

**EFFECTS OF DIFFERENT POULTRY MANURE RATES ON THE GROWTH OF OKRA  
(*Abelmoschus esculentus*) IN MUBI NORTH LOCAL GOVERNMENT AREA, ADAMAWA  
STATE, NIGERIA**

**BY**

**SAMUEL ZAKARIYA  
SA/CP/HND/23/004**

**SEPTEMBER, 2025**

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**BEING A PROJECT SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL  
TECHNOLOGY FEDERAL POLYTECHNIC MUBI IN PARTIAL FULFILMENT  
FOR THE REQUIREMENTS OF THE AWARD OF HIGHER NATIONAL  
DIPLOMA IN CROP PRODUCTION TECHNOLOGY**

**SEPTEMBER, 2025**

## DECLARATION

I Samuel Zakariya with registration number SA/CP/HND/23/004 declare that this project “Effects of Different Poultry Manure Rates on the Growth of Okra (*Abelmoschus esculentus*) in Mubi North Local Government Area, Adamawa State, Nigeria” Federal Polytechnic, Mubi under the supervision of Mr. Simon Ijabula information derived from literature have been duly acknowledged in the text and a list of references provided. No part of this project was previously presented for the award of any Higher National Diploma (HND) at any institution.

.....

SAMUEL ZAKARIYA

.....

Date

## **DEDICATION**

I dedicated this research work to my lovely wife and my family for all their care, support and encouragement throughout my study.

### **APPROVAL PAGE**

This project entitled “Effects of Different Poultry Manure Rates on the Growth of Okra (*Abelmoschus esculentus*) in Mubi North Local Government Area, Adamawa State, Nigeria” meets the regulation governing the award of Higher National Diploma (HND) in Crop Production Technology Federal Polytechnic, Mubi and is approved for its contribution to knowledge and literary presentation.

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(Supervisor)

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Date

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Date

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External Examiner

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Date

## **ACKNOWLEDGEMENTS**

My profound gratitude goes to God Almighty for his blessing and sparing my life up to this point, may he take all praise, honour, glory and adoration. I am highly grateful to my supervisor Mr. Simon Ijabula for his tireless effort in ensuring the success and completion of this research work.

I also acknowledge the Head of Department Dr. Musa Benjamin Vimtim, the project coordinator Mallam Mohammed Isa and the entire staff of Agricultural Technology Department for their guidance during this experimental work.

I also want to appreciate my lovely wife and parents for their love and care and for giving me the opportunity to be trained and achieve my dreams.

Finally, I appreciate the efforts of my uncles and aunties, for their encouragement and support throughout the course of my study and also my friends and relatives, course mates and all well-wishers.

I love you all, may the Almighty God bless you abundantly, Amen.

## ABSTRACT

*The study investigated the effects of different poultry manure rates on the growth of okra (Abelmoschus esculentus) in Mubi North Local Government Area, Adamawa State, Nigeria. The experiment was conducted using a Randomized Complete Block Design (RCBD) with four treatments: T0 (0 kg/plot), T1 (4 kg/plot), T2 (8 kg/plot), and T3 (12 kg/plot), replicated three times. Growth parameters measured included establishment count, plant height, number of leaves, and stem girth. Data collected were analyzed using analysis of variance (ANOVA), and means were separated using the Least Significant Difference (LSD) at 5% probability level. The results showed that poultry manure application significantly influenced okra growth parameters. The 12 kg/plot treatment (T3) consistently recorded the highest values in plant height (19.80, 20.11, and 22.03 cm at 2, 4, and 6 weeks after sowing, respectively) and stem girth (5.49, 7.59, and 8.55 cm at 2, 4, and 6 weeks, respectively). The number of leaves also increased with manure application, with 12 kg/plot giving the highest mean (9.13) at 4 weeks after sowing. Generally, growth performance improved with increasing poultry manure rates, suggesting a steady nutrient supply from the organic amendment. The study concludes that poultry manure, particularly at 12 kg/plot, enhances the growth of okra, making it a sustainable alternative to inorganic fertilizers. It is recommended that farmers in Mubi and similar agro-ecological zones adopt poultry manure application to improve soil fertility, crop productivity, and environmental sustainability. Further studies are suggested to establish optimal application rates for different crops and soil conditions.*

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of the Study

Agricultural sustainability and food security are critical concerns in Nigeria, especially in the face of climate change, soil fertility depletion, and declining crop productivity. Okra (*Abelmoschus esculentus*), a widely cultivated vegetable crop in tropical and subtropical regions, is valued for its nutritional and economic benefits. It belongs to the *Malvaceae* family and is rich in essential nutrients, including vitamins A, C, and K, minerals, dietary fiber, and bioactive compounds with antioxidant, anti-inflammatory, and antimicrobial properties (Oyelade *et al.*, 2020). Okra is an important vegetable crop in Nigeria, contributing significantly to food security, income generation, and health benefits.

