BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULT OF AGRICULTURE AND ENVIROMENTAL SCIENCE

DEPARTMENT OF CROP SCIENCE

EFFECTS OF FERTILISER TYPE AND VARIETY ON PAPRIKA (*CAPSICUM ANNUM L*) PERFOMANCE.

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ABSTRACT

Paprika *(Capsicum annuum L.)* is a high-value spice crop grown for its vibrant color, yield, and shelf life traits that are essential for both domestic consumption and export. In Zimbabwe, although synthetic fertilizers are widely used to enhance productivity, the comparative impact of organic fertilizers on paprika performance has not been thoroughly investigated. This study sought to assess the impact of organic versus synthetic fertilizers on ASTA color value, shelf life and, yield in two paprika varieties, King and Queen. The research was conducted at Wellow 1 Estates in Mutorashanga during the 2024/2025 season using a 2×2 factorial experiment in a Randomized Complete Block Design (RCBD) with four replicates per treatment. Fertilizer type (organic or synthetic) and variety (King or Queen) were the main factors. Data was subjected to Analysis Of Variance (ANOVA) at 5% significance level. There was no interaction between fertilizer type and variety ($p>0.05$) across all parameters. Organic fertilizer significantly enhanced color and shelf life. King Paprika recorded the highest ASTA value of (175.0) and the longest shelf life of (19.06 days) below organic fertilization. Conversely, synthetic fertilizer significantly improved yield, with King Paprika producing 583.56g per plant compared to 508.19g under organic treatment. Correlation analysis revealed a strong positive relationship between ASTA and shelf life ($r = +0.66$), and moderate negative relationships between yield and both ASTA ($r = -0.41$) and shelf life ($r = -0.53$). In regard to this research, it is recommended to apply organic fertilizers to enhance fruit color and extend shelf life, making them ideal for premium and export markets. In contrast, synthetic fertilizers are more effective in maximizing yield, which benefits bulk production systems. Integrated Nutrient Management (INM), which combines organic and synthetic inputs, offers a practical solution for achieving both high quality and high yield.

KEY WORDS: Paprika, Fertilizers, ASTA Levels, Shelf life, Yield.

DEDICATION

This work is dedicated to Whitney Paprika and all paprika farmers all over Zimbabwe.

DECLARATION

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The undersigned certify that they have read and recommended to the Department of Crop Science, this thesis entitled:

EFFECTS OF FERTILISER TYPE AND VARIETY ON PAPRIKA (*CAPSCICUM ANNUM L)* PERFORMANCE.

DECLARATION

I, Tanyaradzwa Muringayi, do hereby declare that this research project is the result of my original work that had been researched and got submitted on fulfilment of the Bachelor of Agricultural Honors Degree Majoring in Crop Science at Bindura University of Science Education. The other information had been derived from other people's work based on trusted sources and had been duly cited, accredited and acknowledged through references.

TANYARADZWA MURINGAYI		18/09/25
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LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
ASTA	American Spice Trade Association
AN	Ammonium Nitrate
CAN	Calcium Ammonium Nitrate
ºC	Degrees Celsius
RCBD	Randomized Complete Block Design
/ha	per hectare
Mm	Millimeters
cm	Centimeters
Kg	Kilograms
PH	Potential Hydrogen
GPS	Global Position System
MOP	Muriate of Potash
%	Percent
Km	Kilometers
N	Nitrogen
P	Phosphorus
K	Potassium
LSD	Least Significant Difference

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CHAPTER 1

1.0 INTRODUCTION

1.1 Background Information

Paprika *(Capsicum annuum L.)* is a globally important horticultural crop known for its vibrant red pigmentation, aromatic flavor, and nutritional value, particularly its high content of carotenoids and vitamins. As both a culinary spice and a nutritional enhancer, paprika's commercial success depends not only on yield but also on specific quality parameters chief among them being ASTA color value, shelf life, and marketable yield. Amedor *et al*., (2024). Paprika's pigment intensity, measured through the American Spice Trade Association (ASTA) color value index, is a primary determinant of its market grade and consumer acceptance. This standardized scale reflects the concentration of red carotenoids, primarily capsanthin, which directly contributes to the spice's visual appeal and nutritional richness. Arimboor *et al*., (2021). High ASTA values are indicative of intense coloration, which is highly prized in both domestic and export markets Siddiqui & Ayala-Zavala, (2020).

