BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

DEPARTMENT OF CROP SCIENCE

A comparative study on different application rates of inorganic fertilizer

(Compound C) with organic foliar fertilizer (Humason Complex) in cabbages (*brassica oleratiaL).*

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A Dissertation Submitted in Partial Fulfillment of the Requirements of the Bachelor of Science Honors in Crop Science Degree.

June 2025.

DECLARATION

I do hereby declare that this research project entitled **A comparative study on different application rates of inorganic fertilizer (Compound C) with organic foliar fertilizer (Humuson Complex) in cabbages (*brassica oleratiaL)*** was written by me and that it is a record of my own study work.

Signature :

Date : 1 June 2025

This is being submitted for the partial fulfilment of the requirements of Bachelor of Science Honours Degree in Crop Science with the approval of supervisors.

APPROVAL FORM

The undersigned certify that they have supervised and recommended to the University for Acceptance and exanimation of the research project entitled **A COMPARATIVE STUDY ON DIFFERENT APPLICATION RATES OF INORGANIC FERTILIZER (COMPOUND C) WITH ORGANIC FOLIAR FERTILIZER (HUMUSON COMPLEX) IN CABBAGES (*BRASSICA OLERATIAL)*** submitted by **ANESU NATALIE BANGOJENA** in partial fulfilment of the requirements for the award of the degree of Bachelor of Science Honours Degree in Crop Science.

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(Signature of supervisor) (Date)

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(Signature of student) (Date)

DEDICATION

I dedicate this project to my mother Fadzai Gertrude Sithole and my brother Abel Bangojena.

Acknowledgements

First and foremost, I give great gratitude to the Almighty God for his never ending grace, mercy and provision throughout the entire project. I also give thanks to, the librarian Mrs F Tsekea, who worked tirelessly and selfless in helping me. Not forgetting my supervisor Professor Mandumbu for his guidance and support in completing my project, forever grateful sir.

My sincere gratitude goes to Agronomist Angellah Chinodakufa at Farmbiz Pvt Ltd Mutare for helping me understanding the power of Humason Complex foliar Fertilizer.

ABSTRACT

The problem with over reliance on synthetic nutrients from inorganic fertilizers is that they cause soil degradation and nutrient imbalance due to soil acidification and soil salinization. While organic fertilizers does not create such problem. The main objective of the study was to compare the different application rates of inorganic fertilizers with foliar fertilizers on the growth and yield of cabbages. The study was carried out in Cleverhill, Bindura, during the 2025 summer farming season., The trial was laid out as a Randomized Complete Block Design with five treatments (0%, 15%, 25%, 50%, and 75% of recommended rates of inorganic fertilizer Compound C in combination with organic fertilizer (Humason Complex) and three replications. The data collected across all treatments was analyzed using Genstat software Seventeenth Edition. Results indicated that while initial number of leaves and leaf length showed no significant difference, a marked increase in the number of leaves and leaf length emerged from week four onwards, particularly in treatments with higher rates of Compound C combined with Humuson Complex. The final yield analysis revealed a significant difference across treatments ($p<0.05$) , with the highest yield recorded in the 75% Compound C treatment. This recommends that optimal combinations of inorganic and foliar fertilizers can enhance cabbage growth and yield, providing valuable understanding for sustainable agricultural practices as well as sustainable soil healthy improvement in Zimbabwe soils.

CONTENTS

List of Figures

List of tables

CHAPTER 1: INTRODUCTION

1.1 Background

Cabbage (Brassica *oleracea var. capitata L*) is a green leafy biennial plant originating from California (Riba et al., 2018). It is cultivated as a yearly vegetable for its compact foliar cluster. They originated from a wild cabbage, *Brassica oleracea var. oleraceae* and they have a close relationship with broccoli and cauliflower. Cabbages are commonly grown in cooler regions and it is a crop that is grown by most of the farmers and are suitable for consumption either as fresh salads or cooked as a vegetable. The leaves can be used uncooked in salads and prickles and even cooked. Some authors say that cabbage is utilized to help with stomach pain, excessive stomach acid, stomach and intestinal ulcers, and a stomach issue known as Roemheld syndrome (Bachynski, 2024). The head contains a rich supply of vitamins, minerals and dietary fibers and also provide vitamin A, B, C, along with minerals such as P, K, Na, Fe, fats, and proteins (Galani et al., 2022).

For cabbages to provide all these nutrients in a diet it must get all its nutrients from the soil for it to grow healthy without any hidden hunger of any lacking nutrient. The nutrients can be provided by the application of fertilizers which provide both macronutrients and micronutrients (Nadeem et al., 2018). Most farmers in Zimbabwe have already acknowledged that the use of inorganic fertilizer is a gateway to archiving great yields to cabbage production (Galani et al., 2022).

Cabbages are grown under overhead, pivot, micro-jet and drip irrigation systems. It is a heavy feeder and input intensive. It is produced by many farmers in Zimbabwe for food and income generation. The crop is grown all year round with a plant population of 40 000 to 50 000 plants per hectare. It has a local and regional demand. Cabbages are capable of growing in climatic conditions that are cool and humid. The petioles are more easily dissemble on the leaves and the head’s quality is reduced in dryer conditions. The ideal temperatures for growth and development fall in the range of 18-20 degrees (Riba et al., 2018). Cabbages can grow in many different climates and can be cultivated all year round in most areas and also in various types of soils, but they do well in loamy soils which are well drained and are capable of retaining moisture, rich organic matter and they do not respond well in highly acidic soils (Riba et al., 2018).

