EFFECT OF DIFFERENT COMBINATIONS OF GARDEN SOIL AND POULTRY MANURE POTTING MEDIA ON THE GROWTH AND YIELD OF FOUR CULTIVARS OF YAM (SPP.)

BY

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FACULTY OF AGRICULTURE
UNIVERSITY OF BENIN
BENIN CITY

OCTOBER, 2023.

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF CROP SCIENCE, FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, BENIN CITY, NIGERIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF AGRICULTURE (B. AGRIC.) IN CROP SCIENCE

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CERTIFICATION

This is to certify that the work in this report entitled: Effect of different combinations of garden soil and poultry manure potting media on the growth and yield of four cultivars of yam was carried out by: Okoh Eucharia Ebehiremen with Matriculation Number AGR1600355 of the Department of Crop Science, Faculty of Agriculture, University of Benin, Edo State, Nigeria.

____________________	____________________________
PROF. T.O. EMEDE	PROF. K. E. LAW-OGBOMO
(Project Supervisor)	(Head of Department)
DATE: _______________	DATE: ___________________

DEDICATION

This project work is dedicated to my God almighty who through His Grace has kept me through this program. I also dedicate it to my family members for their selfless support.

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I want to thank God Almighty for his love and Grace that has kept me throughout my stay and course of study in the University of Benin, Benin City.

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ABSTRACT

The proliferation of Urban Agriculture in sub-Saharan Africa is occurring due to the surging population, which has led to a demand for alternative crop cultivation methods. Consequently, there is a necessity to cultivate yams in containers as a means to enhance food security. Hence, a study was carried out to evaluate the effect of different combinations of garden soil and poultry manure potting media on the growth and yield of four cultivars of yam (*Dioscorea* spp.). The study was carried out in containers (cement bags) in a field plot in Benin City, Nigeria. The treatments included: (i) garden soil alone (1:0), (ii) one part garden soil and one part poultry manure (1:1), (iii) two parts garden soil and one part poultry manure (2:1), while four cultivars of yam including white yam (Ada Onitsha and Fakasa), water yam and yellow yam were used. The experiment was a 3 × 4 factorial laid out as a Completely Randomized Design with three replicates. At nine weeks after planting, data was collected and recorded. At four months after planting harvest was done for only one cultivar (ada onitsha). The data collected was subjected to Analysis of Variance (ANOVA) to test the significance of the treatment means using Genstat Statistical Package.

The results indicated that there were no significant differences observed in the growth characteristics of the different potting media. However, significant cultivar differences were observed in number of vines, leaf area, number of leaves, stem girth, and petiole length. The potting media treatments showed significant differences in tuber length, tuber girth, and tuber yield per bag with 2:1 garden soil and poultry manure producing the highest tuber yield per bag(1.47kg) while (1:1) and (1:0) produced (0.50kg) and (0.47kg) respectively. Therefore, the combination of garden soil and poultry manure with a ratio of 2:1 would be suitable for cultivating yam in containers.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Yams are flowering plants of the family Dioscoreaceae, consisting of more than 800 species of climbing vines and woody shrubs. Many members of the yam family produce subterranean tubers or tuberous stems, and have heart-shaped leaves, small green or white flowers, and a fruit that is a winged capsule or berry (Barton and Paz, 2007). Yams are distributed widely throughout the tropical and warm temperate regions of the world, though current geographic distribution has almost certainly been influenced by human translocations. Today yams are widely used as an important food staple and as a fallback food in Africa, Asia, the Caribbean, Pacific islands, and South America. In 2007, worldwide yam production totalled 52 million tonnes of which Africa produced 96%, most of which derived from West Africa, with Nigeria alone producing 71% of that total (IITA, 2009).

Yam plants are herbaceous annual or perennials with climbing or trailing vines. The vines can be smooth or prickly, reaching 10 m (32.8 ft) or more in length depending on the variety. The leaves of the plant are simple and usually oval to heart-shaped with petioles which are the same length, or slightly longer, than the leaf blade itself. Some varieties possess spikes at the bases of the leaves. The plant can produce one singular tuber or several tubers which extend from stolons from a central corm depending on the species. The tubers can be cylindrical, curved or lobed, with brown, grey, black or pink skin and white, orange or purplish flesh. Most yams are annual plants, harvested after one season, but some are perennial with tubers increasing in size each year with the vines dying back at the end of the growing season and regrowing on the return of favorable conditions.

The origin of the main varieties of yam can be traced back to different parts of the world. Here are some of the main varieties and their origins:

I. *Dioscorea rotundata* Poir. (White yam): The white yam is believed to have originated in West Africa, specifically in countries like Nigeria, Ghana, and Benin (Ayodele *et al.,* 2017).

II. *Dioscorea alata L.* (Water yam): The water yam is native to Southeast Asia, including countries like Indonesia and the Philippines (Nandris *et al.,* 1992).

III. *Dioscorea cayenensis Lam. (*Yellow yam): Yellow yam is believed to have originated in Central and South America, particularly in countries like Venezuela and Colombia. It was later introduced to Africa during the transatlantic slave trade, where it became an important food crop (Orkwor *et al.,* 1998).

IV. *Dioscorea esculenta L.*(Chinese yam): The Chinese yam has its origin in China and other parts of East Asia (Tian *et al.,* 2016).

Yams are used differently in different parts of the world. They are consumed after cooking by frying, boiling or roasting. The green parts of some plants can be cooked and consumed as a vegetable. Yams may also be used to produce flour or starch.

Yam is of great social and economic importance in many countries, particularly in Africa, the Caribbean, and parts of Asia. It plays a crucial role in food security, poverty reduction, and rural development.

In Nigeria, yam farming employs a significant number of people, with the value chain creating jobs for transportation, storage, processing, and marketing. This contributes to poverty reduction and enhances socio-economic development in rural areas (Awoyinka *et al.,* 2007).

Yam has several potential medicinal benefits due to its nutritional composition and bioactive compounds. Some of the reported medicinal values of yam are as follows:

I. Diabetes Management: Yam has been studied for its potential hypoglycemic effects, which can help in managing diabetes (Ojewole, 2005).

II. Digestive Health: Yam is a good source of dietary fiber, which promotes healthy digestion (Oboh *et al.,* 2004)

III. Anti-inflammatory and Antioxidant Properties: Yam contains various antioxidants, including vitamins C and E, as well as polyphenols and flavonoids. These compounds possess anti-inflammatory properties, which may help reduce inflammation and oxidative stress in the body (Fasakin *et al.,* 2007).

IV. Weight Management: Yam is relatively low in calories and fat, making it a suitable food for weight management (Mu *et al.,* 2012).