Similarly, shelf life defined as the duration that paprika fruit remains fresh, visually appealing, and free from spoilage under storage conditions is critical for postharvest handling, transportation, and consumer satisfaction. A longer shelf life reduces postharvest losses, enhances economic returns, and supports sustainable supply chains Amedor *et al*., (2024). In addition to quality traits like ASTA color value and shelf life**,** yield remains a critical factor in paprika production, particularly for smallholder and commercial farmers focused on profitability and food security Hernández-Ortega *et al*., (2021). High yields translate to greater marketable output per unit of land, directly influencing income potential and production efficiency Amedor *et al*., (2024). However, yield must be balanced with fruit quality, as excessive use of synthetic fertilizers can promote vegetative growth at the expense of pigment development and postharvest stability Chowdhury *et al*., (2019). In contrast, organic fertilizers may enhance fruit quality through improved soil health and nutrient release dynamics but may sometimes result in lower short-term yields Valenzuela-García *et al*., (2019). Paprika is widely cultivated in tropical and subtropical regions. However, in resource-limited settings such as southern Africa, paprika production often faces challenges due to low soil **f**ertility, inconsistent access to quality inputs, and climatic stress. To boost yield and meet quality standards, farmers typically rely on synthetic (chemical) fertilizers, which offer rapid nutrient availability and immediate growth benefits Chowdhury *et al.*, (2019). While effective in increasing short-term productivity, synthetic fertilizers can degrade soil health over time and may not consistently improve quality traits such as pigment intensity or postharvest durability. Valenzuela-García *et al*., (2019).

Despite these promising findings, comparative research on the direct effects of organic versus synthetic fertilizer use on paprika especially regarding ASTA levels, yield, and shelf life remains limited in many agro-ecological contexts. This study seeks to explore the gap in knowledge on the effectiveness of different fertilizers organic versus synthetic on different paprika varieties.

1.2 Problem Statement

Most farmers and agronomists base fertilization decisions on short-term productivity, often disregarding potential effects on fruit quality or postharvest longevity. Furthermore, varietal responses to fertilizer type are rarely considered, despite evidence that different paprika cultivars may respond differently to nutrient inputs. Without integrated data on how fertilizer type influences paprika quality and yield, producers face uncertainty in selecting fertilization strategies that balance productivity, environmental stewardship, and market expectations.

1.3 Justification

Improving paprika production is important for enhancing farm incomes and meeting market standards. In regions like Zimbabwe, where paprika is an emerging specialty crop, many farmers have not fully explored the use of organic fertilizers, despite their availability from local resources (farmyard manure, compost, etc.). As a result, the potential benefits of organic nutrition (better soil health, higher pigment content) may be underutilized. At the same time, global consumer demand for organically grown produce has been rising, with buyers often willing to pay premium prices for higher quality, “natural” spices. Therefore, understanding how the fertilization method affects paprika quality is timely.

This study is justified because it directly addresses questions faced by paprika producers and stakeholders (farmers, extension agents, horticultural businesses). By comparing organic and synthetic fertilization, the results will show whether organic amendments can match conventional fertilizer in yield while enhancing color or shelf life. Such information is valuable for advising growers on fertilizer management. If, for example, organic fertilization yields paprika with richer color or longer marketability without sacrificing yield, farmers could adopt more sustainable practices and improve product quality. Conversely, if synthetic fertilizers are shown to dramatically outperform organic ones in yield or longevity that too would inform realistic expectations.

In addition, this research will benefit agronomists and policymakers concerned with sustainable agriculture. It will clarify the trade-offs between productivity and environmental sustainability in a high-value crop. Finally, the study will provide a holistic assessment of paprika crop performance under two fertilization regimes, using both agronomic (yield) and quality (ASTA color, shelf life) metrics. These insights will support efforts to optimize paprika production to meet both productivity and market quality objectives, benefiting the horticultural industry overall.

1.4Objective of the Study

1.4.1 Main objective

The main goal of this research is to compare the effects of organic versus synthetic fertilizers on the quality and productivity of two paprika (*Capsicum annuum L*), varieties king and Queen Paprika

1.4.2 Specific objectives

1. To investigate the effect of variety and fertiliser type on the ASTA color values.
2. To explore the impacts of fertilizer type and variety on fruit yield (g/plant) of paprika.
3. To assess the effect of variety and fertilizer type on shelf life.

1.5 Hypothesis

1.5.1Null Hypothesis (H_0):

1. There no significant difference in ASTA levels of paprika cultivated using organic fertilizers as compared to those plants grown using synthetic fertilizers.

2. There is no significant difference in the shelf life of Capsicum Annum grown under organic fertilizers compared to those produced with synthetic fertilizers.

