BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF CROP SCIENCE

EVALUATION OF THE PERFORMANCE OF DIFFERENT SESAME VARIETIES UNDER DIFFERENT MANURE TYPES (POULTRY, GOAT AND CATTLE).

DOWERA TIMOTHY M.

B201715B

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF AGRICULTURAL SCIENCE

HONOURS DEGREE

(CROP SCIENCE)

SUPERVISORS: MS KAMOTA AND MR MUTSENGI

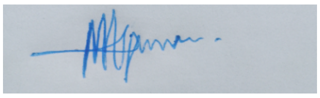
DECLARATION.

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

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

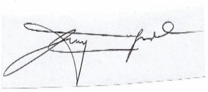
Student:

Signature  Date

Supervisor: Ms. Kamota

Signature  Date

Chairperson: Mr. Mutsengi

Signature  Date

ABSTRACT

The study investigated the effects of different manure types (poultry, goat and cattle) on the performance of two sesame varieties. The experiment was conducted in a randomized complete block design with three replications. The treatments for the experiment included poultry, goat and cattle manures. Data was collected on branching habit, chlorophyll concentration, pod number, plant height and grain weight between the two sesame varieties and among the different manure types. Variety 1(Zimbabwe Black {ZB-1}) performed better under goat manure while Variety 2 (Simsim 33) showed superior performance under goat manure as well, especially under branching habit, pod number and plant height. Moderate performances were observed from the contribution of cattle manure on both varieties. The study demonstrates the potential of organic manure amendments in enhancing sesame production and oil quality and quantity, highlighting the importance of variety-specific manure management for sustainable crop production.

ACKNOWLEDGEMENTS

First and foremost, I give the most to Him the Lord God Almighty for having blessed me with such an opportunity to education and life above all. I would like to extend my sincere gratitude to the following for their valuable contributions to this project, course coordinator Mr. P Mutsengi for his guidance and expertise throughout this journey. Mwavera T., Mahachi T., Dowera T. for your collaboration and support. Mr. and Mrs. Dowera for the financial support that made this project possible.

DEDICATION

I dedicate this project to my parents and family at large, whose unwavering support and Mr. P Mutsengi your guidance has been instrumental in bringing this idea to life. Your contributions have been invaluable and I am forever grateful for your belief in me. This milestone would not have been possible without your encouragement, expertise and inspiration. Thank you for being an integral part of my journey.

TABLE OF CONTENTS

LIST OF FIGURES.

LIST OF TABLES.

LIST OF APPENDICIES.

LIST OF ABBREVIATIONS.

BCE	-	Before Common Era
kg	-	kilogram
ha	-	hectare
g	-	gram
mm	-	millimeter
cm	-	centimeter
m	-	meter
LSD	-	Least Significant Difference
$P<0.05$	-	Probability less than 5%
Variety 1	-	ZB-1
Variety 2	-	Simsim 33

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Sesame (*Sesamum indicum*) is a member of the Pedaliaceae family, which is the most cultivated of its genus and about 20 other species of the genus Sesamum are wild. According to Bedigian (2010) by the 2nd century BCE, sesame had reached China, having originated on the Indian subcontinent and spreading over Mesopotamia and Eastern Anatolia. Because of the existence of wild cousins in Africa and the historical trade routes connecting the two places, others argue for a more expansive origin that includes both India and sub-Saharan Africa. The crop is grown in over 50 countries and it is extensively cultivated in tropical and sub-Saharan regions, particularly Asia and Africa (Shankar, 2012).

According to Webber (2013) in Zimbabwe, sesame is primarily grown by small-scale farmers. The production of sesame in the country has been steadily increasing due to its high demand both locally and internationally. Zimbere, (2022) mentioned in Zimbabwe, the area used for sesame farming has changed across time as well. Sesame production spanned approximately 16,000 hectares in 2018, down from 20,000 hectares in 2017. Sesame seeds are highly nutritious and packed with essential nutrients. They are an excellent source of plant-based protein, providing about 20% protein content by weight. Sesame seeds also have a high concentration of heart-healthy lipids, specifically mono- and polyunsaturated fats. They are also rather high in fiber, which supports gut health and facilitates digestion.

In Zimbabwe, the country's lowveld regions, with their hot, dry weather, are where sesame is primarily grown. The three regions in Zimbabwe that produce the most sesame are Masvingo, Manicaland and Mashonaland Central (Pophiwa, 2023). Sesame is usually planted using a hand hoe or a planter. The seeds are planted at a depth of 1-2 cm and spaced at a distance of 20-30 cm between rows. The seed rate used is usually 5-8 kg per hectare (Sesame Production Systems, 2014).

According to Muzenda (2018) fertilizers are usually applied during sesame production in Zimbabwe in order to improve soil fertility and encourage the growth of strong sesame plants. The success of sesame farming is largely dependent on the type of fertilizers used and how often they are applied. According to Yerokun, (2003) the recommended application rate of nitrogen for sesame in Zimbabwe is around 30-60 kg/ha, applied either as basal or split doses during different growth stages, application rate of phosphorus for sesame cultivation ranges from 20-40 kg/ha applied at planting or as a topdressing fertilizer, application rate of potassium is approximately 20-40 kg/ha, applied either at planting or during the growing season..

According to Isman (2020) while research exists on organic farming in general and organic sesame production to some extent, the specific use of organic top dressing for sesame in Zimbabwe is under-explored. This offers valuable information about the potential environmental and social benefits of promoting organic sesame production in Zimbabwe, contributing to sustainable agricultural practices and improved livelihoods for small-scale farmers.

Studies by Wanjek, (2005) suggest sesame boasts a global presence with numerous varieties, each offering distinct characteristics and uses. While seed colour is a noticeable difference (white, black, brown), variety goes beyond aesthetics. In Zimbabwe, sesame breeding programs have developed specific varieties to thrive in the local climate. These Improved Varieties come in both dark and white seed colours and are tailored to perform well under Zimbabwean conditions, alongside the well-established Lindi variety. Among Zimbabwean farmers, the Lindi sesame variety reigns supreme. Renowned for its resilience in dry conditions and adaptability to various soil types, Lindi has earned its popularity. Efforts are underway to develop even better sesame varieties for Zimbabwe. These Improved Varieties aim to boost productivity, yield, and overall seed quality. While both dark and white sesame seeds find favour with Zimbabwean farmers, these improved varieties offer exciting possibilities for the future of sesame cultivation in the country.

This study seeks to explore the gap in knowledge on the effectiveness of different organic matter sources (poultry, cattle, and goat) as organic top dressing. The research addressed this by comparing the application rates, and impact on yield and soil health of different organic top-dressing materials.

1.2 PROBLEM STATEMENT

There’s no adequate data on sesame production with different manure types (poultry, goat and cattle) and how they affect different varieties. This research aims to provide this missing gaps within the production of sesame organically.

1.3 JUSTIFICATION

Sesame (*Sesamum indicum*) is a critical crop for oil production and food security, yet its yields and quality are often limited by inadequate organic farming practices (Kuol, 2004). The use of different manure types (poultry, goat and cattle) can significantly impact sesame production but the current lack of data on this topic hinders informed decision–making for small-scale farmers and researchers (Nations, 2018). The results are going to provide an addition to which small-scale farmers and the agricultural sector are going to explore in organic farming of sesame.

1.4 OBJECTIVES

1.4.1 MAIN OBJECTIVE

- To evaluate the effectiveness of composted poultry manure, cattle manure, and goat manure as organic top-dressings types on different varieties on vegetative and reproductive stages of sesame grown by small-scale farmers.

1.4.2 SPECIFIC OBJECTIVES

- To compare the impact of organic top-dressing type and variety on vegetative growth of sesame.
- To assess the influence of organic top-dressing type and variety on reproductive growth stages.
- To evaluate the effect of organic top-dressing type and variety on seed yield per plant.

1.5 HYPOTHESES

H_1 - Organic top-dressing type and variety will have effect on vegetative sesame growth.

H_1 - Organic top-dressing type and variety will affect reproductive sesame growth.

H_1 - Organic top-dressing type and variety will have impact on yield.

CHAPTER 2

LITERATURE REVIEW

2.1 TAXONOMY AND ORIGINS OF SESAME

Sesame (*Sesamum indicum*) is a plant in the genus *Sesamum*, cultivated for its edible seeds that grow in pods. The sesame and the wild species closely related to it are classified in the family *Pedaliaceae* (Sesame family) and genus *Sesamum*. It is a popular oilseed crop with high medicinal value and is widely grown in tropical and subtropical regions. The plant is a perennial. Sesame is believed to be one of the oldest oilseed crops known to humanity, with archaeological evidence suggesting domestication in the Indian subcontinent over 5,500 years ago (Bedigian, 2010).

