AN INVESTIGATION ON THE EFFECTS OF POULTRY MANURE AS A TOP-DRESSING MATERIAL ON PERFOMANCE OF *SOLANUM LYCOPERSICUM* (TOMATO).

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURAL AND ENVIRONMENTAL SCEINCES

CROP SCIENCE DEPARTMENT.

Project Submitted By :

NAME: **MANINGI ANDY**

STUDENT NUMBER: **B202152B**

PROGRAMME: **CROP SCIENCE**

DECLARATION

I do hereby declare that this research project entitled **AN INVESTIGATION ON THE EFFECTS OF POULTRY MANURE AS A TOP-DRESSING MANURE ON PERFOMANCE OF *LYCOPERSICON ESCULENTUM* (TOMATO)** was written by me and that it is the record of my own research work. It has neither in part nor in whole been presented for another degree elsewhere.

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

Author: Maningi Andy

Date...09/10/24

Supervisor: Prof R. Mandumbu

Date…09/10/24

Chairperson of the Department: Mr Mutsengi

Date…09/10/24

DEDICATION

I dedicate all my efforts and struggles of the educational life to my dear parents and friends, without them I'm meaningless. Also, I devote the work of this project to all the small scale and commercial horticultural farmers.

ACKNOWLEDGEMENTS

I am immensely grateful to the almighty God for bestowing me with the ability and strength to work diligently and successfully on this project. Words cannot adequately express my profound gratitude. I am deeply indebted to the Bindura University of Science Education, Department of Crop Science, for guiding me and supporting me throughout this journey. I would like to express my sincere appreciation to my Project Supervisor, Professor Mandumbu, whose constant guidance, advice, patience, and diligence played a vital role in the successful execution of this project. His valuable suggestions were crucial in ensuring the flawlessness of this endeavor. Furthermore, I extend my heartfelt gratitude to my family and friends for providing unwavering support and guidance throughout the research and writing process of this project. I am truly humbled and thankful for the support and mentorship I have received from the university, my supervisor, and my loved ones, all of whom have contributed immensely to the completion of this project.

ABSTRACT

The research was carried out to assess the effects of poultry manure as a top-dressing type in tomato production. The field experiment was done in a school garden at Tabudirira high school in Bikita district which is under Masvingo Province. It was done in a randomized completely block design with slope as a blocking factor. The trial had four treatments which were replicated three times and therefore twelve plots were constructed and were three meters long and one meter wide. Land preparation was done using an ox-drawn plough and a fine tilth was made using a hoe. The tomato variety used was the Rio Grande. The spacing of the planting stations was 45cm in-row and 90cm inter-row to give a population of 24 691 plants per hectare. The Agronomic practises which were done include weeding, irrigation, fertilizer application , pruning, disease and pest control amongst the others. The researcher found that a top-dressing treatment of 12g of Ammonium Nitrate (50% increment of standard fertilizer) had the highest number of leaves, number of fruits, number of branches, stem diameter, fruit diameter and the final yield. This was followed by the standard fertilizer (6g of Ammonium Nitrate) and poultry manure respectively. The control had the least values in all parameters (table 4.1 up to table 4.5). The researcher concluded that poultry manure had an effect to the performance of tomatoes but it was outcompeted by the treatments with 50% increment from standard Ammonium fertilizer (12g per plan). Farmers were recommended to use 12g of Ammonium Nitrate as a top-dressing material applied at 4 WAP and 6 WAP for them to maximize yields.

TABLE OF CONTENTS

Contents

LIST OF TABLES

ABBREVIATIONS

ANOVA	Analysis of Variance
LSD	Least Significant Difference
SED	Standard Errors of Differences
WAP	week After Planting
CV	Coefficient of Variation
P	Poultry manure
C	Control
SD	Standard Fertilizer
FI	Fertilizer Increment

CHAPTER 1

1.1 INTRODUCTION AND BACKGROUND

Solanum Lycopersicum (Tomato) is one of the most well-known vegetables all over the world and is mainly grown for its edible fruit and it is grown by both small-holder and commercial farmers either in greenhouses or open field. Tomato is an herbaceous annual crop of the Solanaceae family. It is normally grown for its nutritional value as it is rich in Vitamin C, Vitamin A and dietary fibre. The fruit also contain Vitamin K which is responsible for maintaining strong bonds in humans. Tomatoes have got a high level of lycopene, substances used in some more-pricy facial cleansers which are available for purchase (Wan, 2020)

Tomatoes help in the prevention of cancer, according to (Bathla, 2019) and (Labrie, 2020), the high levels of lycopene in tomatoes reduce the chances of developing prostate, colorectal and stomach cancer. Lycopene is a natural antioxidant which slows down the growth of cancerous cells. Tomatoes are widely consumed in many dishes and also as fruits. The tomato fruit can also be processed into tomato sauces, canned tomatoes and ketchup. It is also grown for economic importance in Zimbabwe. The crop has a high-value and they can fetch a good price at a market with higher profits being experienced during summer season.

The crop is easy to grow, that is why smallholder farmers are also producing them making them a crucial source of income for farmers and processors. There are various varieties of tomatoes grown in Zimbabwe which include STAR, Trinity, Candela, Oasis, Aya F1, Vectra F1 and ROMA VF to mention a few (Bathla, 2019).

According to the information provided, the most limiting factor in agricultural production in Zimbabwe, apart from pests, diseases, and changing climatic conditions, is low and declining soil fertility. Most Zimbabwean soils have lost their fertility and require the use of fertilizers to boost productivity and meet the food demands of the growing population. Tomato is a high-yielding vegetable that requires substantial amounts of fertilizers for proper establishment, growth, and yield (Li, 2018). However, the use of inorganic fertilizers, such as ammonium nitrate, can have negative effects on the soil and the environment (Ruan, 2018). Additionally, many small-holder farmers in Zimbabwe do not apply inorganic fertilizers due to the high costs of production and a lack of knowledge on the appropriate application methods and timing (Ayeni L.T., 2010). Previous research has shown that even the few farmers who use chemical fertilizers do not have adequate knowledge about the recommended application rates (Dalokom D.Y., 2016), leading to over-application and causing soil nutritional imbalances. As an alternative, farmers can use organic manure, such as poultry manure, which is recognized as a suitable organic fertilizer and is considered one of the most valuable animal manures when properly managed (Bulluck, 2002).The current study aims to assess the effects of poultry manure, applied as a top-dressing material, on the physiological growth and final yield of tomato plants. This investigation could provide valuable insights into the potential of organic fertilizers, such as poultry manure, as a sustainable and environmentally-friendly alternative to inorganic fertilizers for tomato production in Zimbabwe.