3. There is no significant difference in the yield of paprika Produced using organic fertilizers compared to synthetic fertilizers

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CHAPTER 2

LITERATURE REVIEW

2.1 Organic versus Synthetic Fertilizers: An Overview

Fertilizers can be broadly categorized into two types organic and synthetic. Organic fertilizers are derived from natural sources such as compost, farmyard manure, poultry droppings, and green manure. These inputs release nutrients slowly, improve soil structure, and support microbial activity Valenzuela-García *et al*., (2019). Some studies like Bonanomi *et al*., (2007) suggest that compost can help suppress certain soil borne diseases, further contributing to healthier plants and increased yields. In contrast, synthetic fertilizers industrially produced nutrient blends such as NPK (Nitrogen, Phosphorus, and Potassium) are formulated for rapid nutrient delivery to plants and are widely used in conventional agriculture due to their immediate effect on growth Chowdhury et al., (2019).

While synthetic fertilizers are often more effective in increasing short-term yields, their long-term sustainability is questionable due to potential risks like nutrient leaching, soil degradation, and reduced microbial diversity. Geisseler, & Scow, (2014). Organic fertilizers, on the other hand, contribute to long-term soil health and are increasingly considered essential in sustainable and organic farming systems. However, the effects of each fertilizer type on paprika-specific outcomes such as ASTA value and shelf life remain underexplored in comparative studies

2.2 Effects of fertilizer type and variety on Crop Yield

Crop yield remains one of the most important indicators of agricultural performance. Numerous studies have shown that synthetic fertilizers typically produce higher yields in vegetable crops due to their immediate nutrient availability Chowdhury et al., (2019). Güneş et al., (2023) In (*Capsicum annuum L),* synthetic NPK blends are known to enhance vegetative growth and fruit set significantly.

However, some studies suggest that organic fertilizers can also maintain competitive yield**s**, especially when properly managed or integrated with inorganic inputs. For instance, Sileshi *et al.,* (2011) demonstrated that certain paprika cultivars responded well to organic inputs, with comparable fruit yields under organic and combined fertilizer treatments in Malawi. Moreover, Valenzuela-García *et al*., (2019) found that poultry manure sustained high yields in jalapeño peppers while improving soil organic matter.

Organic fertilizers such as compost, poultry manure, and cow dung release nutrients more slowly and contribute to improved soil structure, microbial diversity, and long-term fertility, which gradually enhances yield stability Mujtaba *et al.,* (2023). Several recent trials demonstrate that although organic fertilizer treatments generally result in slightly lower initial yields, they improve fruit quality, soil resilience, and sustained production over multiple growing seasons Hamid *et al*., (2022). For instance, a study by Mohamed *et al.,* (2022) found that integrated fertilization (50% synthetic + 50% organic) produced yields nearly equivalent to full synthetic application, while improving soil health indicators and reducing input costs. Thus, while synthetic fertilizers provide superior short-term yields, organic inputs or integrated approaches may offer a more sustainable solution for long-term paprika production.

2.3Effects of variety and Fertilizer type on ASTA value

The ASTA color value is a key quality trait for paprika, reflecting the concentration of red pigments, particularly capsanthin and capsorubin. Mujtaba, *et al*., (2023). These pigments not only enhance visual appeal but are also linked to nutritional and commercial value. Ganeshamurthy *et al*., (2019). ASTA value is influenced by genotype, maturation stage, postharvest conditions, and nutrient availability. Hamid *et al*., (2022).

