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COMPARING THE GROWTH OF AFRICAN NIGHTSHADE *(MANAGU)* USING COMPOST MANURE AND Diammonium Phosphate (D.A.P) in Alego Usonga Sub-County, Kenya.

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Abstract—The agrarian revolution has resulted in major changes in the agricultural sector, especially with a focus on increased agricultural yields. It has led to changes in pesticide application and inorganic fertilizer. However, these have led to adverse effects on crops and environmental resources. Alternative agricultural practices like organic composite and Diammonium Phosphate (D.A.P) can be applied to improve agricultural productivity growth. Farming subsistence crops like African Night Shade (*Managu*) is lucrative in Kenya, and when farmed using appropriate practices, it will help achieve food security. These are why using composite and D.A.P. are important in the farming of *Managu*. This study aimed to determine the effect of Compost and D.A.P. on the growth of African Night Shades and determine which is better between the two. The study was conducted at Siaya Institute of Technology under the experimental agricultural farm. Split plots were used following the Randomized Complete Block Design (RBCD), and replication was done three times. Three plots were treated with Compost, D.A.P., and the remaining acted as control plots. The plots were named H1, H2, and H3, respectively. The plots measured (3 M by 4M), and the plot was divided into three portions, each measuring (1M by 1M) and one pathway measuring (0.5 M). Data was randomly collected by measuring the leaf size and stem heights after intervals of seven days from the day of planting. Findings indicate that compost farming enhances the maximum growth of African Night Shade. Therefore, when Compost with high nitrogen content is used, it leads to a successive increase in leave sizes and the stem growth of *Managu*. Education and awareness creation is important to impart knowledge to farmers regarding making and using Compost for subsistence farming. Application of organic farming will result to achieving the sustainable goal number four, of Zero hunger.

Key Terms— African Nightshade, Compost Manure, Diammonium Phosphate Fertilizer, Environmental Conservation, Food security, Sustainable Agriculture, and Zero Hunger

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1 INTRODUCTION

Over time, after the change in the agricultural revolution, major changes have been conducted in the field of Agriculture. Since the Second World War, the application of pesticides and different inorganic fertilizers has been part of why there has been an increase in agricultural productivity. They, however, have affected flora and fauna. Fields started becoming larger and agricultural changes started emerging. However, these agricultural methods have had severe effects since there have been constant pesticides and insecticide applications on plants (Schroder, 2005). They have leached to the ground causing

major damage to environmental resources. These have led to alternative farming sources such as the application of Compost and D.A.P. on the growth of agricultural products.

The term "Nightshade" refers collectively to a wide-ranging group of plants, including poisonous, medicinal, and edible species (from the genus Solanum) (Sangija et al., 2021). Farming of the African Night Shade, also referred to as *Managu* in Kenya, has become lucrative to farmers, especially from a household environment (Ojiewo et al., 2013). If grown, inappropriate agricultural practices are sustainable and can help households have their food. It is why mechanisms such as the application of Compost and D.A.P. are advocated to improve the sustainable farming of African Night Shade.

Composting method is the farm practice where there is an application of manure from farm products. It helps reduce the volume number of pathogens or weeds, kills them, and helps manage soil status. Compost improves soil fertility and health. It is important for soil and Compost to be tested first for the nutrients before applying them to farming practices (Kamga et al., 2013). Calibrated spreaders are recommended to apply Compost on the farm to minimize pollution and help ensure high plant yields are met. Furthermore, it reduces on chances of pollution. Diammonium Phosphate, also known as D.A.P., is applied in agricultural activities to boost the produce from the farms. D.A.P. can be applied during tilling or sowing and even during pre-sowing cultivation (K'Opondo, 2005). The rationale for applying D.A.P. is that it has a high ability to dissolve in soils. Furthermore, farmers use D.A.P. because it helps in providing temporary alkanization in the soils. When the alkalization is achieved, the soils will have better fertility to aid in plant phosphorus uptake from D.A.P. fertilizers.

