EFFECT OF COW DUNG RATES ON GROWTH AND YIELD OF BAG PROPAGATED YAM *(Dioscorea spp)*

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DEPARTMENT OF CROP SCIENCE

FACULTY OF AGRICULTURE

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A PROJECT SUBMITTED TO THE DEPARTMENT OF CROP SCIENCE, FACULTY OF AGRICULTURE , UNIVERSITY OF BENIN, BENIN CITY.

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CERTIFICATION

This is to certify that this research was carried out by **Osarumwense Joy EJIVIE** with matriculation number **AGR2004338** of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin city, Edo State, Nigeria.

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Head of Department.

DEDICATION

I dedicate this project work to God Almighty and also my parents who were the sources of my strength, finances, provisions, wisdom, understanding and inspiration.

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My profound gratitude goes to God almighty for providing an enabling environment and resources which led to the success of this work. I would like to extend my gratitude and heartfelt appreciation to my parents Mr. & Mrs. Osaretin Ejivie who helped this study in every aspect. Without their active guidance, financial assistance, cooperation, and encouragement, I would not have come this far.

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ABSTRACT

Yam (*Dioscorea spp.)* is a vital staple crop in many tropical regions, valued for its carbohydrate-rich tubers and economic importance. Bag propagation, which uses polythene bags filled with soil, has become a viable substitute that improves plant establishment, makes fertilizer management easier, and permits controlled growth conditions. This study evaluated effects of cow dung on bag propagated yams growth and yield performance. A private farm in Ogida, Benin City was the experimental site. Two treatments (control and cow dung) utilized in the experiment were laid out as a paired plot. Cured cow dung manure was applied at planting. Data collected on the number of leaves, vine length, and stem diameter were collected and recorded at intervals whereas tuber weight, vine weight, and number of leaves were collected at harvest and recorded. Data collected were analyzed as unequal variance t-test. Results revealed that cow dung significantly enhanced the vegetative growth of yam plants, particularly during the early and mid-growth stages. Variables such as vine length ($p \leq 0.05$) and number of leaves ($p \leq 0.05$) showed statistically significant increases compared to the control. The most notable impact was observed in tuber weight, where cow dung application led to a highly significant increase ($p \leq 0.05$), with mean tuber weight rising from 0.25kg (control) to 0.7 kg (cow dung) an increase of approximately 180%. In conclusion, cow dung was effective and is a sustainable fertilizer for bag-propagated yam, enhancing growth variables and yield while probably improving soil fertility and structure for long-term agricultural productivity.

CHAPTER ONE

INTRODUCTION

Yams (*Dioscorea spp.)* are starchy staples grown throughout Africa, the Americas, the Caribbean, the South Pacific, and Asia as giant tubers produced by annual and perennial vines. Both wild and domesticated *Dioscorea species* number in the hundreds. Particularly in the region that dominates yam production in West and Central Africa, the white Guinea yam (*D. rotundata,*) is the most significant specie. Like the yellow yam (*D. cayenensis*,) it is native to West Africa. Originating in Asia, the water yam (*D. alata*), is the most extensively dispersed species worldwide and the second most cultivated. (IITA,2025).

There are significant differences in the nutritional value of yams between species and even within the same species or varieties. Other factors, including agricultural practices, soil and climatic features, maturation stage at harvest, storage duration, and processing method, can also affect variations (Osagie *et al*.,1992, Treche *et al.,*1997).

In sustainable agriculture, cow dung, also referred to as cow manure, is frequently utilized as fertilizer. It is mostly made up of vegetables, fruits, grains, and digested grass. Applying cow dung directly to the soil or combining it with other organic materials makes it a great organic fertilizer. According to Nagavallemma *et al*. (2004), cow dung can be composted to produce nutrient-rich organic matter that can enhance soil health and promote robust plant growth.

Cattle manure is a valuable resource for farmers as it contains an abundance of both macro and micronutrients that are essential for plant growth and development. The nutrients present in manure, such as nitrogen (N), phosphorus (P), potassium (K), and other minerals are essential for soil fertility. One of the most significant advantages of using cattle manure as a fertilizer is that it can enhance the soil organic matter (SOM) content. Soil organic matter plays a crucial role in improving soil structure, water-holding capacity, and nutrient availability.

In a survey of yam storage practices carried out in southeastern Nigeria, it was reported that yam tubers grown with organic manure had longer shelf life than those treated with chemical fertilizer in the field (IITA,1995, Kpeglo *et al.,*1981). Other claims were that fertilization application increased the unit weight of the tubers on one hand; and also increased losses during storage (Dumount *et al.,*1997). All these claims did not take into consideration that there are many varieties, species and cultivars of yam, which may vary in their responses to field management or storage treatment.