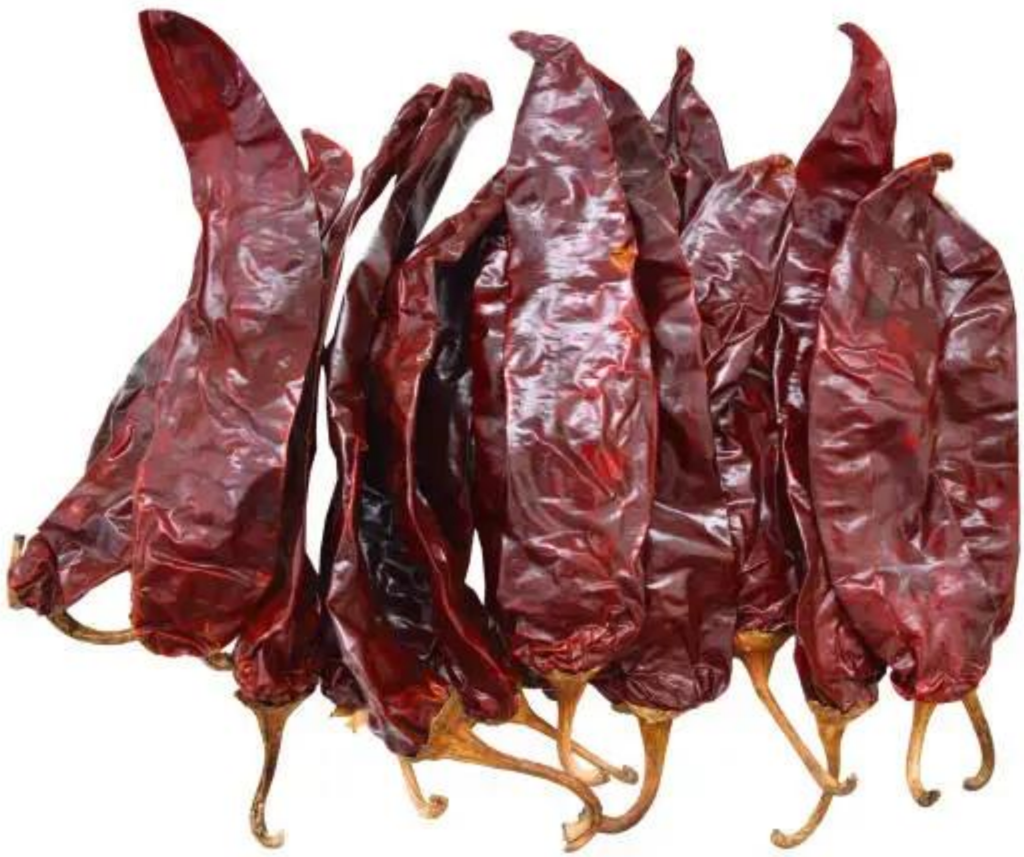
Studies have shown that organic fertilization may enhance pigment biosynthesis, potentially due to increased micronutrient uptake and the stimulation of secondary metabolite pathways.

Valenzuela-García *et al*., (2019) observed improved fruit coloration in peppers grown with organic amendments, possibly linked to higher carotenoid content. Conversely, while synthetic fertilizers promote faster growth, they do not consistently enhance pigment intensity, and in some cases may dilute pigment concentration due to rapid vegetative expansion Chowdhury *et al*., (2019) Synthetic fertilizers, particularly those containing nitrogen (N) and potassium (K), have been shown to increase vegetative growth and yield; however, their effect on ASTA colour values is variable. While moderate levels of N and K can enhance pigment biosynthesis, excessive application often results in lush vegetative growth at the expense of fruit quality and color intensity Ganeshamurthy *et al*., (2019). Hamid *et al*., (2022) in contrast, organic fertilizers such as compost, poultry manure, and vermicompost not only supply nutrients more gradually but also improve soil microbial activity, structure, and nutrient retention, which are favorable for consistent pigment development and higher ASTA values Mujtaba *et al*., (2023).

A recent comparative study by Olaniyi *et al*., (2021) found that organically fertilized paprika fruits had significantly higher ASTA values than those treated with chemical fertilizers, even though total yields were slightly lower. This is attributed to improved physiological conditions in organically amended soils, which enhance carotenoid synthesis and protect pigments from degradation during ripening Arimboor *et al*., (2021) .Moreover, organic inputs have been shown to increase antioxidant activity, which correlates with carotenoid stability and color retention in dried paprika products Siddiqui & Ayala-Zavala, (2020). Overall, while synthetic fertilizers can enhance short-term productivity, organic fertilization appears to support superior ASTA colour values and long-term quality in paprika production systems.

The picture below shows the Grade A paprika with 200% ASTA content.

Fig 2. 1: Paprika Grade A



2.4 Effects of fertilizer type and variety on shelf life

Shelf life refers to the duration that harvested fruits maintain acceptable quality under storage. It is a critical postharvest parameter, especially for export crops like paprika. Factors affecting shelf life include moisture content, microbial activity, and tissue integrity all of which can be influenced by fertilization. Organic fertilizers have been associated with enhanced shelf life in solanaceous crops. Amedor *et al*., (2024) reported that poultry manure applications significantly extended the shelf life of green bell peppers by reducing postharvest weight loss and decay. The improved shelf life is likely due to better tissue structure and lower nitrate accumulation Amedor et al., (2024). In contrast, synthetic fertilizers may increase fruit size but often reduce storage longevity due to higher water content and residual nitrates Chowdhury *et al*., (2019).