The Kenyan economy depends highly on agriculture which contributes 25% of the Gross Domestic Product (G.D.P.) and 75% of industrial raw materials. The agricultural sector comprises the following subsectors, forestry, fisheries, livestock, food crops, horticulture, and industrial crops (K'Opondo, 2005). Fertilizers supplement plants with vital nutrients for optimal, healthy growth. Fertilizers can be organic or inorganic, and inorganic fertilizer can come in a single nutrient or multi-nutrient formula containing macro or macronutrients. Hence, with proper agricultural practices, farmers can help strengthen the need for agriculture in the economy.

1.1 Objective of the Study

To determine which application is better between Compost manure and Diammonium Phosphate (D.A.P) in growth of African Nightshade

1.2 Justification and Significance

The study is significant in sharing the facts regarding how D.A.P. and compost manure can be applied on the farm for growing African Nightshade. Furthermore, the study is significant as it enriches the literature on composite and D.A.P. use when growing agricultural produce. Interestingly, findings from the study can be used to educate farmers on agricultural activities while the county government can dwell on the information to strengthen agricultural practices in the region.

2 LITERATURE REVIEW

Farmers are constantly learning about the effects of inorganic fertilizer applications on crop production and their effects on the environment. For these reasons, viable, sustainable measures are applied in agricultural practices. The use of organic manure results in environmental safety and enriches the soil with nutrients for plant growth. In agriculture, practices or manure applications have to balance nutrients imported and exported to achieve healthy yields (Abukutsa-Onyango, 2007). Organic manure is vital since it helps in nutrient balance leading to minimal loss of nutrients and supporting nutrient cycling.

The African nightshade is among the dicot plants and has many branches. It grows between 0.5 to one meter in height. The plant's characteristic is that they have thin leaves and are oval. The size of the leaves is about 15 cm or 6 inches in length. The leaves are also purplish (Abukutsa-Onyango, 2005). When looking at the plant, numerous flowers pop, and they are either black or purple flowers. There are also round berries that measure around 0.75 cm. The color berries of the plant can either be orange or black. It depends on the species that have been planted.

African Nightshade plants are popular in Kenya, but they are also largely domesticated in West African countries like Nigeria. Initially, it was referred to as food for poor people, but the last decades have resulted in major changes in these perceptions. It has seen the growth of African nightshade change from wild growth to semi-cultivation. It is also available today in supermarkets (Ali, 2005). The Non-governmental Organization (N.G.O). promotion of the plant and numerous research conducted about African nightshade has led to knowledge and understanding of the nutritional and medicinal benefits of the plant. (Ali, 2005). African nightshade has nutritional value and medicinal benefits, such as it can help reduce headaches and pain in the body (Anon, 2006). The African black nightshade helps in boosting the body's immunity based on findings that it reduces the inflammation or body swellings. Period pains and stomach upsets are common in daily lives, and instead of using painkillers, individuals can rely on the medicinal benefits of African nightshade. Gastric issues and arthritis can be controlled using ingestion of African nightshade. (Anon, 2006). The contents of the African nightshade plant leaves are what cause the benefits. They contain 87.2 g water, 1.0 mg iron, 4.3 g protein, 38 calories, 5.7 g carbohydrates, 1.4 g fiber,

442 mg calcium, 20 mg ascorbic acid, 3660 μg β-Carotene, 75 mg phosphorus, and 0.59 mg riboflavin per 100 g fresh weight (Anon, 2006). When humans consume the leaves, they get nutritional benefits that boost the body's health and functioning systems with the above contents.