1.2 PROBLEM STATEMENT

Horticultural farmers lack knowledge on the time and the rate of applying top-dressing fertilizer and most importantly the money to purchase these fertilizers and to those who use organic manure especially small-holder farmers, they lack knowledge on which organic manure releases high nutrients required by the tomato crop (macro and micro nutrients). This study was conducted to assess if the application of poultry manure as a top-dressing material has effect on the performance of tomato plants.

1.3 AIM OF THE STUDY

The main aim of the study is to assess the effects of poultry manure as a top-dressing material in tomato production by small-holders.

1.4 OBJECTIVES OF THE STUDY

i. To assess the effect of top-dressing type on the vegetative growth of tomatoes.

ii. To determine the effects of top-dressing type on the fruiting of tomatoes.

iii. To assess the effect of top-dressing type on the final yield of tomatoes.

1.5 HYPOTHESIS

i. Top-dressing type has an effect on the vegetative growth of tomatoes.

ii. Top-dressing type has an effect on the fruiting of tomatoes.

ii. Top-dressing type has an effect on the final yield of tomatoes.

1.6 JUSTIFICATION OF THE STUDY

The horticultural farmers will benefit the most , both commercial and small-holder farmers as they will have a low-cost of production method and profits will be maximised if poultry manure is proved to have an effect on the performance of the tomato crops. The study also help economy at large through export income from the tomato production and through health benefits that are obtained from consuming the fruit. The experiment will also help in the academia as it will be kept and help the other students and the body of knowledge future references.

CHAPTER 2

LITERETURE REVIEW

2.1 Botany of the crop

The tomato species Lycopersicon esculentum (formerly known as Solanum Lycopersicon) belongs to the Solanaceae family (Zeist, 2017). Its leaves are covered in shiny, usually prostrate hairs, with only the tips being erect. The leaves are large and deeply divided into many leaflets. The plant leaves are arranged alternately along the stems. Both the leaves and the stems have a strong scent (Zeist, 2017). The plant produces clusters of four to six flowers on the stems between the leaves (Zeist, 2017). The flowers are approximately one centimeter in diameter (Wan,b 2020).

The tomato fruits come in a variety of shapes, including large and round, oval, or elongated, depending on the cultivar (Sinha, 2020). The ripe fruits may be orange, yellow, or red in color, and usually contain numerous light brown, hairy, kidney or pear-shaped seeds. Some portions of the fruit may be red or pink during the ripening process, but the fruit will not be fully ripe at that stage (Sinha, 2020).

2.2 Origin and distribution of tomatoes

The tomato originated from Central America, but the first selections were done in Mexico (Bai, 2007). It was then brought to Europe by the Spaniards shortly after 1535, and by the Portuguese to the East before 1604 (Atherton, 1986). The Portuguese also took the tomato to their territories around Southern Africa at an early date, and explorers found it there around 1850 (Atherton, 1986).

2.3 Soil and Climatic requirements

Climate is one of the most crucial factors when determining the best season for tomato production. The wide variation in climate in Zimbabwe allows the planting and production of good quality fresh tomatoes in open fields in various parts of the country all year. Tomatoes are known to be a warm season crop. It can survive certain amounts of cold units, but cannot withstand very low temperatures. The crop requires a minimum temperature which is around 10^oC with the maximum being 34^oC. Optimum temperatures are around $26\text{-}29^oC$. The plant does well in deep, loamy, well-draining soil with a pH between 5.5 and 6.8. The crop does not favour waterlogged conditions

2.4 Economic importances of tomatoes

Tomato is popularly known as the second most important horticultural crop after potato in terms of production and consumption (Panthee, 2010). It is also considered the most important vegetable food crop grown worldwide. Tomato contributes positively to the world's economic wealth and employment creation (Panthee, 2010).Tomato fruits can be consumed fresh in salads and cooked to make soups and flavor dishes. The fruit can also be prepared in various ways, such as sweetened candies, dried fruits added to wine, pureed, juiced, made into ketchup, or canned and diced (Panthee, 2010). Therefore, tomato fruits contribute to human nutrition, food security, and employment creation globally.

2.5 Constraints to tomato production

According (Robinson, 2010), tomato production is faced by a number of challenges world-wide. Farmers growing tomatoes in Zimbabwe are affected by Agronomic constraints which include pests and diseases, physiological disorders, institutional constraints and soil fertility status amongst the challenges. These constraints affect growth and production of high quality and quantity of tomatoes (Machekano, 2017). Approximately 20 pests and 45 diseases are known for attacking the crop and have a depressing effect on quality and yield of tomato. Fungi are amongst the pathogens which cause depressing effects on a tomato plant causing early blight (*Alternaria solani*) and the late blight (*Phytophthora infestans*) mostly in the cooler rainy season (Fry, 2015). Fungicides are used to prevent and control diseases (Masuka, 1998).

2.5.1 Socio-Economic factors

The socio-economic factors include gender and educational levels. These aspects are important as the household head normally coordinates the plot activities and his or her decisions will affect the entire production process , inputs and output at large (Sinha, 2020). Farmer educational levels of great importance as with basic education the farmer is able to make informed decisions (Abebaw, 2013).

2.5.2 Institutional factors

The institutional factors such as access to services , mass media, credit facilities, market share and learn tours, farmer field schools and farmer groups affect the tomato production (Mgimba., 2016). If farmers are able to access the above factors, they can expand the scope of operation, adoption, affording new technologies, and also enhance use and purchase improved inputs not those available at the plot.