Despite its importance, okra production in Nigeria, particularly in the Mubi North, is constrained by poor soil fertility, which limits its growth and yield potential. Many Nigerian soils are inherently deficient in essential nutrients such as nitrogen (N), phosphorus (P), and potassium (K), which are crucial for plant development. Continuous cropping, erosion, and low organic matter content exacerbate soil fertility depletion. Farmers often resort to synthetic fertilizers to replenish soil nutrients, but these fertilizers pose challenges such as high costs, limited accessibility, and negative environmental impacts, including soil degradation, nutrient leaching, and greenhouse gas emissions (Fageria *et al.*, 2019). This necessitates sustainable soil fertility management practices to enhance crop yield while maintaining environmental integrity. Poultry manure, an organic fertilizer derived from poultry waste, has gained attention as a viable alternative to synthetic fertilizers due to its ability to improve soil fertility and crop productivity. It is a rich source of nitrogen, phosphorus, potassium, and micronutrients, making it highly beneficial for soil amendment (Hossain *et al.*, 2021). Unlike chemical fertilizers, poultry manure enhances soil structure, increases organic matter content, improves microbial activity, and enhances water retention capacity, all of which contribute to sustainable agricultural practices. Additionally, organic fertilizers reduce nutrient leaching into

groundwater, mitigate soil acidity, and support long-term soil fertility restoration (Atiyeh *et al.*, 2020).

Despite these benefits, optimal poultry manure application rates for specific crops such as okra remain largely understudied in Nigeria. Many farmers apply organic fertilizers indiscriminately, leading to either suboptimal nutrient supply or excessive nutrient loading, which can result in reduced plant growth, nutrient imbalance, or environmental pollution. Additionally, variations in soil types, climatic conditions, and crop nutrient requirements make it essential to establish appropriate manure application rates to maximize okra production.

Research has shown that organic manure significantly influences the growth, yield, and quality of vegetables, including okra (Gupta *et al.*, 2022). However, limited studies have evaluated the effect of different poultry manure rates on okra performance, particularly in Mubi North, Adamawa State, Nigeria, where okra cultivation is common. Understanding the relationship between poultry manure application rates and okra growth parameters such as plant height, number of leaves, leaf area, and fruit yield is crucial for optimizing production and ensuring sustainable agricultural practices.

Given the increasing demand for sustainable agricultural practices, it is essential to explore organic fertilizers like poultry manure in enhancing soil fertility and crop productivity. This study, therefore, seeks to evaluate the influence of varying poultry manure rates on okra growth, yield, and nutritional composition in Mubi North Local Government Area, Adamawa State.

## **1.2 Statement of the Problem**

Okra cultivation in the Mubi North Local Government Area is constrained by declining soil fertility, which negatively impacts crop yield and quality. Many farmers rely on inorganic fertilizers to enhance productivity; however, these fertilizers are expensive and contribute to soil degradation and environmental pollution. Organic fertilizers, such as poultry manure, offer an eco-friendly alternative, but their appropriate application rates for optimal okra growth and yield remain unclear. Farmers often lack precise guidelines on the suitable poultry manure rates required for maximum productivity, leading to either under-application, resulting in poor crop performance, or over-

application, which may cause nutrient toxicity. Additionally, the impact of poultry manure on the nutritional composition of okra has not been well-documented, limiting its potential as a functional food for addressing micronutrient deficiencies.

Given these challenges, this study aims to determine the optimal poultry manure rates that enhance the growth and yield of okra while maintaining soil health and sustainability in the Mubi North, Adamawa State, Nigeria.

### **1.3 Aim and Objectives of the Study**

The aim of this study is to evaluate the effects of different poultry manure rates on the growth of okra (*Abelmoschus esculentus*) in Mubi North Local Government Area. The specific objectives are:

- i. To assess the impact of varying poultry manure rates on the growth parameters of okra.
- ii. To determine the effect of different poultry manure rates on the yield components of okra.
- iii. To analyze the nutritional composition of okra under different poultry manure treatments.

### **1.4 Significance of the Study**

This study has significant implications for farmers, agricultural researchers, and policy makers in Nigeria. By identifying the optimal poultry manure rates for okra cultivation, the research will provide valuable recommendations that enhance crop yield and soil fertility.

For farmers, the study offers practical insights into the efficient use of poultry manure to maximize okra production, thereby improving income and food security. Researchers will benefit from the findings by gaining a deeper understanding of organic fertilizer interactions with crop physiology. Additionally, policymakers can use the research outcomes to develop sustainable agricultural policies that promote organic farming and environmental conservation.

The study also contributes to the broader goal of sustainable agriculture by reducing dependence on chemical fertilizers, improving soil health, and mitigating the environmental impact of synthetic inputs. Furthermore, enhancing okra production through optimized organic fertilization can support local industries that utilize okra in food processing and pharmaceuticals.

## **1.5 Justification of the Study**

The justification for this study is based on the need to improve soil fertility and crop productivity using environmentally sustainable approaches. The declining soil fertility in Mubi North, Adamawa State necessitates alternative fertilization strategies that maintain long-term agricultural sustainability. Poultry manure, being a nutrient-rich organic fertilizer, has the potential to enhance okra growth and yield while reducing soil degradation and chemical fertilizer dependence.

