

Effects of Chinese Cabbage (*Brassica Rapa*) Based-Organic Fertilizer on Growth and Productivity of Egg Plants, in Lusaka District, Zambia.

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Abstract - This study investigated the efficacy of Chinese cabbage (*Brassica Rapa*) liquid manure as an organic fertilizer and evaluated its role in promoting sustainable vegetable production compared to conventional synthetic practices. A field experiment was conducted in Lusaka over an eight-week period to assess its impact on the growth and yield of eggplant (*Solanum melongena*). The main objective of the research was to assess the effects of Chinese cabbage (*brassica Rapa*) organic fertilizer and synthetic fertilizers on the growth and productivity of eggplants and the specific objectives was to determine the effects on vegetative parameters such as plant height, leaf length, and stem diameter and yield attributes, including fruit number and weight. The experiment followed a completely randomized design with three treatments: T1 (Chinese cabbage liquid manure), T2 (synthetic fertilizer), and T3 (control, no fertilizer). Data collected from replicated plots were analysed using ANOVA, which revealed significant differences in leaf length, stem diameter, and fruit yield among treatments. The results demonstrated that the Chinese cabbage-based manure significantly enhanced fruit production and soil health, supporting its potential as a viable organic alternative for small-scale farmers seeking to reduce reliance on costly synthetic inputs while maintaining productivity.

Keywords - productivity, crop yield, organic fertilizer, smallholder farmers.

INTRODUCTION

Background Eggplant (*Solanum melongena* L.), commonly referred to as brinjal or garden egg in Zambia, is an important horticultural crop belonging to the Solanaceae family. It is widely cultivated in tropical and subtropical climates across the world, including various agro-ecological zones of Zambia. The crop holds significant economic and nutritional value in both rural and urban households, primarily due to its affordability, adaptability, and health benefits (Mweemba et al., 2022). It contributes to food security, serves as a source of income for smallholder farmers, and is frequently included in traditional dishes across the country.

Nutritionally, eggplant is low in calories and rich in essential nutrients such as fibre, potassium, and vitamins B1, B6, and C. It also contains phenolic compounds with antioxidant properties that are beneficial in reducing the risk of chronic diseases like hypertension and cardiovascular ailments (Masebo et al., 2020). In many Zambian communities, the vegetable is valued not only for its palatability but also for its potential medicinal properties, including its use in managing blood cholesterol and improving digestion (Chitundu & Zulu, 2021).

Despite its potential, the yield and quality of eggplant in Zambia remain below optimal levels. This is largely attributed to factors such as soil fertility depletion, limited adoption of improved agronomic practices, pest and disease incidence, and erratic weather conditions. According to Phiri and Simweya (2024), continuous monoculture cropping without adequate nutrient replenishment has led to severe nutrient mining in soils, resulting in diminished productivity.

Many farmers rely heavily on inorganic fertilizers as a quick fix to restore soil fertility. However, these inputs are not only costly but can also negatively impact soil health when applied excessively or inappropriately (Nkumbula et al., 2023). Overreliance on chemical fertilizers has been associated with declining soil organic matter, reduced microbial diversity, and increased soil acidity. Consequently, alternative approaches that combine productivity with sustainability are gaining interest.

Organic fertilizers, including compost, poultry manure, and farmyard manure, are increasingly being promoted as viable alternatives to improve soil fertility and support sustainable agriculture. These inputs enhance soil structure, water

retention, nutrient availability, and biological activity. (Mweemba et al. (2022) reported that application of organic fertilizers significantly improved the growth and yield of eggplant while also contributing to improved soil health in Central Province. However, challenges such as lack of access to quality organic inputs, labour intensity, and inadequate farmer training have limited their widespread use.