2.5.3 Climate and water availability

Climate changes in Zimbabwe pose challenges to tomato cultivation. Droughts, erratic rainfall patterns and extreme temperatures can negatively impact tomato production. Due to this climate change, there must be a reliable irrigation system. Unfortunately, most farmers are failing to secure these water sources thereby affecting the production of the crop (Adejuwon, 2004).

2.5.4 Pests and diseases

Pests and diseases can affect tomato crops in Zimbabwe and these pests include nematodes, aphids, whiteflies tomato leaf miners and bacterial and fungal diseases. Poor management practises as well as limited access to appropriate pesticides and fungicides impact productivity (Landston, 2009).

2.5.5 Poor infrastructure

Tomato is a perishable crop which needs proper handling once it is ripe to avoid post-harvest losses. Inadequate infrastructure including transportation and storage facilities can lead to spoilage and difficulties in reaching distant markets (Mgimba, 2016).

2.5.6. Limited access to inputs

Many tomato farmers in Zimbabwe face challenges in accessing quality inputs such as improved seeds, fertilizers and agrochemicals. The availability and affordability of these inputs can directly affect crop productivity and quality. Some small holder farmers in rural areas usually use landraces as their seeds and this affect the quality and yield of tomato (Mgimba, 2016).

2.6 Important nutrients required in tomato production

Like all plants, tomatoes require three main macronutrients for their growth namely, nitrogen, phosphorus, and potassium. All three are essential for photosynthesis and various other functions. Other important macronutrients include calcium, sulphur, and magnesium. Nitrogen is critical for healthy leaf growth and flower and fruit development. Tomatoes need nitrogen during the seedling stage and just before flowering. (Islam, 2012)The other nutrient is Phosphorus which is essential for photosynthesis, proper root growth, and blossoming. Tomatoes need the highest amount of phosphorus in the early stages of development and especially when transplanting seedlings into the garden. Potassium is critical for flower and fruit development. Tomatoes need this macronutrient in even greater quantities than nitrogen, especially during fruit bulking. Calcium is essential for plant cell structure. Like with potassium, tomatoes need more calcium as they mature, with requirements peaking from flowering through harvest (Hartz, 2005).

2.7 The use of inorganic fertilizers (Ammonium Nitrate) as a source of Macro and Micro nutrients.

Inorganic fertilizers are materials that provide plants with one or more essential nutrients for normal crop growth (Adekiya A. A., 2009). Ammonium Nitrate fertilizers, for example, provide both ammonium and nitrogen nutrients required by crops. Inorganic fertilizers are generally more nutritionally concentrated and release their nutrients immediately (Adekiya A. A., 2009). Straight fertilizers contain only one nutrient, while compound fertilizers contain two or more nutrients. Ammoniacal fertilizers do not readily leach in clay soils due to fixation of the ammonium cations, but their continuous use can acidify the soil as the ammonium ions are oxidized to nitrates and get leached (Adekiya A. A., 2009). The use of a particular fertilizer is influenced by its cost, availability, accessibility, and the method of application.Most

Zimbabwean soils are infertile due to land degradation, and this has been a major challenge for the country's agricultural production, as most farmers, especially smallholders, rarely use fertilizers (Ruan, 2018). This calls for the adoption of inorganic fertilizers to increase crop production in Zimbabwe. However, overreliance on inorganic fertilizers can have negative effects on the soil and environment, thereby limiting sustainable agricultural production (Ruan, 2018). Moreover, inorganic fertilizers are expensive and largely out of reach for small-scale farmers in Zimbabwe, and there is a lack of knowledge on the appropriate application rates and timing for top-dressing crops. Therefore, it is essential to explore the use of organic fertilizers, such as cow, goat, compost, pig, and poultry manure, as a viable alternative to increase crop production in Zimbabwe.

2.8 The use of organic fertilizer as a source of Macro and Micro nutrients.

Organic fertilizers have the ability to increase the water-holding capacity of the soil, as they can absorb and retain water within the root zone, preventing it from moving out (Busscher, 2007). Research has shown that organic fertilizers can hold up to 10 times their own weight in water. This water-holding capacity ensures that plants have adequate moisture available for nutrient uptake, tissue generation, and photosynthesis (Busscher, 2007). Moreover, organic fertilizers provide the necessary nutritional requirements for plants and also suppress pest populations (Bulluck, 2002). They also increase the microbial activity in the soil, as well as the cation and anion exchange capacity, organic matter, and carbon content (Bulluck, 2002). According to Canellas (2015), organic fertilizers have been reported to increase crop yields and improve soil quality, particularly the soil organic matter content. While synthetic fertilizers may contain higher quantities of plant nutrients, the presence of growth-promoting agents in organic fertilizers makes them important for enhancing soil fertility and productivity (Zheng, 2019).

However, the lack of knowledge about the appropriate type of manure to apply is a limiting factor in the yield of tomatoes. This has left room for researchers to investigate which manure releases the required nutrients faster, potentially replacing inorganic fertilizers (Ammonium Nitrate). The researcher wants to conduct an experiment to assess the use of poultry manure, as it is assumed to release nutrients faster than other organic manures (Adekiya A. O., 2017).

CHAPTER 3

EXPERIMENTAL DESIGN AND METHODOLOGY

3.1 Study site

The research was carried in the school garden (Tabudirira High School) which 148.1 km from Masvingo province. The school garden is located in Bikita District which is 80km East of Masvingo town. It lies under natural region v with average rainfall ranging from 450mm to 650mm. Temperature ranges from 22-25 degrees Celsius and the soils are sandy loamy to loam with pH of 5.8 which is slightly acidic. Bikita is located on the latitude of -20.13752^{o} S and longitude of 31.93156^{o} E.

3.2 Experimental treatments and design

The research was done in a Randomised Complete Block Design with four treatments which were replicated three times and the blocking factor was slope. The first treatment (P) with poultry manure, the second with (SD) Standard Fertilizer application rate of 6 grammes whilst the third (FI) Fertilizer increment by 50 % to give 12 grammes per plant and (C) serves as the control (table 3.2.1).