Moreover, okra is a valuable crop due to its economic and nutritional importance. Enhancing its cultivation through appropriate manure management can help combat micronutrient deficiencies, particularly in rural areas where dietary diversity is limited. Understanding the interaction between poultry manure application rates and okra productivity will provide essential knowledge for optimizing crop management practices, ensuring food security, and supporting smallholder farmers in Nigeria.

## **1.6 Scope and Limitation of the Study**

This study focuses on evaluating the effects of different poultry manure rates on the growth and yield of okra (*Abelmoschus esculentus*) in Mubi North Local Government Area. The research will be conducted under field conditions, examining parameters such as plant height, number of leaves, and yield components. The nutritional composition of okra under different manure treatments will also be analyzed.

Limitations of the study may include variability in soil properties, climatic factors, and the duration of the research. Additionally, differences in poultry manure composition may affect nutrient availability, necessitating further studies to standardize organic fertilizer application for okra cultivation. By addressing these aspects, this study aims to contribute to the optimization of organic fertilization practices for improved okra production in Nigeria's agroecological zones.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter reviews existing literature on the importance of okra (*Abelmoschus esculentus*) cultivation in Nigeria, the challenges posed by declining soil fertility, and the role of poultry manure as an alternative nutrient source for sustainable okra production. It also examines previous research on the effect of poultry manure on soil properties, plant growth, yield components, and the nutritional composition of okra. The review aims to identify gaps in knowledge that justify the need for the present study in Mubi North Local Government Area of Adamawa State.

#### 2.2 Agronomic and Nutritional Importance of Okra

Okra (*Abelmoschus esculentus* L. Moench) is an important vegetable crop grown widely in tropical and subtropical regions. It is valued for its nutritional, medicinal, and economic benefits. According to Adeoluwa *et al.* (2021), okra pods are rich in vitamins A, C, and K, as well as minerals such as calcium, magnesium, and iron. Additionally, okra contains mucilage, dietary fiber, and bioactive compounds with antioxidant, antimicrobial, and anti-inflammatory properties, making it a potential functional food in combating non-communicable diseases.

In Nigeria, okra plays a crucial role in enhancing food security, improving dietary diversity, and generating income for rural farmers (Olawaju *et al.*, 2020). Its short growth cycle and adaptability to different agro-ecological zones have contributed to its widespread cultivation. Nevertheless, the productivity of okra remains suboptimal, largely due to declining soil fertility and inadequate crop management practices.

#### 2.3 Soil Fertility Constraints in Nigerian Agriculture

Declining soil fertility is a persistent constraint to agricultural productivity in Nigeria, particularly in the savannah and semi-arid zones. Studies have shown that Nigerian soils are often characterized by low levels of organic matter, nitrogen (N), phosphorus (P), and potassium (K), as well as poor soil structure and microbial activity (Akinrinde & Obigbesan, 2021). These deficiencies are



exacerbated by intensive land use, erosion, leaching, and limited application of organic amendments.

In Mubi North, where the study is situated, sandy soils with low water-holding capacity and poor nutrient retention are common (Abdu *et al.*, 2022). Farmers often rely on synthetic fertilizers to replenish soil nutrients; however, the high cost, limited accessibility, and adverse environmental consequences of chemical fertilizers—such as acidification, nutrient leaching, and loss of soil biodiversity—make them unsustainable for long-term use (Fageria *et al.*, 2019; Ogunwole *et al.*, 2023).

#### **2.4 Poultry Manure as a Sustainable Soil Amendment**

Poultry manure is increasingly recognized as a viable organic alternative to synthetic fertilizers. It is derived from poultry droppings and bedding materials and is rich in essential macronutrients (N, P, and K) as well as micronutrients such as zinc, magnesium, and copper (Hossain *et al.*, 2021). According to Adeniyi and Ojeniyi (2018), poultry manure not only supplies nutrients but also improves soil physical and biological properties by enhancing soil structure, increasing organic matter content, and stimulating microbial activity.

Research by Atiyeh *et al.* (2020) emphasized that poultry manure contributes to improved soil aeration, moisture retention, and cation exchange capacity, all of which are vital for optimal crop growth. Additionally, the slow release of nutrients from organic manure minimizes nutrient losses through volatilization and leaching, thereby enhancing nutrient use efficiency and environmental safety.

#### **2.5 Effects of Poultry Manure on Growth and Yield of Okra**

Numerous empirical studies have demonstrated the positive impact of poultry manure on the vegetative and reproductive growth of okra. In a study conducted in Kaduna State, Nigeria, Okon and Abubakar (2022) reported that poultry manure applied at 6 t/ha significantly increased plant height, number of leaves, stem girth, and pod yield compared to the control and chemical fertilizer

treatments. Similarly, Ekwere *et al.* (2022) observed that poultry manure at 10 t/ha enhanced biomass accumulation and fruit yield, while also improving soil pH and nutrient availability.