1.1 Justification of the study

The goal of investigating how cow dung affects bag-propagated yam is not merely to discover a substitute fertilizer, but to develop a more economical, efficient, and sustainable method of yam production. By utilizing cow dung's natural advantages from its rich nutrient profile and soil-enhancing qualities to its environmental friendliness and financial benefits for farmers this research promises to fully realize the potential of bag propagation. In addition to improving nutrient management in confined growing systems, this study will greatly enhance food security and the economic empowerment of yam-dependent communities by addressing important knowledge gaps. It's an essential step toward a future in agriculture that is more robust and sustainable. Cow dung offers a holistic approach to nourishing bag-propagated yams, providing essential nutrients, improving the physical and biological properties of the soil within the confined space of the bag, and promoting a sustainable and cost-effective cultivation method.

1.2 Objectives of the study

The primary objective of this study was to:

1. Determine the influence of cow dung manure on the vegetative growth and yield of bag-propagated yam.

CHAPTER TWO

LITERATURE REVIEW

2.1 Description, Cultivation and Uses of *Dioscorea*

Dioscorea is a genus with over 600 species of flowering plants in the family Dioscoreaceae, native throughout the tropical and warm temperate regions of the world. The vast majority of the species are tropical, with only a few species extending into temperate climates (Govaerts *et al.*, 2007; Wilkin *et al.*, 2009; Tamaro, 2017). They are perennial lianas, tuberous, herbaceous plants that may reach heights of 2–12 meters (6.6–39.4 feet) or more. The leaves are typically broad, heart-shaped, and spirally organized. Although some species are monoecious, meaning that the male and female flowers are on the same plant, most are dioecious, meaning that the flowers are individually inconspicuous, greenish-yellow, and have six petals. The majority of studied Dioscorea species have extrafloral nectaries on the underside of the petiole or leaf (Weber *et al.*, 2012). They are grown for their enormous tubers, several varieties of yams are important crops in tropical regions. Particularly significant in regions of Africa, Asia, and Oceania, many of these are poisonous while fresh but can be cleansed and consumed. Many species have a class of poisons called steroidal saponins, which can undergo a number of chemical interactions to produce steroid hormones that are used in medicine and as contraceptives.

At the start of the rainy season, complete seed tubers or tuber parts are planted into mounds or ridges to start a yam crop. How and where the sets are planted, the size of the mounds, the distance between plants, the type of yam, the size of the tubers that are required at harvest, and the availability of stakes for the resulting plants all affect the crops production. In West and Central Africa, small-scale farmers frequently grow yams alongside vegetables and cereals. The seed yams are heavy to carry and perishable. Up to 30% of the harvest is typically saved for growing the following year by farmers who do not purchase new seed yams. Nematodes, fungal and viral diseases, and a variety of insect pests put strain on yam harvests. The wet and dry seasons correlate with their growth and dormant stages, respectively. The yams need a humid tropical climate with more than 1,500 millimeters (59 inches) of rainfall each year, evenly spread throughout the growing season, in order to produce their best yield. Yams have very few diseases and pests (Winch *et al.*, 1984). *Colletotrichum gloeosporioides* is the causative agent of an anthracnose that is found in many yam growing regions of the world. Many *Dioscorea species* are afflicted by *C. gloeosporioides*, according to Winch *et al.* (1984). Although yams are expensive to produce and require a lot of labor, there is a large demand for them in several African subregions, which makes growing them viable for some farmers. Cooking easily softens the hard skin of the edible tuber, which is challenging to remove. The skins range in hue from pale pink to dark brown. The majority of the vegetable, or flesh, is made up of a much softer substance that, in mature yams, ranges in color from white or yellow to purple or pink. In many temperate and tropical countries, particularly in West Africa, South America and the Caribbean, Asia, and Oceania, yams are grown for their starchy tubers (Centre for Agriculture and Bioscience International, 2016). Africa produces over 95% of the world's yam crops (Library of Congress USA, 2011). The most significant edible species among the 600 species in the genus *Dioscoerea* are *D. rotundata* (white yam), *D. alata* (water yam), *D. cayenensis* (yellow yam), *D. dumentorium* (bitter yam), *D. esculenta* (Chinese yam) and *D. bublifera* (aerial yam). The most favored and grown is *D. rotundata*.