Table 3.2.1: Experimental design

Block 1	Plot 1 **(C)**	Plot 2 **(IF)**	Plot 3 **(SD)**	Plot 4 **(IF)**
Block 2	Plot 5 **(SD)**	Plot 6 **(C)**	Plot 7 **(P)**	Plot 8 **(P)**
Block 3	Plot 9 **(C)**	Plot 10 **(P)**	Plot 11 **(IF)**	Plot 12 **(SD)**

3.3 Land preparation and nursery production

Land preparation was done using an ox-drawn plough to enable the breaking up of hard top layer of soil and mixing it with softer subsoil preparing for planting. After that, soil clods were manually broken using hoes and thereafter, the total area was marked using a hoe, pegs tape measure and a garden line . Plots which were 3 metres long and 1 metre wide were made. The Rio Grande variety was used in this experiment for nursery production. Marking of planting holes to plant seedlings was done the fifth week after nursery established. Seedlings were transplanted on the fifth week.

3.4 Transplanting

A trowel was used for marking planting stations and the depth of each station was 50mm. The spacing of the stations was 45cm in-row and 90cm inter-row to give a population of 24 691 plants per hectare.

3.5 Fertilizer application

Basal dressing was applied at a rate of 1000kg/ha, Compound S (7% Nitrogen, 21% Phosphorous, 8% Potash, 7.5% Sulphate and 0.04% Boron). A top-dressing of 200kg/ha of Ammonium Nitrate (34.5% Nitrogen) and also poultry 0f 12 000kg/ha was applied. Both Ammonium 6g per plant, 12g per plant and poultry manure were split applied at four weeks and six weeks after transplanting.

3.6 Disease Control

The researcher used Copper oxychloride Demildex to control both early blight and late blight on the midribs of the leaves using a syringe a week after transplanting and repeated every 7-10 days and was applied at a rate of 500g/100L of water. Fungicidal sprays were done according to the experimental unit treatment allocation where contact fungicides were applied a week after late blight disease control and fortnightly thereafter. Systematic fungicides were applied two weeks, five weeks and ten weeks after late blight disease control depending with the experiment unit treatment allocation . Fungicides were applied according to the manufacturer's recommendations. Dithane M45 was applied at a rate of 200g/ 100L of water, Copper Oxychloride was applied at a rate of 500g/ 100L of water, bravo (720g/ 100L chlorothalonil) at a rate of 400ml/ 100L of water and Amstar top (200g/ L azoxystrobin + 125g/L difenoconazole) at a rate of 3.8 ml in 5L of water Shielded knapsack nozzles were placed to avoid fungicide drift.

3.7 Irrigation regimes and weed control

A routine supply of water was done through flooding uniformly in the beds. A week after transplanting and fortnightly thereafter. The irrigation water amounts to 29mm per week to meet the ETP of the crop and avoid stress. Weeding was done in the beds, between the beds and surrounding the beds as well as the paths using a hoe.

3.8Pruning

About five weeks after transplanting, the plants were pruned using disinfected secateurs. The secateurs were also disinfected from bed to bed (they were dipped in a solution of 1 part alcohol and 1 part water plus).

3.9 Insect and pest preventive measures

Malathion 50 EC (Malathion 50% and solvents and emulsifiers 50%) 1-2 teaspoons per gallon to prevent and control Aphids, Lambda cyhalothrine 2.5 EC (Lambda cyhalothrine 25g/L and inert ingredients 975g/L) 25ml/ha to prevent and control bollworms, semilooper, fruit worm, thrips and cutworm. Abamectin 18 EC (abamectin 18g/L and ingredients 982 g/L) was also sprayed to control and prevent red spider mite in tomatoes.

3.10 Data collection

Data collection start at 6 weeks after transplanting and the first top dressing which was done at 4 weeks. Measurements taken are summarised below.

3.10.1 Stem diameter

Three plants were randomly selected from each plot. Stem diameter was taken using a string and a ruler. The average diameter of the three plants was recorded.

3.10.2 Leaf number

The number of leaves of the randomly selected three plants from each plot was counted at 6WAP up to 14WAP.

3.10.3 Stem height

Plant height was measured from the soil surface to the top of the plant using a tape measure. Measurement of plant height commenced at six weeks after first top dressing and continued at two weeks interval until the 14^{th} week.

3.10.4 Number of fruits

The number of fruits was counted from three randomly selected plants in each treatment during at 10WAP and the average of each plot was recorded.

3.10.5 Fruit number

The diameter of the fruits was also measured and recorded. The final yield per plot was calculated after final harvest. Fruit number was recorded at 10WAP.

3.10.6 Final yield

The final yield per plot was calculated after final harvest. This was converted to yield/ha based on the area harvested (kg/ha).

3.10.7 Number of branches

The number of branches was also measured by counting branches of randomly selected three plants from each plot and record the average.

3.11 Data analysis

For growth and yield parameters , analysis of variance (ANOVA) was done using Gen Stat Package 17^{th} edition, using a least significance difference (LSD) of $P<0.05$ to separate means.

CHAPTER 4

RESULTS

4.1 Effect of top-dressing type on stem diameter

Top-dressing type had an effect on stem diameter (P< 0.05) from 6WAP TO 14WAP. The treatment unit of fertilizer increment gave the highest mean value of stem diameter at all weeks (Table 4.1).

Table4.1: Results of effects of top-dressing type on stem diameter

Top-dressing type	6WAP	8WAP	10WAP	12WAP	14WAP
Standard fertilizer	0.607^{a}	0.8267^{b}	1.06^{a}	1.253^{b}	1.467^{b}
50%Fertilizer increment	0.665^{a}	0.9800^{a}	1.13^{a}	1.443^{a}	1.667^{a}
Poultry manure	0.577^{a}	0.7733^{c}	3.88^{a}	1.180^{b}	1.370^{b}
Control	0.450^{b}	0.5433^{d}	0.76^{a}	0.950^{c}	1.177^{c}
CV%	**6.2**	**3.2**	**146.5**	**4.0**	**3.7**
L.S.D	**0.0708**	**0.04950**	**4.999**	**0.0962**	**0.1049**
S.E.D	**0.0289**	**0.02023**	**2.043**	**0.0393**	**0.0429**
P VALUE	**0.002**	**<.001**	**0.447**	**<.001**	**<.001**

The means for factors followed by the same letters in a column are not significantly different from the other according to the range test at P≤0.05.