Fertilization strategy has a measurable influence on the postharvest shelf life of paprika (*Capsicum annuum L),* particularly through its effects on fruit firmness, water loss, oxidative stability, and decay resistance. Synthetic fertilizers, especially those high in nitrogen, often increase vegetative growth and fruit size, but may reduce shelf life due to thinner cuticles, higher moisture content, and faster softening during storage Hamid *et al*., (2022). In contrast, organic fertilizers such as compost and poultry manure tend to enhance shelf life by promoting gradual nutrient release, improving antioxidant capacity, and stimulating cell wall fortification, which delays senescence and microbial decay Olaniyi *et al*., (2021).

Studies have shown that organically fertilized paprika fruits maintain higher firmness and lower weight loss during storage compared to those grown with synthetic inputs Abd El-Hady & Habib, (2020). This is attributed to better nutrient balance, higher dry matter content, and increased biosynthesis of bioactive compounds such as phenolics and antioxidants, which protect against oxidative deterioration Mujtaba *et al*., (2023). Furthermore, organic fertilization supports microbial diversity in the rhizosphere, which may positively affect the fruit’s physiological integrity and natural resistance during storage Zhang *et al*., (2018). These findings support the broader claim that organic fertilizers not only enhance soil and crop quality but also extend the postharvest life of paprika under both ambient and controlled conditions.

CHAPTER 3

METHODOLOGY

3.1 Experimental Area

The experiment was conducted at Whitney Paprika Farm in Mutorashanga Wellow 1 in Zvimba district. The farm is 90km from Bindura via Mvurwi. Off the Harare-Bindura highway from the 20km peg with the GPS coordinates 17^{0}7’60S and 30^{0}36’0E’ and an altitude of 1276m above sea level. It is in a natural agro-ecological region 2a. It receives 750-1000mm rainfall per annum. The soils at the site are red clay loams with a depth ranging from 50cm to 100 cm. The potential hydrogen (pH) of the soil was 5.5-6.5.

3.2 Experiment design

The experiment was laid down as a 2*2 factorial experiment in a randomized Complete Block Design (RCBD). The treatments were replicated 4 times. Two factors were considered .The first factor was fertilizer type (organic and synthetic fertilizer). The second Factor was Paprika Variety (King and Queen Paprika). The blocking factor was different soil types. Four blocks were designed, each block was identical in layout to the one illustrated in Figure 3.2. Within each block, there were eight plots, representing four treatment combinations, each with four replications per block.

Table 3 1Experimental Layout

BLOCK 1

19.5M

King (organic) **1M**	Queen (synthetic)	**King (synthetic)**	Queen (organic)
Queen (organic) **4.5M**	**King (synthetic)**	Queen (organic)	**King (synthetic)**

Fig 3.2

3.3AGRONOMIC MANAGEMENT

3.3.1 General management

Land preparation was done using disk harrow and a tractor to a depth of 30cm, marking of the planting station was done using hoes. Size of each block measures 18.5m x 2m which gives 37 m^2, and a path of 0.5m width on both ends of each plot for demarcation. After clearly designing the beds, the beds were irrigated using a watering can with a fine rose so that if there were any nematodes within the soil beneath the ground, they would rise onto the ground. After watering the beds were filled up with dry wood brush and maize cobs and the beds were burnt down in order to kill all nematodes and other insects which might have been in the soil. All agronomic practices such as keeping the crop weed-free, watering and top dressing, were done.

3.3.2 Planting

Hand planting was used to plant paprika seeds of two different varieties, namely King Paprika and Queen Paprika, on the 10^{th} of August 2024. Shallow digging was done to produce a planting depth of 5cm. Plant depth is necessary for the purpose of germination since the seeds were very small in size. Plant spacing was 0.9m x 0.2m giving a total plant population of 55.556 plants per hectare. Thatching grass was used for mulching each and every block after planting the seedbeds. Fumigation was done with the help of 3 chemicals namely clomazone, Nemat and Lambda. Clomazone was used as a pre-emergence herbicide, Lambda as an insecticide and Nemat for nematodes which might have been brought back on the beds by the mulch which was applied on top of each and every block.

3.3.3Germination

There was an impressive emergence of the paprika seeds, which was about 98.5% germination percentage. In 15 days, all treatments had emerged from the ground. Treatment 4 and treatment 5 of King Paprika all emerged at day 9 with full vigor, followed by treatment 3 of Queen Paprika on day 9. The rest of the treatments were out of the ground by day 13, and on day 15, all seed that was able to emerge had shaded its leaves on the ground surface. This was the first head start to assure the researcher that the trial was going to continue after passing this first stage.

3.3.4 Fertilization

Synthetic fertilizers were applied according to the instructions on their container as shown on the table below.For organic treatments compost manure was used as basal dressing. First top dressing application poultry manure was used followed by cow dung for the second top dressing in all organic treatments. For synthetic treatments Tobacco blend was used as basal dressing. First top dressing   Ammonium nitrate was applied followed by Calcium nitrate for second top dressing.