Yams are mainly grown in tropical and subtropical climates and they do not grow well at temperatures below 22°C (71.6°F) and are killed by frost. The optimum temperature for the growth of yams is between 25 and 30°C (77–86°F). They grow optimally in well-draining fertile soils with a pH between 5.5 and 6.5 in full sun or part shade. Yam is usually the first crop to plant after clearing the land from bush fallow. However, as population has increased, the fallow period has decreased and continuous cropping is resorted to. Very wet soils should be avoided as this promotes tuber rot. Yams are propagated vegetatively from small tubers. Land should be prepared for planting by plowing and harrowing. Tubers should be planted in trenches to a depth of 15 cm (6 in) allowing at least 30 cm (12 in) between individual plants and 1.5 m (5 ft) between rows. The soil is often mounded around plants or ridged to aid drainage. It is common practice to stake plants with a 2–4 m (6.6–13.2 ft) support to allow them to climb and ensure that all parts of the plant receive adequate sunlight.

Yams require 100 cm of water distributed evenly throughout the growing season. Yam plants should be mulched after planting to prevent plants from drying out. Failure to mulch the plants will result in drastic decreases in yield. Harvesting Yams can be harvested at any time after the leaves have started to yellow. The soil should be carefully dug around the tuber and the the tuber cut from the vine. Harvesting is best carried out on sunny, dry days to prevent tuber rot.

As yam require a fertile soil, it's benefits or yield can be improved through inorganic and organic manure application.

As Nigeria's population is increasing and food insecurity is increasing, coupled with insecurity challenges and especially in distant farms, there is need for people to embrace growing of yam in containers.

Many crops are grown in containers under urban agriculture, but it seems to be a recent development for yam. There is therefore need to evaluate different combinations of garden soil and organic manure on growth and yield of yam.

Potting media is defined as a mixture of materials that provides physical support for the plant roots, supplies essential minerals and water, allows proper aeration and drainage and is usually free from insects, pests, and diseases (Barker *et a*l., 2015).

1.2 JUSTIFICATION OF THE STUDY:

Owing to rise in urban agriculture due to increase in urban population and the need to provide more food for the teeming population, many horticultural crops are now grown in container agriculture in green house environment. *Container gardening is well established in history as a practical way to replace lost ground space in urban environments (Welch, 2013). They can be easy to move, allowing seasonal transport of plants indoors to avoid winter or dry-season conditions. In addition, they are easy to arrange and decorate in three dimensions. Urban container gardening is often promoted as a solution to lack of space at ground level for gardens (Bailey, 1993; Choonsingh et al., 2010).*

The choice of potting media for growing crops can vary depending on the specific crop, climate conditions, and desired outcomes. Some commonly used potting media for growing crops include:

I. Peat-based mixes (Robson *et al.,* 2009)

II. Coir-based mixes (Raviv *et al.,* 2008)

III. Compost mixes (Khan *et al.,* 2012)

IV. Soilless mixes (Hoover, 2007).

It's important to note that the choice of potting media may also depend on factors such as cost, availability, and sustainability goals.

Different types of potting media can be used to enhance the yield of specific horticultural crops. A few examples include:

I. Tomato *(Solanum lycopersicum)* - Increased yield using coir-based potting media (Ammar *et al.,* 2017)

II. Orchids *(Phalaenopsis spp.)* - Increased yield using bark-based potting media (Pohlenz *et al.,* 2016)

III. Strawberries *(Fragaria x ananassa)* - Increased yield using peat-based potting media (Hansen *et al*., 2009).

Information is scanty in literature with respect to yam grown in containers. There is therefore need to evaluate the growth and yield of yam using combination of cheap and locally sourced potting materials such as garden soil and poultry manure.

Moreover, there is need to utilize municipal waste such as cement bags for profitable growing of yams. Emede *et al.* (2021) reported that poultry manure at 40tha^{-1} effectively increased soil fertility and produced the highest tuber weight and yield. Soil amendment with organic manure has proven to be beneficial for yam growth. The addition of organic manure enhances nutrient availability, improves soil structure, and increases microbial activity, resulting in healthier and more productive yam plants. Consequently, the adoption of organic manure as a soil amendment can contribute to sustainable yam production and ensure food security in tropical and subtropical regions (Smith, 2018).

1.3 OBJECTIVE OF THE STUDY

The Objective of this study was to evaluate the effect of different combinations of garden soil and poultry manure potting media on the growth and yield of yam.

CHAPTER TWO

LITERATURE REVIEW

2.1 YAM SYSTEMATICS

The nomenclature “Yam” applies to members of the Dioscorea genus of the Dioscoreaceae family within the order Dioscoreales (Alexander *et al,* 1969). The yam crop was initially referred to as Inhame by New Guinea users who predominantly used them as a starchy food source (Karnick 1969). In the course of the 16th century, French sailors erroneously changed the name from Inhame to Igname. Within this period, English seamen called the crop “yam.” Yam was a source of food for enslaved people during their East to West historic migration (Karnick, 1969). The roots, tubers and rhizomes of yams have been used since pre-historic times by aboriginal peoples as a food, as well as for traditional medicine (Singh, 1960). Dioscorea comprises over 600 species, with varying global distribution across Africa, Asia, Latin America, the Caribbean and Oceania (Coursey *et al.,* 1967). Among the wide species reported, only about 10 species are estimated to have been domesticated across Africa, Asia and Latin America for food and income generation (Scarcelli *et al.,* 2017). Yam plants have unique climbing and twining vines that sprout from their characteristic rhizomes or tubers. These rhizomes and tubers most often serve as photosynthetic sinks for starch and other secondary metabolites (Govaerts *et. al.,* 2007).

TAXONOMY OF YAM;

Kingdom: Plantae

Phylum: Magnoliophyta

Class: Liliopsida

Order: Dioscoreales

Family: Dioscoreaceae

Genus: Dioscorea

Subject: Dioscorea spp

Yams are members of the flowering plant genus Dioscorea. They are monocots, related to palms, grasses, and orchids. There are about 600 species of yams found around the world, most of them in the tropics (CGIAR, 1994).

2.2 ORIGIN AND DISTRIBUTION OF YAM

Generally, yam is native to warmer regions of both southern and northern hemispheres (IITA, 2004). White yam *(Dioscorea rotundata)* originated in West Africa and is the most widely grown and preferred yam species. Domestication has been a traditional farmers practice in West Africa (Scarcelli *et al.*, 2006). Guinea yams *(Dioscorea cayenensis-rotundata* complex; *D. rotundata* Poir. *and D. cayenensis* have been described as resulting from a process of domestication of wild yams of the section Enantiophyllum by African farmers (FAO, 1998). Guinea yams were domesticated about 7000 years ago and over the years farmers have selected genotypes that best suit their needs, and thus have generated a large number of traditional cultivars. There is tremendous genetic variability in yam. Contrary to the situation in other crops where the deployment of improved varieties has led to loss of diversity and a narrowing of the genetic base, some kind of domestication of semi-wild yam species is still ongoing in West African countries, which continually augments the germplasm diversity (Mignouna and Dansi, 2003).