There was significant difference between the means of top-dressing materials at 6WAP, 8WAP, 12WAP, 14WAP with increment fertilizer having a highest stem diameter and there was also no significant difference between the top-dressing type at 10WAP.

4.2 Effect of top-dressing type on the number of leaves.

Top-dressing material had an effect on the number of leaves (P< 0.05) from 6WAP TO 14WAP. The treatment unit of fertilizer increment have the highest number of leaves at all weeks (table 4.2).

Table 4:2: Results of effects of top-dressing type on the number of leaves

Top-dressing type	6WAP	8WAP	10WAP	12WAP	14WAP
Standard fertilizer	52.72^{c}	70.65^{b}	87.30 ^{b}	105.96^{b}	124.86^{b}
50%Fertilizer increment	58.21^{b}	77.90^{a}	96.37^{a}	114.14^{a}	131.57^{a}
Poultry manure	50.43^{d}	72.10^{b}	82.55^{c}	108.05^{b}	122.49^{c}
Control	42.81^{a}	58.57^{c}	73.44^{d}	97.06^{c}	118.49^{d}
CV%	**2.3**	**1.7**	**1.1**	**1.6**	**0.7**
L.S.D	**2.374**	**2.371**	**1.921**	**3.362**	**1.748**
S.E.D	**0.970**	**0.969**	**0.785**	**1.374**	**O.714**
P VALUE	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**

The means for factors followed by the same letters in a column are not significantly different from the other according to the range test at P≤0.05.

There was significant difference between top-dressing materials at all WAP with increment fertilizer having a highest number of leaves.

4.3 Effect of top-dressing type on stem height

Top-dressing material had an effect on stem height (P< 0.05) from 6WAP TO 14WAP. The treatment unit of fertilizer increment being the tallest one (Table 4.3).

Table 4.3: Results of effects of top-dressing type on stem height.

Top-dressing type	**6WAP**	**8WAP**	**10WAP**	**12WAP**	**14WAP**
Standard fertilizer	39.69^{b}	59.81^{b}	78.00^{b}	87.21^{b}	89.25^{b}
50%Fertilizer increment	50.37^{a}	70.01^{a}	85.37^{a}	95.66^{a}	98.61^{a}
Poultry manure	36.39^{c}	56.24^{c}	73.85^{c}	83.08^{c}	85.71^{c}
Control	29.83^{d}	49.02^{d}	68.70^{d}	79.40^{c}	79.40^{d}
CV%	**3.6**	**1.7**	**1.4**	**2.2**	**1.4**
L.S.D	**2.794**	**1.961**	**2.118**	**3.872**	**2.426**
S.E.D	**1.142**	**0.802**	**0.866**	**1.582**	**0.991**
P VALUE	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**

From the table above, all the means for factors followed by the same letters in a column are not significantly different from the other according to the range test at P≤0.05.

4.4 Effect of top-dressing type on number of branches

Top-dressing material had an effect on stem height ($P < 0.05$) from 6WAP to 14WAP. The treatment unit of fertilizer increment has the highest number of branches at all WAP.

Table 4.4: Results of effects of top-dressing type on number of branches.

Top-dressing type	6WAP	8WAP	10WAP	12WAP	14WAP
Standard fertilizer	5.317^{b}	7.163^{a}	8.757^{b}	9.427^{a}	10.833^{b}
50%Fertilizer increment	5.596^{a}	6.830^{a}	9.200^{a}	10.533^{a}	12.400^{a}
Poultry manure	5.110^{c}	6.553^{a}	7.863^{c}	8.810^{b}	9.967^{c}
Control	4.887^{d}	5.577^{b}	7.137^{d}	8.100^{c}	9.167^{d}
CV%	**1.6**	**3.9**	**1.8**	**3.3**	**3.3**
L.S.D	**0.1665**	**0.5050**	**0.2927**	**0.6107**	**0.6913**
S.E.D	**0.0681**	**0.2064**	**0.1196**	**0.2496**	**0.2825**
P VALUE	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**

All the means were significantly different from one another as the factors are followed by different letters.

4.5. Effect of top-dressing type on fruit diameter, fruit number and final yield of tomato crop.

Top-dressing type had an effect on fruit diameter, fruit number and final yield as shown below in the Bar graph ($P \leq 0.05$).

Table 4.5: Results on the effects of top-dressing type on fruit diameter, fruit number and final yield.

Top-dressing type	Fruit number 10WAP	Fruit diameter 14WAP	Yield 14WAP
Standard fertilizer	45.15[b]	2.4746[b]	83.946[b]
50%Fertilizer increment	59.68[a]	3.738[a]	102.41[a]
Poultry manure	41.60[b]	2.367[c]	77.51[c]
Control	34.85[c]	1.554[d]	68.06[d]
CV%	**3.2**	**6.2**	**1.4**
L.S.D	**2.912**	**0.3160**	**2.350**
S.E.D	**1.190**	**0.1291**	**0.960**
P VALUE	**<.001**	**<.001**	**<.001**

Means for factors followed by the same letters are not significantly different from one another.

Different top-dressing types had effect on fruit number, fruit diameter and yield as their means showed significant difference with a P value of ($P<.001$).Treatment with 50% fertilizer increment(sums up to 12g) showed high numbers of fruit number, fruit diameter and yield (table 4.5).