Most cabbages have thick, alternating leaves, with margins that range from wavy or lobed to highly dissected; some varieties have a waxy bloom on the leaves (Nakano, 2020). Plants have root systems that are fibrous and shallow. The cabbage plant has a complex structure consisting of various parts such as roots, stems and leaves. Head formation is a quantitative trait, controlled by multiple genes. Currently few studies have identified quantitative traits heading in cabbages such as head weight, head diameter, head height and number of leaves (Báez, 2024).

In combination of inorganic basal and organic foliar fertilizers will give the plants the nutrients they need. It is a fact that the use of inorganic fertilizers for the crops is not good for soil health because of residual effect. Cabbages require low chlorine content basal blends as they are salt sensitive. For this reason it is advisable to use compound C always for cabbage production for greater performance (Shukla, n.d.). However the introduction of organic foliar fertilizers (Humason Complex) has been introduced in the farming sector to increase yields as well as promoting sustainable Agriculture through soil health enhancement. Humason based fertilizers contains Fulvic acid, folic acid and humic acid as well as important vitamins like carotene and vitamin A acid which are important for amending soil by improving nutrient uptake and increase water. As a result increasing the growth and yields of cabbages among farmers. Therefore this study was conducted using different application rates of inorganic fertilizer compound C with Humason based foliar fertilizer on the growth and yield of cabbages.

1.2 Problem statement

It is a fact that the use of inorganic fertilizers for the crops is not good for soil health because of residual effect. The problem with over reliance on synthetic nutrients from inorganic fertilizers is that they cause soil degradation and nutrient imbalance due to soil acidification. While organic fertilizers do not create such problem (Reza et al., 2016).It is also that inorganic fertilizers are a high-cost to the farmers as compared to organic fertilizers. As for (Silva et al., 2021) regardless of the value of cabbage nutritional management and cabbage economic and social impacts, there are a few studies on the appropriate management of the crop fertilizer combinations of Humason foliar fertilizer with compound C. Due to the recent introduction of Humason foliar fertilizers in the agriculture chemical market, it is near to impossible for a researcher to convince farmers to adopt the use of Humason foliar fertilizers and replace inorganic fertilizers for cabbage farming because farmers may not trust new or unfamiliar products. Farmers may not be aware of the benefits of Humason based foliar fertilizers but applying both may be adopted.

1.3 Justification

In order to find the effective combination rates of basal inorganic fertilizer Compound C with organic Humason Complex foliar fertilizer on the growth and development of cabbages this study was carried out. This will help farmers to choose the most effective rate of inorganic fertilizer compound C to use when combining with Humason foliar fertilizers for their cabbages. This will in turn result in the improvement of food and nutrition security and income generation of cabbage farmers.

This research will contribute to the development of sustainable and efficient cabbage production systems, addressing the knowledge gap in inorganic fertilizer (compound C) using foliar fertilizer (humason complex).

1.4 Objectives

1.4.1 Main objective

The main objective of this project is to compare the different application rates of inorganic fertilizers with organic Humason foliar fertilizer on the growth and yield of cabbages *(Brassica oleracea L.*)

1.4.2 Specific objective

1. To determine the effect of different application rates of inorganic fertilizer compound C with organic Humason foliar fertilizer combinations on the number of leaves of cabbages

2. To investigate the effect of different application rates of inorganic fertilizer compound C with organic Humason foliar fertilizer combinations on the of leaf length of cabbages.

3. To determine the effect of different application rates of inorganic fertilizer compound C with organic Humason foliar fertilizer combinations on the yield, head weight of cabbages.

1.5 Hypothesis

1.5.1 Null Hypothesis

There is no significant effect on the different application rates of inorganic and foliar fertilizers in the growth and yield of fertilizers.

1.5.2 Alternative Hypothesis

There is a significant effect on the different application rates of inorganic and foliar fertilizers in the growth and yield of fertilizers.

CHAPTER 2: LITERATURE REVIEW

2.1 History of cabbage farming

According to Taheri et al., (2020) cabbages are a biennial and herbaceous crop, which is widely grown in mild climate one of the world. Farming of cabbages in Bangladesh is mainly limited by the winter months. The edible portion of cabbage is known as head, which is made up of many thick and overlapping smooth leaves (Taheri et al., 2020). Cabbages are cultivated mostly for its leaves and are the most widely cultivated crop in the world and can be used as fresh in salads or cooked vegetable product (Riba et al., 2018).

2.2 Cabbage Uses

The head contains a rich supply of vitamins, minerals, and dietary fibers and also provides vitamin A, B, & C, along with minerals such as P, K, Na, Fe, fats, and protein (Galani et al., 2022). For the cabbages to provide all these nutrients in a diet a number of nutrients must be supplied to the plant during its growing period and these nutrients include both micronutrients and macronutrients in the form of fertilizers.