A comparative study by Ojo *et al.* (2021) found that poultry manure outperformed cow dung and compost in promoting okra growth and productivity. The authors attributed this to the higher nitrogen and phosphorus content of poultry manure and its rapid mineralization in the soil. Moreover, Awodun and Ogunlade (2023) demonstrated that the use of poultry manure led to earlier flowering, increased fruit number per plant, and improved fruit size, all of which are desirable traits for market-oriented okra production.

However, some researchers caution that excessive application of poultry manure can lead to nutrient imbalance, phytotoxicity, and contamination of surface water through runoff (Adebayo *et al.*, 2021). Therefore, optimizing the application rate is critical to maximizing benefits while minimizing environmental risks.

## **2.6 Timing and Method of Application**

The timing and method of poultry manure application play a crucial role in nutrient availability and crop response. Poultry manure is most effective when applied before planting and incorporated into the soil, allowing for partial decomposition and nutrient release by the time seedlings establish (Oyetunji & Olaniyan, 2020). In a field trial, Mornya and Mansaray (2022) reported that plough-incorporated poultry manure at the time of sowing significantly improved okra yield compared to surface application or delayed incorporation.

Additionally, split application of poultry manure has been recommended to align nutrient release with critical growth stages such as flowering and fruiting (Ajayi *et al.*, 2020). These practices enhance synchrony between nutrient demand and supply, reduce nutrient losses, and improve crop nutrient uptake efficiency.

## **2.7 Integration with Inorganic Fertilizers**

Integrated soil fertility management (ISFM) strategies that combine organic and inorganic fertilizers are being promoted to improve soil productivity while ensuring environmental

sustainability. According to Adekiya *et al.* (2021), combining poultry manure with reduced rates of NPK fertilizer enhances nutrient availability, microbial activity, and long-term soil fertility.

In okra production, integrated use of poultry manure (5 t/ha) and NPK fertilizer (60 kg/ha) has been shown to produce higher yields than either source alone (Adediran & Akande, 2019). This synergy is attributed to the complementary roles of organic matter in improving soil physical properties and mineral fertilizers in providing readily available nutrients. Such findings underscore the need for balanced and site-specific nutrient management protocols.

## **2.8 Effect of Poultry Manure on Nutritional Composition of Okra**

Beyond growth and yield, the nutritional quality of okra is also influenced by soil fertility and nutrient management. Organic fertilizers such as poultry manure have been shown to enhance the concentration of essential nutrients in okra fruits. Okoro *et al.* (2023) reported that poultry manure application increased the levels of crude protein, vitamin C, calcium, and iron in okra pods compared to untreated plots. This has implications for addressing micronutrient deficiencies and improving dietary diversity, especially in resource-constrained settings.

However, there is limited empirical data from the northeastern region of Nigeria on the effect of poultry manure on the proximate and mineral composition of okra. This gap highlights the need for location-specific studies that evaluate both agronomic and nutritional outcomes of organic fertilization.

## **2.9 Summary of Literature**

Despite extensive research on the benefits of poultry manure in vegetable production, significant knowledge gaps remain, particularly concerning its application in specific agro-ecological contexts such as Mubi North, Adamawa State. Most existing studies have been conducted in the southern and central regions of Nigeria, with minimal emphasis on the semi-arid zones of the northeast, where soil texture, rainfall patterns, and cropping systems differ considerably. This geographical limitation restricts the applicability of current findings to the Mubi North area. Moreover, there is no established consensus on the optimal application rates of poultry manure required to achieve

maximum growth and yield of okra under varying soil fertility conditions and climatic environments. The lack of standardized recommendations poses challenges for farmers seeking to adopt poultry manure as a sustainable input.

Furthermore, while poultry manure is known to improve soil fertility and crop performance, limited studies have evaluated its effect on the nutritional composition of okra fruits—specifically, the proximate and mineral contents that contribute to the crop's dietary value. Understanding how organic amendments influence nutritional quality is essential for positioning okra as a functional food capable of addressing micronutrient deficiencies. Additionally, few investigations have assessed the long-term sustainability of continuous poultry manure application, particularly its impact on soil health, nutrient cycling, and potential environmental risks such as heavy metal accumulation and water contamination. These research gaps underscore the need for a comprehensive study that not only quantifies the agronomic benefits of poultry manure in Mubi North but also evaluates its implications for food quality and environmental sustainability.

This review has demonstrated that poultry manure is a viable alternative to synthetic fertilizers for enhancing the growth, yield, and nutritional quality of okra. Its use aligns with the goals of sustainable agriculture and soil fertility restoration. Nevertheless, optimizing poultry manure application requires context-specific research that considers soil type, climate, crop variety, and environmental concerns. The current study addresses these gaps by investigating the effects of different poultry manure rates on okra production and nutritional quality in Mubi North Local Government Area, Adamawa State.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Study Area

The study was conducted within Mubi North Local Government Area of Adamawa State in Eastern region of Northern guinea savannah of Nigeria, latitude  $9^{\circ}20'$  and longitude  $13^{\circ}50'$  East and covers an area of  $24,00\text{km}^2$ . The rainfall range between 700 -900mm with highest in the month of August, the temperature is highest at  $30^{\circ}\text{C}$  during March and April, and the minimum is  $15^{\circ}\text{C}$  in January (Adebayo, 2014).