CHAPTER 5

Discussion of the results

The results of this study revealed that Ammonium nitrate fertilizer applied at a rate of 12 grammes per plant (increment from the standard fertilizer) has the highest values in all the parameters at all weeks after planting that are: stem diameter, stem height, number of leaves, number of fruits, the diameter of the fruit, at all, stem height and the final yield. Standard Fertilizer followed the 50% increment fertilizer as its values were lower than that of (FI).Poultry manure is the third one, its values in all parameters were higher than the control but below than that of the Standard fertilizer. This may be due to the fact that Ammonium Nitrate is rich in Nitrogen which is an essential nutrient that promotes vegetative growth, including stem development, in plants. Nitrogen is a building block of amino acids which are also the building blocks of proteins and enzymes. Proteins allow the passage of polar substances such as water which is a crucial factor for the photosynthesis of plants, which is a process where-by plants manufacture their own food which will be distributed to all to the whole parts of the plant and enhance growth (Islam, 2012). Also, the enzymes made by the proteins also takes part in the Calvin cycle during the photosynthesis process. Ribulose biphosphate carboxylase catalyses the carbon dioxide fixation and the aldolase which convert G3P and DHAP into fructose 6-phosphate (Hartz, 2005).Nitrogen is an integral part of the chlorophyll which is a green pigment that traps light needed photosynthesis of carbohydrates. In addition, Nitrogen also increases leaf size, hastens crop maturity, promote fruit and seed formation and hence more fruits will be harvested from plants who received enough Nitrogen. Standard fertilizer and Ammonium Nitrate fertilizer have got a slight difference (M., 2005). The findings indicate that poultry manure could be a potential alternative to the standard ammonium nitrate fertilizer in providing the necessary nutrients for stem diameter. This highlights the potential for organic nutrient sources like poultry manure, especially when applied in higher amounts. This is in agreement with the work of Ayeni L.T. (2010), who reported a significant increase in plant height, number of branches, and number of leaves as a result of applying poultry manure. The experiment showed that the top-dressing type had a significant effect on the number of leaves, as the p-value was less than 0.05 in all weeks after planting (WAP). The highest number of leaves was recorded from the treatment with 12 grams per plant of ammonium nitrate (an increment from the standard rate of fertilizer application), followed by the treatment with 6 grams (standard fertilizer rate), and then the poultry manure treatment. The control treatment had the lowest number of leaves. This was likely due to the faster release of nitrogen from both the organic and inorganic sources (ammonium nitrate and poultry manure) compared to the control. The control treatment produced the least average number of leaves (118 at 14 WAP) and was significantly different from the chicken manure treatments. This result is consistent with the findings of Singh (2020) and Agbede (2008), who found that the application of poultry manure led to an increase in the number of tomato leaves. Regarding the fruit number, the results obtained were similar to those of MEHMOOD (2012), where the lowest number of fruits per plant (34.85 fruits) was produced by the treatment without nitrogen (control). This may be due to the hormonal balance in the aerated part of the plant, as the increased nitrogen supply also increases the synthesis of the gibberellin hormone (GA) on the appendix of the expanding shoots, thereby increasing fruitification (FELIPE, 2000).

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The results indicate that the application of 12,000 kg of poultry manure had a significant effect on the performance of tomato plants. However, it was outperformed by the application of 6 grams of ammonium nitrate (the standard fertilizer rate) and the application of 12 grams (a 50% increment from the standard fertilizer rate). The control treatment had the least values for each parameter measured. This suggests that the application of 12 g of ammonium nitrate had the greatest effect on the physiological growth and final yield of the tomatoes. In summary, while the poultry manure application had a positive impact, the ammonium nitrate treatments, particularly the 12 g increment, were more effective in promoting the growth and yield of the tomato plants compared to the poultry manure and the control treatments.

6.2 Recommendation

According to the conclusion drawn, the researcher recommends farmers to use 12g of Ammonium Nitrate as a top-dressing material split applied at 4 WAP and 6WAP for them to maximise their yields.

REFERENCES

Abebaw, D. &. (2013). The impact of cooperatives on agricultural technology adoption: Empirical evidence from. Food Policy, 38,. Ethiopia.

Adejuwon, S. A. (2004). Impacts of climate change on crop yield in Nigeria.Stakeholders Workshop on Assessment of Impacts and Adaptation to climate change. Obafemi Awolowo University.

Adekiya, A. A. (2009). Growth and yield of tomato(Lycopersicon esculentum Mill) as influenced by poultry manure and NPK fertilizer . Food Agric.

Adekiya, A. O. (2017). Effect of methods and time of poultry manure application on soil and leaf nutrient concentrations, growth and fruit yield of tomato (Lycopersicon esculentum Mill). . Journal of the Saudi Society of Agricultural Sciences 16(4), 383-388.

Agbede, T. S. (2008). Effect of poultry manure on soil physical and chemical properties, growth and grain yield of sorghum in southwest, Nigeria. Am.-Eurasian J. Sustain. Agric., 2: . 72-77 .

Aman, S. R. (2013). Response of tomato to nitrogen levels with or without humic acid. Sarhad Journal of Agriculture, v.29, 181-186.

Atherton, J. G. (1986). The tomato crop. Springer Science & Business Media.

Ayeni, L. T. (2010). In Integrated application of poultry manure and NPK fertilizer on performance of tomato in derived Savannah transition zone of Sci. Nat., 8: 50-54. Southwest Nigeria.

Ayeni, L. T. (2010). Integrated application of poultry manure and NPK fertilizer on performance of tomato in derived Savannah transition zone of Sci. Nat.,. Southwest Nigeria.

Bai, Y. &. (2007). Domestication and breeding of tomatoes: what have we gained and what can we gain in the future?. In Annals of botany, 100(5) (pp. 1085-1094).

Bathla, S. S. (2019). Physio and Organoleptic Characteristics of Tomatoes and Ketchup Prepared from Different Varieties of Tomato. . KRISHI VIGYAN: SCIENTISTS JOINED AS LIFE MEMBER OF SOCIETY .

Bulluck, L. R. (2002). Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms. In Applied Soil Ecology, 19(2) (pp. 147-160.).

Busscher, W. J.-T. (2007). Organic matter and polyacrylamide amendment of Norfolk loamy sand. Soil and Tillage Research, 93(1),.