Yam is Nigeria's leading root crop, both in terms of land under cultivation and in the volume and value of production (Agboola, 1979). The production of the crop in Nigeria is undertaken in the forest, derived savanna and southern guinea savanna environments. This is explained by its ability to thrive under a variety of environmental conditions owing to differences in the ecological requirements of the various species. Generally, its natural habitat is considered to be secondary bush or forest where the canopy has not been disturbed. The branches of trees in the forest zone provide the support required for the climbing vine, thereby reducing the cost of procuring stakes. Yam species are well adapted to the savanna conditions and in such cases the yam vines use the stems of taller and bigger grasses as climbing supports (katung *et al.,* 2006). Some of the most important yam producing areas are located in the savanna environment which supports the speculation that the cultivation of yam probably originated there (Agboola, 1979). Yam production is therefore concentrated in the forest and savanna (the derived and southern guinea savanna) environments. The most important area for yam production with over 50% of cultivated land under the crop covers Ikom, Obubra and Ogoja of the Cross River State and Abakaliki in Ebonyi State. The predominance of yams in the yam producing area is due to absence of export tree crops capable of limiting arable crops production, the high proportion of farmers who grow the crop, its position in crop combinations and the social status attached to the crop. There are four other areas where yam production is also important and 30-49% of cultivated land is under the crop. There are Akwa Ibom, Imo and Anambra States and a more limited extent Delta and Edo, more extensive area stretching from Borgu, Oyo, Ilorin, Ekiti, Ondo and Kwara; and Benue, and Plateau States covering parts of Igala, Idoma, Tiv, Nasarawa and Lafia. The first two of these are located in areas of high population densities; the remaining two are located in the derived and southern guinea savanna environments and with the exception of part of Tivs (Agboola, 1979).

2.3 UTILITY OF YAM

Consumption as staple food is the most prominent use of yams, although certain medicinal applications prepared from yam products have also been in practice in local cultures. Although not yet fully explored, yams could provide important source for potential industrial usage (Andres, 2017).

Consumption

The different ways of preparing and consuming yams very much depend on the species and local traditions. Having a relatively low glycemic index (54, glucose ¼ 100), yams are a comparatively healthy alternative to other tubers such as potatoes (Adeoluwa, 2017)

A popular way of eating white yam and yellow yam in West Africa involves boiling the peeled tubers and subsequently pounding them (sometimes together with cooked plantains) into a doughlike paste to make the traditional dish of 'pounded yam,' which is locally called 'Fufu,' 'Foutou,' or 'Iyan.' Pounded yam is usually eaten with different sauces (groundnut, palm nut, eggplant, etc.) and a source of animal protein. Other forms of preparation include boiling together with other vegetables or frying to make yam chips (Bhullar, 2017)

Water yam is in some cases also prepared like white yam and yellow yam in West Africa. In some Asian countries it is used as an ingredient in sweet desserts (e.g., Philippines, Indonesia, and Hawaii) where it is known as 'Ube,' 'Ubi,' or 'Uhi.' People from other cultures mainly use it in soups (e.g., Vietnam, Japan) or prepare curries from it (e.g., India, Sri Lanka).

The bulbils of air potato and the tubers of lesser yam are much like potatoes from a consumption point of view. They are baked, boiled, or fried. Some varieties can be eaten raw, whereas others require soaking or boiling for detoxification before eating.

Domesticated varieties of bitter yam are popular as a vegetable in parts of West Africa.

A part of the tubers of Chinese yam are consumed right after harvesting while the other part is used as ingredients for other dishes such as noodles.

Medicinal

Almost all known *Dioscorea* species are used to cure different types of diseases and disorders. The tuber of *D. alata* is used to reduce the body temperature. The tuber paste is also applied to cure gonorrhea with neem leaves whereas the boiled tuber of *D. esculenta* is consumed to reduce the body weight. The boiled tuber of *D. pentaphylla* is consumed to reduce abdominal pain after delivery while the tuber of *D. pubera* is consumed as a tonic for good health. Tuber pastes of *D. bulbifera* is used to treat skin infections. The tuber juice of *D. villosa* is used to reduce the complications of menopause. The tuber paste is used to cure skin infections caused by fungus. Tuber juice of D. hamiltonii is used to cure food poisoning (Kumar *et al.,* 2017b, 2017c; Kumar *et al.,* 2012, 2013a, 2013b, 2015; Kumar and Jenna 2014, 2017; Kumar 2015; Kumar 2017). The tubers improve human health by supplying the much-needed proteins and micronutrients (e.g., vitamin C in *D. rotundata*) as well as a lot of potassium. Yams contain abundant amounts of thiocyanate, which is an agent counteracting sickle cell anemia in humans. This explains the higher incidences of sickle cell anemia in African-American populations who do not eat yam frequently, when compared with indigenous Africans. On some Japanese islands, yam products are used as a folk remedy to treat impotence in sympathetic medicine. A part of the tubers of Chinese yam is also used as traditional medicine. Because of their potential to lower blood sugar levels, bitter yam *(D. dumetorum)* products are used to treat diabetes. Besides, in local cultures they are also used to treat rheumatoid arthritis, stomach pain (colic), menstrual disorders, and a disease caused by parasitic worms known as schistosomiasis. *Dioscorea batatas*, a species known to be cultivated solely in China (locally called 'Shanyao') and only for medicinal purposes, has recently experienced a revival in central Europe (Germany, Switzerland, Austria). Locally known as 'Lichwurzel,' which when translated means 'tuber of light,' products made from the tubers are used in anthroposophist medicine (Andres *et al.,* 2017)

Industrial

The potential of yams for industrial usage has not been exploited yet. However, potential applications include yams as a source of starch for industrial purposes. The quality of yam tubers for potential industrial uses is influenced by its dry matter content.

Yam can be processed into yam chips, which will later be grounded as yam flour popularly known as 'amala.' This is a foodstuff that fetches a high price in places like Nigeria and other African countries. Most times this activity is left to middlemen who sometimes make more money than the yam producers. Processing will increase the sources of income and keep the farmer in business all year round (Bhullar *et al.,* 2017).