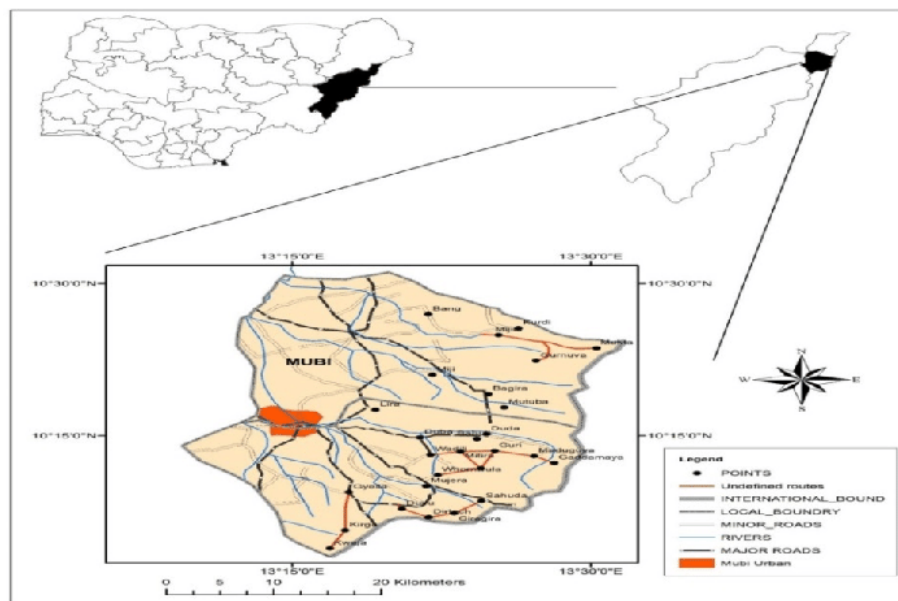


Figure 3.1: Map of the study area

Mubi North Local Government shares common borders with Muchala LGA to the North, Mubi South, Hong Local Government Areas and it's also shares an international border with Cameroon Republic (Adebayo, 2014). Mubi North local government is inhabited by many tribes such as Fulani, Fali, Hausa, and others with Fali and Fulani as the predominant tribes, the people have rich cultural heritage and are predominantly farmers (Crop production and Animals like cattle). The climate condition helps the people to practice agriculture as the occupation particularly farming, cattle rearing and marketing. Because of the international border with Cameroon, this makes the study area a marketing, farming, and cattle route (Adebayo, 2014).

### **3.2 Experimental Design and Layout**

The experiment consisted of four (4) treatments Viz, ( $T_0=0\text{kg}$  of Poultry manure,  $T_1=4\text{kg}$  of PM  $T_2=8\text{kg}$  of PM, and  $T_3= 12\text{kg}$  of PM). replicated three (3) times and was laid out in a Randomized Block Design (RCBD) as shown in figure one (1) below. A total number of 12 sub-plots will be constructed with each sub-plot measured 2m X 3m with an alley of 0.5meters from each angle totalling 115.5m<sup>2</sup>. The beds were tilled manually with a hoe and treatments mixed off properly with the soil in each bed. Two (2) Seeds of Okra dropped at the depth of 2cm, covered with soil and firmed gently. Four (4) crop rows were made with six (6) stands on each row making the sum of 24 stands in each bed. Weeding was commenced three (3) weeks after sowing at an interval of two (2) weeks, three (3) times throughout duration of this experiment.