Integrated Nutrient Management (INM), which involves the combined use of organic and inorganic fertilizers, presents a promising strategy for enhancing crop productivity and ensuring long-term soil fertility. Studies by Phiri and Simweya (2024) show that INM not only increased eggplant yields in peri-urban areas of Lusaka but also maintained soil microbial populations and improved soil nutrient balance. Despite these benefits, adoption rates among farmers remain low due to limited extension services and insufficient policy support.

To harness the full potential of eggplant production in Zambia, there is a need for concerted efforts to promote sustainable nutrient management practices. Research should focus on evaluating the effects of various fertilizer regimes under different agro-ecological conditions to develop location-specific recommendations. Moreover, empowering farmers through training, demonstrations, and improved access to inputs will be critical in translating research findings into tangible on-farm benefits (Ianthina and Mahusoon, 2019).

Problem Statement

The increasing use of inorganic fertilisers in crop production in Lusaka district has raised concerns about the environmental degradation and soil health deterioration. However, the production of crops has been constrained by the declining soil fertility and high cost of inorganic fertiliser which limits plant growth and yield (Silungwe 2024).

The introduction of foliar Chinese cabbage-based organic fertilizer presents a sustainable, cost-effective option for these farmers. However, the lack of awareness, training, and scientific validation regarding its use limits its adoption. Moreover, current research and extension services have not adequately explored or promoted localized organic fertilizer production methods tailored to Zambia's specific socio-economic and agro-ecological conditions (Mweemba, 2020).

This gap has led to continued dependence on costly synthetic fertilizers and neglect of locally available organic resources that could enrich soil health without compromising environmental sustainability. There is a need for research that evaluates the efficacy of Chinese cabbage organic fertilizer in eggplant production and its role in enhancing soil fertility, reducing input

costs, and increasing yields. Addressing this issue will not only empower small-scale farmers but also contribute to Zambia's broader goals of sustainable agriculture and food security (Mweemba, 2020).

Objectives of The Study

The aim of this study was to evaluate the effects of Chinese cabbage (*Brassica Rapa*)-based organic fertilizer and on the growth and productivity of eggplants among small-scale farmers in Lusaka

Specific Objectives

- To determine the effects of Chinese cabbage (*brassica Rapa*) organic fertiliser on the vegetative growth parameters of eggplant example plant height, leaf size and stem diameter and number of fruits.
- To evaluate the impact of Chinese cabbage (*brassica Rapa*) on the yield attributes of egg plant such as the number of fruits, average fruit weight, total yield per plot

HYPOTHESIS

HO: mean plant height, leaf size, and stem diameter are equal across all the fertiliser rates.

H1: mean plant height, leaf size and stem diameter are not equal across all the fertiliser rates.

HO: Fruit number, average fruit weight, and total yield per plant do not differ across rates

H1: fruit number, average fruit weight, and total yield per plant differ across rates.

Significance of The Study

The research findings from this study are very profitable to farmers in different scales of production by providing them with knowledge of profitable and less costly vegetable manure. This will benefit farmers that will produce eggplants on both small and large scale as compared to conventional practices. This research study will contribute to vast streams of knowledge that already exist with hopes of intervening and providing the satisfaction of increased yields in vegetable production (Banuelos, 2020)

II. MATERIALS AND METHODOLOGIES

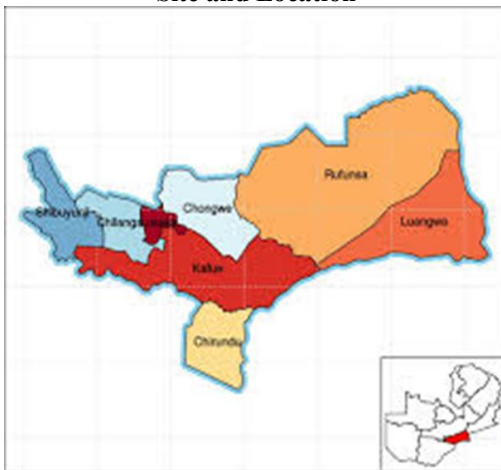
This stage of the research started with material preparation, equipment preparation, and the inspection of the physical properties of aggregates. The primary material required for the study was a suitable variety of eggplants (BLACK BEAUTY), which was sourced from agro stores 8in Lusaka town to ensure the best selection.