2.3 Health and economic benefits of cabbages

Cabbages are a vital basis of vitamins and minerals in a maize-based diet, as well as a source of income for small holder farmers (Jankowski et al., n.d.). As of (Alexandra, 2020) cabbages where traditionally used as medicinal plants for a number of healing properties , as an addition to its normal use as a consumptive vegetable and it has been used as remedy therapy to mushroom poisoning, as a treatment to drunkenness to avoid the adverse effects of drinking, and as a cure of hangovers and head pains. The cleansing effect of cabbages is due to the contents of high sulphur. Beside sulphur cabbages also contain other nutrients such as Calcium, Iron, Vitamin A, C & E, Minerals, Riboflavin, Nicotinamine and Ascorbic Acid which are required by the human body for various functions as for (Singh et al 2021).

2.4 Ecological requirements of cabbages

According to Kengere et al., (2023), depending on the variety of cabbages require water which ranges from 380mm to 500mm per crop throughout the growing period. Soil moisture less than 380mm causes limping and flaccid while moisture higher than 500mm causes root rot resulting to crop death (Daniel et al., 2023). The most favourable temperatures for growth and maturity range from 15°C to 25°C. It is resistant to frost and can tolerate temperatures as low as -3°C without crop failure (Atiq et al., n.d.). Cabbage can thrive well in altitudes which range from 700 to 2200 meters above sea level (Wilson, 2021). Červenski et al., (2022) state that at low sea levels cabbages must be grown during the cool months of the year. In Zimbabwe, serious farmers view the growing of cabbage as a profitable endeavour. It provides financial opportunities and may aid in the expansion of the agriculture industry (Chitapi, 2020). In order to achieve optimal yields, successful cabbage cultivation necessitates attention to issues such proper planting procedures, seedling quality, and pest and disease management. Cabbage's profitability is contingent upon various elements, including market demand, manufacturing costs, and efficient management techniques (Dyeyi&Zenda, 2022). In Zimbabwe, women are heavily involved in the growing of cabbage (Bungu, 2019). They actively participate in all phases of the farming of cabbage. Zimbabwe's current state of cabbage production. Cabbages such as Greenstar, Star 3311, Star 3301,majesty,Kilimo F1, and Fabiola F1 are recommended varieties. Fabiola F1 is immune to fusarium yellow, diamond back moth, and black rot.

2.5 Abiotic and biotic factors that affect cabbage production

According to (Oh et al., 2015) cabbage plants have specific temperature requirements for optimal growth. Excessive temperatures, both high and low, can negatively impact cabbage production. High temperature can cause wilting, bolting and reduced yield. Low temperature can slow down growth and increase susceptible to diseases and pests. Light is essential for photosynthesis and proper growth (Zhang et al., 2018) and insufficient light can lead to weak and elongated plants, reduced leaf developments and poor head formation. Excessive light intensity can cause sunburn damage to the leaves. Cabbage can be affected water stress causing stunted growth and reduced yield and on the other hand they can be affected by root rot, fungal diseases and nutrient leaching which are as a result of water lodging and poor drainage. Soil quality which constitute the texture, structure and nutrient content, can significantly impact cabbage production. The crop favors well drained soils with good organic matter. As for an article for (V. K. Singh et al., 2015) Pests including cabbage worms, flea beetles, aphids, and diamond back moth can all have an impact on cabbages. Cabbage plants can face competitions from weeds for sunshine nutrients and water so this also supports the fact that weeding is a necessity during the growth in of cabbages.

2.6 Altitude

In Zimbabwe, the ideal altitude for growing cabbages ranges from 1 200 to 1 800 meters above sea level.

2.7 Land preparation

Early ground preparation is important for weed control and for the conservation of moisture. Soil testing is required before transplanting to determine the soil acidity or alkalinity and to see if it is necessary to apply lime to control the soil ph.

2.8 Inorganic Fertilizers

Like tobacco and any other horticultural crops cabbages require low chlorine content basal blends as they are salt sensitive. For this reason it is advisable to use compound C always for cabbage production for greater performance (Shukla, n.d.). The Compound C fertilizer from Superfert which has an NPK ratio of 6:15:6 + 0.1B will be used as a basal fertilizer which is recommended for horticultural crops such as tomatoes, pepper, peas, cauliflower and cabbages. Ammonium Nitrate (AN) is a straight fertilizer which provides nitrogen to the plant during the vegetative stage when it is required the most and for cabbage it is a necessity for it is leafy crop (Reid & Morton, 2019). AN is well known as a top dresser fertilizer, which ensures that a crop grows strong. As for Superfert Company AN fertilizer is used for all crop types. The NPK ratio of Superfert is 34.5:0:0.

2.9 Foliar fertilizers

Vegetable crops have a high micronutrients necessity due to its various functions in plant development therefore the application of micronutrients is less costly but can provide top profits than other nutrients (Singh et al., 2021). These micronutrients as for this study will be obtained from a foliar fertilizer called Humuson complex, which has Carboamin as a basal fertilizer and Grow + as top dressing.

2.9.1 Description of carboamin

It is foliar fertilizer of Humuson complex which is formulated by mixing humic acid plant amino acids and various trace elements such as nitrogen, phosphorus, potassium, iron, manganese, zinc, molybdenum and copper (Rashad et al., 2022). It contains 17 essential amino acids which are required by the plant for protein synthesis, growth and development, nutrition and stress response, phytohomons which are essential for growth and tissue culture and flowering and chalets agents which are essential for improving the availability of micronutrients such as Fe, Cu, Mn and Zn. In addition to this they also contain macro elements such as organic NPK, organic carbon and provitamin A. This product also contains acids such as Fulvic acid and humic acid which are important for amending soil by improving nutrient uptake and increase water.