2.1.2 ***Dioscorea rotundata*** (White Yam)

Dioscorea rotundata, or white yam, is one of the most significant yam varieties, particularly in Africa's central and western regions. The vines grow up to 12 meters in length, making them rather enormous. Although the tubers can weigh up to 25 kg or more, they typically average 2.5 to 5 kg each and are harvested after 7 to 12 months of growth. According to molecular studies by Sartie *et al.,* (2012), *D. rotundata* has a close kinship with *D. cayenensis*, and it is likely they shared a common ancestor before being separated by domestication. The datasheet acknowledges *D. rotundata* as a subspecies of *D. cayenensis*, in accordance with The Plant List (2013). The phosphate bonds between the starch molecules in the granules may be the cause of *D. rotundata* starch paste's greater gel strength when compared to cassava gel (Moorthy *et al*., 1989). A more thorough examination of the distinct taxon shows that most individuals of *D. rotundata* are tetraploid (Obidiegwu *et al*., 2009).

2.1.3 *Dioscorea cayenensis* (Yellow Yam)

Dioscorea cayenensis, known as yellow yam, is another highly significant crop in the wet and semi-humid tropics of West Africa. Like *D. rotundata*, it is part of the *D. cayenensis–D. rotundata* complex. The yellow flesh of *D. cayenensis* is due to its high total carotene content. It is high in fat, carbohydrates, and vitamin A. Analysis of ploidy levels within the Guinea yam complex showed that, unlike *D. rotundata*, no accessions of *D. cayenensis* were found to be tetraploid; instead, they were hexaploid or octoploid (Obidiegwu *et al.*, 2009).

2.1.4 *Dioscorea alata* (Water Yam or Purple Yam)

Dioscorea alata or water yam varieties probably originated from Asia and they are also known as winged yam or purple yam. Of all the cultivated yams, it is the most widely distributed. However, compared to African variants, it is not grown in the same quantities. It is cultivated in Africa, the West Indies, Asia, and the Pacific islands. Water yams are much more popular than white yams in Africa. The vines freely branch and reach a length of 10 meters or more. The flesh of the huge, purple tubers is purple. Typically, the plants grow for 8–10 months before going dormant for 2–4 months. When the aerial stems are dormant, they die back. According to the findings, yams are a respectably good source of nutrients.

2.1.5 *Dioscorea bulbifera* (Aerial Yam)

Dioscorea bulbifera: valued for its bulbils, which develop at the base of the leaves and are roughly potato-sized (hence the name "air potato"), weighing between 0.5 and 2.0 kg. Due to its inferior flavor compared to other yams, it is rarely farmed extensively for commercial purposes. However, because it yields a crop after just four months of development and continues to do so for up to two years, it is a favorite in home vegetable gardens. Nonetheless, the bulbils are more significant dietary items than the yam tubers. In local parts of the world, this plant is highly valued for its ethnomedical properties. It is financially beneficial in the pharmaceutical industry for the production of contemporary pharmaceuticals since it contains a variety of secondary metabolites, including carotenoids, tannins, alkaloids, flavanoids, sapogenins, and saponins. This plant is also the source of "diosgenin," a sapogenin that is a very significant and commercially viable phytosteroid. In addition to diosgenin, it contains other biofunctional substances such as catechin, kaempferol, catechuic acid, cortisones, bafoudiosbulbins, diosbulbins, xanthins, dioscin, and dioscrine, among other phyto constituents.

2.1.6 *Dioscorea esculenta* (Lesser Yam)

Dioscorea esculenta, is possibly one of the earliest yam species to be cultivated and is also referred to as the little yam. It is indigenous to Southeast Asia and is not widely grown elsewhere. Its tubers are rather little, and its vines seldom grow more than 3 meters (10 feet). The "lesser yam" may become more well-known in the future due to its easy preparation, tasty flavor, and ability to be grown mechanically due to the tubers' small size. The nutritional content of tuber flour is protein (7.19%), fat (1.10%) dietary fiber (10.16%) inulin (7.49%), and total starch content (71.78%) *D. esculenta* tubers are utilized ethnomedically as immune-boosting, anti-fatigue, anti-inflammatory, anti-stress, and anti-spasmodic remedies. In addition to being anti-inflammatory and anti-diabetic, *D. esculenta* also has anti-microbial, antioxidant, anti-fertility, and anti-cancer properties. Because they can help people with diabetes and have a favorable glycemic index, *D. esculenta* tubers have a lot of potential for usage as an alternative food item. (Marina Silalahi, 2022).

2.1.7 *Dioscorea dumetorum* (Bitter Yam)

It is popular in the western parts of Africa and is known as bitter yam for its bitter taste. Less labour is required for its cultivation than other yams. Its wild forms may be highly toxic. Compared to other yams, this species requires less work to cultivate. Because its wild forms can be quite toxic, they are occasionally combined with bait and then used to poison animals. (Muimba-Kankolongo, 2018).

