

**THE EFFECT OF ORGANIC MANURE AND INORGANIC FERTILIZER
APPLICATION ON CARROT PRODUCTIVITY**

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S21/BBUC/BASE/003

**A DISSERTATION SUBMITTED TO THE FACULTY OF AGRICULTURAL SCIENCES IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
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DECLARATION

I NIWABIINE SETH, declare that this research study is my original work and has never been submitted to any University or institution of higher learning for any award of degree.

Signature:*Niwabiine SETH*.....

Date:31/07/2025.....

APPROVAL

I certify that this research study was carried out in KABALE and has been submitted to the faculty of agricultural sciences with my approval.

Signature.....*UZU*.....

Date.....*31/07/2025*.....

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DEDICATION

This research study is dedicated to my parent Mrs. MARY NKURUNUNGI AIDAH for the appreciation of parental care, she has always given me since childhood to date. May God bless her. Also to all my brothers, sisters (MUHUMUZA JOSHUA, AHEREEZA DERRICK, AMPUMUZA MONIC and ABINSINGUZA DALLEN) who have been giving me comfort in times of my happiness and in times of grief, may the Almighty bless you for ever and ever

ACKNOWLEDGEMENT

I thank the Almighty God for giving me good health and enabling me reach this far in my academic Journey. I extent my heartfelt sincere thanks to **Mr. Kukundakwe Arthurton** for always standing with me in making sure that this journey is a success and smooth regardless of hardships he encounters and my beloved mothers, brothers and sisters for always supporting and praying tirelessly for me in this race and good wishes and words of wisdom that always keep me motivated. I also stretch my token of appreciations to my fellow course mates for always clapping and encouraging during the difficult times along the journey, may God keep you safe to enjoy the fruits of your hard work.

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Abstract

This study aimed to compare the effects of organic manure and inorganic fertilizer application on carrot yield, with a focus on determining which nutrient source provides better performance in terms of crop productivity and cost-effectiveness. The experiment was carried out using a field experiment under controlled plots having individual treatment of organic manure, inorganic fertilizers, and control without fertilizer application. Important traits under consideration were germination rate, length of the roots, diameter of the roots, total yield, and production expenses. The findings revealed that while inorganic fertilizers resulted in slightly higher yields due to their quick nutrient availability, organic manure significantly improved soil structure and sustained nutrient release, contributing to a more stable and environmentally friendly yield over time. Additionally, organic manure proved to be more cost-effective, especially when sourced locally, offering a viable alternative for resource-limited farmers. The study concluded that integrating organic manure into carrot production not only enhances long-term soil fertility but also provides comparable yield outcomes to inorganic fertilizers, making it a sustainable option for improved agricultural productivity.

LIST OF ACRONYMS OR ABBREVIATIONS

UBS: Uganda Bureau of Statistics

SOM: Soil organic matter

SOC: Soil Organic Matter

TN: Total Nitrogen

UCU: Uganda Christian University

ANOVA: Analysis of Variance

AP: Available Phosphorus

LSD: Least Significant Differences

RCBD: Randomize Complete Block Design

SD: Standard deviation

CHAPTER ONE: INTRODUCTION

1.1.0 Introduction

This research was to determine the impact of organic manure and inorganic fertilizer application in carrot yield. The carrots (*Daucus carota*) are the world's most important root crops and are popular for their nutritional value consisting of beta-carotene, vitamins, and antioxidants. The best soil fertility was required for the production in this crop in a bid to secure high yields and good quality. To maintain the fertility of the soil and enhance production in crops, use of fertilization practices is imperative. The chapter constituted background, statement of the problem and objectives of the study, research questions, the scope of the study, Justification of the study and conceptual framework.

1.1 Background

Overtime, agricultural productivity has gradually declined as a result of soil erosion, over cultivation and soil infertility although it's being improved using various organic fertilizers.

According to Smith et al. (2018), organic manure, which is made from decomposed plant and animal matter, is known to increase microbial activity, improve soil structure, and offer a slow-release source of nutrients. On the other hand, inorganic fertilizers are made chemically and give crops easily accessible nutrients, which frequently boosts yields right away (Johnson & Lee, 2016). Comparative research on these fertilizing techniques has been spurred, nevertheless, by worries about sustainability, soil health, and environmental degradation.

The effectiveness and long-term effects of organic versus inorganic fertilizers have been discussed by researchers over the years. While Singh et al. (2019) draw attention to the quick efficacy of inorganic fertilizers in intensive farming, studies such as those conducted by Brown et al. (2017) demonstrate the ability of organic manure to restore soil fertility. The leading carrot growing areas in Uganda 'include Ntungamo (Rushenyi county Rwahi town), Elgon ranges in areas of (Bududa, and Kapchorwa districts].Kumi, Kamuli, Soroti, and on various irrigation 'schemes across Uganda such

as Mubuku irrigation scheme in kasese. (MAAIF.2008).The commonly cultivated variety in Uganda is orange carrot.

The purpose of this study was to present actual data regarding the relative impacts of Organic manure and inorganic fertilizer, on different fertilization techniques on carrot yield.

1.2: Problem Statement.