Table 3 2Fertilizer Application

Fertilizer Type	Fertilizer Name	Rate (kg/ha)	Application Details
Organic	Compost	10,000	Incorporated into soil two weeks before transplanting.
	Poultry Manure	8,000	Applied during bed preparation; well-decomposed to reduce pathogen risk.
	Cow Dung	10,000	Mixed with topsoil and irrigated to promote microbial activity.
Synthetic	Tobacco Blend (6:15:12)	400	Split application; half at planting, half during early vegetative stage.
	Ammonium Nitrate (top dress)	200	Applied at 3–4 weeks after transplanting; promotes vegetative growth.

	Calcium Nitrate	150	Applied twice during fruit set; improves firmness and calcium uptake.

3.2.7 Pest and disease management

Chemical and cultural methods were used for pest and disease control. Chemical control methods involved application of fungicides and insecticide. Cultural control involved rouging out of infected plants to keep the plants healthier. Disease-free seed were used, and clipping was done during the seedbed period when the plant reaches a height of 15cm. This was done using a hedge shear so as to increase lateral branching and make the plant stem strong.

3.3 Data Collection

3.3.1 Yield

Dried fruit yield was measured by harvesting all marketable pods per plot at maturity. Fruits were weighed using a digital scale, and yield was calculated in kilograms per treatment (kg/Treatment).

3.3.2 ASTA Color Value

The ASTA value was assessed via the spectrophotometric technique based on the American Spice Trade Association standard (ASTA, 2020). Dried paprika samples were milled and extracted using acetone; absorbance was recorded at 460 nm, and ASTA units were determined through the subsequent formula:

ASTA value = $A_{460} \times 16.4 \times D / W$

Where:

A_{460} = absorbance at 460 nm

D = dilution factor

W = sample weight (g)

3.3.3 Shelf Life

Shelf life was assessed by monitoring postharvest weight loss and visual quality deterioration of stored fruits. Fruits from each treatment were stored at ambient conditions (25 ± 2°C, 60–70% RH), and observations were recorded daily for up to [14 days]. Parameters included:

3.3.4 Data Analysis

Data was examined using Analysis of Variance (ANOVA) via statistical software which was GenStat. Treatment means were distinguished using the Least Significant Difference (LSD**)** test at the 5% significance threshold ($p < 0.05$).

CHAPTER 4

RESULTS

4 .1 Effects of Fertilizer type and Variety on ASTA Color Value.

There was no interaction between fertilizer type and variety ($p = 0.687$) on ASTA level. Fertilizer type had an effect on ASTA level ($p < .001$). Organic fertilizer had a higher ASTA level of 172.750 compared to synthetic fertilizer which had 159.35.

Table 4 1Effects of fertilizer on ASTA level

Fertilizer	ASTA level
Organic	172.750^{a}
Synthetic	159.375^{b}
Mean	166.062
P-value	0.001
LSD	0.3398
SED	0.1502

Based on the range test at p≤ 0.05, means for factors sharing the same letter(s) are substantially from each other.

Variety had an effect on ASTA level ($p<0.05$). King Paprika had a higher ASTA level of 168.281 as compared to Queen Paprika which had 163.

Table 4 2 Effects of variety on ASTA levels

Variety	ASTA level
King	168.281[a]
Queen	163.844[b]
Mean	166.062
P-value	0.001
LSD	0.3398
SED	0.1502

Based on the range test at $p \leq 0.05$, means for factors sharing the same letter(s) are substantially from each other.

4.2 Effects of fertilizer type and Variety on Yield

There was no interaction between fertilizer type and variety ($p = 0.309$) on Yield. Variety type was statistically significant $p < 0.001$. King paprika had higher yields of 545.88 compared to Queen which had 533.44.

Table 4 3Effects of variety on yield

Variety	Yield
King	545.88^{a}
Queen	533.44^{b}
Mean	539.66
P-value	0.001
LSD	1.441
SED	0.637

Based on the range test at $p \leq 0.05$, means for factors sharing the same letter(s) are substantially from each other.

Fertilizer type was statistically significant p <0.001.Synthetic fertilizer had higher yields of 577.69 compared to Organic fertilizer which had 501.62.

Table 4.4Effects of fertilizer on yield

Fertilizer	Yield
Synthetic	577.69^{a}
Organic	501.62^{b}
Mean	539.66
P-value	0.001
LSD	1.441
SED	0.637

Based on the range test at p≤ 0.05, means for factors sharing the same letter(s) are substantially from each other.