2.9.2 Description of grow

This is a foliar fertilizer manufactured by Humuson Complex which functions as a top fertilizer and it contains vitamins carotene, B1, B2, B3, B4, B5, B6, B12, E, C, D, and P and organic acid such as folic, humic and Fulvic (Rashad et al., 2022). There is the presence of enzymes such as catalase, peroxidase, reductase and protease.

CHAPTER 3: MATERIALS AND METHODS

3.1 Study site description

In order to examine the effects of different application rates of inorganic fertilizers and foliar fertilizer on cabbage field, an experimental trial was conducted in Cleverhill Bindura in Mashonaland central, located to the west of Bindura town. The distance from town to Cleverhill is 2,2 kilometres. Geographically the area is located by coordinates $17^0$16'27.3"S $31^0$19'43.2''E. It was done during the 2025 summer farming season. The yearly rainfall of the region ranges from 700mm to 900mm.The soils are clay loamy soils and they sticky when wet. Usually the rains start from end of November to March although there may be strong down pours both before and after this time. Agro-ecological zones of Bindura are classified into IIA and IIB. Agriculture in Bindura is centred on crop production. The soils in Bindura Cleverhill are a type of clay loamy which is characterized by a high clay and sand content and high cation exchange capacity according to the Zimbabwean soil classification (Nyamapfene, 1991). It is also prone to erosion and nutrient leaching so proper management is important. The area has dark soils, a reflection that they are weathered due to oxidation process. It is sticky when wet and difficult to work with but it is easily washed away.

3.2 Experimental Design and layout

The experimental design used in the study was a Randomized Complete Block Design with 5 treatments, (75%, 50%, 25%, 15% and 0%) of inorganic fertilizer compound C respectively. The experiment was replicated 3 times resulting in 15 plots and the plots had equal sizes; 3m x 3m. The plots were allocated by randomly picking of numbered treatments from the hat. The cabbages were planted using spacing of 40 cm inter-row by 50 cm in-row. Each plot had a total of 25 plants and a total of 375 plants of all the plots. The treatments used in the study are shown in Table 3.1.

Table 3.1 Study treatments

TREATMENTS	Inorganic Compound C	Organic Humuson complex	Combination of Inorganic and Organic
1	0	80ml/ 16l of water	0
2	15%	80ml/ 16l of water	organic + 15% inorganic
3	25%	80ml/ 16l of water	organic + 25% inorganic
4	50%	80ml/ 16l of water	organic + 50% inorganic
5	75%	80ml/ 16l of water	organic + 75% inorganic

3.2.1 Experimental Design layout

Block 1	Block 2	Block3
T1	T3	T5
T2	T5	T1
T5	T4	T3
T4	T2	T4
T3	T1	T2

3.3 EXPERIMENTAL PROCEDURE

3.3.1LAND PREPARATION

Land preparation was done in January 2025 (Figure 3.1). Plant debris were removed so as to avoid innoculum of pests and diseases from the previous season. The soil was tilled to a fine tilth and followed by the making of raised beds. The tape measure was used to measure the beds 3m wide and 3m long. Lastly the beds were levelled using a harrow. The beds where 15 that is 5 treatments with 3 replications.

Figure 3.1 Land preparation

3.3.2 Basal Application

First basal dressing was done on the planting day after holes were made for planting. At basal dressing the beds were treated with Humason complex carboamin+ which is a foliar fertilizer. It was applied through drenching in the holes where cabbages where to be planted in Humason Complex Carboamin + was applied at planting 4ml in the hoe and it was drenched weekly for 3 weeks for soil regeneration and promoting root growth.

$2.5l = 200l/ha$

1/50000×200 000ml =4ml

3.3.3 Planting

Planting was done on 30 January 2025. On the same day seedlings were collected from Manica seedlings. Plant spacing of 50cm interow and 50cm in row and the kilimo variety seedlings were used. There was second basal application to the cabbages after 7 days because the seedlings where still young for two different fertilizers that is humason and compound C.

At day 7, there was application of compound C in the beds. The seedlings were covered with tree branches to avoid scotching of cabbage seedlings.

Figure 3.2; Planting

3.3.4 Pest and Disease Control

Cabbage is more prone to cut worms, aphids, leaf hoppers and grasshoppers so they need to be controlled before they reduce yield. There was controlling of pests by physical methods of controlling pests like picking and crashing. There was also chemical methods by means of spraying the cabbages weekly with dimethoate, lambda and malathion. Sanitation was also being monitored by removal of weeds because they increase pests providing shelter.

At week 2 just after planting, signs and symptoms of cutworms and grasshopper attack were noticed on cabbage plant. Fortunately they were sprayed and cutworms were successfully controlled but grasshoppers were resistant to lambda that was applied. Grasshoppers reduced the yields as some plants where attacked beyond repair but however there was introduction of dimethoate and maintaining sanitation in the plots.

Some other pests that were observed were aphids. Malathion and dimethoate were successfully used to control them; however there was a continuous use of these different pesticides and the aphids were successfully controlled as well as other pests.