2.2 Seed Yam Method of Propagation using Minisetts Technique

Seed yam propagation can be achieved through methods like minisetts, vine cuttings, and traditional double harvesting. The minisett technique involves cutting tubers into small pieces treated with fungicides and insecticides.

Conventional seed tubers are costly, difficult to transport, and have a slow multiplication rate, creating a significant obstacle to production, as seen in Ethiopia. Various conventional and *in vitro* propagation techniques were developed for *Dioscorea species* to boost output (Dessalegn, 2016).

Developed in the late 1970s, the minisett technique uses 20–50g pieces of non-dormant tuber to generate seed tubers independently of ware yam production. This is crucial in Africa, where yam output is hampered by scarce planting materials and high labor costs, which can constitute over 40% of total expenses (Nweke *et al.*, 1991).

2.3. Cow Dungs as Fertilizer

Cow manure, or dung, is composed of digested plant matter and bedding, making it a nutrient-rich organic fertilizer with an NPK ratio of approximately 3-2-1. It is suitable for most plants and helps restore soil nutrient balance. However, because it may contain ammonia and pathogens like E. coli, it must be composted before use to eliminate harmful substances (Nouban *et al.*, 2017).

Beyond its macro- and micronutrient contents, cow dung contains plant growth-promoting bacteria (PGPB) such as *Azotobacter*, *Rhizobium*, and *Bacillus* (Itelima *et al.*, 2018). These rhizosphere microorganisms enhance plant growth by fixing atmospheric nitrogen, improving nutrient uptake, producing growth hormones, and suppressing pathogens (Bashan *et al.*, 2005; Kundan *et al.*, 2015). The application of cow dung improves soil health by increasing organic matter and enhancing nutrient cycling, leading to long-term soil fertility (Kumar *et al.*, 2022).

2.3.1 Cow dungs and urine on crop quality and productivity

Cow dung and urine have been used as traditional agricultural inputs for centuries. They have long been recognized as valuable resources that significantly enhance crop yields (Powell, 2014). Cow dung and urine are rich sources of essential plant nutrients such as nitrogen, phosphorus and potassium. These nutrients are vital for plant growth, development and productivity (Raj *et al*., 2014). Applying cow dung and urine provide plants with a slow-release source of nutrients, which are more readily available overtime than chemical fertilizers (Ansari *et al*., 2016).

Additionally, cow urine contains micronutrients such as iron, magnesium and copper, which are essential for crop growth. Cow dung and urine are excellent inputs for soil fertility management. They contain organic matter, which, when added to soil, enhances soil structure and water-holding capacity (Gugalia, 2021; Shepherd *et al*., 2002). Organic matter is also essential for improving soil fertility by providing a rich source of beneficial microorganisms that support soil health and promote nutrient cycling. Cow dung and urine also have alkaline properties that help neutralize acidic soils, making nutrients more available to plants.

2.4 Bag method of yam cultivation (unconventional method)

As an alternative to the conventional way of planting directly in the soil, yam farming in a bag is a contemporary agricultural practice that involves cultivating yam tubers in specially made bags. The bags are composed of sturdy materials and contain an appropriate growing media that supplies the yam the nutrients it needs to thrive. To promote healthy growth, the bags are positioned in locations with adequate sunlight and temperature. (Njoku *et al*.,2023)

2.5 Advantages of Sack Farming for Yam Cultivation in Nigeria

Nigeria's agricultural sector is transforming due to rapid urbanization and the demand for sustainable food production. Sack farming has emerged as an innovative and efficient method for yam cultivation, offering several advantages over traditional open-field farming. This technique involves growing yams in sacks filled with soil, making it adaptable to limited spaces such as backyards and urban areas, thereby improving land use and enhancing urban food security.

Sack farming allows farmers greater control over soil conditions (fertility, pH, and nutrients) reducing reliance on synthetic fertilizers and promoting long-term soil health. It also conserves water more effectively, minimizing losses from evaporation and runoff, which is especially valuable in drought-prone regions like northern Nigeria.

Overall, sack farming marks a significant shift in yam production, addressing challenges of land scarcity, pest control, water management, and environmental sustainability, while providing a modern, sustainable, and efficient model for Nigerian agriculture.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental site

A private farm in Ogida quarters, Benin city served as the experimental site. It is located on latitude of $6^{0}21'54''$N and a longitude of $5^{0}34'42''$E and a height of 162 meters. The site has an annual temperature of 25.7°C and bimodal mean rainfall of 2679mm. The vegetation on the site is a tropical lowland rainforest. The rainy season in the area usually starts in March and lasts until September.