Various measuring tools was also used, including a measuring tape, and a 30 cm ruler, all of which was obtained from the Lusaka city market. Additionally, fruit weight, measurements was taken using a portable electronic scale, which costs approximately K250.

Other essential materials included a notebook for raw data entry, pens and pencils, and an electronic calculator for data computation. A 20-liter bucket was used for decomposing manure, along with a wooden stick for stirring. Additional equipment includes a watering bucket, planting trays, and growing media.

Furthermore, organic fertilizers such as Chinese cabbage. Other necessary tools include a hand hoe, a rake, and a shovel.

Site and Location



Plant Materials

The plant materials used in this study Where seeds, as they are part of sexual propagation methods. This approach provided more reliable and compelling evidence for assessing the yield of eggplants (black beauty) grown organically using Chinese cabbage (Brassica Rapa) manure, compared to those grown with low concentration of Chinese cabbage organic manure.

Fertilizers

The experiments utilized the same fertilizer with different concentrations, including highly concentrated Chinese cabbage fertiliser and low concentrated organic fertiliser. all the organic fertilizers were sourced from Soweto market, Munyaule market and Lusaka city market. fertilizer making process fertilizer making consisted of Chinese cabbage (brassica Rapa), 80 litters bucket of water, stirring stick and water. I had put water in the bucket and added Chinese cabbage in the water and let it be

there for one week in order for it to decompose and incorporate then it is ready for use.

Data Recording Tools

The data recording tools included a notebook, which facilitate real-time data capture. This was to provide a convenient way to record and store field data in a hard copy format. The collected data was later analysed using computer software such as Microsoft Excel.

In addition to the notebook, an Android notepad will be used to supplement data recording, particularly for tracking operations such as land preparation, planting, and fertilization on specific dates.

Treatments and Experimentl Design

The trials were conducted simultaneously using a experimental cross section design under irrigated conditions. A single variety of eggplant (black beauty) which was used across all three treatments.

- Treatment 1: Chinese cabbage organic fertilizer highly concentrated
- Treatment 2: Chinese cabbage organic fertilizer low concentration.
- Treatment 3: No fertilizer or manure (control).

Each experimental plot was measured 1.5 meters. Eggplant seeds were sown in rows spaced 20 to 30 cm apart at a depth of 50 mm. The growing period took two weeks t2o one month, during which the seedlings germinated. At the end of this period, 8during which fertilizers—both highly and low concentrated organic (Chinese cabbage manure) was applied (Sydney ,2025).

A figure further illustrates the experimental design.

Plot 1	Plot 2	Plot 3
treatment	treatment	treatment
8with	with	with
Chinese	Chinese	control
cabbage	cabbage	
(HC)	(LC)	
treatment	treatment	treatment
with	with	with
Chinese	control	Chinese

cabbage (LC)		cabbage (HC)
treatment with control	treatment with Chinese cabbage (HC)	treatment with Chinese cabbage (LC)

Valid N (listwise)	108				
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From the Anova table above, the results of the experiment show that the p-value for plant height is greater than the significant value of 0.05%, which leads to the conclusion that there is no significant difference in the means of the plant heights across the three treatments. On the other hand, there is a statistically significant difference in the means of leaf length between the three treatments.

Land Preparation

The land was prepared primarily through tillage. The first step involved manually ploughing the soil using a hoe while simultaneously clearing the field of vegetation, stones, and dry grass with tools such as rakes and shovels. This process also included breaking up soil clods, if present, and levelling the land to ensure uniform treatment conditions.

