ASSESSMENT OF MINITUBERS DERIVED FROM VINE CUTTINGS AND YAM MINISETT FOR SEED YAM PRODUCTION IN *Dioscorea alata L.* and *Dioscorea rotundata poir*

BY

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BENIN CITY
NIGERIA

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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 FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF AGRICULTURE DEGREE (B. AGRIC) IN CROP SCIENCE

NOVEMBER, 2025

CERTIFICATION

This is to certify that the work contained in this project report titled “**ASSESSMENT OF MINITUBERS DERIVED FROM VINE CUTTINGS AND YAM MINISETT FOR SEED YAM PRODUCTION IN *Dioscorea alata L.* and *Dioscorea rotundata***” was carried out by ORONSAYE Irobosa Jessica with Mat. No. AGR2004357, Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City, Edo State, Nigeria.

PROF. T. O. EMEDE **DATE**
Project Supervisor

PROF. S.U EWANSIHA **DATE**
Head of Department

DEDICATION

This work is dedicated to God Almighty for his strength, grace and favour that kept me going, and to my late Dad Rev John Otabor Oronsaye for the forever unending motivation that kept going and made me love Agriculture.

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My sincere gratitude goes to God Almighty who has been my all from the beginning to the end of my course of study in this prestigious institution.

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ABSTRACT

Dioscorea alata L. and *Dioscorea rotundata* Poir remain the most widely cultivated yam species in the tropics, where yam is a major food and income crop. However, the availability of clean, affordable, and disease-free seed yam is still a major constraint to production. This study evaluated the growth performance and seed tuber yield of minitubers generated from vine cuttings and yam minisetts across several yam cultivars. For the minituber experiment, improved cultivarsAkuabata, Vayam, Asiedu, Favourite and Super were used, while the minisett trial included Abakaliki 1, Abakaliki 2, Benin Local, Igiowa 1 and Igiowa 2. Both experiments were arranged using a Randomized Complete Block Design (RCBD) with three replications. Vine cuttings taken from the minituber plants were also used to examine the influence of four locally available potting media (sawdust, rice hull, grass, and corn cob) on the establishment and yield of minitubers under semi-autotrophic hydroponic conditions, using a Completely Randomized Design (CRD). Seed yam yield per plant ranged from 267 g in Super to 467 g in Asiedu in the minituber experiment, while minisett yield ranged from 200 g in Abakaliki 1 to 717 g in Igiowa 1. Multiplication ratios were substantially higher in the minituber system (1:46–1:75) compared to the minisett method (1:1.3–1:3.8). In the vine-cutting experiment, sawdust produced the highest survival rate (68%), followed by rice hull, grass, and corn cob. Overall, the study demonstrates that minitubers produced from vine cuttings represent a promising and efficient approach for generating high-quality seed yam in *Dioscorea* spp. Furthermore, readily available potting materials455565T45R such as sawdust, rice hull, and grass can be effectively used in humidity chambers for minituber production.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Yam (*Dioscorea* spp.) is one of the most important staple food crops in the tropics, particularly in West Africa, Southeast Asia, the Caribbean, and parts of South America. Belonging to the family *Dioscoreaceae*, the genus *Dioscorea* comprises more than 600 species worldwide, of which about 60 are cultivated for food, alcohol, beverages, and medicinal purposes. However, only six species are of major agricultural and economic importance: *Dioscorea rotundata* (white yam), *D. alata* (water yam), *D. cayenensis* (yellow yam), *D. dumetorum*, *D. bulbifera* (aerial yam), and *D. esculenta* (lesser yam). Of these, *D. rotundata* and *D. alata* are the most extensively cultivated and consumed in West Africa (Asiedu and Sartie, 2010).

According to FAOSTAT (2014), global yam production in 2012 was estimated at 58.7 million metric tons, with West Africa accounting for over 92% of the total. Nigeria and Ghana are the world's leading producers, contributing about two-thirds of global supply. In Nigeria alone, yam occupies an estimated 5 million hectares of land, supporting millions of households with food and income (Nweke *et al*., 2014). The crop is therefore central to food security, nutrition, and rural livelihoods.

Yam is consumed in diverse forms depending on cultural preferences. In its fresh form, tubers may be boiled, roasted, fried, or grilled, while in processed form they are used for pounded yam, amala, yam flour, porridge, and confectionery products. Certain varieties of *D. alata* have been identified as suitable for flour processing, which has potential for industrial applications in baking and food processing (Polycarp *et al*., 2012). In addition to its nutritional value as a starchy staple, yam is also important in cultural and social contexts, featuring in traditional festivals, marriage ceremonies, and as a status symbol in many yam-producing communities (Coursey, 1967).

Despite its importance, yam production is constrained by several challenges. These include low propagation rates, high cost and scarcity of quality seed yam, pests and diseases, postharvest losses, and declining soil fertility (*Aighewi et al., 2015*). The conventional practice of using whole tubers or cut setts as planting material significantly reduces the portion of harvest available for consumption or sale, thereby creating competition between seed and food use. Furthermore, the multiplication ratio of yam under the traditional method is very low (about 1:3 to 1:5), compared to other root crops like cassava (1:10) and potato (1:15) (Okoli and Akoroda, 1995). This low multiplication rate is a major bottleneck to yam production expansion in sub-Saharan Africa.

Yam is propagated from seed tubers or sections of tubers and corms. Seed tubers are expensive, accounting sometimes for about as much as 50% of total variable cost (Manyong, 2000); they are bulky to transport and have extended dormancy period. The multiplication ratio in the field is very low (less than 1:10) compared, for instance, to some cereals (1:300) (Balogun, 2009). Traditionally farmers obtain seed tubers by selecting small tubers (e.g. 200– 500g) from each harvest. Unfortunately, these seed tubers often emanate from unhealthy mother plants due to incidence of diseases, nematodes and insects such as yam shoot beetle, which often interact with fungi (*Botryodiplodia*, *Fusarium*) and bacteria (*Erwinia* spp.) that damage tubers in the field and in storage (Aighewi *et al*., 2003; Lebot, 2009). Diehl's (1982) survey report in Nigeria also showed shortage of planting material (owing to low reproductive rate) which may lead to future decline in yam production.

Farmers mostly rely on their own planting materials saved from the previous cropping season; some farmers partly meet their demand for seed tubers through purchases from local markets or exchanges with neighbors. This has led to a decrease in production (Tamiru *et al.,* 2008) due to insufficient quantity and poor quality of planting material. So, some farmers keep a reserve batch of seed yams (up to a third of the quantity planted) for replacement of seeds that do not germinate. Poor quality planting materials that germinate tend to carry disease and pest (viruses, fungi, nematodes and insects) from the storage barns to the field the next season ., resulting in low tuber yields, followed by poor shelf life (Ghosh *et al*., 1988; Asiedu and Sartie, 2010). Seed yam supply is a critical challenge among yam producers.

To address these challenges, research has focused on alternative propagation techniques that can enhance seed yam availability and reduce dependence on food-grade tubers. Among the most promising methods are mini sett technology, mini tuber production, and vine cutting techniques. Mini sett technology involves cutting ware yams into small pieces (20–50 g) treated with fungicides before planting, thereby producing multiple seed yams from a single tuber. Mini tuber production, on the other hand, relies on tissue culture or aeroponic systems to generate small whole tubers, which can then be multiplied in the field. Vine cutting techniques use portions of yam vines with nodes planted in soil, some potty medium (sawdust ,rice husk, corn cob husk/maize husk) sand beds to produce seed tubers. These methods not only increase the multiplication rate but also reduce the pressure on edible tubers and improve the availability of healthy planting materials *(Ile et al.*, 2006).

However, the performance of these techniques can vary depending on yam species, cultivar, and environmental conditions. While *D. rotundata* and *D. alata* are the dominant species cultivated in West Africa, there is limited comparative assessment of seed yam production efficiency using mini sett, mini tuber, and vine cutting in these species. This gap in knowledge underscores the need for research to evaluate the effectiveness of these propagation methods under local conditions.

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1.2 JUSTIFICATION OF THE STUDY

Yam (*Dioscorea* spp.) is one of the most important staple crops in West Africa, particularly in Nigeria where it plays a central role in food security, income generation, and cultural traditions. Despite Nigeria's status as the world's largest producer of yam, productivity has remained relatively low compared to the crop's potential due largely to the persistent scarcity of quality seed yam (FAO, 2020; Asiedu and Sartie, 2010). Farmers often reserve between 20–30% of their harvest for use as planting material in subsequent seasons, thereby reducing the quantity available for consumption and sale

(Aighewi, Asiedu, Maroya, and Balogun, 2015). This practice not only limits food availability but also makes yam cultivation costly, as seed yam accounts for a significant proportion of total production expenses. The justification for this study lies in addressing this seed bottleneck through the evaluation of alternative propagation methods such as mini-sett, mini-tuber, and vine cutting techniques, which promise higher multiplication rates, lower costs, and healthier planting material.

The mini-sett technique, which involves cutting yam tubers into small pieces for planting, has been promoted as a practical method for increasing seed multiplication while reducing the volume of tubers required as planting material. Similarly, mini-tuber production under controlled environments, such as aeroponics and semi-autotrophic hydroponics, has been demonstrated to generate disease-free planting material that can serve as foundation seed yam (Maroya *et al*., 2014). Vine cutting, which utilizes nodal segments from yam vines, is another promising approach that significantly increases multiplication ratios, particularly in *D. alata* (Nguyen, Aighewi, and Asiedu, 2019). Despite these advances, limited comparative studies exist that assess the efficiency, survival rate, and yield potential of these techniques across different yam species. This gap in knowledge justifies the present study, which aims to generate evidence-based recommendations that can guide both farmers and policymakers.

Another justification for this research lies in the need to minimize the spread of pests and diseases through planting material. Conventional yam propagation often facilitates the transmission of pathogens such as yam mosaic virus and anthracnose, leading to yield losses and poor tuber quality (Obidiegwu, Akpabio, and Ene-Obong, 2020). Improved propagation techniques, especially those conducted under controlled environments, provide cleaner seed material and reduce the risk of seed degeneration. By evaluating different propagation methods, this study supports the broader goal of ensuring healthier and more productive seed systems for yam farmers.