3.3.5 WEED MANAGEMENT

Weeds are competitors of nutrients, water, sunlight and space with the plant so the weeds have to be removed before they reduce yield and harbor pests. Minimum tillage based control of weeds (hoeing and hand pulling) were used.

Weeds are fast field invaders which plays a big role in yield reduction if not controlled at early growth stages. Mechanical weed control inform of hoeing and uprooting was used as it has little disturbance to plant roots and aerating the soil to improve drainage. Weeding was done on all the 15 plots under normal circumstances and on the same day.

Weeding was done after a forty night but due to the grasshoppers' infestation. Uprooting was done and leaving some weeds to act as a trap crop for grasshoppers so that when spraying day arrive, there will be a quick identification of new pests. After repeated series of weeding and uprooting process, there was reduction in grasshopper' infestation rate.

3.3.6 Top dressing

Top dressing was done after 4 weeks. Humason Complex Grow+ was applied at 6 leaves stage. This was done 3 times, each application in its week by both drenching and foliar. After the addition of basal fertilizers like any other vegetable cabbages also require an addition of a nitrogen containing fertilizer. In this study there was application of ammonium nitrate (AN) but AN was applied in very low proportions since there was a substitute of Humason Complex Grow+. Ammonium Nitrate requirement is 400kg per hectare divided into 3 splitted doses. The first dose is given 200kg/ha, AN applied was only10 grams of AN at week 4, week 6 and week 8.

3.4 DATA COLLECTION

Data was collected in all the plots. The vegetative growth rate for leaf length was measured one week after planting and this was done weekly until head formation started at week 8. This was done by averaging the leaf length of 3 plants in each plot to get an average leaf length in one plot. The counting for the number of leaves was done from the 3 cabbage plants in each plot and then calculates the average. This was also done until head formation. At harvesting head weight was measured on the scale. Data collected was recorded on the table.

3.5 DATA ANALYSIS

The data on the growth rate (number of leaves and leaf length) and yield head weight were subjected to analysis to variance using (ANOVA) in GenStat statistical package. The fisher's least significant difference (LSD) test at 0.05 probability level was used where the means were significantly different.

CHAPTER 4 RESULTS

4.1 Number of leaves

Application rates had an effect on number of leaves as the means were significantly different (p< 0, 05). The highest number of leaves was recorded in treatment with 11.25g and lowest number of leaves was recorded from 0g (FIGURE 4.1).

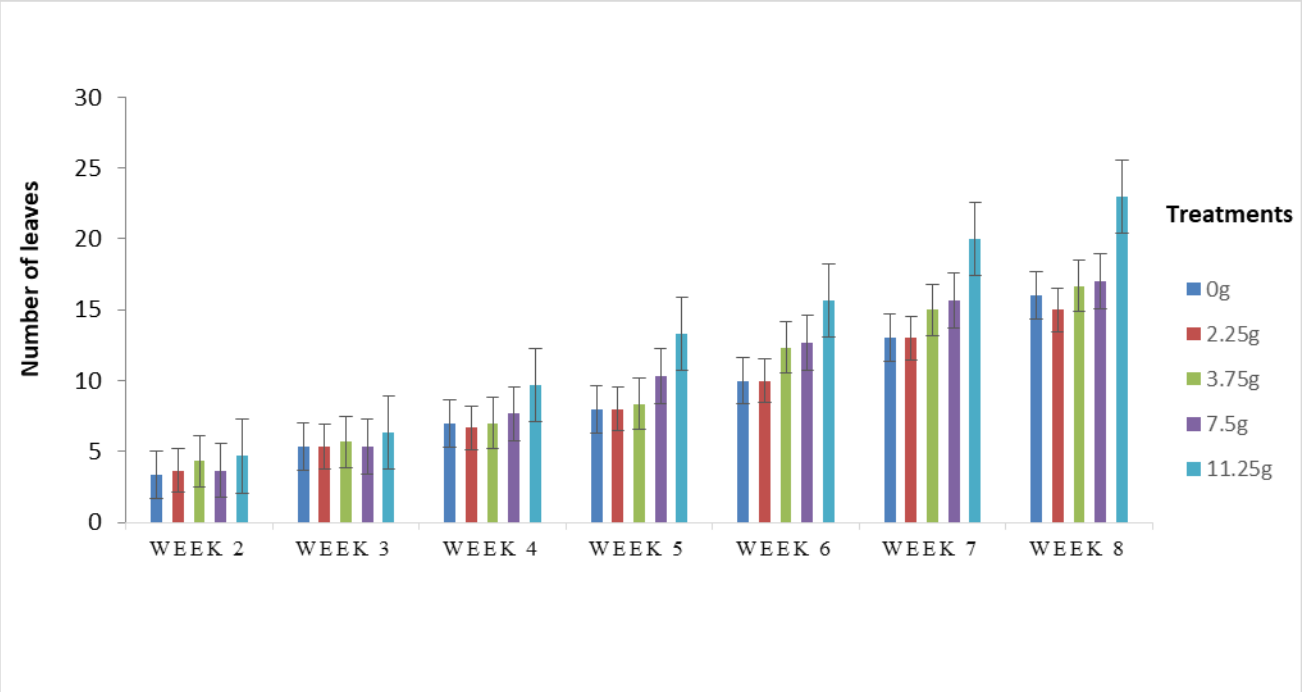

*Figure 4.1; Effect of different application rates of inorganic fertilizer compound C with organic Humason foliar fertilizer on **number of leaves** of cabbages*

4.2 Leaf Length

Leaf length showed a significant difference (p< 0, 05) in week 5 and week 8 across the treatments. Week 8, while week 3, 4, 6 and 7 did not show any statistical significance (p>0.05). The highest leaf length value was recorded in treatment 11.25g and the least value was recorded in2.25g (FIGURE 4.2).