Planting of African nightshade in Kenya can be done either using composting or applying D.A.P. fertilizer. Compost is an organic fertilizer that is prepared in home gardens. It contains a pile of waste, majorly kitchen wastes (Orech et al., 2005). It can be made in the open, or compost bins and barrels can be used. When composting, aeration is crucial to aid with the faster decomposition of the materials. After a few days, the piles are mixed to properly decompose and form quality manure (Ainika et al., 2012). The carbon to nitrogen ratio should be 30: 1, and it will have enough heat that kills pathogens, making it ready for farm application (Adebayo and Akanini, 2012). Diammonium phosphate (D.A.P.) is among the world's largest used fertilizers, and it is bought in Agro vets. The relatively high content in nutrients and the physical structure and granular nature make it a choice for the farmers. For plant nutrition, the use of D.A.P. provides excellent source of Phosphorus (P) and Nitrogen (N) (Evanylo et al., 2008). Farmers apply it because it is also highly soluble in the soil allowing for mixture and easy plantation (Sangija et al., 2021). Farmers prefer Compost because it helps in soli health and fertility. It is cost-effective, helps water storage, and contains nutrients like phosphorus and nitrogen important to plants.

3 METHODOLOGY

3.1 Site Overview

The experiment was carried out on the Siaya Institute of Technology agriculture experimental farm. The ecological requirements of Siaya include: altitude ranges from 1140- 1400M above sea level, the type of soil is ferrasol. The rainfall ranges from 1500mm- 2155mm per annum, and the temperature in the region is mostly warm and overcast. It ranges between *63°F* to *84°F* and is rarely below *60°F* or above *90°F*.

3.2 Experimental Design

The demo agricultural field was arranged in a split-plot arrangement on a Randomized Complete Block Design (RBCD), and it was replicated three times. Three plots were treated with D.A.P., three with Compost, and three as control plots. The plots were laid bare for close to six months, and no plantation had been done on the farm. The plots were named H1, H2, and H3, respectively.

3.3 Clearing and preparation of the plots

The land was prepared during the dry season, where all perennial weeds were removed, and stones and tree stumps were removed. The field was then dug using farm jembe to eradicate weeds on the plot of the experiment. The plot was then measured to get the size of 4 meters by 3 meters and raised above the ground to 15 cm high. The plot was then leveled using a farm rake. The rake aims to achieve uniformity and fine level to help grow the seeds and properly manage the seeds.

The site was cleared manually, and primary and secondary cultivation was done to eradicate the weeds on the plots. The plot was measuring (3 M by 4M), and the plot was divided into three portions, each measuring (1M by 1M) and one pathway measuring (0.5 M). Leveling of the plots was done using hand tools: the rake, panga, and jembe to provide medium tilth for the growth of *Managu* seeds.

3.4 Plantation of the seedlings

After the plots were ready, two days before plantation of the seedlings, Diammonium Phosphate was applied to the soil in the first plot H1, Compost manure in the second plot, H2 and the third plot was Free(control) H3. It was a control plot. Two days were used as a buffer period to allow the D.A.P. and Compost to mix with the soli before plantations were made. The seeds were sown on the three prepared plots directly. To prevent moisture loss, mulching was done using dry grass; then the watering of the plots using the farm watering can. Each divided plot had six seedlings planted in a row with enough spacing to provide for germination and growth. Planting was done at row spacing (30cm by 30cm) followed by a light covering of some soil at a depth of (0.5cm). Mulch materials were placed to cover the seedlings after the plantation was removed on the eighth day after plantation. Removing was that germination had started, and the plants needed maximum light and water for growth. After removing the mulch materials, thinning was done using garden snips to remove the crowded seedlings. There were three rows and three columns.

3.5 What was focused on in Measurement?

(1) Plant Stem height-It is the main plant's height. When measuring it, a ruler is placed from the border of the farm soil through to the top of the main plant.
(2) Leaf size-Measuring of the leaf sizes was done using graph papers. The first step was to trace the leaves on the graph paper. The leaf-covered squares were later counted to provide the accuracy of the leaf size. It was done on three plants picked in each of the selected plots.

4. FINDINGS AND ANALYSIS

After the experiment was done, the variation between D.A.P. fertilizer and compost applications was analyzed. In the three

plots replicated, one had applications of D.A.P. while another had compost applications. *Managu* plant yields' performance measurements were observed based on several parameters such as plant growth rate, stem height, leaf size, and plant population.