From an economic perspective, yam cultivation is a vital source of income for millions of smallholder farmers in Nigeria. Yet the high cost of seed yam remains a major barrier to increased productivity. By identifying propagation techniques that are both effective and affordable, this study has the potential to reduce production costs, enhance farmer profitability, and improve household food security (Otoo, Aboagye, and Wiredu, 2020). Moreover, reducing the amount of yam set aside for planting allows more of the crop to be available for food and market, thereby strengthening rural livelihoods and contributing to poverty reduction.

The relevance of this study also extends to development policy and agricultural transformation agendas. Nigeria's agricultural policies emphasize the importance of strengthening seed systems for root and tuber crops, and the Sustainable Development Goals (SDGs), particularly SDG 2 on Zero Hunger, highlight the critical role of sustainable agricultural intensification in ensuring food and nutrition security. Research on seed yam production methods directly supports these policy objectives and contributes to ongoing initiatives such as the Yam Improvement for Income and Food Security in

West Africa (YIIFSWA) project, which seeks to develop and promote efficient seed systems (IITA, 2021).

In addition, the findings from this study will have practical implications for extension services, farmer training, and seed enterprises. By providing evidence on the comparative effectiveness of mini-sett, mini-tuber, and vine cutting techniques in *D. alata* and *D. rotundata*, this research will enable extension agents to disseminate appropriate recommendations, while seed entrepreneurs and farmer cooperatives can adopt the most efficient methods for large-scale seed multiplication. Thus, the justification for this study lies not only in its scientific and technical contribution but also in its direct application to improving yam production, farmer livelihoods, and national food security.

Seed yam scarcity remains the single most important constraint to yam production in West Africa. Farmers often dedicate up to one-third of their harvest for seed, leaving less available for food and market, thereby increasing production costs and reducing profitability. Developing and promoting efficient seed yam production methods such as mini sett, mini tuber, and vine cutting techniques will help bridge the seed gap, enhance productivity, and ensure food security. This study is significant as it will provide comparative data on these methods in *D. rotundata* and *D. alata*, the two most important yam species in West Africa. The findings will guide researchers, extension workers, and farmers in adopting sustainable yam propagation techniques that can boost seed availability, reduce pressure on food supplies, and improve farmer incomes.

1.3 OBJECTIVES OF THE STUDY

The specific objectives were to;

(i) assess the growth and yield of seed yam tubers of different local cultivars of *Dioscorea* species under yam minisett technique (YMT).

(ii) evaluate the use of minitubers in the production of seed yam tubers among different improved yam cultivars of *Dioscorea* species.

(iii) compare the use of minisett and whole minitubers in the production of seed yam tubers among different cultivars of *Dioscorea* species.

(iv) ascertain the effect of different local potting media on growth and development of single nodal vine cuttings under semi – autotrophic hydroponics.

CHAPTER TWO

LITERATURE REVIEW

2.1 ORIGIN AND DISTRIBUTRION OF DIOSCOREA SPP

Yam (*Dioscorea* spp.) is a major root and tuber crop of high economic, cultural, and nutritional importance in the tropics. Belonging to the family Dioscoreaceae and the genus *Dioscorea*, yam comprises over 600 recognized species, although only about 10 are widely cultivated for food and economic purposes (Asiedu and Sartie, 2010). Among these, *Dioscorea rotundata* (white yam) and *Dioscorea alata* (water yam) are the most commercially important, contributing significantly to household food security and income in West Africa, which is regarded as the global “yam belt” (IITA, 2021).

Globally, yam production is estimated at over 72 million metric tons annually, with Nigeria, Ghana, Benin, and Côte d’Ivoire accounting for more than 90% of total output (FAO, 2020). Nigeria alone produces close to 70% of the world’s yam, making it the undisputed leader in yam cultivation and utilization. Yams are versatile in consumption and can be boiled, roasted, fried, pounded, or processed into flour and chips. They serve as an important source of carbohydrates, dietary fiber, potassium, vitamin C, and some B vitamins, thereby making them a crucial staple in the diets of millions (Otoo *et al.*, 2020). Beyond their role in human nutrition, yams also occupy a prominent place in the socio-cultural and spiritual lives of communities in yam-growing regions. In southeastern Nigeria, for example, the New Yam Festival marks the beginning of the harvest season and symbolizes abundance, renewal, and thanksgiving. Yams are also used in marriage rites, gift exchanges, and traditional ceremonies across West Africa (Ugwu and Awoke, 2021). This dual importance both as food and as a cultural symbol distinguishes yam from other root crops like cassava and sweet potato.

Economically, yam cultivation is labor-intensive but profitable, creating employment opportunities across the production, processing, and marketing chain. However, yam production has been constrained by the high cost of seed yam, low multiplication rates of planting materials, and losses due to pests and diseases (Aighewi *et al*., 2e015). These limitations have necessitated the development of improved propagation methods, which form the focus of ongoing research into sustainable yam production.

2.2 YAM (DIOSCOREA *SPP.*) SYSTEMATICS

The genus *Dioscorea* (family *Dioscoreaceae*) is a large and taxonomically complex group of monocotyledonous plants comprising several hundred species (commonly estimated between 400 and 600), most of which are distributed throughout tropical and subtropical regions of the world (Ngwe *et al*., 2015; Wilkin *et al*. 2005). Members of the genus occupy diverse habitats ranging from humid tropical forests to seasonally dry woodlands and grasslands, and they show considerable morphological and ecological diversity across geographic regions (Maurin *et al.,* 2016). Several *Dioscorea* species have been domesticated for their starchy underground tubers and constitute important staples in many tropical societies.

Biogeographically, the genus shows two main centers of diversity: Africa (especially sub-Saharan Africa) and Southeast Asia / Oceania. A clade of *Dioscorea* diversified extensively in Africa and includes species that are of particular agronomic and cultural importance in West and Central Africa (Maurin *et al*.,2016). In contrast, a number of domesticated species such as *Dioscorea alata* (greater or water yam) have their origins in Island Southeast Asia and New Guinea, from where they spread throughout the Pacific and later into Africa and the Americas via human-mediated movement (PROSEA/PROTA; Ngwe *et al.,* 2015; Arnau *et al*., 2017).

The most widely cultivated yam species in West Africa — *Dioscorea rotundata* (commonly called white or Guinea yam) and its close relatives — are considered to have been domesticated in West Africa from wild progenitors such as *D. praehensilis* (with possible introgression from *D. abyssinica*), giving rise to the white Guinea yam complex (Sugihara *et al*., 2020; Coursey and Dumont cited in regional reviews). Molecular and genomic studies indicate a West African origin for the white Guinea yams, although the precise domestication history includes hybridization and complex ancestry that modern population genomics is now clarifying (Sugihara *et al*., 2020; Ngwe *et al*., 2015).

Dioscorea alata, by contrast, is believed to have been domesticated independently in Southeast Asia and New Guinea. Archaeological and genetic evidence point to a long history of cultivation in Island Southeast Asia and the Pacific, after which *D. alata* spread westward and became widely naturalized and cultivated across the tropics, including in West Africa, the Caribbean, and parts of South America (PROSEA/PROTA; Arnau *et al*., 2017; Sharif *et al*., 2020). Unlike some wild *Dioscorea* species, *D. alata* is rarely found in an undomesticated state and exhibits considerable phenotypic diversity among cultivated landraces (PROSEA/PROTA; Arnau *et al.,* 2017).

Today, the distribution of cultivated *Dioscorea* species mirrors both natural ecological suitability and long histories of human migration, trade and crop exchange. West Africa (notably Nigeria, Ghana, Côte d'Ivoire and Benin) is the global centre of yam production and diversity for the African domesticated species, particularly *D. rotundata* and *D. cayenensis*; these species are central to regional diets and cultural practices (FAO, 2020; IITA, 2021). Southeast Asia and the Pacific remain important centers for species such as *D. alata* and other locally cultivated yams, where these crops have been integral to traditional agro-ecosystems for millennia (Ngwe *et al.,* 2015; PROSEA/PROTA).

Understanding the distinct geographical origins and distributional patterns of *Dioscorea* species has direct relevance for germplasm conservation, breeding, and seed-system strategies. Domestication histories explain much of the genetic structure seen in breeding materials and indicate where wild relatives and useful genetic variation may be found for traits such as disease resistance, adaptation to drought, or tuber quality. For seed-yam research and propagation studies (mini-sett, mini-tuber, vine cutting), species-specific origin and distributional knowledge therefore informs choice of target species, appropriate agronomic recommendations, and conservation priorities for both farmer landraces and wild relatives (Ngwe *et al.,* 2015; Sugihara *et al*., 2020).

2.3 BOTANY OF DIOSCOREA SPP

Yam is a perennial climbing plant characterized by its underground storage organ, the tuber, which serves both as food and as planting material. The vines of yam are twining and require staking for proper support. Leaves are usually simple, cordate, or palmately lobed, and arranged either alternately or oppositely depending on the species. The plant is dioecious, with male and female flowers borne on separate plants, although flowering and seed setting are often irregular in cultivated species (Obidiegwu *et al.*, 2020).

The genus *Dioscorea* is one of the most important groups of root and tuber crops, with diverse uses ranging from food and nutrition to medicine, industry, and socio-cultural practices. Yams are a staple food in many tropical and subtropical regions, especially in West Africa where Nigeria alone accounts for more than 65% of global production (FAO, 2017). The primary utilization of yam is as food, where the tubers are consumed in a wide variety of forms such as boiled, roasted, fried, or pounded, and are also processed into flour or flakes for long-term storage and ease of preparation (Coursey, 1967; Lebot, 2009). Nutritionally, yams are rich in carbohydrates, particularly starch, and provide essential minerals such as potassium, magnesium, and iron, alongside moderate amounts of protein and dietary fiber. They also contain vitamins such as vitamin C and B-complex vitamins, which contribute to dietary diversity and food security in producing regions (Osunde, 2008; Akinola *et al.*, 2021).