According to Shurtleff, (2022) with charred traces of sesame dating to approximately 3500-3050 BCE, archeological evidence points to the Indian subcontinent as the place where sesame was domesticated at least 5500 years ago. The cultivated type of sesame, *S. indicum*, is thought to have its roots in India. Sesame trade is said to have started approximately 2000 BC between Mesopotamia and the Indian subcontinent, suggesting earliest ties between these areas. Sesame trade is said to have started approximately 2000 BC between Mesopotamia and the Indian subcontinent, suggesting earliest ties between these areas (Anderson, 2023).

2.2 BIOLOGICAL DESCRIPTION

Siddique, (2018) described the herb sesame is usually an erect annual, however there are perennial variants as well. The range of height is between 0.5 and 2.5 meters, reliant upon variety and growing conditions. According to Halle, (2012) the primary stem is typically round, but some kinds have branches. These include single-stemmed plants, which have few or unclear branches, and multi-stemmed plants, which have obvious, unmistakable branches and are also known as bushier plants. Leaves are oppositely arranged, simple, and have entire margins (smooth edges). As they ascend the stem, the upper leaves becoming more lanceolate (formed like a pointed oval) and narrower, while the lower leaves are more rounded and larger. Sesame has a taproot system with lateral branching roots. Abrol, (2024) mentioned flowers are usually borne singly or in groups of two or three and are born in the leaf axils, which are the areas where the leaf and stem meet. Because most sesame plants self-pollinate, the ovary is fertilized by pollen from the same flower. However, insects like bumblebees and bees can pollinate plants to some extent.

2.3 GLOBAL DISTRIBUTION

Sesame cultivation is widely distributed throughout the world, with several nations contributing to its production. Sudan, Myanmar, and India were the top three producers of sesame seeds in 2018. A significant amount of the sesame seeds produced worldwide came from these nations (FAO, 2019).

According to Statistical Yearbook, (2023) the African continent remains the undisputed leader in sesame production, accounting for roughly 70% of global output. With Ethiopia having 1.3 million metric tons, Sudan having produced 600,000 metric tons. Tanzania, Nigeria, Uganda also contributed significantly, with individual production figures varying year to year. Asia is another major producer, responsible for around 20% of global sesame output. Key Asian producers include India with 650,000 metric tons, Myanmar with 500,000 metric tons. China, Japan also contributed to Asian sesame production, but to a lesser extent. Sesame production is on the rise in the Americas, currently accounting for around 10% of global output. Notable producers include Guatemala, Nicaragua, these Central American countries are leading the expansion in the Americas. Mexico, United States also have sesame production, with potential for further growth.

According to Majuru (2024) the Zimbabwean government targeted 100 000 tonnes of sesame crop during the 2020/21 summer farming season. The total percentage contribution to African production is not available, however, Zimbabwe’s share of the global sesame seed export market was $85 000 in 2019. This is a very small fraction of the grand total of global exports of $3 billion in 2019. More than 1 200 small-scale farmers are on course to the production of sesame. In Zimbabwe, sesame yields in test plots average 1 000 – 1 500kg/ha of grain, with a potential yield of up to 1 050kg/acre on irrigated fields.

2.4 IMPORTANCE OF SESAME

Sesame seeds are used for a number of things, such as making oil and as an ingredient in food goods. Sesame oil's economic significance as a cash crop is increased by the need for it in the culinary arts and the food sector (Bedigian, 2010). In the food industry, sesame seeds are a major source of healthy fats, proteins, fibre, vitamins (including vitamin B and E) and minerals (calcium and iron). Such a nutrient profile contributes to a balanced diet and can support heart health, bone health and digestive function. Globally, sesame seeds are consumed either directly (sprinkled on salads or baked products) or as sole ingredient in traditional dishes (gomasio seasoning).

Nations, (2022) mentioned mechanized harvesting methods and non-shattering cultivars are two examples of innovations that have increased production efficiency in sesame, lowering labour costs and raising yields. The financial sustainability of sesame farming is improved by these developments. Sesame farming provides smallholder farmers with a means of improving their standard of living and generating revenue. The agricultural communities that produce sesame benefit financially from the sale of sesame seeds and items derived from them. Sesame can be successfully grown by small-scale farmers with limited resources due to its relative drought tolerance and adaptability.

According to Commerce, (2015) including sesame in crop rotations or incorporating sesame growing into other agricultural methods might help reduce risk associated with market swings or climate-related issues, which will increase farm profitability overall. Sesame oil is a versatile cooking oil with a high smoke point, valued for its flavor and stability in high-heat cooking. Sesame oil is also used in cosmetics, pharmaceuticals, and industrial lubricants.

2.5 NUTRITIONAL VALUE OF SESAME

Stanfield, (2009) mentioned because of its great nutritional value and abundance of macronutrients such as proteins, healthy fats and fiber, sesame is one of the most prevalent crops in certain regions and stable oil seeds. Sesame is also abundant in micronutrients such as vitamin B complex, and vital minerals (magnesium, calcium, phosphorus, copper, and others). Also Gupta, (2024) described anti-inflammatory properties that help reduce inflammation in the body by neutralizing free radicals. All of these nutrients are found in the bead of the crop. Agronomic practices, climatic conditions, the processing techniques used for food preparation, and the genetic make-up influence sesame quality.

Table 1: The nutritional value of sesame seeds (per 1/4 cup or 30 gram serving).

Nutrient	**Amount**	**Daily Value (D.V) %**
Calories	**163**	**8**
Total Fat	**18**	**28**
Saturated Fat	**2.6**	**13**

Monosaturated Fat	**9.7**	**-**
Polysaturated Fat	**5.3**	**-**
Protein	**6**	**12**
Carbohydrates	**8**	**3**
Fiber	**4**	**16**
Sugar	**1.5**	**3**
Vitamins		
Vitamin B1(Thiamine)	**0.3**	**20**
Vitamin B3(Niacin)	**1.1**	**7**
Vitamin B6(Pyridoxine)	**0.1**	**5**
Folate	**18mcg**	**5**
Vitamin E (Tocopherol)	**0.9**	**6**
Minerals		
Copper	**1.3**	**65**
Manganese	**1.7**	**83**
Calcium	**291**	**29**
Magnesium	**116**	**29**
Iron	**2.7**	**15**
Phosphorous	**669**	**95**
Selenium	**1.7**	**34**

Source: (Blaak, 2023)

2.6 CONSTRAINTS TO SESAME PRODUCTION

Effective management of pests and illnesses is difficult in organic sesame production since it is not able to access synthetic chemicals and pesticides. This restriction may cause the sesame crop's quality to decline and its output to decline (Muller, 2013). According to Kassie, (2023) for producers of sesame, meeting the strict criteria for organic certification is a difficulty. For farmers, especially smallholders, finding organic markets and guaranteeing adherence to certification requirements can be difficult and time-consuming. Production of organic sesame demands specialized knowledge and abilities linked to organic farming methods. The adoption of sustainable production methods by farmers may be impeded by the absence of training opportunities and extension services specifically designed for organic agriculture practices (Vanangamudi, 2011). Bhatnagar, (2007) mentioned limited access to appropriate infrastructure such as processing facilities, storage units, and equipment tailored for organic production can impede the scalability of organic sesame farming operations.

2.7 EFFECTS OF ORGANIC TOP DRESSING ON VEGETATIVE, REPRODUCTIVE AND YIELD STAGES

Sesame growth may benefit from the addition of organic matter and nutrients to the soil provided by the organic top dressing. Nutrients and advantageous microorganisms that can enhance soil fertility and structure are responsible for this (Singh, 2023). According to Rice, (2017) an organic top dressing encourages the development of healthy soil bacteria that enhance soil structure, aid in the cycling of nutrients, and boost water retention. Sesame plants may grow stronger and healthier as a result.

Compared to synthetic fertilizers, organic top dressing may require fewer applications over time because it fosters soil health and nutrient cycling, which can increase long-term soil fertility (Singh, 2023). Baydar, (2020) reported average plant heights of 80-150 cm for sesame cultivars under conventional fertilizer management. Sesame plants are erect, branched or unbranched, and grow to a height of 80-150 cm under favorable growth conditions. The stem is round, green or purple, and can be hairy or glabrous.