Crop productivity relied highly on the application of nutrient management practices for the increase in yield and fertility of the soil. Carrots (*Daucus carota* L.), are a high-value and an important root vegetable grown widely for their commercial and nutritional potential. The use of organic manure or inorganic fertilizers in the maximum yield and maintenance of sound soil health was yet a topic of controversy. Although inorganic fertilizers offer instant nutrient availability, they have been linked to environmental pollution and long-term soil damage. On the other hand, by enhancing soil structure and nutrient retention, organic manure encourages sustainable farming yet early yields may be lower than those of inorganic alternatives. Finding the most sustainable and efficient fertilizer technique to increase carrot yield while maintaining soil health was the crucial problem. Farmers struggle to strike a balance between environmental sustainability and economic productivity, which frequently results in less-than-ideal choices that affect output and soil fertility over the long run.

Around the world, growing carrots was a major agricultural activity, and there was a growing demand for vegetables. Unsuitable fertilization techniques may result in: decreased carrot output and quality, which has an impact on market supply and farmer profitability. Long-term agricultural productivity was jeopardized by soil erosion, compaction, and nutrient loss. Environmental problems include greenhouse gas emissions and fertilizer runoff contaminating water.

Present-day methods differ greatly, Inorganic Fertilizers due to their rapid nutrient release and consistent yield-boosting effects, many farmers depend on inorganic fertilizers. The usage of organic manure was becoming more and more well-liked due

to its contribution to sustainable agriculture, particularly in organic farming systems. Integrated Nutrient Management (INM) was being practiced to maximize the advantages of both organic and inorganic fertilizers; some farmers mix the two. Research efforts on how these fertilizers affect different crops has been done, although the results are frequently context- and crop-specific.

The effects of organic and inorganic fertilizer application on different crops have been studied, but there isn't much thorough comparative research on carrot farming. Farmers and politicians are left in the dark about the best ratios, how to apply them, and how they will affect soil health and yield over the long run. Furthermore, region-specific factors including soil type, temperature, and farming methods are frequently overlooked in current research.

1.3: Purpose

The purpose of this study was to find out the impact of inorganic fertilizers and organic manure on carrot productivity. Among the goals are, comparing carrot yield and quality under integrated, inorganic, and organic fertilization regimes, evaluating how these fertilization techniques affect the structure, microbial activity, and nutritional content of the soil, evaluating each fertilization strategy's viability from an economic standpoint, supplying farmers and legislators with evidence-based suggestions for maximizing carrot output in a sustainable manner.

1.4.0 Objectives of the study

1.4.1 General Objectives

To determine the most efficient and environmentally friendly technique of fertilizing carrot fields, study was made between Organic manure and inorganic fertilizer application on carrot productivity, and soil health.

1.4.2 Specific Objectives

1. To evaluate the yield of carrot grown using organic manure and inorganic fertilizers.
2. To determine the cost-effectiveness of organic manure and inorganic fertilizers in carrot farming.

1.4.3 Research Questions

1. What is the effect of organic manure on carrot yield compared to inorganic fertilizers?
2. How does organic manure and inorganic fertilizers influence soil properties?
3. What are the economic implications of using organic manure versus inorganic fertilizers in carrot farming?

1.4.4 Significance of the study

This work is highly important in the quest for sustainable Agriculture, the enhancement of food security, livelihood enhancement for smallholder farmers. In analyzing the impacts of organic manure (poultry manure) and inorganic fertilizer (NPK) in the growth and productivity of Carrots (*Daucus carota*), This is necessary in encouraging sustainable farming practices that not only increase crop performance in productivity but also enhance soil quality, microbial activity and long-term fertility.

To the Farmers

It gives farmers useful information on the yield potential and cost-effectiveness of organic manure compared to inorganic fertilizers and this research help them to make good decisions that will optimize earnings and guarantee sustainable farming methods. The research was for the farmers' access to the general information regarding sustainable agriculture by filling the knowledge gap regarding the relative effectiveness of organic manure and inorganic fertilizers, particularly in the root's crops such as carrots.

To the Government

These results help legislators to create incentives or subsidies for using ecologically friendly fertilization techniques and encourage sustainable farming practices.

To Researchers

By adding to the body of knowledge already available on sustainable fertilization and agriculture methods, the study will provide a foundation for future research into soil fertility management strategies.

To Future Researchers

This study is to be used as a benchmark for further research, promoting the investigation of novel strategies for combining inorganic and organic fertilization techniques.

1.5.1 The study's scope

1.5.2 Content, Geographic, Time.

The goal of the study was to determine how inorganic fertilizers and Organic manure affect carrot growth and productivity. It is limited to organic manure and inorganic fertilizer, focusing on the plant growth rate and yield performance under controlled field conditions within a single growing season. These findings are intended to guide sustainable manure use in similar agro-ecological settings. It takes place at Kabale District's Rugarama, Northern Division. In terms of growth rate, root size, yield amount, and general soil health, the study intends to investigate the effects of various organic and inorganic fertilizers on carrot Yields. Kabale District, located in the southwest of Uganda, has Rugarama, Northern Division as one of its administrative divisions. Kabale District's high elevation (about 2,000 to 2,300 meters above sea level) results in hilly topography, deep valleys, and a mild temperature. As a result, temperate crops like carrots can be grown in the district. The two rainy seasons (March to May and September to November) in Kabale contribute to the District's temperate climate and agricultural output. Rainfall ranges from 1,000 to 1,200 mm on average each year. Particularly in the highlands, the district are renowned for its rich

and well drained volcanic soils that are ideal for root crops like carrots. The primary economic activity of Kabale District, which has a high population density, is agriculture. Irish potatoes, carrots, cabbage, and beans are among other crops that are sizable and grown by a larger population for livelihood. The majority of people in the Northern Division, which includes Rugarama, are smallholder farmers, and the area is primarily agricultural. Due to changes in soil fertility, these farmers frequently turn to organic and artificial fertilizers to boost crop yield.