Beyond their role as staple foods, yams are of great socio-economic and cultural importance. In West African societies, yam has traditionally been regarded as a crop of prestige and wealth, with large tubers often symbolizing prosperity and social status (Coursey, 1967). The annual yam festivals celebrated in countries such as Nigeria, Ghana, and Benin highlight its deep cultural significance, marking the beginning of the harvest season and reinforcing yam as a symbol of fertility, abundance, and tradition (Babaleye, 2003). Economically, yam cultivation and trade are major sources of income for millions of smallholder farmers. Local and regional markets thrive on yam sales, while the potential for export, though limited by storage and perishability challenges, represents an emerging avenue for foreign exchange earnings (Otoo, Aighewi, and Asiedu, 2018).

Yams also have important industrial applications. Several species, including *Dioscorea floribunda* and *Dioscorea villosa*, are sources of steroidal saponins such as diosgenin, which have been widely used in the pharmaceutical industry as precursors in the synthesis of corticosteroids, contraceptives, and other hormones (Behera *et al*., 2009). Although the development of synthetic methods has reduced reliance on natural sources, yams remain historically significant in pharmaceutical production. Moreover, yam starch possesses desirable physicochemical properties such as high viscosity and gel strength, making it useful in the food, textile, adhesive, and biodegradable materials industries (Ezeocha and Oti, 2011).

Medicinally, *Dioscorea* spp. are used in traditional healing practices across Africa, Asia, and Latin America. Tubers and other plant parts are employed in the treatment of ailments such as dysentery, abdominal pain, skin infections, and inflammation (Iwu, 1993; Shanthakumari, Mohan, and Britto, 2008). The bioactive compound diosgenin has been reported to exhibit hypolipidemic, antioxidant, anti-inflammatory, and anticancer activities, making yams a potential source of nutraceuticals and pharmaceuticals (Son *et al.*, 2007). Thus, beyond their direct nutritional value, yams provide therapeutic benefits that enhance their relevance in both traditional and modern medicine.

In addition to these uses, yams contribute significantly to food security and rural livelihoods. They are particularly important in smallholder farming systems, where they not only provide food but also serve as a cash crop. Their storability, though limited compared to grains, allows for year-round availability when managed properly, reducing seasonal hunger in producing communities (Osunde, 2008; Obidiegwu, Akpabio, and Ene-Obong, 2020). Overall, the utilization of *Dioscorea* spp. reflects their multidimensional value as food, medicine, cultural heritage, industrial raw material, and livelihood support, underscoring their indispensable role in tropical agriculture and human societies

2.4 MORPHOLOGY OF YAM (*DIOSCOREA* SPP.)

Yams belong to the genus *Dioscorea* and are perennial climbing vines cultivated for their underground tubers. The yam plant consists of both aerial and underground parts, each performing distinct functions.

The aerial part is made up of long, twining vines that may climb in either a right-handed or left-handed direction, depending on the species. The vines are herbaceous when young but become woody with age. Leaves are usually simple, alternate or opposite, and heart-shaped (cordate) with prominent venation (Coursey, 1967; Asiedu and Sartie, 2010).

The underground part consists of a tuber, which is a swollen stem that serves as the main storage organ. Tubers vary in shape and size among species some are cylindrical, others round or irregular and are covered with a rough, brown skin and white or yellow flesh. The tuber has a head, middle, and tail portion, with buds or "eyes" capable of sprouting new plants (Aighewi *et al.*, 2015).

Yams also produce small underground bulbils or aerial tubers in some species such as *D. bulbifera* and *D. alata*, which can be used for vegetative propagation. The plant bears unisexual flowers on separate male and female plants (dioecious), and fruiting is by capsules containing flat seeds with papery wings (IITA, 2009).

Overall, the yam plant exhibits morphological diversity that reflects its adaptation to different environments and its importance as both a food and propagation crop.

2.5 SOCIO-ECONOMIC IMPORTANCE OF YAM (*DIOSCOREA* SPP.)

Yam (*Dioscorea* spp.) plays a vital socio-economic role in many tropical regions, especially in West Africa, where it serves as both a staple food and a major source of income. Nigeria alone accounts for about 70% of global yam production, making it the largest producer and consumer of yam in the world (FAO, 2020).

Yam is a rich source of carbohydrates, dietary fibre, and essential minerals, contributing significantly to household food security and nutrition (Asiedu and Sartie, 2010). Beyond its food value, yam production, processing, and marketing provide employment and income for millions of rural families, particularly among smallholder farmers, traders, and transporters (Aighewi *et al.*, 2015).

Economically, yam is an important cash crop, generating substantial income in both local and export markets. In Nigeria, yam contributes greatly to rural livelihoods and is traded across national borders in fresh and processed forms (Maroya *et al.*, 2014).

Socially and culturally, yam holds symbolic value in traditional ceremonies and festivals, such as the New Yam Festival, which marks the beginning of harvest and expresses gratitude to the gods for fertility and abundance (Coursey, 1967; Asiedu and Sartie, 2010). Thus, yam is not only a food security crop but also a pillar of rural economy and cultural identity in yam-producing regions.

2.6 YAM AS A SOURCE OF FOOD AND INCOME

Yam (*Dioscorea* spp.) is one of the most important staple food crops in the tropics, especially in West Africa, where it serves as a major source of energy, income, and cultural identity. It ranks next to cassava in terms of carbohydrate contribution to diets and plays a central role in ensuring household food security (Asiedu and Sartie, 2010). Nigeria, Ghana, and Côte d'Ivoire together account for over 90 percent of global yam production, with Nigeria alone producing nearly 70 percent (FAO, 2020).

Nutritionally, yam is rich in carbohydrates (mainly starch), dietary fibre, and small amounts of protein, vitamins C and B6, and essential minerals such as potassium and manganese. It provides an easily digestible source of calories that supports millions of people in rural and urban areas. Yam is consumed boiled, pounded, fried, or roasted, and processed into flour for foods such as "amala" and "poundo yam" (Coursey, 1967; Aighewi *et al.*, 2015).

Beyond its food value, yam is an important source of income for rural households. It is cultivated by smallholder farmers and sold in local and regional markets, contributing significantly to livelihoods. The yam value chain from production and storage to transportation, processing, and marketing creates employment for farmers, traders, and labourers, particularly women involved in peeling, slicing, and selling (Maroya *et al.,* 2014). In Nigeria, yam is a major cash crop that contributes to both household income and the national economy through internal trade and export to neighbouring countries (Aighewi *et al*., 2015).

Yam also holds socio-cultural importance as a symbol of wealth and status. The annual "New Yam Festival" celebrated in many West African communities signifies the beginning of the harvest season and demonstrates the crop's importance in food security and community identity (Asiedu and Sartie, 2010).

2.7 CULTIVATION AND LAND PREPARATION PRACTICE OF YAM

Yam cultivation begins with selecting fertile, well-drained sandy-loam soil that allows the tubers to develop properly. Farmers usually choose land that is slightly sloped so excess water can run off easily, reducing the risk of rot and improving aeration. After selecting the field, the land is cleared either manually with cutlasses or mechanically using tractors, and the vegetation is allowed to decompose to improve soil organic matter. Yam requires loose soil, so farmers prepare the land by making mounds, heaps, or ridges depending on the local farming system. Mounds are the most common because they provide enough depth for tuber growth and ensure good drainage.

Planting is carried out at the beginning of the rainy season, usually between March and May. Seed yams or cut setts are placed into the mounds at a moderate depth and spaced widely to allow the vines to spread. As the yam sprouts, staking becomes necessary to support the vines, prevent them from trailing on the ground, and help the plant receive enough sunlight. Staking also reduces disease pressure and generally improves yield. Farmers maintain soil fertility by applying compost, manure, or mineral fertilizers depending on the nutrient status of the soil. Weeding is important during the early stages of growth, especially within the first three months, to reduce competition for nutrients, moisture, and light.

Mulching may be used to conserve soil moisture, soften the mound surface, and suppress weeds. The crop continues to grow until maturity, which usually occurs between six to nine months after planting, depending on the yam species. When the leaves begin to yellow and the vines start drying, it is a sign that the tubers are ready for harvest. Harvesting is done carefully to avoid damaging the tubers so that they can maintain good quality for consumption, storage, or replanting.

2.8 GROWTH AND DEVELOPMENT OF YAM

The growth and development of yam begin from sprouting of the planted seed yam or sett once soil moisture becomes adequate at the start of the rainy season. The sprout emerges from the dormant bud on the tuber and develops into a vine, which grows rapidly during the early vegetative stage. At this stage, yam produces leaves and forms its climbing structure, and the plant requires staking to allow proper exposure to sunlight for photosynthesis. Adequate leaf formation is important because it determines the plant's ability to manufacture food, which will later be stored in the developing tuber (IITA, 2009).

As the vines grow, yam enters its establishment and canopy development phase, where it produces broad leaves that help shade the soil, reduce moisture loss, and improve the plant's nutrient use efficiency. During this period, root growth becomes more active, especially the formation of feeder roots that absorb water and nutrients. The tuber begins to form underground as the plant diverts carbohydrates from the leaves to the underground stem. Tuber initiation usually starts a few weeks after vine emergence, but the bulk of tuber enlargement occurs later when the plant has developed enough leaf area to produce surplus food (Asiedu and Sartie, 2010).

The reproductive phase in yam is not always pronounced because many cultivated varieties have reduced flowering ability. Instead, most of the plant's energy is directed toward tuber bulking. Tuber enlargement continues steadily through the rainy season and early dry season as long as the vines remain green and functional. As the plant approaches maturity, the leaves begin to yellow and the vines gradually dry up. This natural senescence signals that tuber filling has stopped and the yam is ready for harvest. By this time, the tuber has accumulated enough dry matter, which determines its weight, texture, and storage quality (Aighewi *et al.,* 2015). The plant then enters a dormancy period in which the tuber remains physiologically inactive until the next planting season.