2.4 AGRONOMY OF YAM

2.4.1 Nutrition and Soil Conservation

Nutrition

Yams are very nutrient-demanding plants, which explain their prime position in a sequence of crops after clearing land from natural vegetation (either through slash and burn or hand ploughing of fallows). Even though it is known that the crop extracts a large amount of nutrients, especially N and K, from the soil, yams are traditionally produced without any fertilizer inputs. Even if financial resources would allow farmers to apply fertilizers, they often lack access to them. Consequently, soil fertility and thus yields of smallholders are often low. For example, the yields of D. rotundata are typically around 8 t / ha fresh tubers, although the potential yield was estimated to be approximately 30 t / ha. As low soil fertility is one of the major constraints to increasing yam productivity, farmers require adequate soil fertility management practices to attain good yields. These include (1) soil conservation and maintenance of soil organic matter content, (2) crop rotation or intercrops with N-fixing legumes (such as groundnut), and (3) direct applications of manures, compost, or other organic amendments (before planting). Cases of mineral fertilizer use have been reported in some countries, but general complaint on the effect of mineral fertilizers is lowering of the yam quality besides the increased yield. Yams produced with mineral fertilizers are often difficult to store and do not make good pounded yam. However, a few farmers who apply animal manure as fertilizer (not at commercial level) do have better yield with good tuber quality (Andres et al., 2017)

Soil conservation

In soil conservation, measures are taken to prevent a decline in soil water status and soil organic matter. The loss of topsoil through erosion is prevented while conserving and enhancing soil organic matter. In hilly areas, erosion of sloping land is limited by constructing terraces, by planting hedgerows, or by growing boundary strips of grass or placing stones along the contour lines. Minimal soil disturbance and covering the soil surface with plant materials are important to reduce losses of topsoil and water. Additional measures such as green manures may be advisable outside the growing seasons to avoid bare soil and consequent soil loss through wind erosion (Adeoluwa et al., 2017)

2.4.2 Mulching

Mulching is essential to conserve moisture, particularly when the yam vines are still small and there is poor soil cover. Dry grass is normally used for this purpose. Mulch materials later contribute to the organic matter in the soil when fully decomposed with time and thus improve soil fertility (Bhullar et al., 2017). 2.4.3 Crop rotation or intercropping Yams are usually intercropped with maize, cassava, bananas or vegetables. Leguminous crops like cowpea, pigeon pea, green gram, and soybean, or green manure crops like jack beans, perennial peanut, or Mucuna spp. can also be rotated with yam. However, proper rotation is not common in yam production, although the restoration of soil fertility after yam cultivation with green manures is highly recommended (Andres et al., 2017).

2.4.4 Addition of organic materials

Lack of macro-and micronutrients in the soil leads to poor growth and thus low yields. Soil organic matter acts as a ‘nutrient bank,’ which is being mined at each cycle of yam production. It thus needs to be refilled regularly in order to conserve soil fertility and thus continuously attain good yields. This can be done through applications of organic plant materials, compost, or animal manures to the soil. For instance, poultry manure applications can improve soil physical properties while providing a substantial amount of nutrients for vigorous yam growth. Studies have shown that poultry manure increases yam growth and yield and integrating poultry manure application in yam production may help farmers to improve their yields at low costs (Adeoluwa et al., 2017).

2.4.5 Water Management

Good supply of water is needed for optimum yields of yam. Yam requires around 1000 mm of well-distributed water throughout the growing season. Where rainfall patterns do not ensure regular supply, proper water management is essential. Even for farmers who have access to additional irrigation sources, minimizing water losses and increasing water storage in the soil are highly relevant.

2.4.6 Staking

Staking of yam is necessary to optimally expose the leaves to the sunlight throughout its growth, especially in the 'climbing' yams. The larger the surface area of the plant exposed to sunlight, the higher are the yields that are obtained. Non staked cultivation is also practiced. It suppresses weeds better, but gives lower yields. Yam plants are usually staked soon after emergence. Different methods of staking include (1) individual staking (one stake per plant), (2) pyramidal staking (tops of several stakes are slanted to form a peak), and (3) trellising (string wire between two strong posts).

2.4.7 Weed Management

Proper weed management is essential for obtaining good yam yields. Weed control is most important during the first 12– 16 weeks after planting for seed yam, that is, until the yam foliage will start covering the soil. The critical period for table (ware) yam is 4–16 weeks after planting. Weeds are usually removed manually, by hand pulling or with the help of hoes. While weeding, care must be taken not to damage the superficially growing root system of the yam plants. Weeding is done 3–4 times during the season. Delay in weeding can negatively impact yield. This often happens where farmers establish large fields without availability of sufficient labor to perform timely weeding operations. Yield reduction of up to 90% due to heavy weed infestations have been reported (Bhullar *et al*., 2017) 2.4.8 Major Pests and Their Control/Management

Effective control of pests is necessary to optimize yam yields. Some of the most common pests include yam beetle, mealy bugs, termites, and nematodes. Pests may damage the yam tubers by decreasing their dry matter content, thus reducing germination capacity. Furthermore, the damage they cause to the epidermis may trigger secondary infections by rot fungi (i.e., molds), which can lead to high storage losses. Yam farmers hardly use synthetic pesticides. Instead, they rely on preventive methods for pest control. Avoidance of disease infestation is better ensured during planting of seed yam or sets.

2.4.8.1 Nematodes (Scutellonema bradys and Meloidogyne spp.)

Nematodes are one of the most serious threats to yam crops, especially if grown repetitively on the same land (i.e., without adequate crop rotation). Early nematode attack endangers seedling emergence due to rotting of the sets in the soil.

Important preventive measures include proper clearance and land preparation. Nematodes can be controlled by adhering to a properly planned crop rotation. Staggered planting is also effective. Intercropping of Crotalaria spp. alone, or in combination with pigeon pea (*Cajanus cajan*) has also shown to be an effective control measure.

2.4.8.2 Yam beetle (*Heteroligus meles*)

The yam beetle is the most damaging insect in yam production in West Africa. Adult beetles are 2–3 cm long, dark brown to black, and have two prominent knobs on the head. Attack occurs just before harvest when the beetles feed voraciously before migrating to breeding sites. Adult beetles eat the planting sets and affected plants may wilt and die. The holes the beetles drill into the tubers reduce their market value. Proximity to water bodies increases the likelihood of yam beetle attack. Therefore, incidences of yam beetle can be controlled by growing the crop far away from water bodies. Late planting (if possible), as well as spraying with botanicals such as neem preparations or mulching with Cymbopogon citrates and Ocimum viride have also been reported as effective control strategies.

2.4.8.3 Mealy bugs (*Planococcus dioscorea*) and scale insects (*Aspidiella hartii*)

Mealy bugs and scale insects form whitish colonies, which may cover the entire tuber. The sucking insects cause a certain weight loss of the tuber. Infested tubers are not suitable for sale.

2.4.8.4 Termites

Despite being a minor pest, termite attacks can be very severe. By their feeding activity, the ravenous insects create corridors inside the tubers. Termites can hollow out whole tubers within as little as a few weeks, and may destroy whole fields rather quickly. In addition, they may cause considerable damage if they penetrate storage sites.

2.4.9 Major Diseases and Their Control/Management

Most common diseases of yam include tuber rots, the yam mosaic virus, and anthracnose. Tuber rots (*Botryodiplodia theobromae, Rhizopus nodosus, Fusarium oxysporum, Fusarium solani*) Fusarium wilt and other tuber rots mainly afflict tubers of white yam, especially in storage. Tuber rots can be controlled through careful selection of tubers for storage. Tubers having suffered damage to their epidermis (that may happen during weeding and/or harvesting) must not be stored in the same lot as unaffected tubers. In order to prevent fungal rot on the field after planting, yam sets may be dipped in ash solution and air-dried before planting. Fungal incidences can also be controlled by a proper crop rotation. Yam mosaic virus. The yam mosaic virus is the most significant and indispensable virus affecting yams in Africa. Typical symptoms on yams include mosaic, shoestring, green vein banding on leaves, and stunting. Effective preventive measures involve planting of resistant varieties and the use of healthy planting material. Good soil fertility could also minimize the effects of mosaic virus. Affected plants should be uprooted and burned or buried deeply.