4.3 Effects of Variety and Fertilizer on shelf life

There was no interaction between fertilizer type and variety on shelf life $p<0.193$. Variety was significant $p < 0.001$, King Paprika had a longer shelf life of 17.312 than Queen Paprika which had 16.781

Table 4.5 Effects of variety on shelf life

Variety	Shelf life
King	17.312
Queen	16.781
Mean	17.047
P-value	0.001
LSD	0.1509
SED	0.0667
CV	0.4

Based on the range test at p≤ 0.05, means for factors sharing the same letter(s) are substantially from each other.

Fertilizer type was statistically significant $p < 0.001$, Organic fertilizer had a significantly longer shelf life of 18.750 compared to those grown with synthetic fertilizers which had 15.344.

Table 4 6Effects of fertilizer on shelf life

Fertilizer	Shelf life
Organic	18.750
Synthetic	15.344
Mean	17.047
P-value	0.001
LSD	0.1509
SED	0.0667
C.V	0.4

Based on the range test at p≤ 0.05, means for factors sharing the same letter(s) are substantially from each other.

4.4 Correlation Analysis

To understand the relationships between the measured parameters, a correlation analysis was performed. The results are presented in Table below.

Table 4 7 Correlation coefficient (r) between yield and shelf life

Variable Pair	Correlation (r)	Relationship
Yield ↔ ASTA	-0.41	Moderate negative correlation
ASTA ↔ Shelf Life	+0.66	Strong positive correlation
Yield ↔ Shelf Life	-0.53	Moderate negative correlation

Yield vs. ASTA (r = -0.41)

There is a moderate negative correlation of r=-0.41 between yield and ASTA levels. This suggests that as yield increases, pigment concentration (color intensity) tends to decrease, possibly due to nutrient dilution in larger fruit biomass.

ASTA vs. Shelf Life (r = +0.66)

A strong positive correlation exists between ASTA levels and shelf life with r=+0.66. Paprika with higher pigment content (usually from organic fertilizer) tends to retain quality longer, likely due to better antioxidant protection.

Yield vs. Shelf Life (r = -0.53)

A moderate negative correlation r=-0.53 is observed between yield and shelf life, indicating that higher-yielding paprika may have a shorter shelf life, potentially due to thinner skins or higher moisture content.

CHAPTER 5

DISCUSSION

5.1 Effect of Fertilizer Type on ASTA Color Value

The study found that organic fertilizer significantly increased ASTA color values in both paprika varieties compared to synthetic fertilizer. This outcome supports prior research by Valenzuela-García *et al*., (2019), who reported that organic amendments such as poultry manure improve carotenoid accumulation in peppers. The mechanism behind this could involve the slow and steady nutrient release from organic fertilizers, which may promote the biosynthesis of carotenoids such as capsanthin and capsorubin Hornero-Méndez *et al*., (2000). These colouring agents are responsible for the red coloration in paprika. Organic fertilizers may also enhance micronutrient availability and microbial activity, further boosting pigment production.

Although King Paprika had higher ASTA values than Queen, the difference was not significantly influenced by variety-fertilizer interaction**,** indicating that the ASTA-enhancing effect of organic fertilizer applies consistently to both varieties.Furthermore, a strong positive correlation between ASTA value and shelf life suggests that improved pigment concentration may contribute to the antioxidant capacity and physiological stability of the fruit during storage. This relationship supports the view that organic fertilization may improve both aesthetic and functional quality attributes of paprika.

5.2 Effect of Fertilizer Type on Yield per Plant

Synthetic fertilizer significantly increased yield per plant, consistent with the established understanding that synthetic nutrients are more readily available and promote vigorous plant growth Chowdhury *et al*., (2019). Güneş *et al*., (2023).Both King and Queen Paprika responded similarly, with no significant interaction effect observed. This means the yield-enhancing benefit of synthetic fertilizer did not depend on variety. The consistent yield increase highlights the effectiveness of synthetic fertilizers in boosting short-term productivity.

However, a moderate negative correlation between yield and ASTA value (-0.41) suggests a trade-off: higher yields may come at the cost of reduced pigment concentration.