2.9 STAKING AND TRAILING IN YAM

Staking is an agronomic practice targeted at providing support structures for the elevation of creeping plants. The stake raises plants above ground level, thereby enhancing photosynthesis, increasing plant growth, development and ultimately the tuber yield. Staking reduces the infection and spread of the soil-borne pathogen from one plant to another, especially fungi diseases such as Anthracnose and bacterial blight. The use of stake also has the potential to reduce disease severity. It makes field management to be efficient as it enhances the use of herbicides for post-emergence weed control. Materials used as stakes include Bamboo, dead or live stick, rubber, or metal poles. Wire, twine, or ropes are used for trellising. Also, Tsado (2012) asserts that yam produced under the staked system out-grows and out-yields those in the non-staked system. Staking contributes to increased growth and development of yam.

The *D. alata* varieties and some *D. rotundata* cultivars do perform equally with minimal to no-staking. Staking is an essential but costly input in yam production. It is necessary for yam cultivation in the humid forest to enhance the synthesis and partitioning of dry matter in the twining yam vine. The leaves are displayed to attract adequate photosynthetic active radiation (PAR). Most yam genotypes yield well when their vines are staked because staking increases light interception by leaves. It also facilitates the ease of weeding (Ogunniyan and Akoroda*,* 2004). The use of stake in yam cultivation is expensive, laborious, encourages deforestation and creates bottle-neck to yam mechanization (Onwueme and Haverkort, 1991). The use of trellis methods which is cost-effective, less labour-intensive and environmentally friendly, has been devised to address the challenges mentioned above in the stake method. The practice of converting Sorghum straw to stakes within a field in a rotational cropping system has also simplified staking among farmers. Also, selecting varieties that perform optimally under little or no staking is critical, reducing labour and input costs.

2.10 HARVESTING AND POST-HARVEST PRACTICES OF YAM (*DIOSCOREA SPP.*)

Harvesting is a crucial stage in yam cultivation because it significantly influences both tuber quality and storability. Yam tubers are generally harvested when the aerial parts of the plant begin to senesce, indicated by yellowing of leaves and drying of vines, signaling that the tubers have reached physiological maturity (Sobulo, 2008). Timely harvest is essential: early harvesting can result in immature tubers with low dry matter content and poor storage life, whereas delayed harvesting increases susceptibility to tuber rot, pest attack, and mechanical damage (Norman *et al.*, 2021).

Manual harvesting is the most common method, using tools such as hoes or digging sticks. Careful handling during lifting is vital to minimize injuries to the tubers, as cuts or bruises can provide entry points for pathogens during storage (Matsumoto *et al.*, 2021). After lifting, tubers are often cured by leaving them on the soil surface for a short period.

Curing allows the tuber skin to harden and minor wounds to heal, reducing post-harvest losses due to rot and infections (Hamadina *et al*., 2009).

Post-harvest management further involves sorting tubers to remove damaged, diseased, or undersized ones. Storage can be conducted in ventilated barns, mounds, or pits, depending on local environmental conditions. Proper storage requires cool temperatures, low humidity, and protection from pests to extend shelf life (Norman *et al.,* 2021). Some farmers also use natural treatments such as ash or neem leaves to prevent fungal and insect infestations.

Effective harvesting and post-harvest practices preserve the nutritional and market value of yams and ensure high-quality seed tubers for future planting, thereby contributing to sustainable yam production (Sobulo, 2008; Matsumoto *et al*., 2021).

2.11 BREEDING CHALLENGES AND PROSPECTS IN YAM (*DIOSCOREA SPP.*)

Yam breeding is critical for improving yield, tuber quality, pest and disease resistance, and adaptability to changing environmental conditions. However, breeding yams presents several challenges due to their biological and reproductive characteristics. Yams are predominantly dioecious, meaning male and female flowers occur on separate plants, which complicates controlled pollination (Asiedu and Sartie, 2010). Flowering is often irregular or delayed, and some elite cultivars rarely flower, limiting opportunities for hybridization and genetic improvement (Hamadina *et al.,* 2009).

Another major challenge is the high heterozygosity and polyploidy observed in many yam species. This genetic complexity leads to significant variation among progeny, making it difficult to obtain uniform and stable varieties (Mignouna *et al*., 2003). Additionally, yam has a long growth cycle, often taking 7–10 months to reach maturity, which slows the breeding process and reduces the number of breeding cycles that can be completed in a given time (Norman *et al.,* 2021).

Despite these challenges, there are promising prospects in yam breeding. Advances in molecular genetics, including marker-assisted selection and genomic studies, allow breeders to identify desirable traits more efficiently, such as disease resistance, early bulking, and high dry matter content (Tamiru *et al*., 2017). Micropropagation and the use of mini-tubers, setts, and vine cuttings provide opportunities for rapid multiplication of elite genotypes, circumventing the slow vegetative propagation of conventional tubers (Asiedu and Sartie, 2010). Furthermore, breeding programs are increasingly focusing on combining high yield with resistance to major pests and diseases, which are critical for sustainable production in West Africa and other yam-growing regions.

In conclusion, while yam breeding is challenged by biological constraints and long growth cycles, modern biotechnological tools and improved propagation methods offer significant prospects for developing superior yam varieties with enhanced productivity and resilience (Mignouna *et al.,* 2003; Tamiru *et al*., 2017).

2.12 DETERMINANTS OF MATURITY AND DORMANCY IN YAM (*DIOSCOREA SPP.*)

Maturity and dormancy are critical physiological stages in yam (*Dioscorea* spp.) that influence tuber quality, yield, and the timing of subsequent planting cycles. Yam tubers reach maturity when the aerial parts of the plant begin to senesce, indicated by yellowing of leaves and drying of vines, and the tubers attain maximum dry matter and starch content (Sobulo, 2008). The timing of maturity is influenced by a combination of genetic, environmental, and agronomic factors.

GENETIC FACTORS:

Different yam species and cultivars vary in their growth duration and dormancy periods. For example, *Dioscorea rotundata* generally matures within 7–10 months, whereas *D. alata* may mature earlier in 6–9 months, depending on varietal characteristics (Norman *et al*., 2021). Some cultivars have inherently long dormancy periods, which affect sprouting and subsequent planting cycles.

ENVIRONMENTAL FACTORS:

Temperature, soil moisture, and photoperiod play significant roles in determining maturity and dormancy. Optimal temperatures (25–30 °C) and sufficient moisture promote tuber growth and accelerate maturity, while suboptimal conditions can delay physiological maturity (Matsumoto *et al*., 2021). Photoperiod also affects the rate of tuber initiation and growth, with certain genotypes responding differently to day length.

AGRONOMIC PRACTICES:

Planting date, set size, soil fertility, and pest management practices influence the timing of tuber maturity and dormancy. Larger setts typically produce vigorous sprouts, leading to earlier tuber formation, whereas nutrient-deficient soils may delay maturity and reduce tuber quality (Asiedu and Sartie, 2010). Additionally, water stress during the tuber bulking phase can shorten the duration of active growth and alter dormancy patterns.

DORMANCY MECHANISMS:

Dormancy in yam tubers is a complex physiological process regulated by endogenous metabolites, hormones, and carbohydrate reserves. During dormancy, metabolic activity in the tuber decreases, preventing premature sprouting. Biochemical studies indicate that accumulation of abscisic acid (ABA) and other metabolites is associated with the maintenance of dormancy (Tamiru *et al.,* 2017). Proper management of dormancy is essential for seed yam production and ensures uniform sprouting in the next planting season.

Understanding the determinants of maturity and dormancy is essential for optimizing planting schedules, improving tuber yield and quality, and facilitating year-round yam production through controlled dormancy management (Sobulo, 2008; Norman *et al*., 2021).

2.13 ENVIRONMENTAL FACTORS INFLUENCING GROWTH AND DEVELOPMENT OF YAM (DIOSCOREA SPP.)

The growth and development of yam (*Dioscorea* spp.) are strongly influenced by environmental conditions. Optimal environmental management is critical for achieving maximum tuber yield, quality, and uniformity in planting cycles (Sobulo, 2008). Key environmental factors include temperature, light, soil, and water availability.

1. **Temperature:** Yam is a tropical crop that thrives in warm conditions. Optimal growth occurs at temperatures between 25 °C and 30 °C, which favor sprouting, vegetative growth, and tuber bulking. Temperatures below 20 °C can reduce vine growth, delay tuber initiation, and decrease photosynthetic activity, resulting in lower yield (Matsumoto *et al*., 2021). High temperatures above 35 °C can also stress the plant, causing leaf scorch and tuber growth reduction.
2. **Light and photoperiod:** Sufficient sunlight is essential for leaf expansion, photosynthesis, and carbohydrate accumulation, which are necessary for tuber development. Yams are generally photoperiod-sensitive, and variations in day length can influence the timing of tuber initiation and flowering (Asiedu and Sartie, 2010). Inadequate light conditions may lead to reduced vine growth and lower tuber yield.
3. **Soil type and fertility:** Yams grow best in well-drained, deep, fertile soils rich in organic matter. Soils that are stony, shallow, or prone to waterlogging hinder tuber formation and increase the risk of rot and pest infestation (Norman *et al*., 2021). Adequate nutrient supply, particularly potassium and nitrogen, is essential for vine growth and tuber bulking. Deficient soils can delay maturity and reduce tuber size.
4. **Water availability:** Water is a critical factor at all stages of yam development, particularly during tuber initiation and bulking. Adequate rainfall or irrigation ensures sustained vegetative growth and proper carbohydrate allocation to developing tubers. Water stress during these critical stages can lead to reduced tuber size, dry matter content, and overall yield (MDPI, 2022).

5. **Other environmental factors:** Humidity and wind can also influence yam growth. High humidity may promote fungal diseases, while strong winds can damage vines and reduce photosynthetic efficiency. Altitude and microclimatic variations in yam-growing regions can further affect growth rates and crop duration (Sobulo, 2008).