1.5.5 Justification

The study tackled the problem of decreasing soil fertility in Kabale District as a result of ongoing agriculture and erosion on the steep terrain. Understanding the efficacy of inorganic fertilizers and organic manure, which are frequently used to restore nutrients in the soil, was essential for sustainable agricultural methods. The performance of inorganic fertilizers and organic manure should be compared in light of the increased interest in organic farming. The study can shed light on whether chemical fertilizers in carrot growing can be supplemented or replaced by organic alternatives.

In Kabale District, carrots are a vital horticulture crop that boosts household income and food security. Knowing the best fertilizer techniques can increase productivity, and increasing carrot yields can greatly improve farmers' livelihoods. Although organic manure are a natural source of nutrients and inorganic fertilizers are artificial, improper use of these two can pollute the environment. This study provided an insight on the type of manure that can contribute to reducing environmental deterioration and promoting environmentally friendly sustainable farming practices by investigating the proper application techniques.

1.6.0 CONCEPTUAL FRAMEWORK

Independent variables

Dependent Variables

- Organic Fertilizer manure
- Inorganic Fertilizer
- Control Group (No Fertilizer)

- Plant height
- Carrot Yield
- Root development (size, shape, and

Intervening

- Weather conditions
- Soil type and initial fertility
- Application practices

CHAPTER TWO: LITERATURE REVIEW

2.1.0 Introduction

A foundational aspect of crop production, fertilization directly affects crop productivity, the fertility of the soil, and economic sustainability. The inorganic fertilizer versus organic manure question has been the subject of numerous studies due to the implications for environmental conservation and sustainable crops. This literature review reviews existing studies whose findings underlie the objectives of this work, such as estimating cost-effectiveness, estimating carrot productivity, and estimating soil nutritional compositions and microbial functions.

2.1.1 Carrot Yield under Organic Manure and Inorganic Fertilizers

Carrot productivity was the subject of various studies for inorganic fertilizers and organic manure. Organic manures such as compost and animal manure enhance soil structure and availability of nutrients in the long run and boost production. Kumar et al. (2017), for instance, found carrots grown in organic manure exhibited improved root weight and development due to gradual release of essential minerals such as the phosphate, potassium, and nitrogen.

Conversely, inorganic fertilizers make nutrients readily available for instant use, a phenomenon which often results in heavy early yields. Due to their high concentration of nutrients and fast plant uptake rates, inorganic fertilizers significantly improved the productivity of carrots in a single season of cultivation as revealed by Adeola and Afolabi in 2019. They did, however, point out a few potential dangers such as reduced long-term fertility and leaching of the nutrients.

In addition, hybrid strategies made up of inorganic and organic fertilizers have also been investigated. The potential for strategies of fertilizing to support each other was revealed by Singh et al. (2020), who found interchanging reduced application rates of inorganic fertilizers and organic manure maximized the production of carrots while maintaining the fertility of the soil.

2.1.2 Impact on Soil Nutrient Content and Microbial Activity.

Increasing the amount of the soil's organic matter and promoting the activity of microbes, organic manure is best known for promoting the fertility of the soil. Organic manure does boost microbial biomass and enzymic activity significantly and promotes cycling of the nutrients and good soil health, according to research by Brown et al. (2018).

In comparison, excessive use of inorganic fertilizers was linked with nutritional imbalances and acidification of the soil. The crops under the exclusive use of inorganic fertilizers reduced microbial diversity in the soil, according to Johnson et al. (2016). Excessive solubility in the inorganic fertilizers might cause the nutritional loss to occur very quickly and therefore more applications are needed.

Similar relative studies have also been carried out regarding various inputs. For instance, Liu et al. (2021) unveiled the fact that inorganic fertilizers had temporarily enhanced the concentration of constituents but were unsuccessful in maintaining soil biota, yet microbial activity and element retention in the soil were enhanced by organic manure.

2.1.3 Cost-Effectiveness of Organic Manure and Inorganic Fertilizers

Cost effectiveness was also an important consideration in the decision by the farmers. Although organic manure is usually inexpensive and readily available in the farm vicinity, others may be discouraged by the labor for application and slow nutrient release. Although the purchase cost of the organic manure is cheap, the return period of organic manure depended upon long-term yield increase and improved soil quality by Ahmed et al. (2020).

Though costly, inorganic fertilizers are popular due to the fast outcomes and ease of application. But due to the fact that inorganic fertilizers have more applications and in addition lead to soil degradation, Das and Rahman's (2018) research indicated that the use of them might ultimately increase production expenses.

Integrated approaches have been promoted as lucrative alternatives. A balanced approach for the cost-effectiveness of carrot production was proposed by Rahim et al.