Canellas, L. P. (2015). Humic and fulvic acids as biostimulants in horticulture. Scientia Horticulturae, 196,.

Dalokom D.Y., L. N. (2016). Effects of Green Manure on Crop Performance and Yield in the Savanna Region of Nigeria. : A Review: Journal of Biology, Agriculture and Healthcare 6(2), 29-35.

FELIPE, E. C. (200). Fertilizacion con nitrogen, fosforoy potasio en tomate(Lycopersicon esculentum Mill). Revista Unellez de Ciencia y Tecnologia v.17, 21-44.

Fry, W. E. (2015). Five reasons to consider Phytophthora infestans a reemerging pathogen. Phytopathology, 105(7). In PHYTOPATHOLOGY (pp. 966-981).

Hartz, K. H. (2005). Processing tomato yield and fruit quality improved with potassium fertilization. Horticu. Sci 40:1862-1867.

Islam, M. a. (2012). Effect of organic and inorganic fertilizer on growth, productivity, nutrient uptake and economics of maize (Zea mays L) and toria (Brassica campestris L)) . Agric. Scie. Res.j.

Labrie, C. &. (2020). Modulation of the Tomato Fruit Metabolome by LED Light. Metabolites, 10(6), 266. .

Landston, D. a. (2009). Disease control in the home vegetable garden. Cooperate extension. University of Georgia: Athens, Ga.

Li, X. W. (2018). Lycopene is enriched in tomato fruit by CRISPR/Cas9-mediated multiplex genome editing. Frontiers in plant science, 9, 559.

M., W. (2005). Visual symptoms of plant nutrient deficiencies in nursery and landscape plants. University of Hawaii, In Soil and Crop Management.

Machekano, H. M. (2017). Integrated pest management of tomato (Solanum lycopersicum) pests in Zimbabwe. In A review, African Entomology, 25(2). (pp. 267-278).

Masuka, A. J. (1998). Diseases of tomato (Lycopersicon esculentum Mill.) and their management in Zimbabwe. . In Crop Protection, 17(6) (pp. 463-468).

MEHMOOD, N. A. (2012). Response of tomato (lycopersicon esculentum) cultivars to nitroggen levels. Pure and Applied Biology, 63-67.

Mgimba, S. A. (2016). An Analysis of Constraints that affect Smallholder Farmers in the Marketing of Tomatoes. Tanzania. Imperial Journal of interdisciplinatory Research .

Mgimba., S. A. (2016). An Analysis of Constraints that Affect Smallholder Farmers in the Marketing of Tomatoes. Imperial Journal of Interdisciplinary Research, 396-431.

Panthee, D. R. (2010). Genomics of fungal disease resistance in tomato. Current genomics, 11(1), .

Robinson, E. a. (2010). The case of Tomato in Ghana: Marketing GSSP Working Paper #20. Ghana Strategy Support Programme (GSSP).GSSP Working Paper No. 20. Accra, Ghana: International Food Programme. Ghana.

Ruan, H. Z. (2018). Global negative effects of nitrogen deposition on soil microbes. The ISME journal, 1817-1825.

Singh, P. S. (2020). Growth and Yield of Tomato Grown Under Organic and Inorganic Nutrient Management. Int. J. Curr. Microbiol. App. Sci, 9(3), . . 365-375.

Sinha, A. S. (2020). Evaluation of tomato (Solanum lycopersicum L.)genotypes for morphological, qualitative and biochemical traits for protected cultivation. Current Journal of Applied Science and Technology, , 105-111.

Wan, Y. H. (2020). Tomato spotted wilt orthotosporous influences the reproduction of its insect vector, Western flower thrips, Frankliniella Occidentalis to facilitate transmission. Pest Management Science.

Zeist, A. R. (2017). Agronomic characteristics of tomato plant cultivar Santa Cruz Kada grafted on species of the genus Solanum.55(3), . In Horticultura Brasileira (pp. 419-424.).

Zheng, S. S. (2019). Restoration of soil fertility and microbial communities by combining organic and inorganic fertilizers on degraded mountain slope. Soil and Tillage Research, 192. 83-91.

APPENDICES

Appendix 1: ANOVA for the effect of top-dressing type on stem diameter 6WAP

Variate: Diameter_of_stem

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.001806	0.000903	0.72	
block.*Units* stratum					
Treatment	3	0.074009	0.024670	19.64	0.002
Residual	6	0.007538	0.001256		
Total	11	0.083353			

Coefficient of Variation 6.2

Appendix 2:ANOVA for effects of top-dressing type on the diameter of stem 8WAP

Variate: Stem_diameter_8

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.0013167	0.0006583	1.07	
block.*Units* stratum					
Treatment	3	0.2946917	0.0982306	160.01	<.001
Residual	6	0.0036833	0.0006139		
Total	11	0.2996917			

Coefficient of Variation 3.2

Appendix 3: ANOVA for the effect of top-dressing type on stem diameter 10WAP

Variate: Diameter_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	13.219	6.610	1.06	
block.*Units* stratum					
Treatment	3	19.162	6.387	1.02	0.447
Residual	6	37.566	6.261		
Total	11	69.947			

Coefficient of Variation 146.5

Appendix 4: ANOVA for effects of top-dressing type on the stem diameter 12WAP

Variate: Stem_Girth_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.004017	0.002008	0.87	
block.*Units* stratum					

Treatment	3	0.374333	0.124778	53.80	<.001
Residual	6	0.013917	0.002319		
Total	11	0.392267			
Coefficient of Variation	4.0				

Appendix 5:ANOVA for effects of top-dressing type on the diameter of stem 14WAP
Variate: Stem_diameter_cm_14

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.001850	0.000925	0.34	
block.*Units* stratum					
Treatment	3	0.374200	0.124733	45.22	<.001
Residual	6	0.016550	0.002758		
Total	11	0.392600			
Coefficient of Variation	3.7				