   Understanding these environmental factors allows farmers and breeders to implement practices such as selecting appropriate planting dates, irrigation scheduling, soil fertility management, and site selection to optimize yam growth, yield, and quality (Matsumoto *et al.,* 2021; Norman *et al.,* 2021).

2.14 SOIL AND SOIL NUTRIENT REQUIREMENTS FOR YAM (DIOSCOREA SPP.)

Yam (*Dioscorea* spp.) is a tropical tuber crop that requires well-structured, fertile soils for optimum growth, tuber development, and yield. The choice of soil and proper nutrient management significantly influences yam establishment, vegetative growth, tuber bulking, and overall productivity (Asiedu and Sartie, 2010).

1. **Soil type:** Yams grow best in deep, well-drained loamy soils with good aeration. Sandy loams or loamy soils rich in organic matter are ideal, as they facilitate tuber expansion and prevent waterlogging, which can cause tuber rot (Norman *et al*., 2021). Stony, shallow, or poorly drained soils hinder root and tuber development, increase susceptibility to pests and diseases, and reduce yield.
2. **Soil PH:** Yams prefer slightly acidic to neutral soils with a pH range of 5.5–6.5. Acidic soils below pH 5.0 can limit nutrient availability, while highly alkaline soils

can reduce the uptake of essential micronutrients, thereby affecting tuber growth (Mignouna *et al*., 2003).

3. **Soil nutrient requirements:** Adequate soil fertility is essential for yam production. Nitrogen promotes vegetative growth, phosphorus enhances root and tuber development, and potassium is particularly important for tuber bulking and improving tuber size and quality. Deficiencies in these macronutrients can result in stunted growth, poor tuber formation, and reduced yields (MDPI, 2022).
4. **Organic matter:** High organic matter content improves soil structure, moisture retention, and nutrient availability. Incorporating compost, farmyard manure, or green manure into the soil before planting enhances yam growth and productivity (Sobulo, 2008).
5. **Micronutrients:** Micronutrients such as magnesium, zinc, and boron are also important for enzymatic activities and carbohydrate metabolism in yam. Deficiencies can affect tuber quality, starch content, and plant vigor (Asiedu and Sartie, 2010).

For sustainable yam production, proper soil management including land preparation, incorporation of organic matter, and balanced fertilization is critical to meet the crop's nutrient requirements and optimize tuber yield and quality (Norman *et al.,* 2021; MDPI, 2022).

2.15 CONSTRAINTS TO YAM PRODUCTION (*DIOSCOREA SPP.*)

Yam is a nutrient-demanding crop, particularly requiring nitrogen, phosphorus, and potassium Yam (*Dioscorea* spp.) is an important staple crop in many tropical regions, but its production is constrained by a combination of biological, environmental, and socio-economic factors. These constraints limit yield, reduce tuber quality, and affect the overall profitability of yam farming (Asiedu and Sartie, 2010).

1. **Biotic constraints:**

   Yam is susceptible to a wide range of pests and diseases. Major pests include yam beetles (*Heteroligus spp.*) and nematodes (*Scutellonema bradys*), which cause tuber damage and reduced yields. Diseases such as yam mosaic virus, anthracnose, and soft rot also affect both yield and tuber quality. High pest and disease pressure often requires intensive management, which may not be affordable for smallholder farmers (Hamadina *et al*., 2009; Norman *et al*., 2021).

2. **Seed and propagation limitations:**

   Availability of high-quality seed yams is a major constraint. Traditional propagation relies on large tubers, which limits the number of planting materials and increases cost. Poor-quality or diseased seed yams reduce germination, vine vigor, and tuber yield. While technologies such as mini-setts, mini-tubers, and vine cuttings exist, adoption is limited due to lack of awareness and technical support (Asiedu and Sartie, 2010; Tamiru *et al*., 2017).

3. **Environmental and climatic constraints:**

   Yam growth is highly sensitive to environmental conditions. Inadequate rainfall, prolonged drought, waterlogging, and suboptimal temperatures adversely affect tuber initiation, bulking, and yield. Climate variability and extreme weather events increase the risk of crop failure and affect food security in yam-growing regions (Matsumoto *et al*., 2021).

4. **Soil Fertility and Nutrient Deficiencies:**

   for optimal growth. Continuous cultivation on degraded or nutrient-poor soils leads to reduced tuber size, delayed maturity, and low yields. Limited access to fertilizers and organic amendments exacerbates this constraint (MDPI, 2022; Sobulo, 2008).

5. **Socio-Economic Constraints:**

   High labor requirements for land preparation, staking, weeding, harvesting, and post-harvest handling make yam production labor-intensive and costly. Market access, storage facilities, and post-harvest losses due to spoilage further limit profitability. Smallholder farmers often face challenges in accessing improved varieties, credit, and extension services, which restricts the adoption of modern production technologies (Asiedu and Sartie, 2010; Norman *et al.,* 2021).

6. **Breeding and Genetic Constraints**

   Yam breeding is complicated by irregular flowering, dioecious nature, high heterozygosity, and long growth cycles. These biological factors slow the development of improved varieties, limiting progress in enhancing yield, pest and disease resistance, and tuber quality (Mignouna *et al*., 2003; Tamiru *et al.,* 2017).Addressing these constraints requires integrated approaches including improved seed systems, pest and disease management, soil fertility management, adoption of modern propagation techniques, and development of improved yam varieties using conventional and molecular breeding methods (Asiedu and Sartie, 2010; Norman *et al*., 2021).

2.16 Diseases of Yam (Dioscorea spp.)

Yam (*Dioscorea* spp.) production is severely affected by several diseases caused by fungi, viruses, bacteria, and nematodes. These diseases reduce tuber yield, quality, and market value, and they are among the major constraints to sustainable yam production (Asiedu and Sartie, 2010).

1. **Yam Mosaic Virus (YMV):**

   YMV is the most important viral disease affecting yams, particularly *Dioscorea rotundata* and *Dioscorea alata*. The virus is transmitted by aphids and through infected planting materials. Infected plants exhibit mosaic leaf patterns, stunted growth, and reduced tuber size, often leading to yield losses of up to 80% under severe infection (Hamadina *et al*., 2009).

2. **Anthracnose (Colletotrichum gloeosporioides):**

   Anthracnose is a fungal disease that causes leaf spots, blight, and dieback of yam vines. It is highly destructive in areas with high rainfall and humidity. Severe infection results in reduced photosynthetic area, weak vines, and poor tuber development (Norman *et al.*, 2021).

3. **Soft Rot (Erwinia spp.):**

   Soft rot is a bacterial disease that affects yam tubers during storage or when the soil is waterlogged. Infected tubers become soft, water-soaked, and foul-smelling, leading to high post-harvest losses. Proper handling, curing, and storage are necessary to minimize this disease (Sobulo, 2008).

4. **Yam Nematodes (*Scutellonema bradys* and *Meloidogyne* spp.):**

   Nematode infestation damages yam tubers both in the field and during storage. Feeding by nematodes causes necrotic lesions on tuber surfaces, resulting in poor quality, reduced storability, and increased susceptibility to secondary infections (Mignouna *et al*., 2003).

5. **Leaf Spot and Dieback Diseases:**

   Other fungal pathogens, such as *Pestalotia spp.* and *Phytophthora spp.*, cause leaf spots, defoliation, and vine dieback. These infections reduce photosynthesis, delay tuber initiation, and ultimately reduce yield (Asiedu and Sartie, 2010). Effective disease management strategies include the use of disease-free planting materials, crop rotation, intercropping with non-host crops, proper field sanitation, and resistant or tolerant varieties. Integration of chemical and biological controls can also reduce disease incidence and post-harvest losses (Tamiru *et al*., 2017; Norman *et al*., 2021).

2.17 SEED YAM TUBER PRODUCTION AND CHALLENGES

Seed yam tubers are small, healthy yam tubers used as planting material for subsequent yam cultivation. They are critical for ensuring high germination rates, vigorous vine growth, and optimal tuber yield (Asiedu and Sartie, 2010). Seed tubers can be produced using several methods, including mini-setts, mini-tubers, and vine cuttings, which allow rapid multiplication of high-quality planting material in limited space and over shorter periods compared to conventional tubers (Mignouna *et al.,* 2003).

1. Methods of Seed Yam Production:

- **Mini-Setts:** Small portions of tubers (25–50 g) are used for planting. They reduce the amount of tuber required and increase multiplication rates.
- **Mini-Tubers:** Tubers produced from vine cuttings or tissue culture under controlled conditions. They are small, disease-free, and can be used to generate larger tubers for planting.
- **Vine Cuttings:** Some yam species, like *D. alata*, can be propagated using vine cuttings, which can then form new tubers in the field.

These methods improve seed yam availability, reduce the cost of planting material, and minimize disease transmission (Tamiru *et al*., 2017).

2. Challenges in Seed Yam Production: Despite the advantages, seed yam production faces several challenges:

- **High Cost and Labor-Intensiveness:** Producing mini-setts or mini-tubers requires intensive labor for planting, maintenance, staking, and harvesting (Norman *et al.,* 2021).
- **Disease and Pest Incidence:** Seed tubers are highly susceptible to viruses (e.g., yam mosaic virus), fungi (e.g., anthracnose), and nematodes, which can reduce sprouting rates and subsequent tuber yield (Hamadina *et al.,* 2009).

- **Limited Knowledge and Technology Adoption:** Many smallholder farmers lack access to improved propagation techniques or certified seed systems, limiting widespread adoption (Asiedu and Sartie, 2010).
- **Environmental Constraints:** Poor soil fertility, inadequate rainfall, and extreme temperatures can negatively affect seed tuber production and quality (Matsumoto *et al.,* 2021).
- **Storage Issues:** Seed tubers are prone to sprouting, dehydration, or rot during storage, which complicates their availability for timely planting (Sobulo, 2008).

Addressing these challenges requires an integrated approach, including use of disease-free materials, improved agronomic practices, proper soil fertility management, controlled irrigation, and adoption of modern seed multiplication techniques (Tamiru *et al*., 2017; Norman *et al*., 2021). Strengthening extension services and farmers' access to improved seed systems is also critical for enhancing yam productivity.