(2022), who indicated the use of a combination of organic manure and reduced inorganic fertilizer inputs reduced costs while ensuring a stable yield. The trade-offs in the use of organic manure and inorganic fertilizers in the production of carrots are emphasized in the literature currently in print. While organic manure promotes sustainability and long-term soil fertility, it might induce slow yield responses. While inorganic fertilizers promote yield increase in the short term, they induce soil degradation and long-term economic returns. A balanced strategy for attaining maximum productivity, soil fertility, and cost recoverability appears to be offered by integrated fertilization methods. These findings underlie the need for additional research in a bid to achieve the specified objectives outlined.

CHAPTER THREE: RESEARCH METHODOLOGY.

3.1.0 Introduction

This section describes the methodology that was employed to compare the effects of organic manure and inorganic fertilizers on carrot yield. The study involved, data collection, and Data analysis, Research approach, population of Interest, Experimental Site, Experimental set up , Inclusion and Exclusion Criteria, Techniques for Sampling, Design of Experiments, Data Collection methods, Plan of Dissemination, Analysis of Statistics, Ethical consideration, Limitations of the study to ensure reliable findings.

3.1.1 Research approach

The research methodology that was used in this study is quantitative experimental. Comparing the impact of inorganic fertilizers and organic manure on carrot yield under controlled settings was the main goal. The yield differences between treatments were analyzed using statistical methods and experimental plots.

3.1.2 Population of Interest

Targeting agricultural fields in a designated region (to be decided based on accessibility and soil uniformity), the study focuses on the cultivation of carrots. Contextual interviews with farmers who use either organic or inorganic fertilizers will also be taken into consideration in order to offer insights into real-world use.

3.1.3 Experimental site.

This study was conducted at Uganda Christian University-Bishop Barham University College at the College demonstration farm in Kabale District. Kabale District has a high population density dealing in agriculture. Irish potatoes, carrots, cabbage, and beans are among other crops that are sizable and grown by a larger population for livelihood. The majority of people in the Northern Division of Kabale which includes Rugarama which has smallholder farmers and the area is primarily agricultural. Due to changes in soil fertility, these farmers frequently turn to organic and artificial fertilizers to boost crop yield. The location permits the controlled application of various fertilizers and is appropriate for growing carrots

Experimental set up

Plot preparation: The experimental area was cleared, ploughed and divided into plots to the number of treatments and replications. The size of the plot and the spacing between plots and blocks was determined and clearly marked out.

Treatment allocation: The three treatments (Poultry manure , NPK fertilizer and Zero control) were randomly assigned to the plots within each block. The randomization was crucial for reducing bias.

Planting materials: Healthy and uniform seeds of carrot were used for planting and these seeds were obtained from the faculty seed bank from the microbiology through a well written request.

3.1.4 Inclusion and Exclusion Criteria

3.1.4.1 Inclusion Criteria

Fields with similar soil texture and pH levels.

Carrot varieties commonly grown in the region.

Farmers with at least 3 years of experience using the respective fertilizers.

3.1.4.2 Exclusion Criteria

Fields with prior contamination of both organic and inorganic fertilizers.

Extreme weather-affected regions.

Farmers using mixed fertilizer regimes (organic and inorganic)

3.1.5 Techniques for Sampling

Random Sampling: To guarantee objective depiction, plots were chosen at random.

Stratified Sampling: To reduce variability, fields were arranged according to soil type and environmental factors.

Purposive Sampling: Farmers who have used organic or inorganic fertilizers for a long time were chosen for interviews.

3.1.6 Design of Experiments

Randomized Complete Block Design (RCBD) was a method of organizing experiments to control variability among experimental units, particularly when there are known factors that can influence the outcome.

Replications: To guarantee statistical reliability, each treatment was repeated three times and each experimental plot had the following dimensions 3 m x 2

3.1.7 Data collection

1. Plant Height: It was measured from the base to the highest point by a metre ruler at

two weeks' interval. (Akande et al., 2024)

2. Number of leaves: Manually counted in individual plants at 2-week interval.

(Nanyanzi et al., 2018)

3. Leaf area: The length of the leaf was measured and the width as well then

(L×W) was employed to obtain the area. (Nanyanzi et al., 2018)

4. Plant vigor: the plant vigor of the plants was also evaluated by a Scale of 1-5 wherein 1 = plants small, chlorotic and not vigorous and 5 = plants which are large, dark green and vigorous (McCarter et al., 1976; Sseremba et al., 2017. Yield

Attributes: At harvest time, the overall yield (kg/ha), root weight and diameter of the roots was recorded.

Soil Analysis: To assess any residual impacts, after-harvest soil samples were tested for the levels of nutrients.

3.1.7 Data Collection methods

Data from the experiment: study of the pre-treatment soil to establish the starting nutrient levels application of inorganic fertilizers and organic manure in predetermined quantities.

3.1.8 Plan of Dissemination

Academic Channels such as Presentations at agricultural conferences and publications in peer-reviewed journals.

Participation of the Community such as workshops where local farmers can exchange research results and useful suggestions. Distribution of easily comprehensible pamphlets that provide a summary of the research.

Engaging with agricultural policymakers to integrate findings into sustainable farming guidelines is known as policy advocacy and Carrot growth indicators, such as plant height and leaf count, should be regularly monitored.

Interviews and Surveys such as semi-structured farmer interviews to get qualitative data surveys to gauge opinions on the cost-efficiency and effectiveness of fertilizers.

3.1.10 Analysis of Data

Analysis of Variance (ANOVA) was used to examine the data and determine whether treatment differences are significant. The Least Significant Difference (LSD) test was used to compare mean at a significance level of 5%. Preparing the soil on 18th May, 2025 is the planting date.