Anthracnose *(Colletotrichum gloeosporioides)*

Anthracnose is a serious disease, which can have devastating impacts particularly when it strikes at early stages. Attacks results in blackening between leaf veins and dieback of leaves. The disease is favored by wet, humid, and warm weather conditions. It is most severe on white yam than on other edible yams. Anthracnose spreads by infected seed, rain splash, and moist wind. The diseases may attack all parts of the plant at any growth stage. Usually, it appears on leaves first, causing small and irregular yellow to black spots. The black spots can expand and merge to cover the whole affected area, coalescing to form large lesions. Adequate soil nutrient management may lower the crop's susceptibility to anthracnose. Where the risk of infection is high, farmers are encouraged to remove old leaves from the field before land preparation. Together with rouging out infected plants, these measures reduce the sources of inoculum. Vines can be sprayed with copper fungicides. In addition, crop rotations and/or intercropping with crops such as maize are other possible control measures. However, the best option is still the use of resistant cultivars. (C Andres et al., 2017)

2.4.10 Harvesting, Curing, and Storage

Yams mature 7–9 months after planting, indicated by the yellowing of the leaves and natural dieback of the vines. In order to maximize yield, harvesting must be done when the yam reaches full maturity and before the soil becomes too dry. After removing the vines, hand tools are used to carefully dig out the tubers taking care not to damage them as little as possible. After harvesting, the yams with bruises must be cured, and may be dipped in wood ash, in order to avoid fungal rot. All tubers should be cured for a few days before storing them. Yams could be stored at ambient temperature for relatively longer time (up to 6 months) than other tropical fresh produce, and the multitude of species with different maturity periods may ensure an extended period of availability of yam tubers in homes and markets. Moreover, the long storability enables producers to sell at high prices in periods of peak demand and low supply. Consequently, yam is an essential source of income and dietary calories in rural areas of West Africa during the annual period of food shortage (August–October). However, despite the good storability, tubers are often damaged during and after harvest, which can lead to postharvest losses. Good storage is best achieved in shaded, cool conditions (29–32 C) with relative humidity of 90–95%. The tubers should be stored in a well-ventilated place that is kept dry. Traditionally, yam is stored in barns of vertically arranged wooden poles and palm leaf midribs. Another method is to bury the tubers in a ditch covered with soil and shaded by, for example, coconut leaves. Stored tubers have to be checked regularly. Barns or storage areas must be securely fenced, and traps and/or baits should be used to prevent rodents and other pest from attacking the tubers. The tubers remain dormant for a period of some 3–4 months after harvest and may start to re sprout while in storage (Adeoluwa et al., 2017).

2.5 SOIL AND CLIMATIC REQUIREMENTS OF YAM

The tropical food species of *Dioscorea* grow in warm, sunny climates with temperatures between 25ºC and 30ºC. Short days of 10-11 h result in tuber formation, while days longer than 12 h favor vine growth. Yams require deep, loose, textured loamy soil that is rich in organic matter. They are best planted at the beginning of the rainy season. Mulch around the planted sets protects them from excessive heat and desiccation, especially in areas with hot temperatures and dry weather. It also adds organic matter to the soil, prevents soil erosion, preserves water in the soil, and increases microbial activity in the soil. Yams do not tolerate waterlogged conditions. (Mignouna et al., 2009)

2.6 PRODUCTION STATISTICS

Yam plays a significant role in food security, medicine and economy in the developing countries. Its importance places it as the fourth most essential and utilized root and tuber crop globally after potatoes (Solanum spp.), cassava (*Manihot esculenta*) and sweet potatoes (Ipomoea spp.) and the second in West Africa after cassava (Lev and Shriver, 1961-1966; Dansi et al., 2013). This is evident in annual global production, especially in West Africa. In

2018, the Food and Agricultural Organization (FAO) of the United Nations reported a worldwide production of approximately 72.6 million tons over 8.7 million hectares of harvested area at a yield rate of 83515 hg/ha, with Africa contributing 97.1% of global production (FAOSTAT, 2020). Remarkably, among the African nations, three countries (Nigeria—67.4%, Ghana—11.1%, Côte d'Ivoire—10.3%) in the west recorded the highest proportion of production, although the production increase (85.1% between 2000–2018) in Africa is attributed mainly to the increase in the area of yam field into marginal lands and non-traditional yam growing areas (Mignouna et al., 2008). While D. alata originated in Asia and is the most globally cultivated yam species, D. rotundata represents a great significance in respect to production volume in the West of Africa, followed by D. alata and D. cayenensis (Lebot, 2019). Statistics have shown evidence of an annual production increase of yam between 2011 and 2018 in several countries on the African continent including Cameroon, Central African Republic, Côte d'Ivoire, Gabon, Ghana, South Sudan and United Republic of Tanzania (FAOSTAT, 2020).

2.7 CONTAINER AGRICULTURE

The growing of crops in containers or pots containing soil, soil amendment or soilless materials is known as container cropping. Other names for this fast developing and diversifying cropping method are container gardening, pot farming, pot agriculture, pot horticulture or crops in pots.

Container gardens have been used for thousands of years. Carved scenes on limestone walls of an Egyptian temple, dating back 3,500 years, depict frankincense trees growing in pots (Manso and Castro-Gomes 2015). Container gardening is well established in history as a practical way to replace lost ground space in urban environments (Welch, 2013). They can be easy to move, allowing seasonal transport of plants indoors to avoid winter or dry-season conditions. In addition, they are easy to arrange and decorate in three dimensions. Urban container gardening is often promoted as a solution to lack of space at ground level for gardens (Bailey, 1993; Choonsingh et al., 2010). Container-based systems are also sometimes the only form of gardening available in dense cities where soils are largely covered with hard surfaces, resulting in strong competition for space. In both private spaces (e.g., around houses, roofs, balconies) and public spaces (e.g., open spaces and roadsides), container gardens are frequently seen. In heavily built-up areas, both formal and informal container gardens can be seen. Formal versions of container gardens are often placed in public lands such as city squares, managed by municipal staff and consist mainly of ornamental landscape plantings similar to those used in in-ground (growing directly in the ground) landscaping in public parks. These can also be found in corporate and institutional settings, such as courtyards in the urban core, but are similar to other formal container plantings in that paid staff manage the vegetation according to organizational standards. In contrast, informal container gardens tend to be more diverse, driven by the needs and preferences of individual gardeners. They are also generally created and maintained on an unpaid basis. In general, container gardening can be considered as small mobile versions of living architecture. Container gardens are frequently used informally at private dwellings whereas many other kinds of living architecture may be more common in public spaces. While green roofs and living walls may involve containers for plants and growing media, container gardening, especially when done by private citizens, often uses much smaller container formats. This results in high maintenance requirements (e.g., irrigation) but also allows for high plant diversity within small areas due to owner preference.