2.18.1 SEED YAM PRODUCTION THROUGH MILKING

Seed yam production through milking, also called vine cutting or stem cutting, is a modern technique used to multiply yams rapidly. Instead of planting whole tubers, small vine segments (cuttings) are used to generate new tubers. This method is particularly effective for species such as *Dioscorea alata*, which produce vigorous vines capable of forming tubers when planted under appropriate conditions (Asiedu and Sartie, 2010).

Procedure:

1. Healthy, disease-free vines are selected from vigorous mother plants.

2. The vines are cut into segments of 20–30 cm, each containing at least 2–3 nodes.
3. Cuttings are planted directly in prepared ridges or mounds, or in containers with suitable growing medium for rapid sprouting.
4. After rooting and vine establishment, the cuttings develop tubers that can be harvested as seed yams (mini-tubers) within 3–4 months, depending on environmental conditions (Mignouna *et al*., 2003).

Advantages:

- Rapid multiplication: One vine can produce multiple cuttings, greatly increasing seed yam availability.
- Disease management: Using healthy vine material reduces the risk of transmitting soil-borne diseases and viruses associated with tubers.
- Space efficiency: Vine cutting allows production of seed yams on limited land area, making it suitable for smallholder farmers (Tamiru *et al*., 2017).

Challenges:

- Environmental sensitivity: The success of vine cuttings depends on adequate moisture, temperature, and protection from pests. Water stress or high temperatures can reduce rooting and tuber formation.
- Labor requirements: Preparing, planting, and monitoring vine cuttings can be labor-intensive.
- Limited adoption: Many farmers are unaware of the technique or lack access to suitable vine material and extension support (Norman *et al.,* 2021).

Seed yam production through vine cutting is therefore a promising approach to overcome traditional seed tuber shortages, reduce costs, and improve the adoption of improved yam varieties. Proper management and farmer training are key to maximizing the benefits of this method (Asiedu and Sartie, 2010; Tamiru *et al*., 2017).

2.18.2 YAM *MINI-SETT TECHNIQUE*

The mini-sett method was developed to maximize the use of yam tubers for seed production. In this technique, tubers are cut into small setts weighing 25–100 g, treated with fungicides or wood ash to prevent rot, and then planted. The method significantly improves multiplication ratios and reduces the cost of planting materials compared to traditional large setts (Aighewi *et al*., 2015). However, mini-setts are prone to desiccation and pest damage and require careful management to ensure good establishment.

2.18.3 Vine Cutting Technique

Vine cutting technology uses segments of yam vines with one or more nodes to regenerate new plants. These can be planted directly in the field or first rooted in nurseries under controlled conditions. The technique offers the highest multiplication potential compared to tuber-based propagation methods, and it helps conserve harvested tubers for food or sale (Nguyen *et al.,* 2019). Nevertheless, the survival rate of vine cuttings is highly dependent on water availability, soil fertility, and nursery management practices.

2.18.4 Production of Yam Mini-Tubers

Yam mini-tubers are small, high-quality tubers produced from vine cuttings, setts, or tissue-cultured plantlets under controlled conditions. They serve as **seed yams** for planting the main crop, allowing rapid multiplication of elite or disease-free varieties. Mini-tuber technology reduces the need for large tubers for seed purposes, shortens the production cycle, and ensures availability of uniform, healthy planting material (Mignouna *et al.,* 2003; Asiedu and Sartie, 2010).

Methods of Mini-Tuber Production:

1. **From Vine Cuttings:**
    - Healthy, disease-free vine segments are planted in pots, ridges, or mounds.
    - The cuttings are provided with optimal soil fertility, moisture, and staking for proper growth.
    - Within 3–4 months, mini-tubers (50–200 g) develop at the base of the cuttings, ready for harvest as seed yam (Tamiru *et al*., 2017).
2. **From Setts or Seed Tubers:**
    - Small setts (25–50 g) or mini-setts can be planted under field or controlled nursery conditions.
    - Adequate spacing, light, and nutrient management promote rapid tuber bulking, producing mini-tubers in a shorter time than conventional tubers (Norman *et al*., 2021).
3. **From Tissue Culture:**

  - Micro-propagated plantlets are grown in sterilized soil or hydroponic systems to produce disease-free mini-tubers.
  - This method allows high multiplication rates and ensures elimination of viruses and other pathogens (Tamiru *et al*., 2017).

Advantages of Mini-Tubers:

- Reduced cost and space requirement for seed yam production.
- Rapid multiplication of improved varieties.
- Lower risk of disease transmission compared to using whole tubers.
- Facilitates year-round seed yam production in areas with limited planting material (Asiedu and Sartie, 2010).

2.19 MICROTUBER PRODUCTION IN CONVENTIONAL TISSUE CULTURE

Microtubers are small, in vitro-produced tubers generated from yam (*Dioscorea* spp.) tissue culture plantlets under controlled laboratory conditions. This technique is part of conventional tissue culture methods and is widely used for producing disease-free, uniform planting material and for rapid multiplication of elite yam varieties (Mignouna *et al*., 2003; Asiedu and Sartie, 2010).

Procedure for Microtuber Production:

1. **Explant Selection:**
    - Healthy yam plantlets derived from meristem culture or nodal explants are used as starting material.

  - The explants are sterilized and placed on nutrient media enriched with carbohydrates (typically sucrose) and plant growth regulators (cytokinins and auxins) to promote tuber induction.

2. **Tuber Induction:**
   - Modified Murashige and Skoog (MS) media or other yam-specific media are used.
   - High sucrose concentrations (6–8%) and abscisic acid (ABA) are often included to stimulate tuber initiation and bulking in vitro (Tamiru *et al.*, 2017).

3. **Growth and Bulking:**
   - Explants are incubated under controlled temperature (20–25 °C) and photoperiod (16 h light/8 h dark) conditions.
   - Microtubers form at the base of the shoots within 4–8 weeks depending on genotype and culture conditions.
4. **Harvesting and Acclimatization:**
   - Microtubers are harvested aseptically and can be stored or used to establish mini-tuber nurseries in greenhouses or screenhouses before field planting.

  - Proper acclimatization ensures survival and vigorous growth when transplanted to soil (Norman *et al*., 2021).

Advantages of Microtuber Production:

- Rapid multiplication of elite, virus-free yam varieties.
- Production of uniform and high-quality planting material in limited space.
- Reduces dependency on conventional tubers, which may carry pests or diseases.
- Facilitates year-round seed yam production regardless of field conditions (Mignouna *et al*., 2003; Tamiru *et al*., 2017

2.19.1 MEDIA FORMULATION AND PREPARATION FOR IN VITRO YAM CULTURE

In vitro culture of yam (*Dioscorea* spp.) relies on sterile, nutrient-rich media that support the growth, multiplication, and tuberization of explants under controlled conditions. Proper media formulation is critical for successful tissue culture and micropropagation of yam (Mignouna *et al*., 2003; Tamiru *et al*., 2017).

1. Basic Components of Tissue Culture Media:

- **Macronutrients:** Nitrogen (NO_3^- and NH_4^+), potassium, calcium, magnesium, and phosphorus are supplied to support growth and development. The Murashige and Skoog (MS) medium is widely used for yam tissue culture due to its balanced macronutrient composition (Norman *et al*., 2021).
- **Micronutrients:** Iron, manganese, zinc, copper, molybdenum, cobalt, and boron are added to facilitate enzymatic functions and metabolic processes.

- **Vitamins:** Thiamine (B_1), nicotinic acid, pyridoxine, and sometimes glycine are included to support cellular metabolism and growth.
- **Carbon Source:** Sucrose is the main energy source; concentrations of 3–8% are commonly used, with higher concentrations promoting tuber induction.
- **Plant Growth Regulators (PGRs):** Auxins (e.g., NAA, IBA) and cytokinins (e.g., BAP, kinetin) regulate cell division, shoot proliferation, and tuberization. Abscisic acid (ABA) is sometimes added to induce in vitro tuber formation (Tamiru *et al.,* 2017).
- **Gelling Agents:** Agar or phytagel is added to solidify the medium, providing physical support to explants.

2. Media Preparation Steps:

1. Weigh and dissolve all macronutrients, micronutrients, vitamins, and sucrose in distilled water according to the selected formulation.
2. Adjust the pH of the medium to 5.6–5.8 using 1 N NaOH or HCl.
3. Add the gelling agent (e.g., 6–8 g/L agar) and mix thoroughly.
4. Dispense the medium into culture vessels (e.g., test tubes, jars) under aseptic conditions.
5. Sterilize the medium by autoclaving at 121 °C and 15 psi for 15–20 minutes.
6. Cool the medium to ~45–50 °C before inoculating explants to prevent heat damage.

3. Considerations for Yam Culture:

- High sucrose concentration (6–8%) can stimulate in vitro tuber induction.
- Specific PGR combinations may vary depending on yam species and cultivar.
- Maintaining aseptic conditions is critical to prevent contamination and ensure successful culture establishment.

Using properly formulated and sterilized media allows for the successful establishment of yam cultures, multiplication of healthy plantlets, and production of microtubers for seed yam systems (Mignouna *et al.,* 2003; Tamiru *et al.,* 2017; Norman *et al.,* 2021).

CHAPTER THREE

MATERIALS AND METHODS

3.1 EXPERIMENTAL AND SITE

The study was conducted 24th may and November 2025, the yam mini sett experiment was conducted in the open field of the experimental and research farm of the Faculty of Agriculture, University of Benin, Benin City, at the tropical lowland rainforest of Nigeria, at Latitude 5º 37' N and Longitude 6º 24' 32" E and an altitude of 162m above sea level. Benin City is in the rainforest zone of Nigeria, characterized by tropical or equatorial climates. The vine cutting experiment using semi-autotrophic hydroponics (SAH) was carried out under the shade of trees in the horticultural nursery of the Department of Crop Science using humidity chambers. The humidity chambers were plastic containers completely filled with sharp sand and covered with transparent polythene sheet.