A thick layer of organic mulch applied as top dressing can help suppress weed growth, reducing competition for water and nutrients with sesame plants. Deepthi, (2018) mentioned on the application of pre-emergence herbicides had minimal impact on the chlorophyll content of sesame leaves. The minimal impact on sesame chlorophyll content suggests that these pre-emergence herbicides are able to selectively control weeds without significantly damaging the crop plants when applied at the recommended rates. Sesame seeds are small, flattened and somewhat oval in shape.

The size of sesame seeds varies according to cultivar. The 1000-seed weight ranges from 2.5 to 4.0 g under conventional cultivation unlike under organic farming conditions, the 1000 seed weight of sesame cultivars ranges from 3.0-4.5g (Baydar, 2020). Compared to conventional farming practices, organic sesame production resulted in improved agronomic performance. The harvest index, which represents the ratio of economic yield to total biological yield, was 10-15% higher in the organic sesame crops compared to the conventionally grown sesame

(Namvar, 2013). According to Chung, (2021) organic sesame cultivars had 10-15% more branching on average than the conventionally cultivated.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 SITE DESCRIPTION

The research study was conducted at Bindura University of Science Education Farm, it is located along Shamva road close to Shamva Agriculture College. It is situated in the North-Eastern part of Zimbabwe, in the Mashonaland Central Region. This region is in natural region 2a. Rainfall patterns of 750 to 1000 millimeters (mm) annually. The farm's geographical coordinates are 17^0 14' 29" S, 31^0 03' 54" E and it is at an elevation of 1400m above sea level and experiences warm and dry climatic conditions and an average temperature of 20^0 C.

3.2 EXPERIMENTAL DESIGN

The experimental design was a 2-factor randomized block design. Factor 1 was the organic manure type (poultry, goat and cattle). Factor 2 was variety namely black and white. The blocking factor was the slope. This trial was replicated 3 times.

3.3 AGRONOMIC MANAGEMENT

3.3.1 LAND PREPARATION AND PLANTING

Using garden liners the block for the experiments was marked. The purpose of marking the block was such that there could be demarcations for boundaries and the separation from neighboring blocks.

After having marked the land, clearing started using a slasher to remove unwanted plants. With the aid of a tape measure measurements were used in setting pegs for the experimental plots. Marking of the plots using pegs ensured no encroaching of boundaries. The plots measured 2m by 1m.

The follow up was digging up the ground particularly the marked plots. This was to uproot the roots of the weeds, remove stones and loosen up the soil for planting purposes. The lingering roots would be picked up by hand and the soil clods broken down using a hoe.

After clearing the land of unwanted materials, this left the plots clean and fine for sesame sowing. Direct sowing of seeds took place in rows that had a spacing of 25cm apart. Having sown the seeds at a depth of 1-2cm, a light covering with sand soil was done.

The plants had to be thinned regardless of disease or pest attack. This offered the remaining plants an opportunity to fully capitalize on nutrients and other resources. The remainder of the plants had an in-row spacing of 20cm.

3.3.2 FERTILIZATION

Basal fertilizer was applied in all the experimental plots, it was chemical fertilizer. The fertilizer was applied at a rate of 0.5kg per plot. The manure was incorporated into the soil using a hoe, thoroughly mixing the soil and manure for an even distribution. Application of the top-dressing commenced at 6 weeks after planting. The organic top-dressing was applied randomly to the plots. Manure type; goat cattle and chicken were allocated to different plots, the application rate for all these was 8kg per plot. Watering of the plots was done 2 times per week.

3.3.3 WEED AND PEST CONTROL

Throughout the growing season, no weeds were given the opportunity to fully germinate or even grow. There was a strict program of monitoring weeds on a weekly basis. Every other week the beds were subjected to weeding thus destroying the weed cycles and populations. And as for pest and disease control, any plant affected by disease and or attacked by pests was rogued, this was the control measure to keep the plants healthier.

3.4 DATA COLLECTION

3.4.1 PLANT HEIGHT

The height in cm of random plants in each block was measured at a 2 week period spacing after application of the manure. The height from the plant's base to the tip of the longest leaf was measured and recorded using a tape measure.

3.4.2 CHLOROPHYLL CONCENTRATION

Chlorophyll concentration was measured using a SPAD meter. Samples were collected from random plants and readings were made comparison from other time frames.

3.4.3 POD NUMBER

The number of pods per random plant was counted at 2week period after top-dressing to assess pod development.

3.4.4 BRANCH NUMBER

The number of branches per random plants was counted after top-dressing to assess branching habit. Only primary branches extending from the main stem were counted.

3.4.5 DAYS TO FLOWERING

The time to flowering was recorded as the number of days from planting to the observation of at least 50% of plants in treatment with at least one fully opened flower.

3.4.6 TOTAL DRY WEIGHT

Total dry weight was determined by harvesting plant material at maturity, drying it in an oven at temperature 60°C for 48 hours until constant weight was achieved. Dry weight was recorded in grams per plant or per unit area (g/m^2).

3.4.7 GRAIN WEIGHT

Grain yield was determined by threshing mature sesame capsules to separate the seeds. The weight of the collected seeds was recorded as total grain weight.

3.4.8 HARVEST INDEX

Seed harvest index was determined by threshing mature sesame capsules to separate the seeds. The weight of the collected, cleaned seeds was recorded as total seed per plant. The fresh portion of biomass was dried to a constant moisture level and weighed. The calculation is HI = (Dry weight of harvestable seeds/ Total dry biomass) * 100.

3.5 ANALYSIS OF RESULTS

Analysis of variance was done using GenStat Statistical Analysis Package 18th edition, using a least significance difference (L.S.D) of $P<0.05$ to separate means.

CHAPTER 4

RESULTS

4.1 EFFECTS OF VARIETY AND MANURE ON SESAME BRANCH NUMBER

There were interaction effects at ($P<0.05$) between variety and manure on Sesame branches. Manure had an effect ($P<0.05$) on Sesame number of branches at 12 WAP. Variety also had an effect ($P<0.05$) on Sesame number of branches at 8 WAP, 10 WAP and 12 WAP.

4.1.1 EFFECTS OF MANURE ON SESAME BRANCHING HABIT

There was a significant difference at ($P<0.05$) on sesame with manure on branch number at 12 WAP. The highest branch number was observed in manure 2 (goat) with 9.33 branches. Significant difference ($P<0.05$) was noticed on manure 2 (goat) 9.33 branches and manure 1 (poultry) 7.50 branches. There was no significant difference ($P>0.05$) on manure 2 (goat) 9.33 and manure 3 (cattle) 8.50.

