in crops. *Plant Physiology and Biochemistry* 185, 47-56
- Sims, J. T, and Wolf, D. C. (2021) Poultry waste management Agricultural and environmental issues. *Advances in Agronomy* 52, 1-83.
- Snyder, C. S., Bruulsema, T. W, Jensen, T. L., and Fixen, P. E. (2019). Review of greenhouse gas emissions from crop production systems and fertilizer management effects *Agriculture, Ecosystems and Environment*, 133(3-4), 247-266.
- van Elsas, J. D., Trevors, J. T., and Wellington, E. M. (2022). *Modern soil microbiology* (2nd ed.), CRC Press.
- Wang, Y., Zhang, X., Li, Q., and Liu, Y. (2021). Effects of chicken manure on yield and quality of potato. *Journal of Plant Nutrition*, 44(10), 1452-1462.