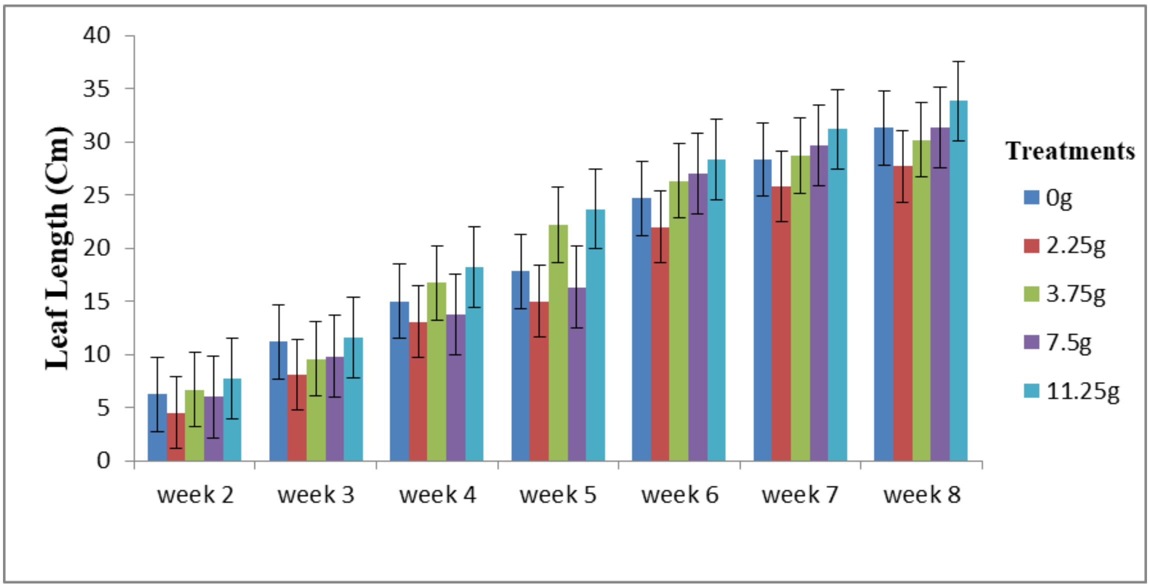

*Figure 4.2 Effect of different application rates of inorganic fertilizer compound C with organic Humason foliar fertilizer on the **leaf length** of cabbages*

4.3 Final Yield

The final yield had had a significant difference across all treatments, (p< 0, 05).The highest mean yield was obtained in 11.25g of compound C, followed by 7.5g, then 3.75g and 2.25g. The lowest mean yield was obtained in 0g. FIGURE 4.3.

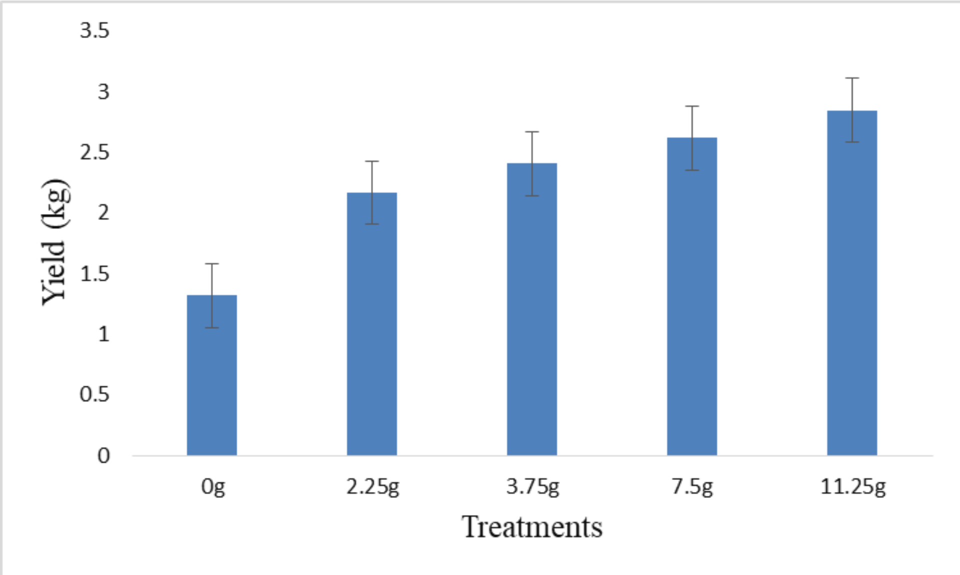

Figure. 4.3; Effect of different application rates of inorganic fertilizer compound C with organic Humason foliar fertilizer combinations on the ***yield, (head weight)*** *of cabbages*

CHAPTER 5: DISCUSSION OF RESULTS

5.1 Effect of different application rates of inorganic fertilizer compound C with organic foliar fertilizer combinations on the number of leaves of cabbages.