Next, holes were made which were used to plant the eggplants in lines. A total of 9 lines were established—two for the initial experiment and four for replications. Finally, the vegetable beds were watered once a day before planting to ensure optimal soil moisture for seed germination (Cedula, 2023)

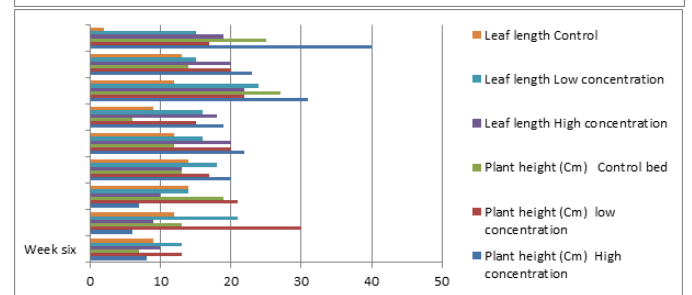
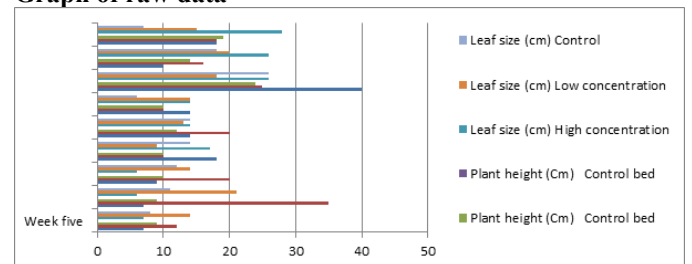
Findings/ Results

For Objective one, the tables of ANOVA analysis display the tests that were performed on Plant height, leaf size, stem diameter and number of fruits in chrono-sequence. Furthermore, raw data for the various test parameters have been displayed at the end of objective one display results.

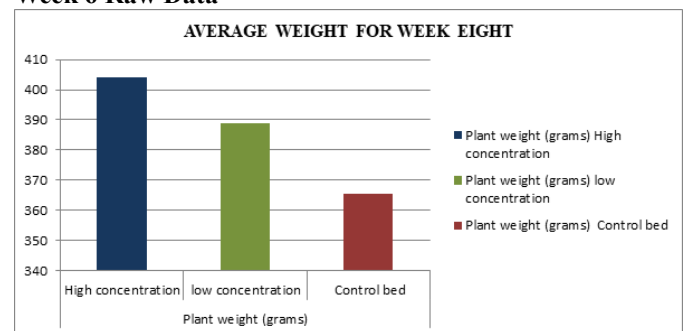
Table 1; Summary Statistics of Plant Height And Leaf Length Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Plant height	108	5	42	17.70	8.774
Leaf length	108	2	28	14.31	5.270
Groups	108	1	3	2.00	.820