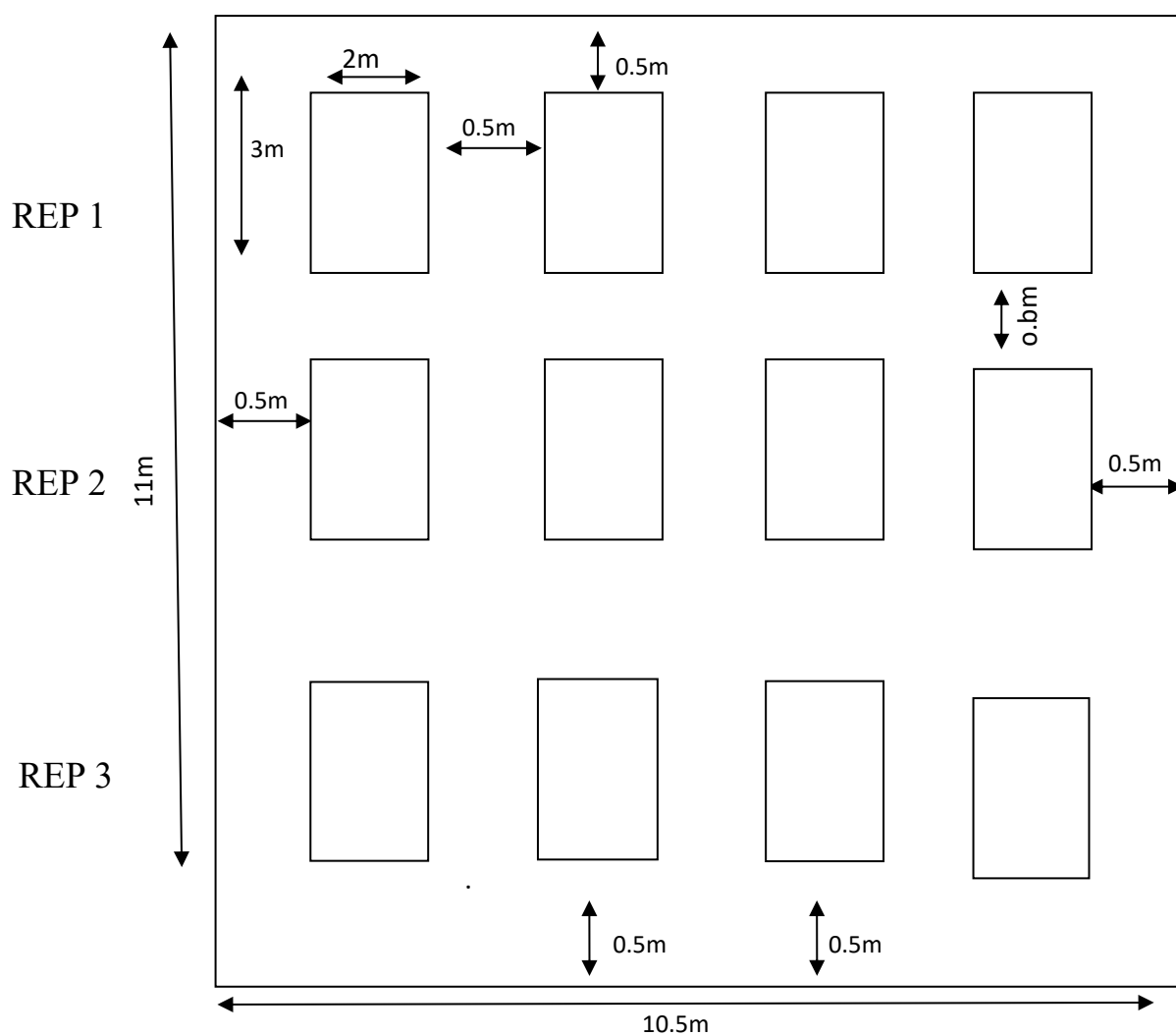


Figure 3.2: Field layout of the experiment

**Key:**

**Rep 1** - means replication 1

**Rep 2** - means replication 2

**Rep 3** - means replication 3

**T<sub>0</sub>** - 0kg of Poultry Manure (Control)

**T<sub>1</sub>** - 4kg of Poultry Manure

**T<sub>2</sub>** - 8kg of Poultry Manure

**T<sub>3</sub>** - 12kg of Poultry Manure

### **3.3 Cultural Practice**

The cultural practice that was employed for this experiment include the following

#### *3.3.1 Ploughing*

After clearing the field and demarcation each sub- plot was prepared manually with a hoe. The soil was dogged mixed with cow dung manure in each case and levelled flat. The experiment was conducted during the raining season raised with beds.

#### *3.3.2 Sowing*

For the purpose of this research, a vegetable crop (Okra) a variety was selected. Two (2) seeds were 40+40cm both between crop row as well as between stands.

#### *3.3.3 Weeding*

It will be done manually with a simple farm tool (hoe). Weeding started three (3) weeks after sowing and continued at interval of two (2) week, three (3) times throughout the growing period.

### **3.4 Data Collection**

Data from the following growth and yield parameters with be taken during this experience.

#### **GROWTH PARAMETERS**

##### *3.4.1 Establishment count*

The number of established Seedling from each plot was taken and recorded three (3) weeks after planting.

##### *3.4.2 Plant height*

Three (3) seedlings were randomly elected from the center of each plot and tagged. The height of plant will be taken from them with aid of ruler meter at an interval of two (2) weeks after planting, three (3) time in all, with the exception of first reading which was taken three (3) weeks after planting. A ruler meter was placed at the base of each seedling runs to the terminal End, reading will be taken and record appropriately.



#### *3.4.3 Number of leaves/plants*

The number of leaves appeared on the selected seedlings was counted systematically and record.

#### *3.4.4 Stem diameter*

Data on stem diameter from the selected Okra seedling in each plot was measured carefully using a digital Vanier calliper and was recorded.