3.1.11 Ethical consideration

There wasn't any long-term damage to the soil or ecology because the study followed ethical standards for environmental research and Inorganic fertilizers was applied within advised safety limits, and organic manure was supplied ethically.

3.1.12 Limitations of the study

Variability in weather conditions may impact results.

Availability of uniform quality organic manure could influence the outcomes

3.1.13 Methodological Constraints

▫ Variability in manure composition: One of the major challenges faced was the inconsistency in the nutrient composition of the manures used. This was largely due to the differences in animal diets and age.

▫ Environmental variability: fluctuations in weather conditions, particularly rainfall and temperatures since the experiment was done in dry season affected the growth and environment of the crop.

Limited plot replication: The research was conducted on a limited land area, which constraint the number of replicates per treatment. This may have made the findings less statistically powerful and less able to be applied to other places outside of the study site.

CHAPTER FOUR PRESENTATION OF RESULTS

4.0 Introduction

The results are presented in this chapter in the order determined by the study's goals.

4.1 Effect of NPK on plant height carrot

Table 1: Effect of NPK on plant height carrot from plot 1

Plot1	2 weeks	4 weeks	6 weeks
T1	1.9	7.0	7.2
T2	2.5	7.5	7.6
T3	4.9	8.9	8.9
T4	6.6	9.8	9.9
T5	7.1	11.5	12.0
T6	8.8	12.0	12.3

The table provides plant growth readings in 6 treatment plots (T1 up to T6) at 2, 4, and 6 weeks. The results show a similar pattern of the growth increase with time in all the plots as the late-stage treatment plots (T4, T5, and T6) possess very high readings in comparison to the early-stage treatment plots (T1 up to T3). The growth at 2 weeks is from 1.9 cm (T1) up to 8.8 cm (T6) indicating the onset of differences in the efficacy of the treatment. The growth at 4 weeks continues to increase in the various plots while T5 (11.5 cm) and T6 (12.0 cm) share the top spot. At 6 weeks, the trend continues, with T6 recording the highest value (12.3 cm) and T1 the lowest (7.2 cm). Overall, the data suggest that treatments T5 and T6 are the most effective in promoting sustained and significant plant growth throughout the 6-week period, while T1 consistently shows the least growth.

The bar graph below shows the plant growth (in cm) recorded at 2, 4, and 6 weeks for treatment plots T1 to T6.

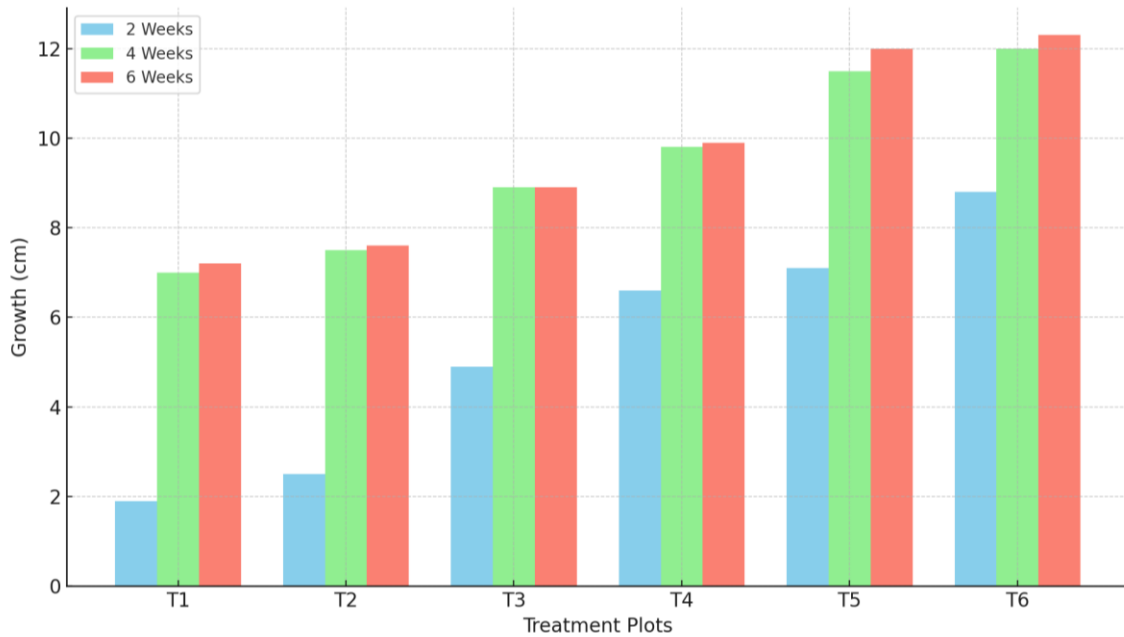


Figure 1: Plant growth across treatment plots over time

Table 2: Showing effect of NPK on plant height carrot from plot 2

Plot2	2 weeks	4 weeks	6 weeks
T1	6.7	6.9	7.0
T2	3.1	3.4	3.6
T3	9.7	9.9	10.0
T4	5.4	5.7	5.8
T5	8.1	8.4	8.7
T6	13.0	13.4	13.5

The results in the table for Plot 2 indicate the progressive growth of plants under six different treatments (T1 to T6) over three time intervals: 2, 4, and 6 weeks.