5.3 Effect of Fertilizer Type on Shelf Life

The study showed that organic fertilizer significantly extended the shelf life of paprika fruits. This result corresponds with Amedor *et al*., (2024), who found that poultry manure extended postharvest longevity in green pepper. Improved shelf life under organic fertilization may result from firmer fruit texture, stronger cell walls, and enhanced antioxidant content attributes that slow spoilage. This may also be as a result of lower nitrate levels, and improved antioxidant capacity Valenzuela-García *et al*., (2019). Queen and King Varieties exhibited similar trends, with no significant interaction effect observed. This suggests organic fertilization can be broadly recommended for shelf life extension, regardless of variety. Furthermore, the strong positive correlation between ASTA value and shelf life (+0.66) indicates that fruits with higher pigment content also tend to have better storability, reinforcing the quality benefits of organic fertilization.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Based on the data and analysis presented, several key conclusions can be drawn. Organic fertilizer was shown to enhance paprika quality by improving pigment intensity, as measured by ASTA values, and extending postharvest shelf life.

Synthetic fertilizer resulted in higher yields. A clear trade-off emerged between productivity and quality: while synthetic fertilizers increased yield, they tended to compromise color and shelf life. Conversely, organic fertilizers improved these quality traits but produced comparatively lower yields. Although varietal differences were not statistically significant for yield or shelf life, the King paprika variety consistently showed higher ASTA values. Importantly, fertilizer effects remained consistent across both cultivars. Correlation analysis further revealed a strong positive relationship between ASTA value and shelf life, and moderate negative relationships between yield and both ASTA value and shelf life. These results suggest that excessive vegetative growth may diminish fruit quality. Overall, the findings highlight the critical role of fertilizer management in achieving both productivity and quality objectives in paprika cultivation.

6.2 Recommendations

6.2.1 Recommendations for Practice

For growers prioritizing high-quality paprika particularly in markets where pigment intensity and shelf life are essential, such as the export or processing sectors organic fertilization methods, including poultry manure or compost, are recommended. On the other hand, growers seeking high-yield, short-cycle production, especially for markets that emphasize quantity over quality, may continue to benefit from synthetic fertilizer applications. Where resources permit, integrated nutrient management (INM) strategies that combine organic and synthetic inputs should be explored. INM offers potential to balance productivity with quality while also contributing to long-term soil health Ghosh et al., (2020). Specifically, for quality-oriented production systems targeting export or the spice industry, organic fertilization is ideal. In contrast, for yield-driven production aimed at bulk fresh markets with less stringent quality standards, synthetic inputs may be more appropriate. INM strategies that blend organic and synthetic nutrients could help optimize outcomes by offering a middle ground between yield and quality, though further local trials are needed to refine these approaches.

6.2.2 Recommendations for Research

Several avenues for further research are warranted. First, multi-locational and multi-seasonal trials should be conducted to validate the current findings across different agro-ecological zones and under varying climatic conditions, while also assessing long-term effects on soil health and nutrient cycling. Second, future studies should explore a broader range of paprika varieties and fertilizer types, including bio-fertilizers, to identify optimal input combinations. Thirdly, comprehensive economic analyses are needed to assess the cost-effectiveness and profitability of organic versus synthetic fertilization systems in paprika production. Fourth, postharvest management strategies should be investigated to determine how they might enhance shelf life and complement pre-harvest fertilization practices. Fifth, additional research into the physiological and biochemical mechanisms by which organic fertilizers increase ASTA values and shelf life is crucial. Finally, trials that investigate integrated fertilizer systems, such as 50:50 organic-synthetic blends, will help determine the most effective nutrient ratios for balanced outcomes. Future studies should also include detailed biochemical analyses of carotenoids and postharvest spoilage patterns to deepen our understanding of fruit quality dynamics.

APPENDIX

Appendix 1 Analysis of variance

Variate: ASTA_Value

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	3	0.40625	0.13542	1.50	
Block.*Units* stratum					
Fertiliser	1	715.56250	715.56250	7926.23	<.001
Variety	1	78.76562	78.76562	872.48	<.001
Fertiliser.Variety	1	0.01562	0.01562	0.17	0.687
Residual	9	0.81250	0.09028		
Total	15	795.56250			

Appendix 2 Analysis of variance

Variate: Yield_kg

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	3	6.703	2.234	1.38	
Block.*Units* stratum					
Fertiliser	1	23142.016	23142.016	14256.47	<.001

Variety	1	618.766	618.766	381.19	<.001
Fertiliser.Variety	1	1.891	1.891	1.16	0.309
Residual	9	14.609	1.623		
Total	15	23783.984			

Appendix 3 Analysis of variance

Variate: Shelf_Life_days

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	3	0.04297	0.01432	0.80	
Block.*Units* stratum					
Fertiliser	1	46.41016	46.41016	2608.02	<.001
Variety	1	1.12891	1.12891	63.44	<.001
Fertiliser.Variety	1	0.03516	0.03516	1.98	0.193
Residual	9	0.16016	0.01780		
Total	15	47.77734			

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