2.7.1 Potting media for yam production

Top soil should be used for growing of yam in containers. The top soil should be mixed with well cured manure or compost. The soil may be solarized in order to kill the harmful microbes in it. Coco peat, perlite and other growing media can also be used for yam farming.

2.7.2 Fertility status of poultry manure mixed with soil

Poultry manure (PM) is considered as a rich source of nutrients as it improves soil fertility and crop production, and it is an enriched source of various major macronutrients such as nitrogen (N), potassium (K), and phosphorus (P) (Tarafder et al, 2020; Khan, et al, 2023). Important plant nutrients like nitrogen, phosphorous, potassium, calcium, magnesium, sulphur, copper, zinc, chlorine, boron, iron, and molybdenum, all are present in poultry manure.

The nutrient content of poultry manure varies depending on several factors such as the type of poultry, diet, age, and management practices. According to the U.S. Department of Agriculture (USDA), fresh poultry manure typically contains around 1.4-3.4% nitrogen, 0.6-1.6% phosphorus, and 0.9-2.0% potassium on a dry weight basis. These nutrient levels can be higher or lower depending on the factors mentioned earlier.

So, poultry manure can be utilized as a good fertilizer to fulfill all or a portion of nutritional requirements of crop plants. Moreover, PM has good carbon-to-nitrogen ratio which facilitates the microorganisms that ultimately improves the soil properties and plant productivity (Solaiman *et al*., 2020; Saina *et al*., 2022) Addition of PM increases the cation-exchange capacity of the soil (Domingues, 2020).

2.7.3 Growth and yield response of yam to garden soil amended with Poultry Manure

The growth and yield response of yam (*Dioscorea spp*.) to garden soil amended with poultry manure has been widely studied. Poultry manure is a rich source of nutrients, including nitrogen, phosphorus, and potassium, which are essential for plant growth.

study conducted by Adeyemo *et al.* (2016) investigated the effect of poultry manure amendment on the growth and yield of yam. The researchers applied different rates of poultry manure to the garden soil, including 0, 5, 10, and 15 tons per hectare. The results showed that yam plants grown in soil amended with poultry manure exhibited significantly higher growth parameters, such as plant height, number of leaves, and vine length, compared to those grown in un amended soil. Additionally, yam plants grown in amended soil also had higher tuber weight and yield compared to the control group. The highest tuber yield was observed in the treatment with 10 tons of poultry manure per hectare.

This study demonstrated that the amendment of garden soil with poultry manure can enhance the growth and yield of yam crops. The added nutrients provide essential elements for plant growth and development, resulting in improved plant vigour and increased tuber production.

2.7.4 Reasons for growing yam in containers

Effah *et al.,* (2017) reported on several reasons why people choose to grow yams in containers. These reasons include:

I. Limited space: Containers provide a solution for individuals with limited space. Growing yams in containers allows people who live in apartments or houses with small yards to still enjoy cultivating their own food.

II. Convenience: Containers offer ease and convenience. They can be placed on a patio, balcony, or in a small garden, making it easier for individuals to care for and harvest yams without the need for extensive gardening.

III. Control over growing conditions: Containers provide more control over growing conditions. This includes the ability to control soil quality, moisture levels, and sunlight exposure. By growing yams in containers, gardeners can create optimal conditions for the plant's growth.

IV. Pest and disease control: Growing yams in containers helps to minimize the risk of pests and diseases. Containers can be placed above ground level, making it more difficult for pests to access the yams. Additionally, container-grown plants are less susceptible to soil-borne diseases that may be present in the ground.

V. Season extension: Containers allow for season extension. Yams can be grown in containers and moved indoors during colder months, extending the growing season and providing a continuous supply of fresh yams throughout the year.

CHAPTER THREE

MATERIALS AND METHODS

3.1 LOCATION AND SITE PREPARATION

The experiment was carried out in the teaching and research Farm of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin city. Benin City is located at latitude 06° 19′00″ E to 6° 21′ 00″ E and longitude 5° 34′ 00″E to 5° 44′ 00″E with an average elevation of 77.8 m above sea-level and characterized by a tropical humid climate with a bimodal rainfall. The mean annual rainfall is 1761.90 mm while mean daily temperature of 26.5°C

3.2 COLLECTIONS OF PLANTING MATERIALS

Seed yam/planting materials of four different yam cultivars which included two variants of white yam (*D. rotundata*) locally known as Ada Onitsha and Fakasa, water yam (*D. alata*) and yellow yam (*D. cayenensis*) were purchased from the open market. Thirty-six empty cement bags were also obtained, the cement bags were perforated at the bottom to enable proper drainage.

The average weight of the seed yam of each cultivar determined by weighing was:

1. Ada Onitsha (0.46kg)

2. Water yam (0.7kg)

3. Yellow yam (0.56kg)

4. Fakasa (0.61kg)

The seed yams/setts of each cultivar were planted on the 14th April, 2023 in a low ridge in order to have sprouted seed yams/setts ready for planting in cement bags filled with media.

3.3 EXPERIMENTAL DESIGN, TREATMENT AND LAYOUT

The treatments consisted of:

1. 1:1 (one part garden soil, one part poultry manure)

2. 2:1 (two-part garden soil, one part poultry manure)

3. 1:0 (Control (garden soil alone))

The garden soil was obtained from the Land surrounding the Faculty of Agriculture Farm, University of Benin, Benin city, while the cured poultry manure (PM) was obtained from the Farm Project of the Faculty of Agriculture, University of Benin, Benin City. The treatments as indicated above were mixed in parts and filled into empty cement bags, while the control (garden soil) was used to fill the remaining twelve empty cement bags. The treatments were left to mineralize for three weeks before planting with the pre-sprouted yam.

The experiment was a 3 × 4 factorial laid out as a Completely Randomized Design (CRD) in three replications.

3.4 PLANTING AND MANAGEMENT PRACTICES

The sprouted seed yam/sett of each cultivar were planted in the cement bags filled with the potting media on May 13th, 2023. Watering was carried out twice a week. Staking was done using one stake per plant. Weeding was carried out once every two weeks at the early stage. Polythene bags were placed under each cement bags to avoid termite infestation.

3.5 SOIL AND POULTRY MANURE ANALYSIS

Bulk samples of the different potting media were analysed for physical and chemical properties using standard laboratory practices. Parameters includes;

I. Soil pH

pH1:1 in H_2O

20 g of fine air-dried soil was weighed into 50 ml beaker

20 ml of distilled water was added and the mixture was stirred intermittently for 30 minutes

using a stirring rod.