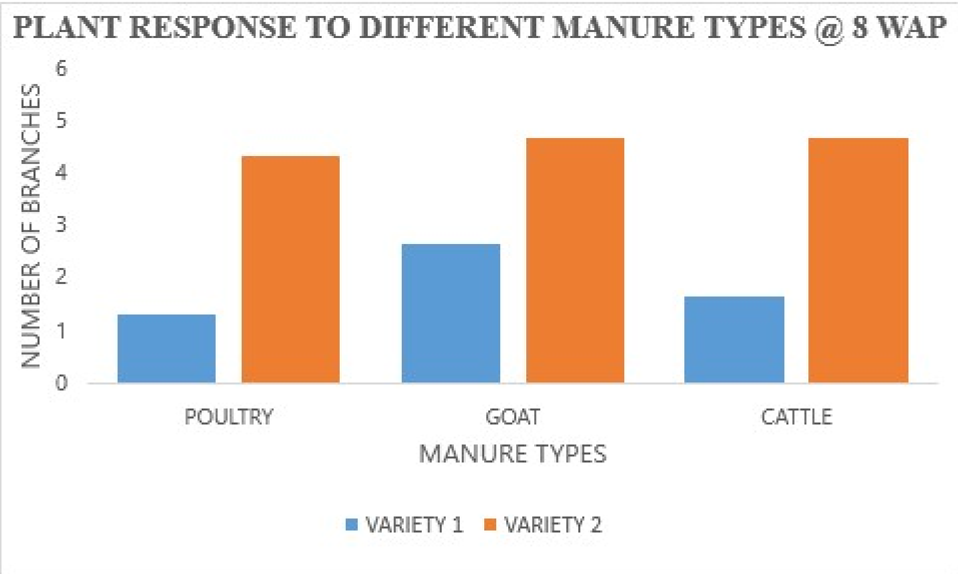


Figure 1: Effects of manure on sesame branching habit @ 8 WAP

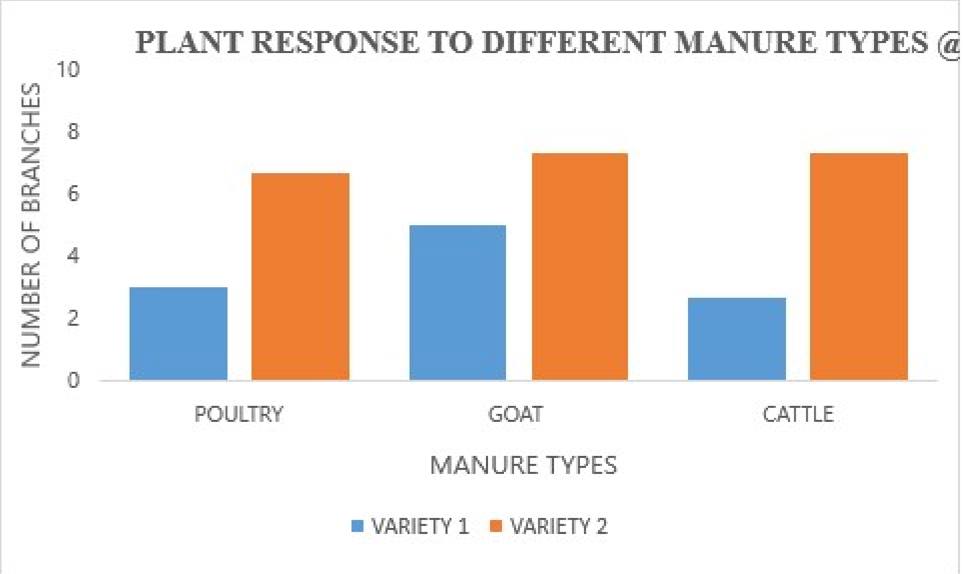


Figure 2: Effects of manure on sesame branching habit @ 10 WAP

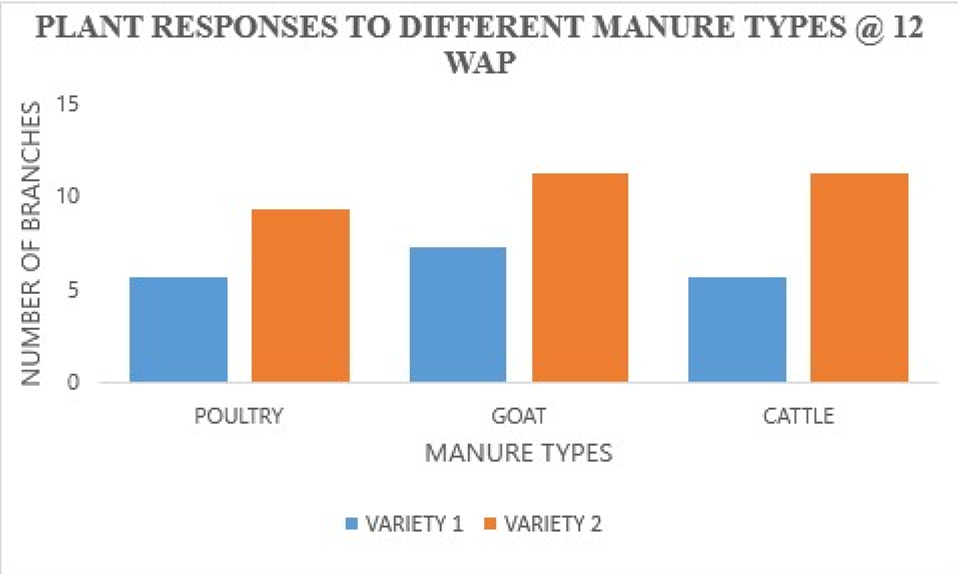


Figure 3: Effects of manure on sesame branching habit @ 12 WAP

4.2 EFFECTS OF VARIETY AND MANURE ON SESAME CHLOROPHYLL CONCENTRATION

There were no interaction effects ($P>0.05$) between variety and manure on chlorophyll concentration. Manure had an effect ($P<0.05$) on sesame chlorophyll concentration at 8 WAP and 12 WAP. Variety had no effect ($P>0.05$).