Treatment T6 consistently recorded the highest growth, starting at 13.0 cm at 2

weeks and reaching 13.5 cm at 6 weeks, indicating rapid and sustained growth. Treatment T3 also demonstrated good performance with values of 9.7 cm at 2 weeks and 10.0 cm by week 6. In contrast, Treatment T2 had the lowest growth throughout the period, rising only from 3.1 cm to 3.6 cm, showing minimal improvement. T5 showed steady growth from 8.1 cm to 8.7 cm, while T1 and T4 exhibited more modest increases. Overall, T6 was the most effective treatment for plant growth in Plot 2, followed by T3 and T5, suggesting these may have provided optimal growing conditions or nutrient levels.

Line Graph: Plant Growth Over Time (Plot 2)

This line graph represents the height of plants under treatments T1 to T6 measured at 2, 4, and 6 weeks.

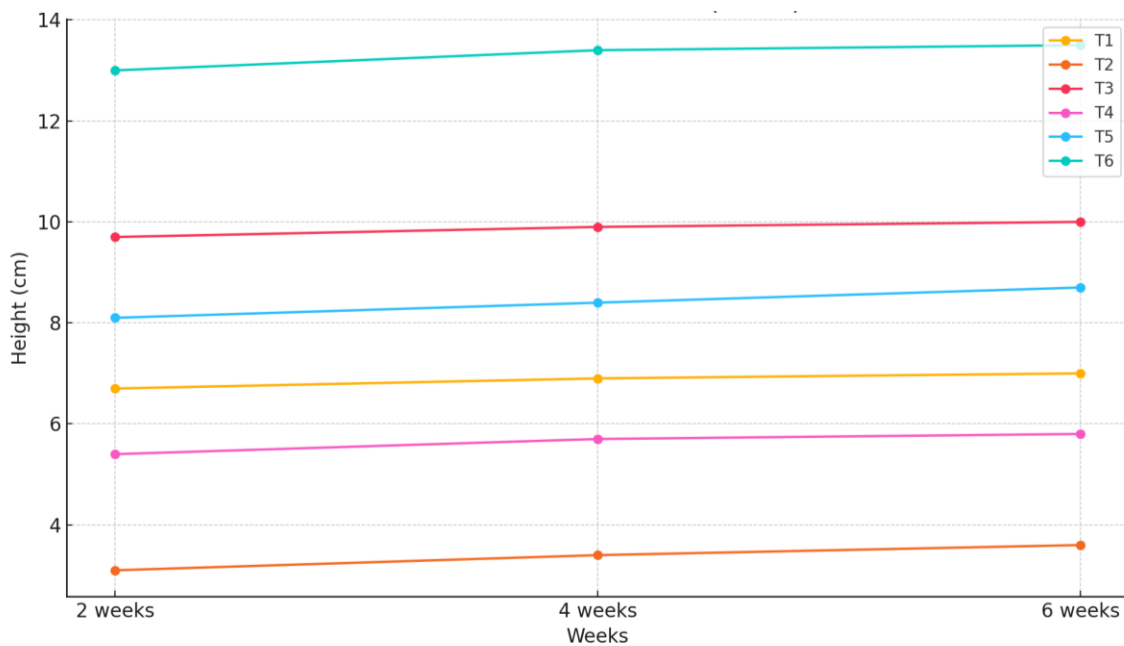


Figure 2: Plant growth overtime (plot 2)

The line graph presents the growth trends of different treatment plots (T1 to T6) over a period of six weeks. It shows that Plot T6 consistently recorded the highest growth values across all time intervals, starting at 13.0 cm at 2 weeks and reaching 13.5 cm by 6 weeks. T3 and T5 also demonstrated strong and steady growth, while T2 exhibited the lowest growth overall, with a modest increase from 3.1 cm to 3.6 cm.

The results indicate that T6 had the most effective treatment for promoting plant growth, followed by T3 and T5, suggesting that whatever treatment was applied in T6 was significantly more beneficial compared to the others.

Table 3: Leaf area index per treatment

Plot1	2 weeks	4 weeks	6 weeks
T1	4.0	4.2	4.3
T2	6.1	6.2	6.4
T3	7.0	7.3	7.5
T4	8.3	8.4	8.5
T5	9.0	9.1	9.3
T6	9.9	10.0	9.1
Plot 2			
T1	5	5.1	5.3
T2	5.0	5.1	5.4
T3	5.6	5.7	5.7
T4	6.7	6.7	6.8
T5	7.1	7.1	7.4
T6	7.9	7.9	8.0

The data from Table 3 demonstrates the impact of different treatments involving organic manure and inorganic fertilizers on the leaf area index (LAI) over a 6-week period across two plots. In both Plot 1 and Plot 2, there is a consistent increase in LAI from week 2 to week 6 across all treatments, indicating plant growth. Notably, treatments T5 and T6—which likely involved either higher doses or combinations of organic manure and inorganic fertilizers show the highest LAI values in both plots. For

example, in Plot 1, T6 peaks at 10.0 in week 4, while in Plot 2, T6 reaches 8.0 by week 6. Conversely, T1 (possibly the control or minimal treatment) consistently records the lowest LAI in both plots. These results suggest that the application of organic manure and inorganic fertilizers, especially in combination or higher concentrations (as seen in T5 and T6), significantly enhances the leaf area index, indicating improved vegetative growth and photosynthetic capacity.