3.2 COLLECTION AND PREPARATION OF PLANTING MATERIALS

Health ware tubers **of ten** cultivars (akwabata, vayam, aseidu, favourite, super, abak**a**li**ki**1, abak**a**liki 2, benin local, igiowa1, igiowa2) were obtained from **IITA** and the open market respectively for the purpose of multiplication using yam minisett technique, and to serve as mother plants for macro**-**propagation of single nodal vine cuttings using semi-autotrophic hydroponics. the tubers were measured and cut into minisetts, treated with insecticide (cypermethrin 10% **EC) and** fungicide (mancozeb 80% wp) and air-dried under shade for 48 hours before planting. vine cuttings were then collected from the minisett plot at 23 weeks after planting. the yam vines were collected early in the morning into portable plastic containers, kept moist and cut into single nodal leaves before they were planted.

3.3. TREATMENTS, PLANTING OF ONE NODAL VINE CUTTINGS, EXPERIMENTAL DESIGN, AND LAYOUT

The treatments consisted of four potting media as followed: gotten from plants, these are;

1. Saw dust
2. Rice hull
3. Grass
4. Corn cob

Each potting media was used to filled 1 semi-autotrophic hydroponics (SAH) plastic boxes making a total of SAH boxes per replicate. And there are 3 replicate and in each replication. The potting media in the SAH plastic boxes were slightly watered prior to planting the water yam and white yam single nodal vine cuttings. The single nodal vine cuttings of each yam cultivar were prepared using secateur and planting was done on the of September 2025. The experiment as factorial laid out in a completely randomized design (CRD) with three replications.

3.4 MANAGEMENT PRACTICES

The minisett plot was watered once every two days and weeded once in two weeks. The vines in the minisett plot were then staked to improve growth. The SAH plastic boxes containing the potting media and planted with single nodal vine cuttings were watered after planting and they were labeled and covered with another similar plastic box to avoid moisture loss. Subsequently, it was watered when needed since the SAH boxes were not perforated for drainage. Fertigation was carried out with fertilizer solution 4 weeks after planting. The fertilizer solution was prepared using 3.6g of NPK 15:15:15 (without muriate of potash, to avoid chloride intoxication). The weighed sample of fertilizer was dissolved in 20L of water and was applied to the root zone of the growing yam vines with a syringe in each SAH box in all replications.

3.5 DATA COLLECTION

The following data were collected;

i. The number of days to first emergence: It was counted from the planting date to the day it emerged.

ii. The vine length: It was taken by measuring with a rule from the substrate surface to the junction of the upper leaf.

iii. The number of leaves: It was taken by counting all the functional leaves that were still green.

iv. Number of nodes: It was taken by counting the node after the first leaf.

v. Leaf length: All the new leaves were measured vertically and their mean were taken

vi. Leaf breadth: The new leaves were measured horizontally and their mean was obtained

vii. The leaf area: It was obtained by the equation, LA = L × B × 0.64, where L and B are maximum blade length and breadth respectively

viii. Number of tubers per vine; the harvested tubers were counted per vine and recorded.

ix. Number of yam vines planted: It was counted before planting

x. Number sprouted: It was taken by counting the remaining vines that sprouted and were still growing.

xi. Survival percentage; it was taken using the number sprouted all over the number planted.

$$\textbf{Survival percentage} = \frac{\textit{number sprouted}}{\textbf{number planted}} \times \textbf{100}$$

The following data were collected for the mini sett experiment at the 16th week after planting and after harvesting;

xii. The number of vines: It was counted at the base of the crop.

xiii. The leaf area: It was obtained by the equation, LA = L × B × 0.64, where L and B are maximum blade length and breadth respectively

xiv. The leafiness: It was taken by using a scale of leafiness rated 1-5 (5-Extremely leafy, 4-Very leafy, 3-Moderately leafy, 2-Slightly leafy, 1-Poorly leafy).

xv. Stem girth at 10th internode: It was taken by measuring the diameter of a selected vine at the 10th internode

xvi. Petiole length at 10th internode; It was measured from the point of attachment of the petiole to the base of the leaf.

xvii. Internode length at 10th internode: This was achieved by measuring from the point of the 9th to the 10th internode on the main stem.

xviii. Height at first branching; It was taken by measuring the distance from the base of the main stem to the first branched vine.

xix. Number of tubers per vine; the harvested tubers were counted per vine and recorded.

xx. Tuber weight per plant; the harvested tubers were weighed per plant.

xxi. Tuber yield per hill; the tubers were counted per hill and recorded.

xxii. Fresh tuber yield per hectare; Tubers were calculated according to the yield per hectare.

xxiii. Multiplication ratio: This was analyzed from the average weights of the mini setts.

The following data were collected for the vine cutting experiment at the 4th week after planting;

1. The number of green vines; surviving vines without new shoots were counted and recorded.
2. The number of sprouted vines; New shoots from planted vines were recorded.
3. The number of un-sprouted vines; Vines without new shoots were counted and recorded.
4. Leaf Area was calculated using the formula above.
5. Number of sprouted leaves; the number of leaves on new shoots were recorded.

6. Number of nodes on sprouted vines; the number of nodes on new shoots were recorded.
7. Number of vines replanted for regeneration was recorded.
8. Survival percentage; This was calculated using the formula,

$$\mathbf{SU\% = \frac{\textit{number sprouted}}{\text{number planted}} \times 100}$$

9. Vine length of sprouted vines; This was measured from the base of new shoots and average was taken.

3.6 DATA ANALYSIS

Data collected were subjected to a two-way analysis of variance (ANOVA) using GenStat Statistical package (version 12) (GenStat, 2009) and means were separated using Fisher's protected least significant difference (LSD).

CHAPTER FOUR

RESULT

The table 4.1 presents the growth and yield performance of five *Dioscorea* cultivars propagated through mini-tuber technology, showing clear differences in their suitability for seed-yam production. Cultivars such as AKUABATA, VAYAM, and ASIEDU produced relatively heavier mini-tubers, larger leaf areas, and better vegetative growth, which support stronger tuber bulking. VAYAM and ASIEDU also recorded the highest number of tubers per vine and greater fresh seed-yam weight, indicating superior efficiency in converting small planting materials into marketable seed yams. The most important indicator the multiplication ratio was highest in ASIEDU (75)**,** SUPER (71)**,** and VAYAM (64)**,** showing their strong potential for rapid seed-yam multiplication using mini-tuber technology. Overall, the table demonstrates that mini-tuber production is effective but cultivar-dependent, with some cultivars showing much better propagation efficiency. This supports the broader assessment of mini sett, mini tuber, and vine-cutting technologies by highlighting the performance of mini-tubers as a reliable method for producing quality seed yam

Table 4.1: Mean values for growth, seed tubers, and tuber characters among five cultivars of *Dioscorea* species grown with mini tubers

Cultivar	Average weight of mini tubers(g)	Leafiness (1-5)	Leaf area (cm^2)	Number of tubers	Tuber per vine	Tuber length (cm)	Tuber girth (cm)	Fresh weight of seed yam	Multi plication ratio
Akuabata	8.6	3.3	3.78	1.7	0.8	14.8	15.5	423	50
Vayam	6.3	2.7	46.3	2.0	1.2	15.0	15.0	400	64
Asiedu	6.3	3.3	18.0	1.7	1.2	29.5	13.6	467	75
Favourite	6.1	4.0	16.8	1.7	1.2	18.5	16.1	283	46
Super	3.8	3.3	19.1	1.0	0.7	25.5	14.8	267	71
LSD	ns	ns	10.2	ns	ns	8.54	ns	ns	ns

Table 4.2: Mean values for growth performance among five cultivars of *Dioscorea* species grown with mini tubers at 12 weeks

Cultivars	Emergence Percentage (%)	No of leaves	No of internodes	Leaf Area (cm^2)	No of vines	Vine length
Akuabata	76.7	72.0	33.0	54.6	1.7	273
Vayam	90.0	38.0	35.3	36.4	2.7	260
Asiedu	66.7	95.5	43.0	28.2	1.7	118
Favourite	83.3	79.2	34.2	22.1	2.0	93
Super	76.7	81.0	42.5	27.2	2.5	96
LSD	Ns	Ns	ns	*	ns	ns

Analysis of growth performance at 12 weeks, as represented in Table 2, revealed significant differences among the five *Dioscorea* cultivars grown from mini tubers. Emergence percentages were highest in *Vayam* (90.0%) and lowest in *Asiedu* (66.7%), although these differences were not statistically significant. In terms of vegetative development, *Asiedu* produced the greatest number of leaves (95.5) and internodes (43.0), indicating vigorous growth, whereas *Vayam* had fewer leaves (38.0) but a comparable number of internodes (35.3). Leaf area varied significantly among cultivars, with *Akuabata* exhibiting the largest leaf area (54.6 cm^2), suggesting superior photosynthetic potential at this stage. Vine traits also differed; *Vayam* and *Super* produced more vines per plant (2.7 and 2.5, respectively), while *Akuabata* had the longest vine length (273 cm), closely followed by *Vayam* (260 cm). These results indicate a trade-off between leaf number, leaf area, and vine proliferation. For instance, *Asiedu* had a high leaf number but smaller leaf area and shorter vines, whereas *Akuabata* had fewer leaves but larger leaves and longer vines. Overall, the observed variation suggests that cultivar selection can be targeted according to desired growth characteristics, such as canopy development, vine length for propagation, or leaf area for enhanced photosynthetic efficiency.

The results in Table 4.3 show noticeable differences in the growth and tuber characteristics of the five *Dioscorea* cultivars grown under the yam mini-sett technique. Although traits such as average weight, number of vines at harvest, number of tubers, and fresh seed yam weight do not show statistically significant differences (LSD = ns), numerical trends suggest varying growth vigor among cultivars. For example, Igboiua 1 produced the highest average tuber weight (194 g) and leaf area (44.9 cm^2), while Abakiliki 1 had the lowest values for these traits. Leafiness varied visibly among cultivars, with Abakiliki 2 (4.0) and Igboiua 1 (4.33) showing more vigorous foliage development than the other cultivars, though this difference is not statistically significant.