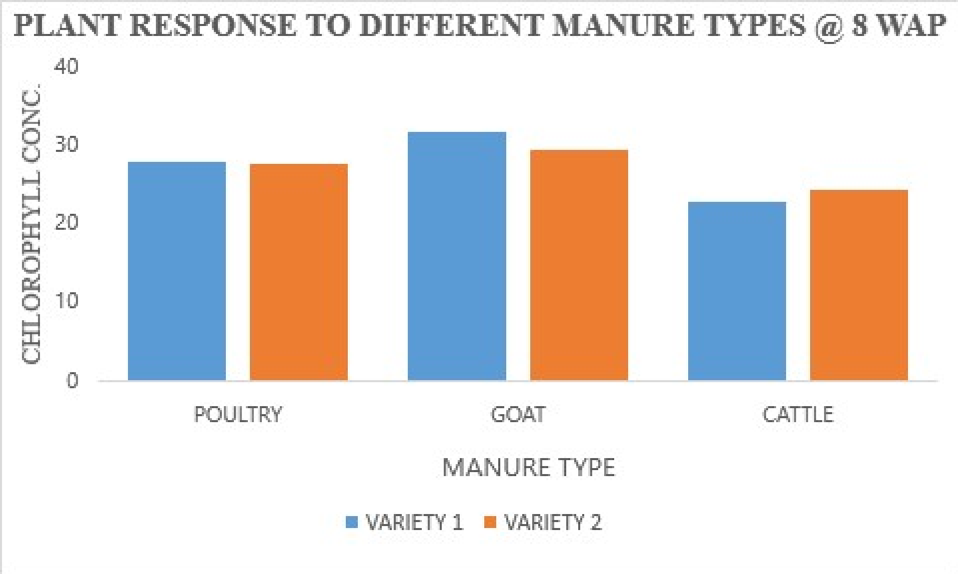


Figure 4: Effects of manure on sesame chlorophyll concentration @ 8 WAP

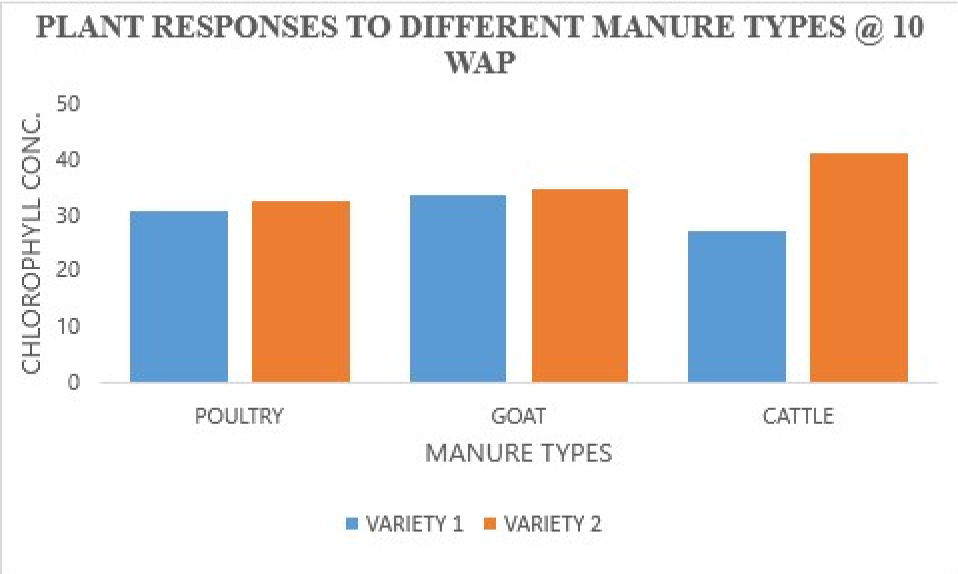


Figure 5: Effects of manure on sesame chlorophyll concentration @ 10 WAP

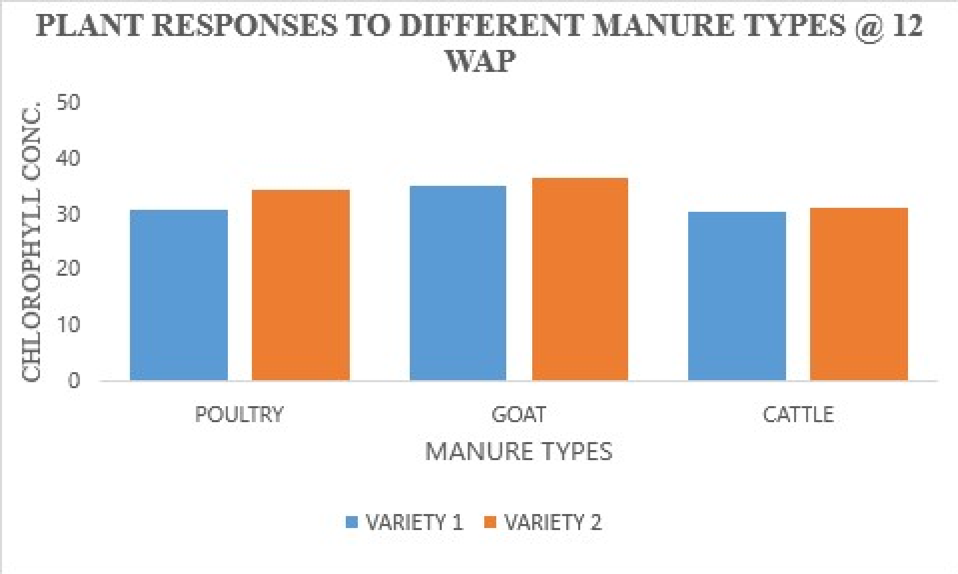


Figure 6: Effects of manure on sesame chlorophyll concentration @ 12 WAP

4.3 EFFECTS OF VARIETY AND MANURE ON SESAME POD NUMBER

There were interaction effects (P<0.05) between variety and manure at 8 WAP. Manure had no effect (P>0.05). Variety had an effect (P<0.05) on sesame pod number at 8 WAP, 10 WAP and 12 WAP.

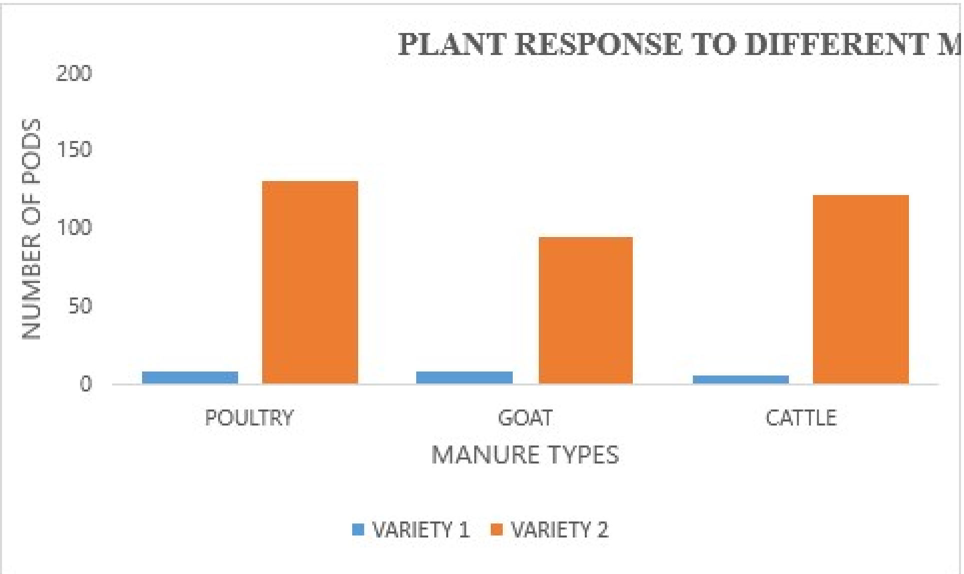


Figure 7: Effects of manure on sesame pod number @ 8 WAP

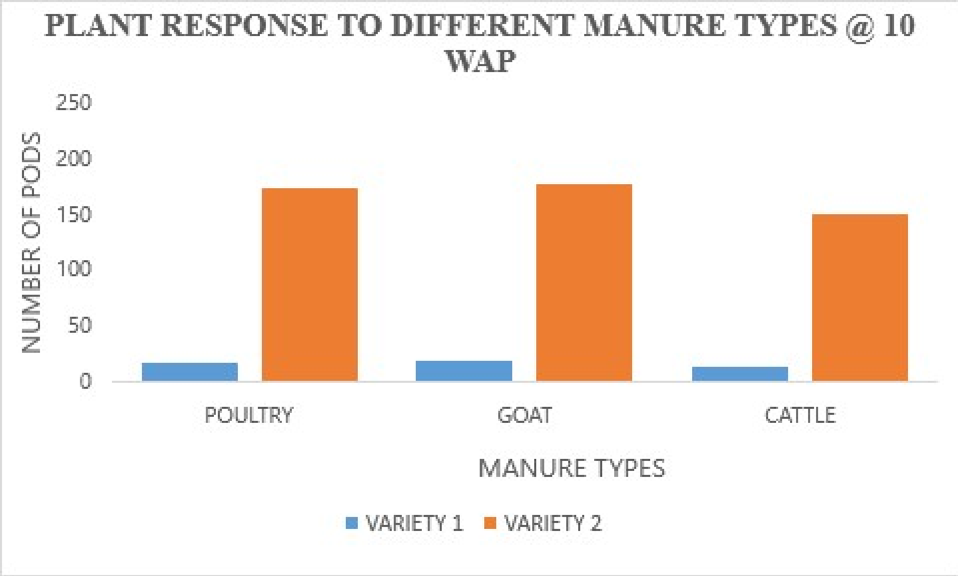


Figure 8: Effects of manure on sesame pod number @ 10 WAP

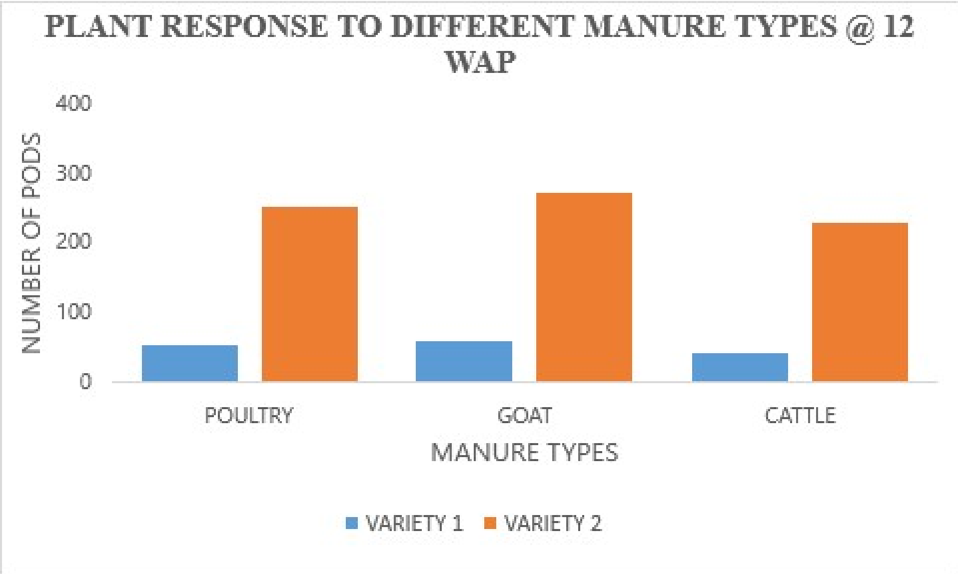


Figure 9: Effects of manure on sesame pod number @ 12 WAP

4.4 EFFECTS OF VARIETY AND MANURE ON SESAME HEIGHT

There were no interaction effects (P>0.05) between variety and manure on height. Manure had no effect (P>0.05). Variety had an effect (P<0.05) on sesame height at 8WAP, 10 WAP and 12 WAP.