The results from this study showed that from week 2 to week 3 there was no significant difference in the number of leaves across all treatments. This was probably because cabbage plants at initial stage they produces few number of leaves which eventually increases as the plant grow and matures (Smith, 2020). Additionally after transplanting, cabbages may experience shock, leading to slower growth and fewer leaves at the initial growth stage (Johnson, 2019). However from week 4 to week 6 a significant difference emerged across all treatments, with Humason Complex foliar fertilizer playing a crucial role in increasing leaf count. According to Abou-Hussein et al, 2025, he states that application of humic acid and fulvic acid by drenching or foliar spray improves the growth, yield and superiority of vegetable crops like cabbages. More over there was an enhancement in the number of leaves because fulvic acid which is one of the composition in Humason, it contains small molecular weight and is more soluble. This allows for high absorption by the plant leaves leading to high nutrient uptake and plant health (Abou-Hussein et al, 2025). This increase in leaf number enhances photosynthesis rates promoting healthy growth and development (Taiz et al., 2015).

Humason Complex also contains vitamin carotene (Pro vitamin), vitamin B1, B2, B3, B4, B5, B6, B12 and also vitamin E, These vitamins for example B3 increases NADPH levels reducing oxygen production and hydrogen peroxide levels in the leaves, increasing tolerance to abiotic stress and increasing the number of leaves of cabbages. A higher number of leaves also contributes to the formation of larger, denser cabbages as leaves absorbs nutrients from the soil, which are then store in the cabbage head (Kumar et al., 2018). Foliar fertilizers are absorbed directly by the leaves, allowing for rapid nutrient uptake and utilization, quickly increasing number of leaves in cabbages.

5.2Effect of different application rates of inorganic fertilizer compound C with organic foliar fertilizer on leaf length of cabbages.

The findings of this study showed that even at lower rates of inorganic fertilizers, organic fertilizers like Humason Complex can stimulate cabbage leaf length increase. Statistically, significant differences in leaf length were observed in week 2, 5 and 8 across treatments. This can be attributed to the presence of humic acid in Humason Complex which auxin production, a plant growth regulator which promotes cell elongation and cell division leading to leaf growth (Chen et al., 2014). Humic and fulvic acids in Humason Complex also enhance nutrient uptake, providing essential nutrients for leaf elongation (Nardi et al., 2002).

Additionally humic substances improve water relations whereby humic substances can improve plant water relations, allowing for better turgor pressure and cell expansion, contributing to increased leaf length. (Verkleji et al., 1998). Another composite of Humason Complex is folic acid which can influence leaf area and also reducing drought stress (Raziye Kul, 2025). However, leaf length in cabbages with 2,25g was not increasing at a higher rate unlike other treatments, this might be due to environmental factors like temperatures since extreme temperatures can impact leaf growth and development (Brown, 2020) cabbages requires lower temperatures. Leaves of cabbages are very susceptible to pest and diseases infestations, which can damage leaves and impact growth (Taylor, 2021).

5.3 Effect of different application rates of inorganic fertilizer compound C with organic foliar fertilizers combinations on the yield (head weight) of cabbages.

The research outcome recorded a significant difference in final yield across all treatments, with 11.25g of compound C yielding the highest cabbage head weight. This can be attributed to the presence of humic acid, plant amino acids and various trace elements in Humason Complex such as nitrogen, phosphorus potassium, iron, manganese, zinc, molybdenum and copper, (Rashad et al., 2022).These elements play a crucial role in increasing yield of cabbages because zinc and copper plays a role in increasing cabbage yield as zinc and copper are involved in enzyme function, protein synthesis and growth regulation (Hafeez et al.,2013).Fulvic acid and humic acid in Humason Complex also promote root development, allowing plants to absorb more nutrients an water thereby increasing cabbage yield (head weight) (Chen at al., 2014). There are enzymes in Humason Complex for example peroxiases, catalases and proteases. These enzymes play a crucial role in controlling diseases like black rot, thereby increasing the yield of cabbages. These enzymes also enhance vigour, preventing disorders and senescence thereby promoting head formation Singh et al, (2009). However, lower yields were also produced in treatment with 0grams of compound C, yielding 1.32kg though Humason Complex foliar fertilizer was sprayed and drenched evenly in all treatments. This might be due to inadequate water supply, which can limit cabbage growth leading to reduced yields (Davis, 2017).

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1: CONCLUSIONS

This study provides valuable understanding into the effects of different application rates of inorganic fertilizer (Compound C) and foliar fertilizer (Humuson Complex) on the development and yield of cabbages (Brassica oleracea L.). The results note that the combination of these fertilizers significantly influences number of leaves, leaf length, and final yield. Specifically, higher application rates of Compound C, particularly at 11.25g, resulted in the highest yielding outcomes in terms of cabbage head weight and overall plant growth rate and plant health. Farmers can not only expect high productivity but also minimizing the use of chemical fertilizers as well as combining them with organic fertilizers so as to improve soil healthy.