### **3.5 Data Analysis**

The collected data was analyze using analysis of variance and means was separated using the least significance difference (L.S.D) at 50% probability level.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Effects of Poultry Manure Rates on the Plant Height (cm) of Okra (*Abelmoschus esculentus*) at Different Weeks (2, 4 & 6)

The effects of poultry manure rates on the plant height (cm) of Okra (*Abelmoschus esculentus*) at different weeks (2, 4 & 6) is presented in Table 1. The result showed that, there were significant difference in plant height in the levels of poultry manure rate in week two (P 0.001), week four (P<0.01) and week six (P<0.05). The highest significant mean for all the weeks were recorded by 12 kg rate of application of 19.80, 20.11 and 22.03 kg, week 2, 4 & 6, respectively. The result also revealed that there was general increase in plant with increase in the rate of application and the number of weeks.

The application of poultry manure significantly impacted the height of Okra (*Abelmoschus esculentus*) plants. According to the findings, the 12 kg rate of poultry manure resulted in the highest plant height at 2 weeks (19.80 kg), 4 weeks (20.11 kg), and 12 weeks (22.03 kg). This suggests that higher manure rates promote plant growth and development. The positive effect of poultry manure on plant height can be attributed to the nutrient-rich composition of the manure. As noted by Omololu *et al.* (2023), poultry manure is a valuable organic fertilizer that can improve soil fertility and promote plant growth. The increased plant height with higher manure rates is consistent with the findings of Olowoake *et al.* (2018), who reported that poultry manure application significantly increased plant height and yield of okra. Also, the highest plant height observed at the 12 kg rate of poultry manure might be due to the adequate supply of essential nutrients such as nitrogen, phosphorus, and potassium (Okoro & Orodeji (2022). Havlin *et al.* (2013), observed that nutrients play a crucial role in plant growth and development, including cell division, cell elongation, and photosynthesis. The results of this study is in agreement with those of Adejumo *et al.* (2020) who have reported that, poultry manure application significantly improved the growth and yield of okra.

**Table 1: Effects of Poultry Manure Rates on the Plant Height (cm) of Okra (*Albelmoschus esculentus*) at Different Weeks (2, 4 & 6)**

Levels of poultry manure (Kg)	Weeks		
	2WAS	4WAS	6WAS
0	8.13 <sup>c</sup>	8.23 <sup>c</sup>	8.91 <sup>c</sup>
4	8.10 <sup>c</sup>	8.98 <sup>ab</sup>	9.17 <sup>c</sup>
8	9.56 <sup>b</sup>	9.02 <sup>b</sup>	15.09 <sup>b</sup>
12	19.80 <sup>a</sup>	20.11 <sup>a</sup>	22.03 <sup>a</sup>
±SEM	0.77	0.69	0.71
LOS	***	**	*

<sup>a,b,c</sup> Means in the same column bearing different superscript (s) is significantly (P<0.05) different, SEM = Standard error of the mean, LOS = Level of significance, WAS = Week after sowing, \* = P<0.05, \*\* = P<0.01, \*\*\* = P<0.001

#### **4.2 Effects of Poultry Manure Rates on the Number of Leaves of Okra (*Abelmoschus esculentus*) at Different Weeks (2, 4 & 6)**

The effects of poultry manure rates on the number of leaves of Okra (*Abelmoschus esculentus*) at different weeks (2, 4 & 6) is shown in Table 2. There was significant difference in the levels of poultry manure rate at week 4 ( $P < 0.05$ ), while week 2 and 6 revealed insignificant difference among the various levels. Similarly 12kg level of application gave the highest number of leaves at week 4 (9.13).

The application of poultry manure significantly increased the number of leaves of Okra (*Abelmoschus esculentus*) plants. Based on the findings 12 kg rate of poultry manure resulted in the highest number of leaves at 4 weeks (9.13). This suggests that higher manure rates promote leaf growth and development (Uka *et al.*, 2021). The positive effect of poultry manure on leaf number can be attributed to the nutrient-rich composition of the manure. As noted by Omololu *et al.* (2023); AdeOluwa *et al.* (2018), poultry manure is a valuable organic fertilizer that can improve soil fertility and promote plant growth. The increased leaf number with higher manure rates is consistent with the findings of Olowoake *et al.* (2018), who reported that poultry manure application significantly increased leaf number and yield of okra.

The insignificant difference in the number of leaves among the different rates of poultry manure observed at 2 week might be due to the fact that the plants were still in the early stages of growth and had not yet responded to the manure application. According to Havlin *et al.* (2013), plants require time to respond to nutrient applications, and the effects of fertilizers may not be apparent immediately. Similarly, the insignificant difference at week 6 might be due to the fact that the plants had reached maturity and the leaf number had plateaued. As stated by Taiz and Zeiger (2010), plant growth and development are influenced by a complex interplay of genetic and environmental factors, including nutrient availability.