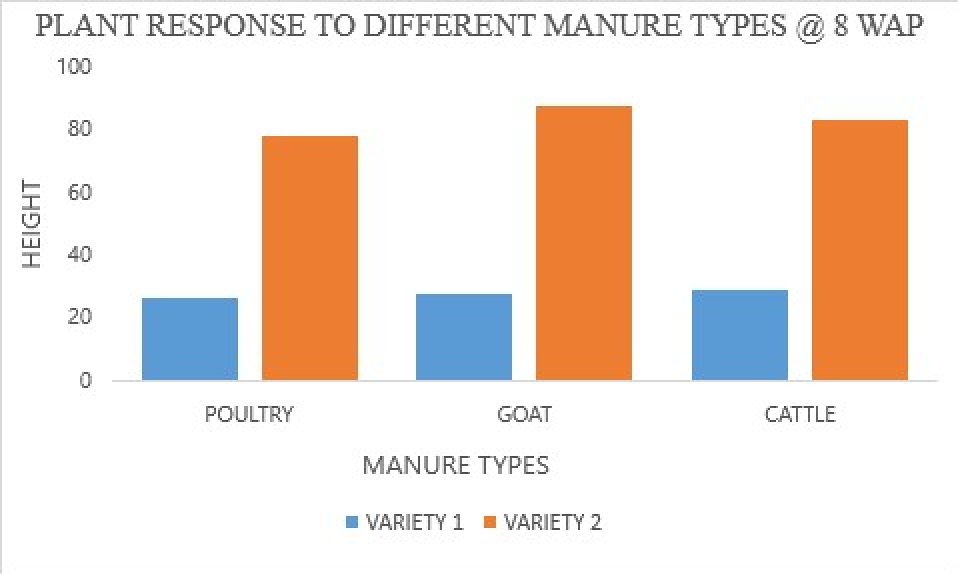


Figure 10: Effects of manure on sesame height @ 8 WAP

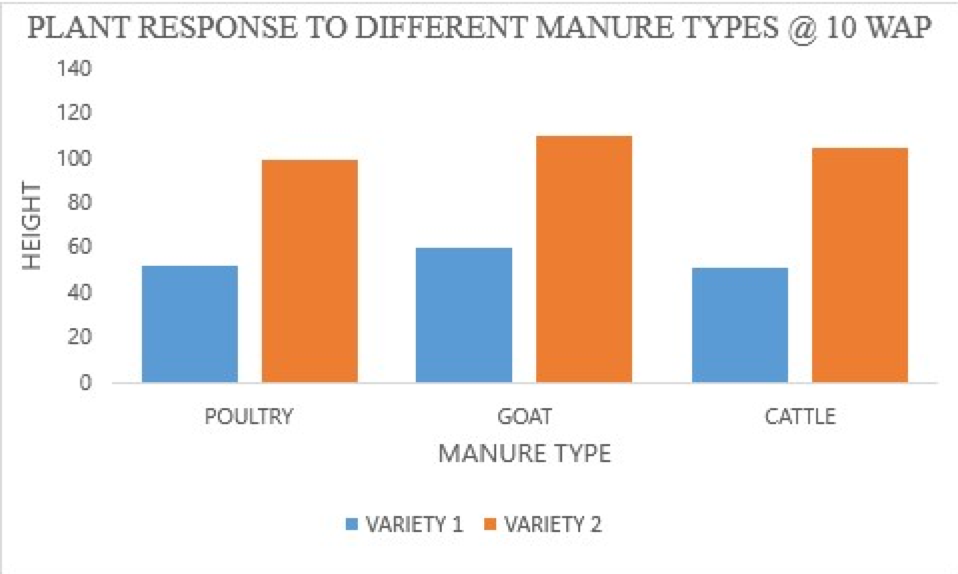


Figure 11: Effects of manure on sesame height @ 10 WAP

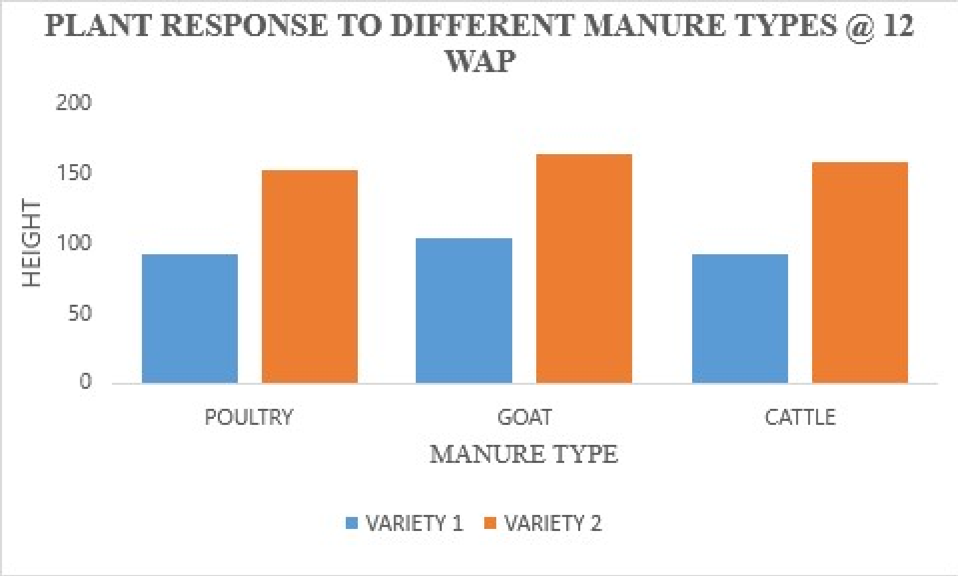


Figure 12: Effects of manure on sesame height @ 12 WAP

4.5 EFFECTS OF VARIETY AND MANURE ON GRAIN WEIGHT

There were no interaction effects ($P>0.05$) between variety and manure on grain weight. Manure had no effect ($P>0.05$). Variety had effect ($P<0.05$) on sesame grain weight.

4.5.1 EFFECTS OF VARIETY AND MANURE ON SESAME GRAIN WEIGHT

There was significant difference ($P<0.05$) on grain weight as per the data collected, in relation to variety used.

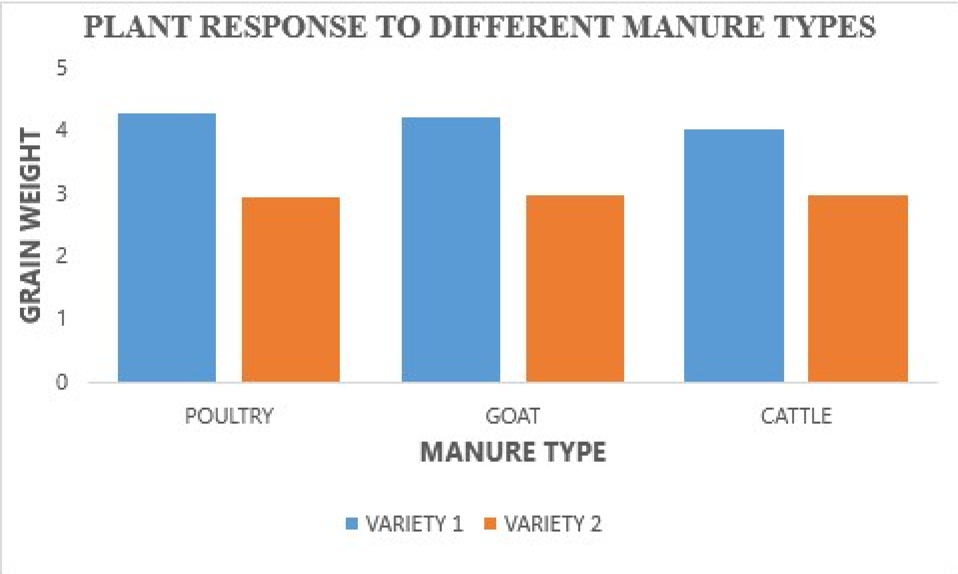


Figure 13: Effects of manure on sesame grain weight

CHAPTER 5

DISCUSSIONS

5.1.1 EFFECTS OF MANURE ON SESAME BRANCHING HABIT

Sesame plants benefit from various organic mulches that enhance both their vegetative growth and reproductive growth. Studies have shown that goat manure might be a better choice than poultry manure for sesame (Chen, 2014). This is because nitrogen, a key component of chlorophyll, is crucial for plant health, and goat manure may provide a more balanced supply of nitrogen compared to poultry manure (Bhatla, 2023). Research has also found that the type of manure used can significantly influence branching in sesame plants ($P<0.05$). Sesame plants treated with goat manure exhibited the most branching (9.33 branches), while those receiving poultry manure had the least (7.50 branches) at 12 weeks after planting. Satyanarayana, (2012) mentioned goat manure has a more balanced nutrient profile, containing N, Phosphorus (P), and K in significant amounts, unlike poultry manure which is generally higher in readily available N compared to goat manure. The lower N content in goat manure might lead to a more balanced auxin level, allowing for better expression of genes promoting lateral bud development and ultimately resulting in more branches. Excess N can promote the production of auxin, a plant hormone known to suppress lateral bud growth (branching). Goat manure, with its more balanced nutrient profile (including K), might create conditions that reduce apical dominance and allow for better lateral bud development, resulting in more branches.

Bashan, (2018) described the microbial activity in soil plays a significant role in nutrient availability to plants. Goat manure has been found to enhance microbial diversity and activity in the soil due to its composition, which can lead to better nutrient uptake by plants. This increased microbial activity can promote better root development and overall plant growth.