After intervals of seven days, observations were made. Seven days was selected as the ample time frame to allow for germination and make candid measurements of the selected parameters. Watering was done during the day and in the evening when there were no rains in the area. The amount of water used in plots having D.A.P. applications was the same as the amount used in control plots and those with Compost application. The findings are shown in the tables below.

Table 1.
Plant stem height and leaf size of *Managu* seedlings planted

		Week 1	Week 2	Week 3	Week 4	Week 5
D.A.P. fertilizer	Stem in cm	2.0	3.1	3.5	5.2	5.5
	Leaf in cm	3.0	3.3	3.2	5.6	6.1
Compost	Stem in cm	2.0	3.5	4.2	6.2	6.3
	Leaf in cm	4.0	4.5	5.2	6.7	6.9
Control	Stem in cm	2.3	3.3	4.4	5.3	5.8
	Leaf in cm	2.2	2.5	3.2	4.2	4.6

In plots that had applications of Compost, the leaf and stem sizes were larger than plots containing D.A.P. and control plots. Some advantages are extracted from compost manure in farming and when applied to manage seedlings planting (Evanylo et al., 2008). The seedlings get enough sunlight for photosynthesis and growth, and the soil is broken into loose particles that support the faster growth of African Nightshade seedlings.

Germination percentage (%)

This was done at an interval of one week for the three plots. Germination percentage was done on each row in the plots with 3 rows. The results were recorded, and the average percentage worked out, as shown below.

Germination percentage = Number of seeds that germinated ÷Amount of seeds planted (grams) × 100%

Table 2.

Table showing Germination percentages

D.A.P. fertilizer plot H2	Compost manure plot H1	Control plot H3
65 percent	84 percent	76 percent

The total number of seeds allocated for each plot was 25 seedlings. Therefore, that was the amount used to calculate the germination percentage. 16 seedlings were healthy and germinated in the D.A.P. plot, giving a 65 percent percentage. In the plot that had Compost, 21 seedlings germinated, giving the 84 percent germination rate, while in the control plot, 19 seedlings germinated, providing a total of 76 percent germination rate. The findings show that in areas with compost applications as a fertilizer, the seedlings germinate faster, and there are many yields that the farmer gets from the seedlings that are planted (Moyo et al., 2021). The advantage of Compost is that it helps in balancing the soil density, making the environment appropriate for seedlings to grow faster as opposed to control plots or those with D.A.P. applications (Sharma & Reynnells, 2016). Furthermore, Compost helps make the soil loose so that sunlight, air, and water can percolate easily to aid in germination and growth.

4 CONCLUSIONS AND RECCOMENDATIONS

4.1 Conclusion

Compost farming enhances maximum growth and high yields of the African Night Shade plant. Practicing compost farming using a high content of nitrogen nutrients leads to successive increases in *Managu* leaves and growth, yields, germination percentage, and the plant leaf size, among other parameters measured, recorded, and presented in the form of data. The use of Compost can therefore improve the production of crops. This will lead to high yields harvest. The observation made from the experiment carried out shows that use of poultry manure is better in growth and yields performance of manage crops than D.A.P. fertilizer even though it takes a long time to release nutrients to crop after going a process of decomposition as compared to Diammonium phosphate fertilizer that releases nutrients faster to crops, but it increases soil acidity. The cost-effective nature of Compost and health benefits to the soil is appropriate consideration to farmers. It results in increased yields that can help achieve food security in farm households.

4.2 Recommendations

1. The county government should work with relevant stakeholders on Agriculture extension services and develop strong policies that will aid in achieving the goals of Conservation Agriculture. It will help sup-

port the small-scale farmers in the area to educate them and increase their food production hence promoting food security.

2. Small scale farmers should start to embark on the use of organic manures in their farms for better soil fertility and improved infiltration. The method of organic manure application is less costly and has high returns when applied in the right directions.

More research is needed to be considered the following aspects of using poultry manure farming to try other improved vegetable varieties. Inclusion of other organic manure plant farming activities besides the D.A.P. fertilizers has been used for a long time by farmers in research of managing crop.

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