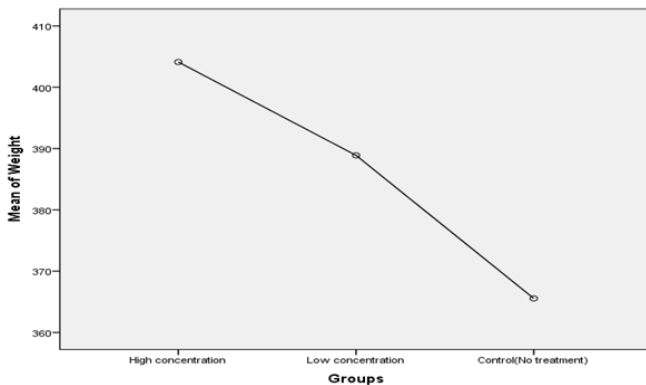
Graph of raw data



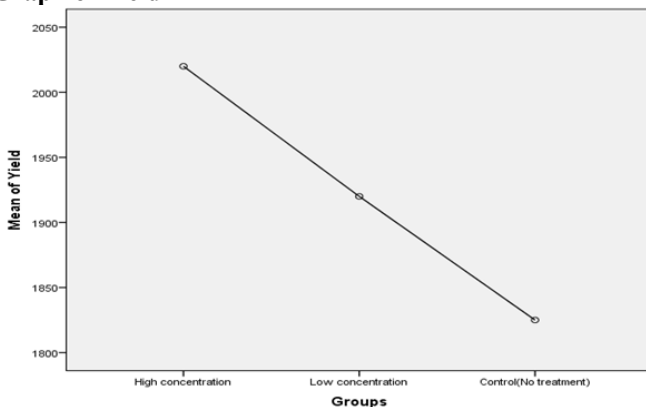
Week 6 Raw Data



Objective 2
Graph of mean weight



Summary of Calculated Yield
Graph of Yield



Discussion

The results of this study offer a detailed understanding of the effectiveness of organic fertilizer made from Chinese cabbage (*Brassica rapa*) in the cultivation of eggplant (*Solanum melongena*). The null hypothesis was rejected for certain factors, particularly leaf length and fruit weight, but not for plant height, revealing a varying effect of the organic amendment on different dimensions of plant physiology and growth. The lack of a significant difference in plant height implies that the nutrient release pattern of the Chinese cabbage compost may not have delivered the immediate, high concentration of nitrogen commonly associated with synthetic fertilizers, which is crucial for stimulating rapid vegetative growth and stem elongation, Singh et al., (2021). This aligns with the well-documented concept that organic fertilizers often mineralize nutrients more slowly, providing a steady, sustained release rather than a rapid growth stimulus, Edmeades, (2022). Consequently, while synthetic fertilizers might produce taller plants initially, the organic treatment achieved comparable structural growth over the trial period.

This improvement indicates that the foliar application successfully delivered vital micronutrients or substances that promote plant growth directly through the leaf surface, avoiding any potential issues of nutrient immobilization or fixation in the soil. Brassica species are recognized for their high content of nutrients such as potassium, phosphorus, and sulfur, along with beneficial bioactive compounds, Ahmed et al., (2020). The direct uptake of these elements likely enhanced cellular growth and metabolic processes within the leaf, resulting in an increased photosynthetic area and efficiency, which ultimately supports fruit development.

However, realizing this potential is contingent upon overcoming the awareness, knowledge, and adoption barriers identified in the third objective. The perceived slower action of organic inputs, labour-intensive production processes, and a lack of technical know-how are significant hurdles, Nyambo et al., (2019). The positive yield data from this study provides a compelling evidence-based argument for extension services. To promote adoption, demonstration plots, hands-on training in simple compost preparation and foliar spray techniques, and knowledge-sharing among farmer groups are essential strategies to bridge the gap between research and practice, Mutyasira et al., (2018).

The implications of these findings for small-scale farmers in the Lusaka agro-ecological area are significant, especially concerning the second and third specific objectives. The ability to utilize a locally sourced waste product to enhance yield can lessen reliance on expensive synthetic fertilizers, thereby improving both farm profitability and sustainability. Nonetheless, there are considerable barriers to adoption, including limited awareness, insufficient knowledge about production methods, and the common perception that the effects of these alternatives are slower than those of synthetic inputs, Tadesse et al., (2021). Consequently, extension services need to not only communicate these favourable outcomes but also offer practical and affordable training on how to prepare compost and apply foliar treatments to help mitigate these challenges to adoption.

The statistically significant difference in stem diameter observed between the treatment groups underscores the efficacy of the Chinese cabbage-based organic fertilizer in promoting substantial structural growth in eggplants. Stem diameter is a key indicator of plant vigor, vascular development, and mechanical strength, all of which are critical for supporting fruit load and resilience against environmental stressors, Li et al., (2021). The superior performance of the organic treatment, likely comparable to or exceeding synthetic alternatives, can be attributed to the synergistic effects of

improved nutrient availability particularly potassium and phosphorus, which are vital for cell wall integrity and cellular expansion and enhanced soil conditions facilitating better root development and nutrient uptake. These findings align with recent studies demonstrating that organic amendments derived from Brassica species contribute not only to macronutrient delivery but also to the release of bioactive compounds that stimulate root and shoot development, Franciosi et al., (2021). This result reinforces the potential of locally sourced organic fertilizers as a viable strategy for enhancing crop productivity and resilience in small-scale farming systems.