3.2 Materials

The materials used included;

- Sandy loam soil for propagation.
- Yam (*Dioscorea rotundata*), purchased from Ugbogiobo market at Ovia North East local government area, Edo state.
- Cow manure obtained from the cattle market at Federal Government Girls College Road, Benin City.
- Bags were purchased from a poultry feed distributor in Benin City.
- Z-force powder (mancozeb 80% WP) and cyperforce (cypermethrin 10% EC) for disease control and insect/ rodent pest control.

- Bamboo sticks, hoe, spade, watering cans were also used during the course of the study.

3.3. Experimental Treatments and Replications

Two treatments were control (no manure) and fertilizer (with manure). In both experiments the treatments have 6 replications each.

3.4 Cultural Practices

3.4.1 Bag and media preparation

Using a pair of scissors, the bags were perforated to allow for simple drainage and aeration against water logging to promote healthy tuber development. The bags were filled with a 1:1 mixture of top soil and cured cow dung.

3.4.2 Pest control

Z-force powder plus cypermetrin solution was applied to the surface of the yam seedlings to repel insects and prevent infection on seedlings before planting and emergence.

3.4.3 Weed control

Hand weeding of the bags was done 3 weeks after planting, while the weeds around the bags were removed using hoe as required.

3.4.4 Manure application

At the 3rd week after planting, heaping up of cured cow dung was applied to the yam at the rate of 2.5kg per sack

3.5 Data Collection

Vine length (VL), stem diameter (SD), numbers of leaves(NOL) and number of days to emergence (NDE) were assessed four weeks after planting. Visual counting was used to determine the number of days to emergence and number of leaves, whereas measuring tape was used to determine the vine length, stem diameter.

3.6 Statistical Analysis

Data collected were analyzed using excel and the t-test method was employed to compare the two means with a probability of 0.05 with unequal variance.

CHAPTER FOUR

RESULTS

4.1. Growth variable of yam at eleven weeks after planting

Table 1 shows the growth variable of yam at eleven weeks after planting among the two treatments. It was observed that number of leaves and vine length were significant while stem diameter were not significant.

4.2. Yield variable of yam at 24 weeks after harvest

The results of the yield variable for both treatment is shown in Table 2. It was observed that there is a significant difference in the tuber weight, while the number of tubers and vine weight were not significant.

Table 1: Growth variables of yam at eleven weeks after planting

VARIABLES	CONTROL	COW DUNG	P-VALUE	SIGNIFICANCE
Stem diameter	1.91	2.14	0.114	ns
Vine length	90.32	126.18	0.002	**
No of leaves	29.83	37.3	0.014	**

ns = Not significant **= highly significant

Table 2: Yield variables for yam at 24 weeks after harvest

VARIABLES	CONTROL	COW DUNG	P-VALUE	SIGNIFICANCE
Tuber weight	0.26	0.7	0.013	**
Vine weight	0.43	0.72	0.124	ns
No of tubers	1.16	1.33	0.221	ns

ns = Not significant **= highly significant

CHAPTER FIVE

DISCUSSION

5.1 Vegetative Growth and Yield of Yam

The vegetative growth variables such as vine length and number of leaves increased remarkably under cow dung treatment, while stem diameter showed no significant difference. This indicates that the nutrient composition of cow dung effectively stimulated vegetative growth. In terms of yield, there was a significant increase in tuber weight in the cow dung treatment compared to the control, showing that cow dung positively influenced tuber development. Similar results were reported by Raj *et al.* (2014) and Uzoma *et al*. (2011), who observed that organic manure application improves tuber bulking, carbohydrate accumulation, and nutrient availability. However, the number of tubers and vine weight were not significantly different, implying that cow dung enhances the size of tubers rather than the number produced.

Furthermore, the bag propagation method used in this study enabled for efficient nutrient usage, reduced leaching, and minimized pest and disease exposure, which supports the reports of Njoku *et al.* (2023) and Udoh (2000) that sack farming is an effective and sustainable method for urban and small-scale farmers.

5.2 Conclusion

It was concluded that the use of cow dung manure significantly improved both the vegetative growth and yield of bag-propagated yam. Plants treated with cow dung displayed longer vines, higher leaf counts, and heavier tubers compared to those without manure. This confirms that cow dung is a sustainable, cost-effective, and environmentally friendly alternative to synthetic fertilizers for yam cultivation.

Bag propagation method combined with cow dung application, it is a practical solution for yam cultivation in areas with limited land space, such as urban and peri-urban environments.

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