Another factor that could contribute to the difference in branch number between sesame plants treated with goat manure versus poultry manure is the acidification potential of these organic fertilizers. Goat manure tends to have a lower pH compared to poultry manure, which can influence nutrient availability in the soil. Sesame plants may respond differently to varying soil pH levels, impacting their branching patterns (Mashingaidze, 2023).

5.2. EFFECTS OF MANURE ON SESAME CHLOROPHYLL CONCENTRATION

Sesame varieties treated with different manure types exhibited variations in chlorophyll concentration, highlighting the interplay between variety and manure selection. Goat manure led to the highest chlorophyll concentration at 12 weeks after planting (WAP). Lakshamanan (2014) suggests this might be due to the presence of essential nutrients in goat manure that support chlorophyll production in sesame plants. Additionally, goat manure's faster decomposition rate compared to cattle or poultry manure could contribute to its positive impact on chlorophyll concentration.

Sesame plants treated with cattle manure showed a significant difference ($P<0.05$) in chlorophyll concentration at both 8 and 12 weeks after planting (WAP). This could be due to the gradual nutrient release pattern of cattle manure as it decomposes (Williamson, 2013). Compared to faster-releasing manures, cattle manure might contribute to a slower but steadier rise in chlorophyll concentration over time, potentially explaining the difference observed between 8 and 12 weeks. Another factor to consider is the changing needs of the sesame plants themselves (Rajasree, 2016). Younger plants (8 weeks) might have different physiological requirements for chlorophyll compared to more mature plants (12 weeks). This difference in plant development stages could also contribute to the observed variations in chlorophyll concentration.

5.3. EFFECTS OF MANURE ON SESAME POD DEVELOPMENT

At 8 WAP poultry manure showed a higher number of pods in black variety (130.7 pods). Poultry manure generally has a higher nitrogen content compared to cattle and goat manure. The nutrient is essential for vegetative growth, which can translate to more flowers and potentially more pods in the early stages. The decomposition rate itself is faster as compared to the other manures, this results in the nutrients benefiting the plants in the short term and thereby leading to a boost in pod production early on (Williamson, 2013).

During 10 and 12 WAP there was a change in the manure type from poultry to goat, for the highest number of pods produced with 178 pods and 273 respectively. The potassium content in goat manure is higher than that of poultry manure. Potassium is crucial for flower and fruit in plants generally. Looking at the decomposition rate of goat manure is steadier than that of poultry hence there would be a more sustained supply of nutrients throughout the sesame's growth cycle. This impact is more noticeable later in the development stages rather than in the earlier like poultry (Pathak N, 2018).

5.4. EFFECTS OF MANURE ON SESAME HEIGHT

According to Pathak, (2018) goat manure is known to offer a more balanced nutrient profile compared to poultry manure which is higher in nitrogen and also cattle manure has a slower decomposition rate which affects its impact pace. This balance is known to provide a more sustained nutrition for both vegetative growth (stem height) and other vital plant functions. Chen, (2014) describes the slower and steadier release of nutrients by manure types. Goat manure decomposes at a moderate pace, releasing nutrients much more gradually than poultry and cattle manure. This steadier supply of nutrients can favor consistent growth throughout the season for the crop. With the steadier sipply a more pronounced increae in sesame height is obtained.

5.5.1 EFFECTS OF MANURE ON GRAIN WEIGHT

As for the white variety with the higher grain, it might be contributed by its preferential nitrogen requirement. The variety might be particularly suited with poultry manure hence such a higher grain weight due to its high nitrogen content (Chen, 2020). For the black variety, the highest weight was obtained from the treatments of goat and cattle both. This variety has shown to favor a steadier and balanced absorption of nutrients from goat and cattle manure (Egli, 2017).

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The results of this study demonstrated that manure type as top-dressing on sesame varieties has aided on their overall performance. With most of the physiological displays largely centered on varietal properties. The research's primary objective was to determine which manure type could give the best performance on which variety with regard to vegetative, reproductive and yield stages. All of the 2 varieties were impacted by the 3 manure types (poultry, goat, cattle), Variety 2 treated with goat manure outperformed Variety 1 with either poultry or cattle manure. The higher branch number, pod number and plant height demonstrated the performance of Variety 2.

6.2 RECOMMENDATIONS

Small-scale farmers should grow Variety 2 (white) and use the following preferential order when selecting for manure type: goat, cattle and poultry. It is also critical for future researches to focus on the effects of moisture stress tolerance amongst the different sesame varieties as it will give a clear picture as to which varieties are better suited in which regions of the nation.

References

A. Namvar, T. K. (2013). R. *Zahedan Journal of Agricultural Research*, 34-40.

Abrol, D. (2024). *Pollination Biology of Cultivated Oil Seeds and Pulse Crops.* CRC Press.

Adrian F. Muller, N. H. (2013). *Organic Agriculture for Sustainable Livelihoods.* Routledge.

Anderson, I. (2023). *The History and Natural History of Spice: The 5000-Year Search for Flavour.* History Press.

Anjali Gupta, A. M. (2024). *Oils and Fats as Raw Materials for Industry.* Wiley.

Bashan Y. (2018). Current Opinion in Microbiology. *Organic farming: A review on rhizosphere biology and plant growth promotion by beneficial microorganisms*, 347-354.

Baydar, H. (2020). *Sesame, Safflower and Sunflower. In Handbook of Plant Breeding.* Springer.

Bedigian, D. (2010). *Sesame: The Genus Sesamum.* CRC Press.

Bhatla Satish C., L. M. (2023). *Plant Physiology, Development and Metabolism.* Springer Nature Singapore.

Bhatnagar, A. (2007). *Successful Experiments in Rural Development: Sage & Sound Recipes- Volume 1.* Madhya Pradesh Rural Livelihoods Project, State Livelihoods Forum & Zenith Books International, New Delhi.

Blaak, E. E. (2023). *Insights in Nutrition and Metabolism.* Frontiers Media SA.

Brahma Singh, P. K. (2023). *Vegetables for Nutrition and Entrepreneurship.* Springer Nature Singapore.

Chen X, Z. H. (2020). Pollination Dynamics in Sesame (Sesamum indicum L.): Implications for Pod Number and Yield. *Frontiers in Plant Science*.

Chen X, Z. Y. (2014). Comparison of nutrient contents between swine and goat manures as organic fertilizers for vegetable production. *A review. Journal of Environmental Quality*, 986-995.

Chittaranjan Kole, P. R. (2019). *The Castor Bean Genome.* Springer International Publishing .

Commerce, U. S. (2015). *Overseas Business Reports* . U.S. Department of Commerce, Bureau of International Commerce.

E. Zimbere, N. M. (2022). *Growth and Tolerance of Sesame (Sesamum indicum L.) Varieties to Pre and Postemergence Graminicides.* Advances in Agriculture.

Egli, D. B. (2017). *Seed Biology and Yield of Grain Crops.* CABI.

F. Halle, R. A. (2012). *Tropical Trees and Forests: An Architectural Analysis.* Springer Berlin Heidelberg.

Hopkins, W. G. (2006). *Plant Development.* Facts On File, Incorporated.

K. H. M. Siddique, X. L. (2018). *Future Smart Food: Rediscovering Hidden Treasures of Negelected Underutilized Species for Zero Hunger in Asia*. Food and Agricultural Organization of the United Nations.

K. V. Deepthi, A. M. (2018). Influence of pre-emergence herbicides on chlorophyll content of sesame (Sesamum indicum L.). *Journal of Pharmacognosy and Phytochemistry*, 2846-2848.

K. Vanangamudi, V. M. (2011). *Organic Seed: Traditional Varieties and Technologies.* Scientific Publishers .

Kassie, G. T. (2023). *Scoping study on Ethiopian sesame value chain* . Intl Food Policy Res Inst.

Kuol, B. G. (2004). *Breeding for Drought Tolerance in Sesame (Sesame Indicum L.) in Sudan.* Cuvillier.

Lakshamanan, M. S. (2014). *Comparative Study on Nutrient Content of Different Animal Manures.*

Majuru, A. (2024). *Demand for sesame seeds growing.* Sunday Mail.

Mashingaide Arnold, P. C. (2023). *Sustainable soil fertility practices for smallholder farmers.* Frontiers Media SA.

Murray B. Isman, P. C. (2020). *Pesticidal Plants: From Smallholder Use to Commercialisation.* Mdpi AG.