Reading was taken using calibrated pH meter that has been standardized with buffer 4 and 7 solutions. The pH was measured by immersing the glass electrode into the partially settled suspension and pH was recorded as soil pH in H_2O 1:1.

II. Organic carbon

It was determined using Walkley-Black wet oxidation method

Ig of soil sample was weighed into 250 ml conical flask.

10 ml of 1N Potassium heptaoxodichromate - $K_2Cr_2O_7$ solution was added and the mixture swirled for proper mixing.

20 ml of concentrated H_2SO_4 was added carefully. The mixture was again swirled to mix up and was left to completely oxidize for 30 minutes and coldness of the flask was observed.

III. Available phosphorus

It was determined by colorimeter method after extracting with Bray I solution.

5 gof soil was weighed into a 250 ml shaking bottle

35 ml of extracting solution (IM NHF) was added

The mixture was shaken for 3 minutes and was filtered into 100ml volumetric flask and the leachate determined in a spectrometer

Calculation:

Weight of sample used -5g

Volume of extract used (V)-35ml

Volume of extract used - 250ml diluted to 50ml

Therefore, ppm soil =ppm graph ×35/35×50/2.5

IV. Exchangeable acid (II"*+ Ar") determined using titre procedures

5g of air-dried soil was weighed into a plastic bottle.

50ml of 1M KCl was added and shakes for 30minutes with a mechanical shaker.

The solution filtered using the whateman number one filter paper into a volumetric flask and made to mark with 1M KCl.

Aliquot of the extract was obtained.

Thereafter, 100ml of distilled after was added to increase the volume to prevent attack on glassware and the mixture was again swirled

Five (5) drops of ferroin indicator was added.

The excess chromic acid was titrated with 0.5N ferrous sulphate to dirty brown end-point (Tml); titre value taken at color change.

A blank was run, using the sample procedure, but without soil sample (Bml).

The blank measured the amount of reducing substance present in the reagents as impurities,

% organic carbon was calculated as follows:

Where:

B=Blank titre value

T=Titre value

N=Normality of ferrous sulfate solution

F=Correction factor (1.33)

V. Organic matter

The organic matter was computed by multiplying the value of the organie carbon by-a standard value of 2.0.

30ml of water was added and 3 drops of indicator was added to the aliquot.

Titration was done with 0.01M NaOH standard solution until a permanent pink colour was observed.

VI. Particle size

The particle size Analysis by the hydrometer method as modified was used to know the textural class of soils. Soils and separated into percentage sand, silt and clay.

50g of prepared soil sample was weighed into a 250ml shaking bottle. 100ml of Calgon was added and was allowed to soak for 30 minutes, and add 10ml H_2O_2(20%). 100ml of distilled water was then added and the suspension was transferred into a one litre measuring cylinder. The mouth of the cylinder covered with palm and was inverted several times until all soil is in suspension. The cylinder was placed on a flat surface and soil hydrometer placed inside the soil suspension after 40 seconds for the first reading and second reading was taken after 120 minutes, and temperature reading taken thereafter.

Calculations:

% Sand = 100-(Corrected 40sec. Hydrometer reading) x 100/Weight of sample used

% Clay = (Corrected 2hrs hydrometer reading) x 100/Weight of sample used

% Silt= 100- (%sand + %clay)

VII. Exchangeable base (Ca, Mg, K and N)

They were extracted with IN ammonium acetate solution (1N NH, OAC) buffered at pH 7.0 the Ca and Mg were determined from the extract using 0.01m EDTA (ethylenediaminetraacetic acid) titration method, while K and Na were determine using flame photometer.

3.6 DATA COLLECTION

Data collection was done at Nine weeks after planting as follows:

I. Number of leaves: the leaves of each cultivar in each experimental unit were counted and recorded.

II. Internode length (cm): this measurement was determined using a meter rule.

III. Stem girth (cm): This was determined using a vernier caliper

IV. Leaf Area (cm): This was carried out using two randomly selected leave at the base and middle by measuring the length of the laminar from the point of attachment to the petiole to the leaf tip and the maximum width of the lamina at the widest portion at nine weeks after planting. The leaf Area was obtained by the equation LA= LxBx0.64, where Land B are maximum blade length and breadth respectively (Emede *et al.,* 2013).

V. Number of Vines: the number of Vines were counted and recorded.

VI. Height at first branch (cm): this was determined using a meter rule caliberated in centimeters (cm).

VII. Length of petiole (cm): this was determined using a meter rule caliberated in centimeters (cm) from the point of attachment to the vine to the point of expansion of the lamina.

Data collection for yield was carried out at Four months after planting for one cultivar (Ada Onitsha) alone due to inadequate time for complete development of yam cultivars planted.

I. Tuber yield (kg): this was determined by measuring the weight using a scale.

II. Tuber length (cm): this was determined using a meter caliberated in centimeters (cm).

III. Tuber girth (cm): this was measured using a vernier caliper.

IV. Number of tubers: the number of tubers per plant were counted and recorded.

V. Number of tubers per vine: the number of tubers per vine were counted and recorded.

3.7 Data Analysis

The data collected was subjected to a one-way Analysis of Variance (ANOVA) to test the significance of the treatment means using Genstat Statistical Package.

CHAPTER FOUR

RESULTS

The physical and chemical characteristics of the three-potting media before planting is presented in Table 1.

The treatment Control; garden soil alone (1:0) had the highest acidic pH followed by one part garden soil (Gs) + one part poultry manure (Pm) (1:1) and two part garden soil(Gs) + one part poultry manure(Pm) (2:1) had the least acidic pH. One-part Gs + one part Pm contained the highest total nitrogen, total organic carbon, total organic matter and A.V.P followed by two parts Gs + one part Pm with Gs alone having the lowest total nitrogen content, total organic carbon and matter and A.V.P content.

However, for the Exchangeable bases content; Gs alone contained the highest hydrogen content followed by one-part Gs + one part Pm, two parts Gs + one part Pm contained the lowest content. One-part Gs + one part Pm had the highest potassium content followed by Gs alone and two parts Gs + one part Pm had the lowest content. Two parts Gs + one part Pm contained the highest calcium, magnesium, sodium and C.E.C contents followed by one-part Gs + one part Pm with Gs alone having the least contents. Gs alone had the highest aluminum content, with one-part Gs + one part Pm and two parts Gs + one part Pm had the same lowest value. Two parts Gs + one part Pm and Gs alone had the highest values for E.C.E.C content while one-part Gs + one part Pm had the lowest content.

The physical properties on the table showed that two parts Gs + one part Pm had the highest sandy properties, followed by Gs alone and one-part Gs + one part Pm had the lowest sandy properties. One-part Gs + one part Pm had the highest Silt properties followed by Gs alone while two parts Gs + one part Pm had the lowest silt properties. Gs alone and two parts Gs + one part Pm had the highest Clay properties while one-part Gs + one part Pm had the lowest clay properties.