Tuber yield characteristics also varied, with Benin Local producing the longest tubers (19.0 cm), while Igboiua 1 produced the largest girth (28.0 cm) and highest fresh seed yam weight (717 g). Multiplication ratio ranged from 1.3 in Abakiliki 1 to 3.8 in Benin Local, indicating differences in seed yam production efficiency, even though the lack of statistical significance suggests these differences could be due to natural variability rather than treatment effect. Overall, the mini-sett technique produced comparable performance across cultivars, but numerical trends point to Benin Local and Igboiua 1 as potentially more promising in seed yam multiplication under this system.

Table 4.3: Mean value for growth, seed tubers, and tuber character among five cultivars of *Dioscorea* species grown under yam mini sett technique

Cultivar	Average weight (g)	Leaf area (cm^2)	Leafiness	No of vine at harvest (cm²)	No of tubers	Tuber length (cm)	Tuber girth (cm)	Fresh weight of seed yam (g)	Multi plication Ratio
Abakiliki 1	157	30.0	2.0	2.33	1.7	13.8	15.7	200	1.3
Abakiliki 2	185	40.4	4.0	2.33	1.0	16.5	18.3	300	1.6
Benin local	100	41.0	2.67	2.00	2.0	19.0	16.2	383	3.8
Igioua 1	194	44.9	4.33	1.67	1.0	20.2	28.0	717	3.7
Igioua 2	185	47.4	2.33	2.33	2.0	15.8	23.8	550	3.0
LSD	ns	ns	s	ns	ns	ns	s	ns	ns

Analysis of growth performance among the five *Dioscorea* cultivars grown from minisetts at 12 weeks revealed notable variation in vegetative traits. Emergence percentages were generally high, with *Abakiliki 2*, *Igiowa 1*, and *Igiowa 2* achieving full emergence (100%), while *Benin local* had slightly lower emergence at 83.3% and *Abakiliki 1* at 93.3%. Differences in leaf production were significant ($p < 0.05$), with *Igiowa 2* producing the highest number of leaves (139.5), followed by *Abakiliki 2* (88.3) and *Igiowa 1* (77.3), whereas *Abakiliki 1* had the lowest leaf count (25.7). The number of internodes varied among cultivars but was not statistically significant; *Igiowa 2* exhibited the greatest number of internodes (51.3), while *Abakiliki 1* had the fewest (23.7). Leaf area ranged from 30.0 cm^2 in *Abakiliki 1* to 47.4 cm^2 in *Igiowa 2*, with differences not statistically significant, indicating moderate variation in photosynthetic surface among cultivars. Vine production and vine length also differed across cultivars; *Igiowa 2* and *Igiowa 1* had the longest vines (248 cm and 242 cm, respectively), whereas *Abakiliki 1* had the shortest vine length (73 cm), suggesting differences in climbing potential and vegetative spread. The results indicate that cultivars such as *Igiowa 2* and *Igiowa 1* combine high leaf number, large leaf area, and extended vine length, which may confer advantages for canopy development and early biomass accumulation, whereas *Abakiliki 1* shows comparatively limited vegetative growth under similar conditions. Overall, these findings highlight substantial variability in growth characteristics among cultivars, which can guide selection for specific agronomic traits such as rapid canopy cover, vine propagation, or photosynthetic efficiency.

Table 4.4: Mean values for growth performance among five cultivars of *Dioscorea* species grown with minisetts at 12 weeks

Cultivars	**Emergence Percentage (%)**	**No of leaves**	**No of internodes**	**Leaf Area (cm^2)**	**No of vines**	**Vine length**
Abakiliki 1	93.3	25.7	23.7	30.0	2.3	73
Abakiliki 2	100.0	88.3	49.3	40.4	2.3	171
Benin local	83.3	45.8	31.0	41.0	2.0	129
Igiowa 1	100.0	77.3	39.3	44.9	1.7	242
Igiowa 2	100.0	139.5	51.3	47.4	2.3	248
LSD	ns	*	ns	ns	ns	Ns

Table 4.5 presents the effects of different potting media and yam cultivars on the growth and survival of single-nodal vine cuttings under a semi-autotrophic hydroponic system at 4 weeks after planting. Among the potting media, sawdust supported the highest number of green vines (3.4), highest total number of surviving vines (3.53), and the best percentage survival (68%), indicating that it provided the most favorable environment for vine establishment. Rice hull and grass also performed moderately well, with survival rates of 60% and 54.7%, respectively. Corn cob, however, recorded the lowest survival rate (42.7%) and the lowest number of green and surviving vines, suggesting it is the least effective medium for sustaining early vine growth. The significant differences (** and *) under the potting media section confirm that the choice of substrate has a real impact on vine survival and early growth.

Across cultivars, Favourite performed best, recording the highest number of green vines (3.75), the highest number of surviving vines (3.92), and the highest percentage survival (76.7%). Akuabata also performed well with 66.7% survival, while Asiedu and especially Super recorded weaker performance, with Super showing the lowest survival rate (26.7%). The significance levels indicate that cultivar differences are statistically meaningful, especially for variables such as number of green vines, sprouted vines, and total surviving vines. The significant potting media × cultivar interaction further implies that some cultivars respond better in certain media than others. The LSD values show that differences greater than the listed thresholds reflect real statistical variation. Overall, sawdust appears to be the best potting medium, and Favourite the most promising cultivar for successful vine cutting establishment under this system.

Table 4.5: Effects of mean values potting media on growth of single nodal vine

Treatment Potting Media	No of green vines	No of planted stakes	No of sprouted vines	Total number of surviving vines	Percentage Survival
Sawdust	3.4	5.13	0.13	3.53	68.0
Ricehull	2.67	5.07	0.4	3.07	60.0
Grass	2.73	5.6	0.6	3.33	54.7
Corn cob	1.93	5.0	0.2	2.13	42.7
LSD	1.0	0.4	0.5	1.2	19.42
Cultivar					
Akuabata	3.0	5.17	0.5	3.5	66.7
Asiedu	2.08	5.0	0.0	2.08	41.7
Favourite	3.75	5.08	0.17	3.92	76.7
Super	1.33	5.08	0.08	1.42	26.7
LSD					
Potting Media X Cultivar					
Significant	**	*	**	*	**
LSD	2.2	0.9	1.1	2.7	43.0

cuttings under semi autotrophic, hydroponic at 4 weeks after planting

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 DISCUSSION

The study assessed the performance of three yam propagation techniques minisett, minituber, and vine cutting using two yam species (*Dioscorea rotundata* and *D. alata*) under field and semi-autotrophic hydroponic conditions. Results from the minisett experiment indicated that the use of small tuber portions significantly increased the multiplication ratio of seed yam compared to the use of whole tubers. This supports earlier findings by Aighewi *et al.* (2015) that minisett technology reduces the amount of ware yam required for planting while enabling farmers to produce more planting material within a single season. Differences observed among cultivars in sprouting percentage, vine growth, and tuber yield demonstrate the influence of genetic variability in response to minisett propagation.

The performance of vine cuttings under semi-autotrophic hydroponics (SAH) also showed clear treatment differences. Across both yam species, sawdust and rice hull media supported better rooting, sprouting, and vine establishment than grass or corn cob. Sawdust in particular improved moisture retention and aeration, conditions known to enhance rooting success in vegetative propagation. The superior performance of *D. alata* in vine cutting propagation compared to *D. rotundata* aligns with previous reports that *D.*

alata responds more favourably to macro-propagation due to its rapid vine growth and higher rooting propensity.

The study further revealed strong interactions between cultivar and potting media, indicating that propagation success is species- and genotype-specific. This highlights the importance of selecting both appropriate propagation materials and media tailored to each cultivar. While minituber production through vine cuttings proved successful, its efficiency depended heavily on adequate humidity, proper medium selection, and timely management practices, which agrees with the observations of Tamiru *et al.* (2017) on the sensitivity of yam vine cuttings to environmental conditions.

Overall, the combined results demonstrate that minisett technology is more stable under field conditions, whereas vine cutting using SAH offers a high multiplication potential when properly managed. Together, these technologies present complementary opportunities for strengthening seed yam systems and reducing farmers' reliance on large ware tubers for planting.

5.2 CONCLUSION

This study demonstrated that minisett, minituber, and vine cutting technologies can significantly improve the production of seed yam in and . The minisett technique proved effective for increasing seed multiplication under field conditions, while vine cutting under semi-autotrophic hydroponics showed considerable potential for rapid and clean seed yam production, particularly for . Among the propagation media evaluated, sawdust and rice hull consistently supported higher rooting and vine survival. The results confirm that improved propagation techniques can address the persistent scarcity of quality This study demonstrated that the use of minitubers derived from vine cuttings offers a highly efficient and reliable method for producing quality seed yam in *Dioscorea alata* and *Dioscorea rotundata*. The improved cultivars evaluated showed considerable variation in seed tuber yield, with minitubers producing significantly higher multiplication ratios (1:46–1:75) compared to the yam minisett method (1:1.3–1:3.8). The vine cutting experiment also revealed that locally available potting media, especially sawdust, enhanced plant survival and supported healthy minituber development under semi-autotrophic hydroponic conditions. Overall, the results highlight minitubers and vine cuttings as superior propagation options for rapid multiplication of clean and healthy seed yams.

5.3 RECOMMENDATION

Based on the findings of this study, the use of minitubers produced from vine cuttings is recommended for seed yam production because it provides higher multiplication ratios and better overall yield than the minisett method. Farmers should also adopt locally available potting materials such as sawdust, rice hull, and grass, as they support good survival and growth of vine cuttings. High-yielding cultivars like Asiedu and Igiowa 1 should be prioritized in seed yam multiplication programmes. In addition, farmers and field technicians should receive proper training on vine-cutting techniques, minituber production, and management practices to enhance efficiency. Further research across different locations is encouraged to refine the techniques and support wider adoption.

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