Muzenda A., C. F. (2018). *Impact of Pluralistic and Demand Driven Extension on Crop Production. A Case Study of Gokwe South Ward 23, Zimbabwe.*

N. Popihwa, J. M. (2023). *Lived Experiences of Borderlands Communities in Zimbabwe: Livelihoods, Conservation, War and Covid-19.*

Nations, F. a. (2018). *Agrobiodiversity - a training manual for farmer groups in East Africa.* Food & Agriculture Org.

Nations, F. a. (2019). *FAO: Challenges and Opportunities in a Global World.* FAO.

Nations, F. a. (2022). *Handbook on the Integtared Crop Management of Groundnut and Sesame for Farmer Field Schools in Central DryZone of Myanmar.* FAO.

Naturland, e. V. (2002). *Organic Farming in the Tropics and Subtropics: Cultivation Guide for 20 Crops.* Grafelfing.

Pathak N, R. A. (2018). Effect of abiotic stress on expression of flavanoid biosynthesis genes. *In Biochemical Mechanisms and Regulation of Photosynthesis* , 293-312.

R. Rajasree, V. S. (2016). *Endomycorrhizal Association in Sesame. Effects on Growth and Nutrition.* Anchor Academic Publishing.

Rice, C. W. (2017). *Enhancing Soil Health to Mitigate Soil Degradation.* MDPI AG.

S.Chung, J. L. (2021). Agronomic traits of organic sesame cultivars compared to conventional cultivation. *Agronomy Journal*, 2345-2355.

Satyanarayana T., J. B. (2012). *Microorganisms in Sustainable Agriculture and Biotechnology* . Springer Netherlands.

Sesame Production Systems. (2014). Lap Lambert Academic Publishing GmbH KG.

Shankar, S. (2012). *Nutrition, Diet and Cancer.* Springer.

Siddique S, H. M. (2014). *Organic farming: the return to nature. Importance of crops in the Era of Climatic Changes: Volume 2* (Vol. 2).

Singh R., K. R. (2018). Genetic diversity analysis of Indian sesame germplasm using simple sequence repeat markers. *A review Journal of Applied Genetics*, 379-390.

Stanfield, P. S. (2009). *Nutrition and Diet Therapy: Self-Instructional Approaches.* Jones & Barlett Learning.

Statistical Yearbook: World Food And Agriculture. (2023). Food and Agricultural Organization of the United Nations.

Wanjek, C. (2005). *Food at Work: Workplace Solutions for Malnutrition,Obesity and Chronic Disease.* ILO.

Webber C. M., C. G. (2013). *Building agricultural competitiveness in Zimbabwe: lessons from the International perspective.*

William Shurtleff, A. A. (2022). *History of Sesame (100CE to 2022): Extensively Annotated Bibliography and Sourcebook.* Soyinfo Center.

Williamson, G. L. (2013). *Slow-Release Fertilizers for Sustainable Agriculture.* Springer.

Yerokun, I. M. (2003). Sesame and safflower Newsletter (18). *Response of sesame (Sesamum indicum L.) to plant population and nitrogen fertilizer in north-central Zimbabwe.*, 64-69.

Zhang Y, Z. X. (2013). Genome Biology. *Genome sequencing of important ilseed crop Sesame indicum L.*, 401.

Appendices.

Appendix 1: Branch number at 8 WAP.

Variate: Branch_number

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	1.4444	0.7222	1.59	
Block.*Units* stratum					
Manure	2	2.1111	1.0556	2.32	0.149
Variety	1	32.0000	32.0000	70.24	<.001
Manure.Variety	2	1.0000	0.5000	1.10	0.371
Residual	10	4.5556	0.4556		
Total	17	41.1111			

Appendix 2: Branch number at 10 WAP.

Variate: Branch_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	3.0000	1.5000	4.09	
Block.*Units* stratum					
Manure	2	6.3333	3.1667	8.64	0.007
Variety	1	56.8889	56.8889	155.15	<.001
Manure.Variety	2	4.1111	2.0556	5.61	0.023
Residual	10	3.6667	0.3667		
Total	17	74.0000			

Appendix 3: Branch number at 12 WAP.

Variate: Branch_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	1.4444	0.7222	1.59	
Block.*Units* stratum					
Manure	2	10.1111	5.0556	11.10	0.003
Variety	1	88.8889	88.8889	195.12	<.001
Manure.Variety	2	3.4444	1.7222	3.78	0.060
Residual	10	4.5556	0.4556		
Total	17	108.4444			

Appendix 4: Branch number at 8 WAP.

Variate: Branch_number

Grand mean 3.22

Manure	1	2	3
	2.83	3.67	3.17

Variety	1	2
	1.89	4.56

Manure	Variety 1	2
1	1.33	4.33
2	2.67	4.67
3	1.67	4.67

Appendix 5: Branch number at 10 WAP.

Variate: Branch_10

Grand mean 5.33

Manure	1	2	3
	4.83	6.17	5.00

Variety	1	2
	3.56	7.11

Manure	Variety	1	2
1		3.00	6.67
2		5.00	7.33
3		2.67	7.33

Appendix 6: Branch number at 12 WAP.

Variate: Branch_12

Grand mean 8.44

Manure	1	2	3
	7.50	9.33	8.50

Variety	1	2
	6.22	10.67

Manure	Variety	1	2
1		5.67	9.33
2		7.33	11.33
3		5.67	11.33

Appendix 7: Chlorophyll concentration at 8 WAP.

Chlorophyll concentration

Variate: Chlorophyll_concentration

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	88.70	44.35	2.55	
Block.*Units* stratum					
Manure	2	149.71	74.85	4.30	0.045
Variety	1	0.89	0.89	0.05	0.826
Manure.Variety	2	12.21	6.11	0.35	0.712
Residual	10	174.00	17.40		
Total	17	425.51			

Appendix 8: Chlorophyll concentration at 10 WAP.

Variate: Chloro_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	156.40	78.20	0.86	
Block.*Units* stratum					
Manure	2	24.35	12.18	0.13	0.876
Variety	1	138.89	138.89	1.53	0.245
Manure.Variety	2	163.74	81.87	0.90	0.437
Residual	10	909.57	90.96		
Total	17	1392.95			

Appendix 9: Chlorophyll concentration at 12 WAP.

Variate: Chloro_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	52.741	26.371	3.47	
Block.*Units* stratum					
Manure	2	82.074	41.037	5.40	0.026
Variety	1	18.809	18.809	2.47	0.147
Manure.Variety	2	6.861	3.431	0.45	0.649
Residual	10	76.039	7.604		
Total	17	236.524			

Appendix 10: Pod number at 8 WAP.

Variate: Pod_number

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	438.1	219.1	1.75	
Block.*Units* stratum					
Manure	2	1000.8	500.4	4.00	0.053
Variety	1	52920.9	52920.9	422.95	<.001
Manure.Variety	2	1058.8	529.4	4.23	0.047
Residual	10	1251.2	125.1		
Total	17	56669.8			

Appendix 11: Pod number at 10 WAP.

Variate: Pod_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	844.8	422.4	1.15	
Block.*Units* stratum					
Manure	2	940.1	470.1	1.28	0.319
Variety	1	101700.5	101700.5	277.37	<.001
Manure.Variety	2	427.0	213.5	0.58	0.576
Residual	10	3666.6	366.7		
Total	17	107578.9			

Appendix 12: Pod number at 12 WAP.

Variate: Pod_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	5441.	2721.	0.70	
Block.*Units* stratum					
Manure	2	2707.	1354.	0.35	0.714
Variety	1	179600.	179600.	46.21	<.001
Manure.Variety	2	595.	298.	0.08	0.927
Residual	10	38870.	3887.		
Total	17	227214.			

Appendix 13: Height at 8 WAP.

Height

Variate: Height

Grand mean 55.4

Manure	1	2	3
	52.4	57.7	56.0

Variety	1	2
	27.8	82.9

Manure	Variety 1	2
1	26.6	78.2
2	27.6	87.7
3	29.1	82.8

Appendix 14: Height at 10 WAP.

Variate: Height_10

Grand mean 79.6

Manure	1	2	3
	75.5	85.0	78.3

Variety	1	2
	54.5	104.7

Manure	Variety 1	2
1	51.7	99.2
2	60.2	109.8
3	51.6	105.1

Appendix 15: Height at 12 WAP.

Variate: Height_12

Grand mean 126.5

Manure	1	2	3
	121.5	133.0	125.2

Variety	1	2
	95.4	157.7

Manure	Variety	1	2
1		91.3	151.6
2		102.8	163.2
3		92.0	158.3