Table 1: Physical and chemical properties of potting media used in the experiment

SOIL PARAMETERS	1:0 Garden soil alone	1:1 Garden soil + Poultry manure	2:1 Garden soil + Poultry manure
Chemical properties			
pH	4.42	4.83	5.14
Total N(g/kg)	0.73	1.23	1.10
Total CO(g/kg)	16.0	22.3	18.8
Organic Matter(g/kg)	27.58	38.45	32.41
A.V.P	0.36	14.6	12.9
Exchangeable bases (cmol/kg)			
K	0.18	0.2	0.17
Ca	0.74	0.78	0.80
Mg	0.22	0.25	0.27
Na	0.10	0.12	0.15
H^+	0.25	0.20	0.17
Al^{3+}	0.20	0.09	0.09
CEC	1.49	1.55	1.6
ECEC	1.69	1.64	1.69
PHYSICAL PROPERTIES			
Sandy(g/kg)	886	880	889
Silty(g/kg)	58	65	55
Clay(g/kg)	56	55	56

The growth parameters in relation to potting media and cultivars of four *Dioscorea* spp. are presented in Table 2.

According to the table below, all of the growth parameters in relation to the potting medium were not significant.

However, in terms of cultivars, the number of vines, leaf area, number of leaves, and stem girth were highly significant, petiole length were significantly different, and height at first branch, internode length, and number of leaves were not significantly different.

The interaction between cultivars and potting media were not significant.

Table 2. Effect of different combinations of garden soil (GS) and poultry manure (PM) potting media on growth of four *Dioscorea spp*. at Nine weeks after planting

Treatment	NO. of vines	Leaf area (cm^2)	No. of leaves	Stem girth (cm)	Internode length (cm)	Petiole length (cm)	Height at first branch(cm)
Potting Media							
1:0(Garden soil)	1.75	64.00	154.00	3.67	9.82	6.61	10.60
1:1(Gs+Pm)	1.42	73.70	104.00	3.40	9.13	5.92	17.20
2:1(Gs+Pm)	1.58	74.50	144.0	3.23	10.53	6.97	12.10
Significance	ns	ns	ns	ns	ns	ns	ns
LSD							
Cultivars							
Ada Onitsha	2.33	44.8	158.00	3.09	9.57	5.54	11.20
Fakasa	1.78	35.50	122.00	2.97	12.09	4.83	13.60
Water Yam	1.11	114.10	138.00	3.94	8.92	8.73	12.70
Yellow Yam	1.11	88.70	118.00	3.73	8.74	6.89	15.60
Significance	**	**	**	**	ns	*	ns
LSD	0.607	26.63	69.40	0.652		1.605	
PM×Cultivars							
Significance	ns	ns	ns	ns	ns	Ns	ns
LSD							

*, ** Significant at 0.05 and 0.01 level of probability respectively ns = not significant

Pm=Poultry manure Gs=Garden soil PM= Potting Media

The yield characteristics of one *Dioscorea spp*. (Ada Onitsha) is presented in Table 3.

Tuber length and tuber weight were highly significant, tuber girth was significant, and number of tubers was not significant.

Table 3. Effect of different combinations of garden soil and poultry manure potting media on yield of One *Dioscorea spp*. (Ada Onitsha) at harvest

Treatment	Tuber Length (cm)	Tuber Girth (cm)	No. of Tubers	No. of Tuber/ vine	Fresh Tuber yield/Bag (Kg)	Fresh Tuber Yield/ha (tons/ha)
1:0(Garden soil)	11.63	20.70	2.67	1.17	0.47	4,670
1:1(Gs+Pm)	13.70	18.00	2.50	1.03	0.50	5000
2:1(Gs+Pm)	23.30	27.07	1.67	0.72	1.47	14,670
Significance	**	*	ns	ns	**	**
LSD	5.594	5.111			0.5729	1854.32

*, ** Significant and highly significant at 0.05 and 0.01 level of probability respectively, ns = not significant, Gs=Garden soil Pm=Poultry manure

CHAPTER FIVE

DISCUSSION

Garden soil alone as a potting media has been shown in this study to be low in fertility and so cannot sustain yam production in containers. However, amending garden soil with poultry manure at the rate of 2:1 (two parts garden soil and one part poultry manure) and 1:1(one part garden soil and one part poultry manure) improves the physical and chemical properties of the soil making it a viable option for growing of yams in containers. The best was potting media 2:1(two parts garden soil and one part poultry manure). Here, the weight of the garden soil was suitably incorporated with the weight of the poultry manure. Its pH was 5.14, total organic carbon content was 18.8 g/kg, total nitrogen content was 1.10 g/kg, A.V.P. was 12.79 mg/kg, and K content was 0.23 cm3/kg. Sand, silt, and clay totaled 889, 55, and 56 grams per kilogram, respectively. It has the advantage of enhancing the physiochemical characteristics of the soil ensuring food security for persons living in urban areas and can, therefore, maintain general crop production and not only yam cultivation. The outcome aligns with the findings of Ibeawuchi *et al.* (2006), indicating that poultry manure contains a substantial proportion of organic matter and contributes to an elevation in various soil chemical constituents. Poultry manure possesses a considerable capacity to slowly release nutrients into the soil, potentially aiding in the rejuvenation of depleted soil fertility.

There were no significant differences in the growth data collected when comparing the with respect to the various potting media during the growth period since the growth data collected was consistent for all treatments, when compared amongst cultivars, there were substantial differences in the number of vines, leaf area, petiole length, and stem girth. This could be a result of the distinctive qualities of each cultivar. For instance, yellow yam *(D. Cayenensis)* and Water yam *(D. alata)* had higher leaf areas because their leaves were larger than those of Ada Onitsha and Fakasa *(D. Rotundata).*

Fresh tuber yield and tuber characteristics, such as their length, and girth, were significant during harvest. In terms of yield, potting media 2:1 (two parts garden soil and one part poultry manure) outperformed the other potting media, followed by 1:1(one part garden soil and one part poultry manure), and then 1:0(garden soil alone), suggesting that treatments 2:1 and 1:1 were more fertile than 1:0. In 1:1, 2:1, and 1:0, respectively, the total amount of organic matter and carbon were greatest. These results suggested that the potting media combined with poultry dung had a better fertility. High levels of organic carbon improved the soil's structure, enabling improved air, water, and plant root penetration, according to Nwaoguala *et al.,* (2018). The level of organic carbon increases with the amount of organic manure (poultry manure).

CONCLUSION AND RECOMMENDATIONS

Garden soil alone as a potting media has been shown in this study to be low in fertility and so cannot sustain yam production in containers, however, amending garden soil with poultry manure at the rate of 2:1 (two parts garden soil and one part poultry manure) and 1:1(one part garden soil and one part poultry manure) improves the physical and chemical properties of the soil making it a viable option for growing of yams in containers.

Thus, two parts garden soil mixed with one part poultry manure (2:1) is more promising for growing of yams in containers.

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