Appendix 6: ANOVA for effects of top-dressing type on the number of leaves 6WAP

Variate: Leaves

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	1.126	0.563	0.40	
block.*Units* stratum					
Treatment	3	367.052	122.351	86.68	<.001
Residual	6	8.469	1.412		
Total	11	376.647			
Coefficient of Variation	2.3				

Appendix 7: ANOVA for effects of top-dressing type on the number of leaves 8WAP
Variate: Leaf_Number_8

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.647	0.324	0.23	
block.*Units* stratum					
Treatment	3	592.802	197.601	140.36	<.001
Residual	6	8.447	1.408		

Total	11	601.896			
Coefficient of Variation	1.7				

Appendix 1:ANOVA for effects of top-dressing type on the number of leaves 10WAP

Variate: Number_of_leaves_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	3.7825	1.8913	2.05	
block.*Units* stratum					
Treatment	3	822.4750	274.1583	296.55	<.001
Residual	6	5.5469	0.9245		
Total	11	831.8045			
Coefficient of Variation	1.1				

Appendix 9: ANOVA for effect of top-dressing type on the number of leaves 12WAP

Variate: Leaves_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	5.603	2.802	0.99	
block.*Units* stratum					
Treatment	3	450.071	150.024	52.97	<.001
Residual	6	16.992	2.832		
Total	11	472.666			
Coefficient of Variation	1.6				

Appendix 10:ANOVA for effects of top-dressing type on the number of leaves 14WAP

Variate: Leaves_14

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.6310	0.3155	0.41	
block.*Units* stratum					
Treatment	3	270.4886	90.1629	117.84	<.001
Residual	6	4.5906	0.7651		
Total	11	275.7103			
Coefficient of Variation	0.7				

Appendix 11: ANOVA effect of top-dressing type on the stem height 6WAP

Variate: Height

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.

block stratum	2	1.777	0.888	0.45	
block.*Units* stratum					
Treatment	3	661.652	220.551	112.74	<.001
Residual	6	11.737	1.956		
Total	11	675.167			
Coefficient of Variation	3.6				

Appendix 12: ANOVA for effect of top-dressing type on stem height 8WAP

Variate: Height_of_stem_8

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	4.0279	2.0140	2.09	
block.*Units* stratum					
Treatment	3	686.2579	228.7526	237.35	<.001
Residual	6	5.7826	0.9638		
Total	11	696.0684			
Coefficient of Variation	1.7				

Appendix 13 ANOVA for effects of top-dressing type on stem height 10WAP

Variate: Stem_height_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	1.452	0.726	0.65	
block.*Units* stratum					
Treatment	3	446.103	148.701	132.30	<.001
Residual	6	6.744	1.124		
Total	11	454.298			
Coefficient of Variation	1.4				

Appendix 14:ANOVA for effect of top-dressing type on stem height 12WAP

Variate: Height_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	2.712	1.356	0.36	
block.*Units* stratum					
Treatment	3	439.214	146.405	38.98	<.001
Residual	6	22.534	3.756		
Total	11	464.460			

Coefficient of Variation 2.2

Appendix 15: ANOVA for effect of top-dressing type on stem height 14WAP

Variate: Height_cm_14

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	5.585	2.793	1.89	
block.*Units* stratum					
Treatment	3	579.331	193.110	131.01	<.001
Residual	6	8.844	1.474		
Total	11	593.759			
Coefficient of Variation	1.4				

Appendix 16: ANOVA for effect of top-dressing type on number of branches 6WAP

Variate: Branches

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.005482	0.002741	0.39	
block.*Units* stratum					
Treatment	3	0.820412	0.273471	39.36	<.001
Residual	6	0.041685	0.006947		
Total	11	0.867578			
Coefficient of Variation	1.6				

Appendix 17: ANOVA for effect of top-dressing type on number of branches 8WAP

Variate: Branch_Number_8

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.00252	0.00126	0.02	
block.*Units* stratum					
Treatment	3	4.20149	1.40050	21.92	0.001
Residual	6	0.38328	0.06388		
Total	11	4.58729			
Coefficient of Variation	3.9				

Appendix 18: ANOVA for effect of top-dressing type on number of branches 10WAP

Variate: Branch_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.00062	0.00031	0.01	

block.*Units* stratum					
Treatment	3	7.64329	2.54776	118.70	<.001
Residual	6	0.12878	0.02146		
Total	11	7.77269			

Coefficient of variation 1.8

Appendix 19 : ANOVA for effect of top-dressing type on number of leaves 12WAP

Variate: Branches_12

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.00080	0.00040	0.00	
block.*Units* stratum					
Treatment	3	9.57009	3.19003	34.15	<.001
Residual	6	0.56053	0.09342		
Total	11	10.13142			

Coefficient of Variation 3.3

Appendix 20:ANOVA for effect of top- dressing type on number of branches 14WAP

Variate: Branches_14

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.4617	0.2308	1.93	
block.*Units* stratum					
Treatment	3	17.2492	5.7497	48.03	<.001
Residual	6	0.7183	0.1197		
Total	11	18.4292			

Coefficient of Variation 3.3

Appendix 21: ANOVA for effects of top-dressing material on stem diameter 14WAP

Variate: Fruit_diameter_cm_14

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	0.21160	0.10580	4.23	
block.*Units* stratum					
Treatment	3	7.32625	2.44208	97.65	<.001
Residual	6	0.15006	0.02501		
Total	11	7.68791			

Coefficient of Variation 6.2

Appendix 22: ANOVA for effect of top-dressing type on the number of fruits 10WAP

Variate: Fruit_number_10

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	2.720	1.360	0.64	
block.*Units* stratum					
Treatment	3	988.597	329.532	155.12	<.001
Residual	6	12.747	2.124		
Total	11	1004.063			

Coefficient of variation 3.2

Appendix 23: ANOVA for effects of top-dressing type on the final yield

Variate: Yield_kg_plot

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	2	19.266	9.633	6.97	
block.*Units* stratum					
Treatment	3	1893.031	631.010	456.26	<.001
Residual	6	8.298	1.383		
Total	11	1920.595			

Coefficient of Variation 1.4