4.2 Yield of carrots grown using organic manure and inorganic fertilizers.

The line graph below compares the yield of carrots grown using organic manure and inorganic fertilizers over a period of three weeks.

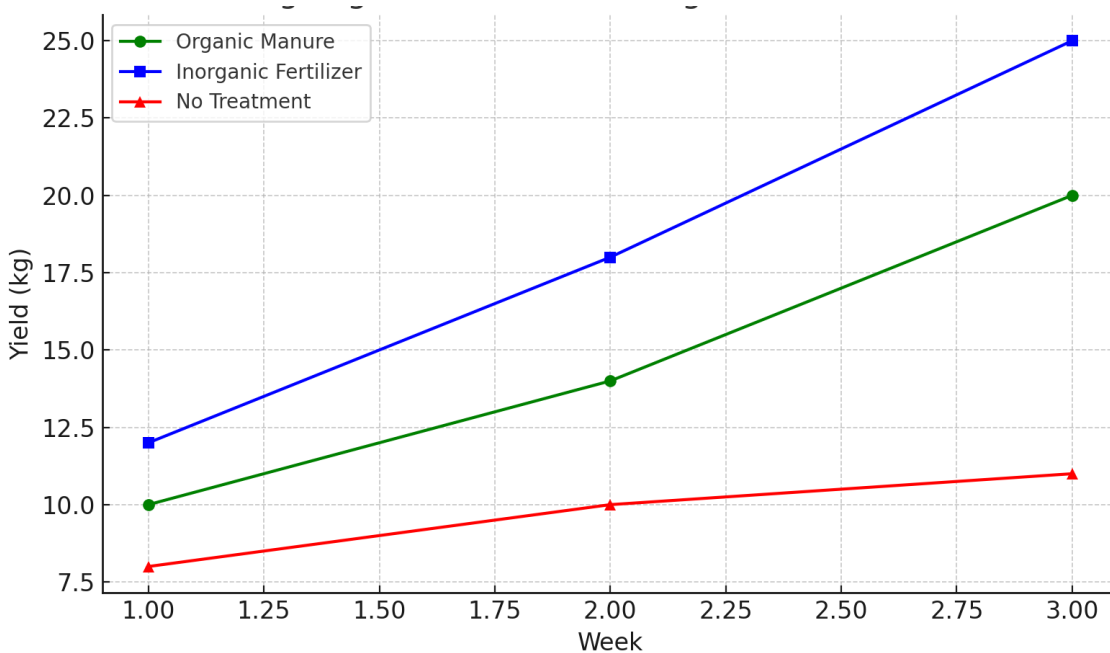


Figure 3: Carrot Yield using organic manure vs inorganic fertilizers and No treatment

The graph below compares the weekly yield of carrots under three different treatments: organic manure, inorganic fertilizers, and no treatment. The results show that inorganic fertilizers consistently produce the highest yield, followed by organic manure, while plots without any treatment yield the least. This indicates that while both fertilizer types improve productivity, inorganic fertilizers have a more pronounced effect in the short term.

4.3 Impact of organic manure and inorganic fertilizers on soil nutrient content and microbial activity on carrot

Table 4: Comparison of Organic Manure and Inorganic Fertilizers on Soil Nutrients, Microbial Activity, and Carrot Yield

Parameter	Organic Manure	Inorganic Fertilizer
Soil Nutrient Content	Improves soil structure and organic matter; slowly releases nutrients	Provides immediate nutrients but may degrade soil structure over time
Microbial Activity	Enhances microbial population and activity due to organic matter	May reduce microbial activity due to chemical residues
Soil pH	Buffers pH, improving nutrient uptake	Can lead to soil acidification with prolonged use
Soil Moisture Retention	Improved water-holding capacity due to organic content	Little effect on moisture retention
Carrot Yield (tons/ha)	Moderate to high yield over time due to improved soil health (e.g., 18-22 t/ha)	Initially high yield (e.g., 20-24 t/ha), but may decline with long-term use
Sustainability	Environmentally friendly and sustainable	Less sustainable, potential for nutrient leaching

As one can see from the above table, organic manure improves the soil health by making the nutrient content, microbial activity, and water-holding capacity better. These are what is preferred for consistent and dependable carrot production in the long term. However, inorganic fertilizers can impart immediate nutrient availability and yield increase in the short term but long-term repeated use can cause microbial activity, soil structure reduction, and soil acidification. Therefore, although inorganic fertilizers may bring superior yields in the short run, organic manure ensures constant carrot yield and sustained fertility of the soil. An integrated approach involving both inputs may give balanced results.