The findings highlight the need of balanced nutrient management in cabbage production, emphasizing that the integration of Humason foliar fertilizers can enhance the effectiveness of inorganic fertilizers. This approach not only improves crop yield but also supports sustainable agricultural practices by potentially reducing reliance on synthetic fertilizers which are now a threat to the production soils in Zimbabwe

6.2: RECOMMENDATIONS

1**.** According to this research study, it is therefore recommending that farmers should adopt using 11.25g of compound C in combination with organic Humason based foliar fertilizers to produce high yields of cabbages. The study suggests that combining these fertilizers, can lead to healthier plants and higher productivity.

2. Farmers should also use Humason based fertilizers by both spraying and drenching for high absorption by plants resulting to formation of higher number of leaves and longer leaves.

3. Under circumstances of limited budget for compound C, farmers can also lower the application rate to about 7.5g compound C and combining it with carboamin+ Humason basal fertilizer through drenching application.

4. Farmers should use the recommended application rate of Humason based fertilizers for effective fertilizer application, which is 2.5litres of Humason fertiliser diluted in 200litres of water per hectare or 80ml per 16 litre knapsack.

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APPENDIX

Appendix 1 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on number of leaves of Brassica oleratiaL on week 2

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	0.9333	0.4667	1.56	
BLOCK.*Units* stratum					
Treatment	4	3.6000	0.9000	3.00	0.087
Residual	8	2.4000	0.3000		
Total	14	6.9333			

Appendix 2 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on number of leaves of *Brassica oleratiaL* on week 3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	0.4000	0.2000	0.32	
BLOCK.*Units* stratum					
Treatment	4	2.2667	0.5667	0.92	0.498
Residual	8	4.9333	0.6167		
Total	14	7.6000			

Appendix 3 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on number of leaves of *Brassica oleratiaL* on week 4

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	1.6000	0.8000	1.00	
BLOCK.*Units* stratum					
Treatment	4	17.6000	4.4000	5.50	0.020
Residual	8	6.4000	0.8000		
Total	14	25.6000			

Appendix 4 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on number of leaves of *Brassica oleratiaL* on week 5

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	0.4000	0.2000	0.29	
BLOCK.*Units* stratum					
Treatment	4	63.6000	15.9000	22.71	<.001
Residual	8	5.6000	0.7000		
Total	14	69.6000			

Appendix 5 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on number of leaves of *Brassica oleratiaL* on week 6

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	0.9333	0.4667	0.53	
BLOCK.*Units* stratum					
Tretment	4	65.7333	16.4333	18.60	<.001
Residual	8	7.0667	0.8833		

Appendix 6 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on number of leaves of *Brassica oleratiaL* on week 7

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	8.9333	4.4667	9.57	
BLOCK.*Units* stratum					
Treatment	4	98.6667	24.6667	52.86	<.001
Residual	8	3.7333	0.4667		
Total	14	111.3333			

Appendix 7 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on number of leaves of *Brassica oleratiaL* on week 8

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	0.533	0.267	0.08	
BLOCK.*Units* stratum					
Treatment	4	119.067	29.767	8.46	0.006
Residual	8	28.133	3.517		
Total 14 147.733					

Appendix 8 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on the leaf length of *Brassica oleratiaL* on week 2

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	0.129	0.065	0.06	
BLOCK.*Units* stratum					
Treatment	4	16.196	4.049	4.05	0.044
Residual	8	8.004	1.001		
Total	14	24.329			

Appendix 9 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on the leaf length of *Brassica oleratiaL* on week 3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	10.185	5.093	1.09	
BLOCK.*Units* stratum					
Treatment	4	23.591	5.898	1.26	0.361
Residual	8	37.461	4.683		
Total	14	71.237			

Appendix 10 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on the leaf length of *Brassica oleratiaL* on week 4

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	3.781	1.891	0.43	
BLOCK.*Units* stratum					
Treatment	4	53.957	13.489	3.04	0.085
Residual	8	35.539	4.442		
Total	14	93.277			

Appendix 11 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on the leaf length of *Brassica oleratiaL* on week 5

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	2.100	1.050	0.12	
BLOCK.*Units* stratum					
Treatment	4	168.833	42.208	4.92	0.027
Residual	8	68.567	8.571		

Total 14 239.500

Appendix 12 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on the leaf length of *Brassica oleratiaL* on week 6

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	23.433	11.717	1.64	
BLOCK.*Units* stratum					
Treatment	4	71.333	17.833	2.50	0.126
Residual	8	57.067	7.133		

Total 14 151.833

Appendix 13 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on the leaf length of *Brassica oleratiaL* on week 7

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	25.972	12.986	3.01	
BLOCK.*Units* stratum					
Treatment	4	47.271	11.818	2.74	0.105
Residual	8	34.521	4.315		
Total	14	107.764			

Appendix 14 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on the leaf length of *Brassica oleratiaL* on week 8

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	8.933	4.467	3.13	
BLOCK.*Units* stratum					
Treatment	4	59.900	14.975	10.51	0.003
Residual	8	11.400	1.425		
Total	14	80.233			

Appendix 15 Analysis of variance for the effects of different application rates of Compound C with organic Humason Complex foliar fertilizer on final yield (head weight) of Brassica oleratiaL.

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
BLOCK stratum	2	0.026013	0.013007	1.53	
BLOCK.*Units* stratum					
Treatment	4	4.153707	1.038427	122.07	<.001
Residual	8	0.068053	0.008507		
Total	14	4.247773			