III. CONCLUSION

This study demonstrates that organic amendments, specifically Chinese cabbage organic fertilizer, have a significant positive impact on various growth parameters of eggplants, including plant height, root diameter, fruit weight, total yield, and plant height. The findings reinforce the role of organic amendments in enhancing eggplant cultivation by improving nutrient availability, promoting root development, and supporting sustainable agricultural practices.

One of the primary findings was the substantial increase in number of fruits observed with both high and low concentration of Chinese cabbage applications. Fruit weight is vital in egg plant, a fruit crop. The nitrogen content in Chinese cabbage likely contributed to this by promoting cellular growth and elongation, The increased root length indicates that organic amendments not only improve immediate nutrient availability but also foster root structure that may have long-term benefits for soil health and future crops.

Stem diameter is a critical parameter for eggplants since consumer preference often leans towards thicker, uniform fruits, which are perceived as higher quality. Both amendments contributed significantly to an increase in root diameter. Chinese cabbage, nitrogen content likely stimulated cell division and expansion For farmers, the increased root diameter means a potentially higher market value, as thicker fruits are often more desirable in the market. This finding suggests that using organic amendments could enhance not only the physiological health of the plants but also their commercial viability, making eggplant more appealing to consumers.

Recommendation

It is strongly recommended that agricultural extension services and local farmer cooperatives prioritize the promotion of Chinese cabbage-based organic fertilizer as a key strategy for enhancing eggplant productivity, particularly due to its

significant positive impact on fruit number. This result demonstrates the fertilizer's efficacy in improving reproductive yield, which is a critical economic factor for small-scale farmers. To facilitate adoption, practical, hands-on training programs should be developed to demonstrate the simple process of preparing and applying the liquid manure, emphasizing its cost-effectiveness and the use of locally available waste materials. Establishing community demonstration plots would allow farmers to observe the increased fruit load first hand, helping to overcome perceptions about the slower action of organic inputs by providing visible evidence of their benefits.

Furthermore, the implementation of community-based composting hubs is essential to address the identified barrier of limited farming space. These centralized facilities would enable the collective production of high-quality liquid manure, reducing the individual labour and space requirements for farmers. This approach not only makes the technology more accessible but also fosters a circular economy by converting agricultural waste into a valuable resource. By providing a reliable and convenient source of organic fertilizer, these hubs can significantly lower dependency on synthetic fertilizers, reduce production costs, and enhance the sustainability of farming systems in the Lusaka region.

Finally, it is recommended that future efforts integrate this organic fertilization strategy with other climate-resilient practices, such as water conservation techniques, to create a holistic and adaptive farming system. Participatory on-farm trials should be conducted to fine-tune application rates and timing, ensuring optimal results across diverse local conditions. These trials, coupled with knowledge-sharing workshops led by successful early adopters, will help build trust and accelerate the uptake of this practice. By addressing both the technical and social barriers to adoption, these initiatives can unlock the full potential of Chinese cabbage-based fertilizers to improve livelihoods, enhance food security, and promote environmental sustainability in small-scale agriculture.

To ensure long-term sustainability and maximize the benefits observed in this study, it is further recommended that policymakers and agricultural development agencies consider incorporating subsidies or incentives for farmers who adopt Chinese cabbage-based organic fertilizers. Financial support could offset initial setup costs for community composting hubs or provide resources for scaling up production. Additionally, integrating this practice into national agricultural extension programs would institutionalize its use, ensuring widespread dissemination and continuity beyond pilot projects. By creating an enabling policy environment and aligning this innovation

with broader food security and climate resilience goals, the significant gains in fruit productivity demonstrated here can be sustained and amplified across the agricultural sector.

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