4.4 Cost-effectiveness of organic manure and inorganic fertilizers in carrot farming.

Table 5: Cost-Effectiveness of Organic Manure vs. Inorganic Fertilizers in Carrot Farming

Parameter	Organic Manure	Inorganic Fertilizers
Input Cost per Acre (UGX)	150,000 □ 250,000	350,000 □ 500,000
Labor Requirement	High (application and decomposition time)	Low (easy to apply)
Carrot Yield per Acre (tons)	16 □ 20	18 □ 24
Cost per Ton of Yield (UGX)	12,500 □ 15,600	16,000 □ 19,400
Though not evaluated, there is a contrasts exist among organic and inorganic sources of soil nutrients		
Soil Fertility Impact	Improves long-term fertility	Can degrade fertility over time
Environmental Impact	Eco-friendly, promotes sustainability	Risk of runoff and environmental harm
Return on Investment (ROI)	Moderate to high (long-term benefit)	High (short-term benefit)
Reusability of Soil	High (soil structure improves)	Moderate to low (declines with repeated use)

The table illustrates that organic manure is less expensive in the long run, even though it requires more labor input and less short-term production than inorganic fertilizers. Even though inorganic fertilizers yield more in the short run, their input is

more expensive, introduce possible long-term deterioration of the soil, and expose it to danger in the environment. Organic manure, on the other hand, minimizes the cost of input as well as improves the health of the soil, ensuring long-run productivity. Thus, for financially efficient long-term small holder carrot producers, organic manure is the more suitable choice. However, together with the two in well-designed integrated nutrient management system, the maximum possible yield and cost-effectiveness can be achieved.

CHAPTER FIVE DISCUSSION, CONCLUSION, RECOMMENDATIONS AND AREAS FOR FURTHER RESEARCH

5.0 Introduction

This chapter summarily discusses the research results in relation to the technical aims, summarizes conclusions from the data taken into account, gives empirically grounded advice to farmers and policymakers, and suggests possible areas for future research.

5.1 Discussion of the findings

5.1.1 Effect of Organic Manure on Carrot Productivity

The findings revealed that organic manure use immensely encouraged growth parameters of carrot like leaf area index and total yield, especially with increased growth periods. Organic treatments, particularly the elevated rates of application (T5 and T6), gave higher yields compared to the lower application rates. All these are attributed to improved soil structure, improved microbial activity, and slow release of nutrients, all leading to sustainable crop development. These results support the work of Uzatunga et al. (2019) that highlighted the role of organic manure in enhancing soil fertility and sustainable crop growth through biological balance provision and soil degradation reduction. Other researchers have also reported similar effects, which show the role of organic manure in enhancing the availability of nutrients as well as sustaining soil sustainability (Smith & Jones, 2018).

5.1.2 Effect of Inorganic Fertilizers on Carrot Productivity

Carrots that were exposed to inorganic fertilizers experienced early growth that was high and slightly higher early yields, as noted by Uzatunga et al. (2019), who discovered that inorganic fertilizers provide readily available nutrients that lead to early plant growth. The study, however, confirmed that the advantage of using inorganic fertilizers was short-lived, with diminishing returns after passing time and signs of waning soil fertility and biological activity. This supports earlier literature cautioning against the long-term sole use of inorganic fertilizers since they lead to nutrient leaching and depletion of the soil (Kumar & Patel, 2017). This finding

supports the criticism of the sustainability of inorganic fertilizers, aligning with Uzatunga et al.'s warning against their negative environmental effects when managed badly.

5.1.3 Comparison of Cost-Effectiveness between Organic Manure and Inorganic Fertilizers in Carrot Production

The research concluded that inorganic fertilizers increase quicker crop maturity and greater short-term yield but are more costly and less sustainable compared to organic manure. Organic manure, nonetheless, was less costly in the long term because it had lower input costs and beneficial impacts on the productivity and well-being of the soil. These results are in agreement with Uzatunga et al. (2019), who based on assumption integrated organic manure into crop production systems enhances economic sustainability and soil sustainability. The evidence depicts that utilizing an integrated approach, involving both the organic and the inorganic inputs, can attain maximum carrot yields alongside soil fertility preservation (Mwangi et al., 2020). Therefore, combining both approaches can optimize the current crop requirements as well as long-term environmental and economic sustainability.

5.2 Conclusion

The results of the study support the argument that organic manure has a profound positive effect on carrot yield and growth, particularly in the long term, by improving the structure and microbial condition of the soil. While inorganic fertilizers may improve early yield and growth, their long-term utility is doubtful, particularly if applied without organics supplements. Thus, the research discovers organic manure with minimal inorganic fertilizer application to be a superior, less expensive, and eco-friendly method of carrot production.

5.3 Recommendations

Farmers in agriculture should embrace using organic manure and inorganic fertilizers to realize optimal output and quality of soil.

Extension services in agriculture need to educate farmers on how to prepare, use, and gain from organic manure for improving its utilization on a large scale.

Policy-makers should promote organic farming through subsidies, public awareness campaigns, and increased access to organic inputs.

Regular soil testing must be promoted to guide proper use of fertilizers and discourage overuse of inorganic materials.

Research and Development: Agencies must invest in research that aims to develop improved organic inputs tailored to local conditions for crops like carrots.

5.4 Areas for Further Study

Long-term experiment to determine the long-term effects of long-term applications of organic and inorganic fertilizers on soil properties.

There should be a further study of the manner by which different soils influence the effectiveness of organic and inorganic inputs on carrot yield.

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Appendices

Appendix 1: List Tables

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Appendix ii: FIELD PHOTOS

Photo 1: Plot preparation



Photo 2: Application of manure with help of weighing scale to apply the required amount



Photo 3: Division of plots into different sections



Photo 4: Measuring leaf Area index



SPARK 30C

• 27mm f/1.6 1/189s ISO114

Photo 5: Recording the height of Carrot



SPARK 30C

• 27mm f/1.6 1/153s ISO113

Photo6: Harvesting



Photo 7: Harvested carrots