**Table 2: Effects of Poultry Manure Rates on the Number of Leaves of Okra (*Albelmoschus esculentus*) at Different Weeks (2, 4 & 6)**

Levels of poultry manure (Kg)	Weeks		
	2WAS	4WAS	6WAS
0	6.87	8.67 <sup>ab</sup>	7.47
4	7.60	6.73 <sup>c</sup>	8.33
8	8.40	8.00 <sup>b</sup>	8.40
12	8.67	9.13 <sup>a</sup>	9.00
±SEM	0.31	0.28	0.26
LOS	NS	*	NS

<sup>a,b,c</sup> Means in the same column bearing different superscript (s) is significantly (P<0.05) different, SEM = Standard error of the mean, LOS = Level of significance, WAS = Week after sowing, \* = P<0.05

### **4.3 Effects of Poultry Manure Rates on the Stem Girth (cm) of Okra (*Abelmoschus esculentus*) at Different Weeks (2, 4 & 6)**

Effects of poultry manure rates on the stem girth (cm) of Okra (*Abelmoschus esculentus*) at different weeks (2, 4 & 6) is presented in Table 3. The result depicted that levels of poultry manure rate significantly affected stem girth at week 2 ( $P<0.05$ ) and week 4 & 6 ( $P<0.01$ ). The stem girth of Okra (*Abelmoschus esculentus*) plants, based on the present study revealed that 12 kg rate of poultry manure resulted in the highest stem girth at 2 weeks (5.49 cm), 4 weeks (7.59 cm), and 6 weeks (8.55cm). This suggests that higher manure rates promote stem growth and development. The positive effect of poultry manure on stem girth can be attributed to the nutrient-rich composition of the manure. As noted by AdeOluwa *et al.* (2020), poultry manure is a valuable organic fertilizer that can improve soil fertility and promote plant growth. The increased stem girth with higher manure rates is consistent with the findings of Olowoake *et al.* (2018), who reported that poultry manure application significantly increased stem girth and yield of okra.

The general increase in stem girth with increase in the number of weeks might be due to the continuous availability of nutrients from the poultry manure. According to Havlin *et al.* (2013), the nutrient release pattern of organic manures like poultry manure can provide a steady supply of nutrients to plants over time. This steady supply of nutrients likely contributed to the observed increase in stem girth over time. The highest stem girth observed at the 12 kg rate of poultry manure might also be due to the adequate supply of essential nutrients such as nitrogen, phosphorus, and potassium. As stated by Taiz and Zeiger (2010), these nutrients play a crucial role in plant growth and development, including cell division, cell elongation, and photosynthesis.

**Table 3: Effects of Poultry Manure Rates on the Stem Girth (cm) of Okra (*Albelmoschus esculentus*) at Different Weeks (2, 4 & 6)**

Levels of poultry manure (Kg)	Weeks		
	2WAS	4WAS	6WAS
0	2.08 <sup>b</sup>	1.93 <sup>c</sup>	2.82 <sup>d</sup>
4	2.84 <sup>b</sup>	4.03 <sup>b</sup>	4.26 <sup>c</sup>
8	5.45 <sup>a</sup>	7.40 <sup>a</sup>	5.58 <sup>b</sup>
12	5.49 <sup>a</sup>	7.59 <sup>a</sup>	8.55 <sup>a</sup>
±SEM	0.31	0.27	0.30
LOS	*	**	**

<sup>a,b,c</sup> Means in the same column bearing different superscript (s) is significantly (P<0.05) different, SEM = Standard error of the mean, LOS = Level of significance, WAS = Week after sowing, \* = P<0.05, \*\* = P<0.01.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Summary**

The study on the effects of poultry manure rate on the growth of Okra (*Abelmoschus esculentus*) in Mubi North Local Government Area of Adamawa State, has provided valuable insights into the potential benefits of using poultry manure as an organic fertilizer. The results of the study showed that the application of poultry manure significantly impacted the growth parameters of Okra, including plant height, number of leaves, and stem girth.

#### **5.2 Conclusion**

The findings of this study revealed that the 12 kg rate of poultry manure application resulted in the highest growth parameters, including plant height and stem girth, in all the weeks. Although the number of leaves was not significant in weeks 2 and 4, the 6 kg rate still recorded the highest number of leaves at week 4. These results suggest that poultry manure is a valuable organic fertilizer that can improve the growth and development of Okra.

The general increase in growth parameters across the weeks and down the levels of poultry manure application suggests that poultry manure can provide a steady supply of nutrients to plants over time. This can lead to improved crop yields and better plant growth. The use of poultry manure as an organic fertilizer can also contribute to sustainable agriculture practices, reducing the environmental impact of inorganic fertilizers and promoting soil health.

#### **5.3 Recommendations**

Based on the findings of this study, the following recommendations are made:

- i. Farmers in Mubi, Adamawa State, and surrounding areas can apply poultry manure at a rate of 12 kg per plot to improve the growth and development of Okra.
- ii. Poultry manure can be used as a sustainable and environmentally friendly alternative to inorganic fertilizers to improve soil fertility and promote plant growth.
- iii. Further studies should be conducted to determine the optimal application rates of poultry manure for different crops and soil types in the region.
- iv. Extension services should be provided to farmers to educate them on the benefits and proper use of poultry manure as an organic fertilizer.



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